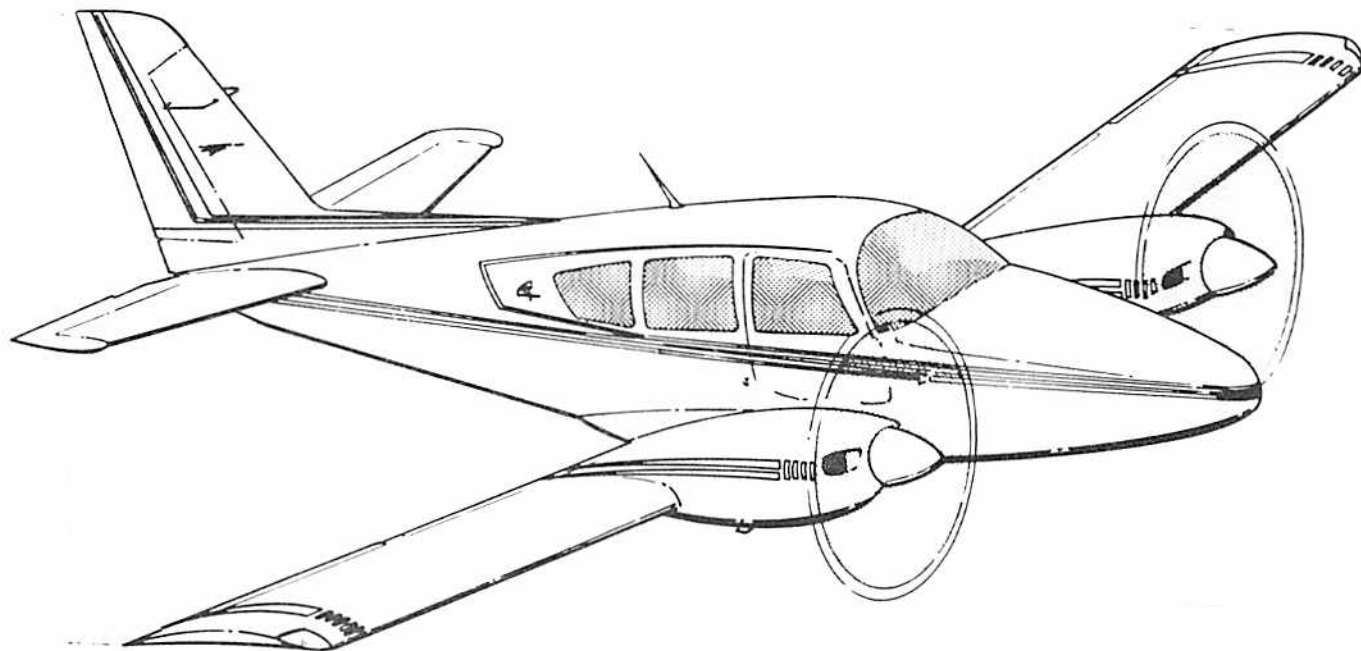


MAINTENANCE MANUAL

MODEL

GA-7/COUGAR



GRUMMAN AMERICAN

ISSUED: July 15, 1977
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GRUMMAN AMERICAN AVIATION CORPORATION
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INTRODUCTION

GENERAL

The function of this Maintenance Manual is to acquaint maintenance personnel with the systems and their components of the GA-7/Cougar aircraft and to direct them in the proper procedures for maintaining the aircraft in an airworthy condition.

This manual contains information on installations made in the aircraft during manufacture and optional equipment only. However, information derived from applicable Aircraft Service Kits, Service Bulletins, and Service Letters will be included in the manual as soon as possible after the issuance of these documents. Changes or installations made by the operator are not included in this manual.

The ability of maintenance personnel is recognized, and those procedures which are considered common to all aircraft have been either briefly referenced or omitted.

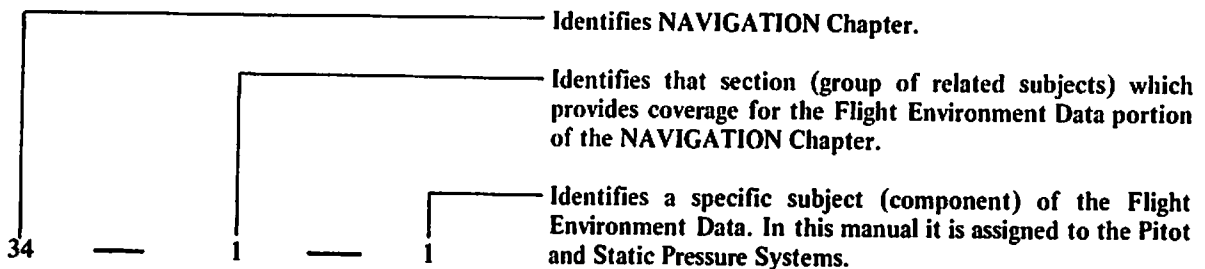
FORMAT

The chapter identification in this manual has been prepared in accordance with Air Transport Association (ATA) Specification No. 100. A functional breakdown is employed whereby all data pertaining to a given system, or component of a system, may be found in one chapter with a minimum of crossreferencing to other chapters.

The Electrical Power Chapter in this manual covers only the power sources and distribution equipment for the electrical system. There is not a chapter in this manual specifically designated for instruments. Details of individual branch electrical or instrument systems will be found in the applicable chapter.

IDENTIFICATION OF SUBJECT MATTER

A three-dash number system is employed to identify subject matter. The first dash number identifies the chapter, the second dash number the section, and the third dash number the component or sub-section of the section. The following example illustrates how the numbering system is used in the NAVIGATION Chapter:



The dash 0 (-0) is provided as a means for covering a complete system or sub-system. The chapter number followed by a zero (34-0) will segregate that material covering the complete system; the chapter-section numbers followed by a zero (34-1-0) is used for further details covering the sub-system, or component.

PAGE NUMBER IDENTIFICATION

Page number blocks are used to separate the subject matter into the following categories:

General Coverage and Unit Description	Pages 1 through 100
Troubleshooting	Pages 101 through 200
Maintenance Practices	(See Below)

Maintenance Practices include as applicable the following sub-topics: Servicing, Removal/Installation, Adjustment/Test, Inspection/Check, Cleaning/Painting, and Approved Repairs.

If all sub-topics, under Maintenance Practices are brief, they are combined into one topic. All such combined topics are numbered within page number block 201-300. Whenever individual sub-topics are so lengthy that a combination requires several pages, each sub-topic is treated as an individual topic. Page number blocks used for this sub-topic arrangement are as follows:

Servicing	301 – 400
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Cleaning/Painting	701 – 800
Approved Repairs	801 – 900

Each new subject starts with page 1, 101, 201, etc., and continues through the page block assignment to the extent necessary. The first page of each block is placed on a right-hand page.

FIGURE IDENTIFICATION

Figures (illustrations) are numbered consecutively within each topic (subject) as follows:

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Inspection/Check –	601, 602, 603, etc.
Cleaning/Painting –	701, 702, 703, etc.
Approved Repairs –	801, 802, 803, etc.

INDEXING

Each chapter is prefaced with a table of contents identifying the subject matter within the chapter in the order of presentation. The table of contents is arranged with the following headings: DESCRIPTION, TROUBLESHOOTING, and MAINTENANCE PRACTICES.

PART NUMBERS

This manual must not be used for identifying spare parts by number. Consult the Illustrated Parts Catalog for this information. Part numbers are used in this manual only as a means of identification when nomenclature alone is inadequate.

REVISIONS

Revisions to the original text are indicated by vertical lines in the left margin of the page, adjacent to the revised material.

The manual is provided with a "Log of Revisions" page for recording revisions by number and the dates on which they were inserted in the manual.

Each page revised or added to the initial manual will be identified by the date of revision at the bottom of the page. Pages issued with the original manual are identified with the issue date of the manual.

Each revision also contains a "List of Effective Pages". This list contains the chapter, page number and date of each page which is effective since the issuance of the initial manual. This list is up-dated for each revision, with page changes indicated by asterisks (*) placed adjacent to the page number as shown below:

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CHAPTER 5

TIME LIMITS – MAINTENANCE CHECKS

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TIME LIMITS/MAINTENANCE CHECKS – DESCRIPTION/OPERATION

1. General

This Chapter contains the manufacturer's recommended time limits, scheduled and unscheduled maintenance checks, and inspections.

TIME LIMITS – DESCRIPTION/OPERATION

1. General

The Service Guide (Figure 1) contains the manufacturer's recommended time limits for inspection, maintenance, and overhaul of the GA-7/Cougar aircraft, its systems and units.

All wing and fuselage structural components are subject to normal inspection, maintenance, repair, and replacement procedures. In addition, if corrosion is detected on wing and inboard spars, remove it as quickly as possible and protect the surface from further corrosion in accordance with AC 43.13-1A and subsequent revisions, "Acceptable Methods, Techniques and Practices – Aircraft Inspection Repair."

2. Service Life Limited Components

Current Federal Aviation Regulations require that all new aircraft be certified, for which application for a type certificate was made after September 14, 1969, have the critical wing structural components investigated for fatigue strength and that, where applicable, these components be service life limited. Two critical areas of the GA-7/Cougar wing were investigated per these requirements, the front spar lower cap at W.S. 76.60 and W.S. 22.416. The service lives of these two critical areas, as defined by structural analysis, are shown in Figure 1. As on-going fatigue testing extends these life-limits, revisions to this manual will be supplied.

Component	Part Number	Service Life (Airframe Hours)
Lower Cap of Front Spar at W.S. 76.50	7W10214-11 7W10214-12	87,157
Lower Cap of Front Spar at W.S. 22.415	7W10214-11 7W10214-12	5,705

Service Life Limited Components
Figure 1

3. Inspection Details

A. Pre-Inspection Procedures

- (1) Just prior to beginning the inspection, run up the engines to facilitate oil drainage.
- (2) Observe the following actions and indicators, noting any discrepancies.

Oil and fuel pressures	Oil temperature
Magneto rpm drop	Gyro pressure gage
Propeller cycling	Fuel selector (Check operation in all positions.)
Static rpm (dual tachometers)	Carburetor heat control
Idling speed (dual tachometers)	Engine response to power changes
Ammeter	Idle cutoff
Manifold pressure	

B. Post Inspection Procedure

CAUTION: REPLENISH OIL SUPPLY PRIOR TO POST INSPECTION RUNUP.

After completion of the inspection, another engine runup should be performed to ensure that all discrepancies have been eliminated and no new discrepancies have been introduced.

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SCHEDULED MAINTENANCE CHECKS – DESCRIPTION/OPERATION

1. **General**

The inspection procedures guideline included in this section may be used by the owner, inspector, or mechanic to ensure complete and comprehensive coverage of the inspection requirements. The format of the procedures can be reproduced for ready use by the personnel performing the inspection. The checklist includes the minimum requirements for the 100-hour or Annual Inspection.

INSPECTION MAINTENANCE	Inspection Interval (Operating Hours)			
	50	100	1000	NOTE:
AIRFRAME				
1. Clean aircraft. 2. Aircraft structure (especially inboard wing spars and fuselage attachments, landing gear attachments, and empennage attachments). 3. Windows and windshield. 4. Seats, console, interior, and seat belts. 5. Instrument panel instruments and placards. 6. Baggage compartment and cargo tiedowns. 7. Radio antennas. 8. Control T-Column and bearings. 9. Cabin door and baggage door (fwd and aft) seals and latches. 10. Emergency exit window.	X X X	X X X X X X X X	X X X X X X	
LANDING GEAR				
1. Main gear strut lubrication, strut extension, and fluid level. 2. Nose gear strut lubrication, strut extension and fluid level. 3. Nose and main wheel bearing lubrication. 4. Perform gear retraction check and check doors for proper operation. 5. Brake linings and discs. 6. Main and nose tires pressure. 7. Nose gear shimmy dampener condition, leakage, and fluid level.	X	X X X X X	X X X X X	a
CONTROL SYSTEMS				
1. Cables, turnbuckles, pulleys, guards, and terminals. 2. Rudder pedals and springs. 3. Flaps, flap actuator jackscrew, flap push-pull rods, flap hinges, torque tube bearings, bearing supports, and position indicator. 4. All control stops. 5. Trim wheel assembly, indicator, bungees, and actuator shaft drive screw. 6. All control surface hinges.		X X X X X	X X X X X	i h

Service Guide
Figure 1 (Sheet 1 of 4)

INSPECTION MAINTENANCE	Inspection Interval (Operating Hours)			
	50	100	1000	NOTE:
POWER PLANT				
1. Oil change.	X	X	X	
2. Oil screens and cooler.	X	X	X	
3. Replace oil filter if external filter is installed.		X	X	
4. Spark plugs.		X	X	
5. Ignition harness.	X	X	X	
6. Magneto timing.				b
7. Exhaust system.	X	X	X	
8. Throttle, carburetor heat, mixture, and propeller controls operation.	X	X	X	
9. Engine baffles and seals.	X	X	X	
10. Air filter.	X	X	X	j
11. Engine shock mounts (both engines).	X	X	X	
12. Oil breather vents.	X	X	X	
13. All lines, flex ducts, and connections.	X	X	X	c
14. Oil and fuel pressure lines, fittings and wiring.	X	X	X	
15. Oil temperature lines, fittings and wiring.	X	X	X	
16. Manifold pressure lines, fittings and wiring.	X	X	X	
17. Propeller and spinner.	X	X	X	
18. Alternator belt.	X	X	X	
19. Cylinders, crankcase, accessory section, and front crankshaft seal.	X	X	X	
20. Engine overhaul.				d
21. Engine upper and lower mount attachments and mounting hardware. (Refer to Chapter 71.)		X	X	
FUEL SYSTEM				
1. Electric fuel pump filters.	X	X	X	
2. Fuel cap gaskets.	X	X	X	
3. Fuel overboard vents.	X	X	X	
4. Fuel tanks and quick drains (4).	X	X	X	
5. Fuel gauges, fuel tank selectors, and placards.		X	X	
6. Fuel tank outlet screens.				g
7. All hoses and lines.	X	X	X	c
8. Fuel primers.		X	X	
9. Transmitters		X	X	

Service Guide
Figure 1 (Sheet 2 of 4)

GRUMMAN AMERICAN AVIATION
GA-7/COUGAR
MAINTENANCE MANUAL

INSPECTION MAINTENANCE	Inspection Interval (Operating Hours)			
	50	100	1000	NOTE:
UTILITY SYSTEMS				
1. Master cylinder fluid level.	X	X	X	
2. Parking brake operation.		X	X	
3. All hoses, lines, and connections.	X	X		
4. Pitot and static systems.		X	X	
5. Pitot and static line drain.		X	X	
6. Gyro pressure system, pressure pump regulator, and filters.		X	X	e
7. Flexible ducts for heating system.		X	X	
8. Cabin heat control operation.		X	X	
9. Fresh air ventilation system.		X	X	
10. Compass check.			X	f
11. Hydraulic system, lines, pump, and fluid level.	X	X	X	k
ELECTRICAL SYSTEM				
1. Battery fluid level.	X	X	X	
2. Battery hydrometer check.		X	X	
3. All connections.		X	X	
4. All lights for operation.	X	X	X	
5. All wiring harnesses and wires.		X	X	
6. Stall warning.	X	X	X	
7. Electric flap motor.		X	X	
RADIO AND ELECTRONIC EQUIPMENT				
1. Communication Equipment		X		h
2. Navigation Equipment		X		h
3. Antennas		X		l
4. Wiring, bonding, and shielding		X		m

NOTES:

- a. Clean and repack wheel bearings at first 100 hours. Inspect wheel bearing grease for contamination and solidification at each annual or 100-hour inspection. Do not exceed 500 wheel miles between repacking intervals.
- b. Maximum time between magneto timing checks is 100 hours. Magneto replacement recommended after 900 hours of service.
- c. Recommend replacement of all flexible lines at engine overhaul or every 5 years, whichever occurs first.
- d. Engine overhaul time recommended by engine manufacturer is 2000 hours
- e. Replace gyro pressure air system inline filter every 500 hours or annually, whichever occurs first, and when a pressure pump is replaced. For operation in dusty climates, replace filters more frequently. Replace pressure pump inlet filter when clogged or dirty as required.
- f. Check accuracy of compass every 1000 hours or at each time that an item of equipment is installed or removed that could affect the accuracy of the unit.
- g. Remove and clean fuel tank outlet screens every 1000 hours.
- h. Check for improper installation and insecure mounting.

Service Guide
Figure 1 (Sheet 3 of 4)



- i. Thoroughly clean all control cables where they pass under the pulley group. Inspect all cables in accordance with AC 43.13-1A and subsequent revisions, paying close attention to the rudder cables. Acceptable wire breakage limits area is maximum of four wires per cable. Cables with more than the acceptable number of broken wires must be removed from service. In order to adequately inspect the cables, it will be necessary to actuate the controls to the full extent of travel to expose the cable pulley contact area for examination.
- j. If filter has any holes or torn spots or is 50 percent covered with foreign material, it should be replaced. Do not blow off filter with compressed air or attempt to wash element in any liquid or soak in oil. Filter should be replaced at each 300 hours or 12 calendar months, whichever occurs first.
- k. Perform a hydraulic fluid contamination check at the first 50-hour and first 100-hour inspection and thereafter at each 500-hour inspection or 1 year, whichever occurs first. (Refer to Chapter 12 for procedures.)
- l. Check for poor condition, insecure mounting, and improper operation.
- m. Inspect for wear, poor condition, improper installation, insecure mounting and obvious defects.

SCHEDULED MAINTENANCE CHECKS – MAINTENANCE PRACTICES

1. Annual or 100-Hour Inspection Procedures

A. Perform Annual or 100-Hour Inspection

Complete the inspection by performing each of the procedures detailed on the checklist, Figure 201. Indicate completion by signoff in the appropriate column.

B. In addition to the Service Guide and Annual or 100-Hour Inspection Procedure, the following steps should be adhered to when performing an inspection or overhaul:

- (1) Check any FAA Airworthiness Directive or Grumman American Aviation Service Bulletins/Letters for compliance at the time specified thereon.**
- (2) Check that the following aircraft documents are present and in order:
Aircraft Airworthiness Certificate (Form FAA 8100-2)
Aircraft Registration Certificate (Form FAA 8050-1 or FAA 8050-3)
Weight and Balance Sheet
Aircraft Equipment List
Any Repair and Alteration Forms if applicable (Form FAA 337)
Aircraft Radio Station License if applicable (Form FCC 566 or FCC 453B)
Aircraft and Engine Log Book**

NOTE: All of the above items except the log books must be carried in the aircraft at all times. Form FAA 8100-2, FAA 8050-3, and FCC 556 (FCC 453-B) must be visually displayed.

- (3) Check that operating limitations placards (Refer to Chapter 11) are displayed.**

MODEL GA-7/COUGAR

ANNUAL OR 100-HOUR INSPECTION PROCEDURE (AIRCRAFT IN SERVICE HOURS)

ANNUAL OR 100-HOUR INSPECTION PROCEDURE GUIDELINE (AIRCRAFT IN SERVICE HOURS)

FAR 43.15 (c) (1) states: "Each person performing an annual or 100-hour inspection shall use a checklist while performing the inspection. The checklist may be of the person's own design, one provided by the manufacturer of the equipment being inspected, or one obtained from another source. This checklist must include the scope and detail of the items contained in appendix D to this part and paragraph (b) of this section." The following pages contain a comprehensive annual or 100-hour inspection procedure checklist. This checklist has been prepared to assist a mechanic in performing a detailed inspection of such scope and detail that when the inspection is completed, the mechanic is absolutely sure that he has not overlooked any areas, even though he may not have previous experience on this particular model aircraft. Once a mechanic becomes familiar with this aircraft, he may wish to prepare his own checklist, which must be within the scope of Appendix D of FAR Part 43.

<u>OWNER'S NAME</u>		<u>STREET ADDRESS</u>	
<u>CITY</u>	<u>STATE</u>	<u>ZIP CODE</u>	
<u>IDENTIFICATION NUMBER</u>	<u>SERIAL NUMBER</u>	<u>HOURS</u>	<u>DATE INSPECTION COMPLETED</u>
<u>SERVICING AGENCY</u>	<u>CITY</u>	<u>STATE</u>	

NOTE: Check conformity with FAA Specifications, Airworthiness Directives, and Grumman American Aviation Corporation and Supplier's Service Bulletins and Letters.

NOTE: It is recommended that reference be made to the applicable maintenance handbook, service bulletins, letters, installation instructions, and vendor specifications for torque values, clearances, settings, tolerances, and other specification data.

NOTE: Indicate airworthiness of aircraft after completion of 100-hour/annual inspection by person making this determination placing their signature and certificate identification in the appropriate block at the end of the inspection procedure guide.

<u>MODEL GA-7/COUGAR</u>																							
ANNUAL OR 100-HOUR INSPECTION PROCEDURE																							
PRE-INSPECTION ENGINE RUNUP (BOTH ENGINES)	MECH	INSP																					
<p>Prior to beginning the annual or 100-hour inspection, an engine runup is made to facilitate oil drainage and to observe the following, noting any discrepancies: (Refer to Pilot's Operating Handbook.)</p>																							
<p>1. Fuel Pressure (0.5 to 8 psi) Electric Pump only prior to engine startup (Left) _____ (Right) _____ Turn pump off for engine start (Left) _____ (Right) _____ Both (Left) _____ (Right) _____ Engine pump only after engine startup.</p>																							
<p>2. Oil Pressure (60 to 90 psi) Approx. 25 psi idling Actual (Left) _____ (Right) _____ Actual, Idle (Left) _____ (Right) _____</p>																							
<p>3. Oil Temperature</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">Average</td> <td colspan="2" style="text-align: center;"><u>Oil Inlet Temperature</u></td> </tr> <tr> <td style="text-align: center;"><u>Ambient Air</u></td> <td style="text-align: center;"><u>Desired</u></td> <td style="text-align: center;"><u>Maximum</u></td> </tr> <tr> <td>Above 60°F</td> <td style="text-align: center;">180°F (82°C)</td> <td style="text-align: center;">245°F (118°C)</td> </tr> <tr> <td>30° to 90°F</td> <td style="text-align: center;">180°F (82°C)</td> <td style="text-align: center;">245°F (118°C)</td> </tr> <tr> <td>0° to 70°F</td> <td style="text-align: center;">170°F (77°C)</td> <td style="text-align: center;">225°F (107°C)</td> </tr> <tr> <td>Below 10°F</td> <td style="text-align: center;">160° F(71°C)</td> <td style="text-align: center;">210°F (99°C)</td> </tr> <tr> <td></td> <td colspan="2" style="text-align: center;">Actual (Left) _____ Actual (Right) _____</td> </tr> </table>	Average	<u>Oil Inlet Temperature</u>		<u>Ambient Air</u>	<u>Desired</u>	<u>Maximum</u>	Above 60°F	180°F (82°C)	245°F (118°C)	30° to 90°F	180°F (82°C)	245°F (118°C)	0° to 70°F	170°F (77°C)	225°F (107°C)	Below 10°F	160° F(71°C)	210°F (99°C)		Actual (Left) _____ Actual (Right) _____			
Average	<u>Oil Inlet Temperature</u>																						
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Above 60°F	180°F (82°C)	245°F (118°C)																					
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Below 10°F	160° F(71°C)	210°F (99°C)																					
	Actual (Left) _____ Actual (Right) _____																						
<p>4. Manifold Pressure (_____) Actual (Left) _____ Actual (Right) _____</p>																							
<p>5. Cylinder Head Temperature (Normal 200°F to 300°F; Never exceed 500°F.) Actual (Left) _____ Actual (Right) _____</p>																							
<p>6. Perform propeller operational Check. (Refer to Hartzell propeller owner's manual that is supplied with aircraft.)</p>																							
<p>7. Magneto rpm drop (Maximum drop on either magneto 175 rpm. No more than 50 rpm difference between magnetos.)</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">Actual Drop Left Engine</td> <td style="text-align: center;">Actual Drop Right Engine</td> </tr> <tr> <td style="text-align: center;">Left _____ Right _____</td> <td style="text-align: center;">Left _____ Right _____</td> </tr> </table>	Actual Drop Left Engine	Actual Drop Right Engine	Left _____ Right _____	Left _____ Right _____																			
Actual Drop Left Engine	Actual Drop Right Engine																						
Left _____ Right _____	Left _____ Right _____																						
<p>8. Static rpm (2675 to 2700 rpm) Actual (Left) _____ Actual (Right) _____</p>																							

PRE-INSPECTION ENGINE RUNUP (Continued)	MECH	INSP
9. Idling Speed (600 to 650 rpm) Actual (Left) _____ Actual (Right) _____		
10. Ammeter (indicates alternator output in relation to battery state of charge).		
11. Gyro Pressure Gauge (4.6 to 5.4 psi)		
12. Fuel Selector (Check operation in all positions.)		
13. Carburetor Heat Controls for proper operation.		
14. Engine Response to changes in power settings.		
15. Idle cutoff.		
A. PROPELLER GROUP (BOTH PROPELLERS)		
1. Remove spinners and check for cracks.		
2. Inspect blades for erosion, scratches, nicks, and cracks. Dress out nicks as required. (Refer to Chapter 61).		
3. Inspect backplate for nicks, cracks, and damage. Smooth out nicks and scratches as required. Cracks may be welded.		
4. Inspect front crankshafts seal and blade hub/dome area for oil leaks.		
5. Inspect propeller governor for condition and evidence of oil leakage.		
6. Check propeller mounting bolts. Torque to 40 to 50 foot-pounds and safety.		
7. Reinstall spinners. Torque spinner bulkhead bolts to 22 inch-pounds. Check spinner runouts (1/16 inch maximum runout).		
B. ENGINE GROUP (BOTH ENGINES)		
1. Remove engine cowl. Clean and check for cracks, wear, distortion, loose or missing fasteners.		
2. Drain oil sumps. Remove oil screens, clean and inspect for metal particles. Reinstall and safety. Replace oil filter as required.		
3. Check oil temperature sending units, oil coolers, oil lines, and fittings for leaks, chafing, and secure mounting.		
4. Fill engines with oil per lubrication chart. (Refer to Chapter 12.)		
5. Clean engines.		

**Inspection Procedures Guidelines
Figure 201 (Sheet 4 of 12)**

C. CABIN GROUP (Continued)	MECH	INSP
4. Check seatbelts and shoulder harnesses for condition, security of mounting, and latch operation.		
5. Check elevator, rudder, and aileron trim control for condition, security of mounting, proper operation, and indication.		
6. Check rudder pedal and brake system for proper operation and condition. Check brake fluid level.		
7. Check control T-Column for security of mounting and adequate clearance from other equipment.		
8. Check cables, pulleys, turnbuckles, and cable ends for condition, secure attachment, and safeties. Check cables at pulleys for fraying while actuating controls through full travel. (Maximum of four broken wires per cable is acceptable.)		
9. Check cable tension (at the average temperature for aircraft operation).		
10. Check all controls for clearance and proper operation.		
11. Check all interior bond lines for any indication of damage, peeling, corrosion, or cracking.		
12. Check flap actuator, push rods, limit switches, and indicator for proper operation and security of mounting.		
13. Lubricate flap actuator and linkage. (Refer to Chapter 12, lubrication chart.)		
14. Check all plumbing in cabin area for leaks and condition.		
15. Check gyro system filters, replace if necessary.		
16. Check instruments for condition, security of mounting, legible markings, and placards.		
17. Check electrical wiring, switches, lights, and electronic equipment for condition and security.		
18. Inspect baggage compartment and cargo tiedowns.		
19. Inspect all placards in cabin for condition and legibility.		
20. Reinstall baggage floor inspection covers, console panels, and inspection covers.		
21. Check fresh air vents for proper operation.		
22. Check emergency exit window for condition and proper operation.		

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C. CABIN GROUP (Continued)	MECH	INSP
23. Inspect emergency locator transmitter for security, operation, and battery expiration date (if installed).		
D. FUSELAGE AND EMPENNAGE GROUP		
1. Remove tail cone empennage covers, nose baggage doors, and battery access panel.		
2. Check pitot heating element for proper operation (if installed).		
3. Check pitot tube openings and lines. Drain if required and leak check.		
4. Inspect exterior surfaces for condition and damage. Check all drain holes in the fuselage bottom for obstructions.		
5. Check battery electrolyte level and specific gravity. Clean and tighten battery terminals. Check battery box drains and vents for condition and drainage clear of aircraft structure.		
6. Check voltage regulators, starter relays, and master switch relays for secure mounting and proper operation.		
7. Check electrical wiring for condition and secure connections.		
8. Inspect bond lines for any indication of damage, peeling, corrosion, or cracks.		
9. Check horizontal and vertical stabilizers for damage and security of mounting. Ensure that horizontal stabilizer and elevator drain holes are open.		
10. Check elevator and rudder trim mechanism for damage, security of mounting, and proper operation.		
11. Check rudder and elevator cables and pulleys for damage, proper operation, and safeties. Check bellcrank attaching hardware for wear.		
12. Lubricate per lubrication chart. (Refer to Chapter 12.)		
13. Inspect antenna mountings, wiring, and electronic installations.		
14. Check static system lines and the alternate air source valve (if so equipped). Drain any accumulated moisture from system drain and leak check after draining.		
15. Check position and anti-collision lights for security of mounting.		
16. Check forward and aft baggage compartment doors, seals, and latches for security, condition, and proper operation.		

D. FUSELAGE AND EMPENNAGE GROUP (Continued)	MECH	INSP
17. Reinstall inspection covers and panels.		
E. WING GROUP		
1. Remove wing tips and access panels. Inspect surfaces, skins, ribs, and tips for damage. Check position and anti-collision (if equipped) lights for security of mounting.		
2. Check wings for security of attachment.		
3. Visually inspect interior and exterior bond lines for any indication of damage, peeling, corrosion, or cracks.		
4. Check ailerons, aileron bearings and stops, flaps, flap hinges, and bearings for damage and security, proper travel, and wear.		
5. Check fuel vents and connecting lines for damage and restrictions.		
6. Check fuel cap gaskets for airtight seal.		
7. Check wing leading edge, cove area aft of rear spar, lower wing area, and wheel well for fuel tank leakage.		
8. Inspect fuel tank placards.		
9. Check for interior corrosion of skin indicated by a white flaking ash.		
10. Install wing tips and access panels.		
F. MAIN LANDING GEAR GROUP		
1. Remove wheels and check for cracks. Check condition of brake linings and wheel cylinders. Pack wheel bearings, reinstall wheels, and key axle nuts at first 100 hours and each 100 hours thereafter. Inspect wheel bearing grease for contamination and solidification at each annual or 100-hour inspection. Do not exceed 500 wheel miles between repacking intervals. For operation in dusty areas or areas of high humidity, repack every 100 hours. Perform a complete wheel inspection when tires are replaced.		
2. Check tires for approved type, wear, and proper inflation.		
3. Check brake lines for leaks and secure attachment.		
4. Check retracting mechanism and hydraulic lines for leakage, security of mounting, and evidence of damage.		
5. Check struts for proper extension, inflation, leakage, fluid level, security of mounting, and proper lubrication. (Refer to Chapter 12.)		
6. Perform landing gear operational check (retraction). (Refer to Chapter 32.)		
7. Inspect inside all wheel wells for cleanliness and evidence of damage to components.		

Inspection Procedures Guidelines
Figure 201 (Sheet 9 of 12)

G. NOSE GEAR GROUP	MECH	INSP
1. Check nose gear strut for security of mounting, corrosion, damage, cracks, and proper servicing. (Refer to Chapter 12.)		
2. Check steering mechanism for security of mounting, corrosion, damage, cracks, and proper operation.		
3. Check shimmy dampener for security of mounting, evidence of leakage, and proper servicing. (Refer to Chapter 12.)		
4. Check retracting mechanism and hydraulic lines for leakage, security of mounting, evidence of leakage, and proper servicing.		
5. Remove nose wheel; check for cracks; clean, inspect, and repack bearings; reinstall wheel and safety axle nuts at first 100 hours and each 500 hours thereafter. Inspect wheel bearing grease for contamination and solidification at each annual or 100-hour inspection. Do not exceed 500 wheel miles between repacking intervals. For operation in dusty areas or areas of high humidity, repack every 100 hours. Perform a complete wheel inspection when tire is replaced.		
6. Inspect nose wheel for cracks, corrosion, and loose or broken bolts.		
7. Check tire for approved type, wear, and proper inflation.		
8. Perform landing gear operational check (retraction). (Refer to Chapter 32.)		
H. OPERATIONAL INSPECTION		
1. Check brake operation (including parking brake).		
2. Check fuel primer operation and lines for leaks.		
3. Check operation of auxiliary fuel pumps.		
4. Check fuel pressure.		
5. Check starter for proper operation.		
6. Check oil pressure and temperature (both engines).		
7. Check engine controls for proper operation. Check throttle, mixture, and propeller controls for proper cushion.		
8. Check cylinder head temperature (both engines).		

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H. OPERATIONAL INSPECTION (Continued)	MECH	INSP
9. Check operation of left and right engine magnetos (1800 rpm); both on, left off, both on, right off, both on. (Maximum magneto drop 175 rpm with 50 rpm maximum difference between magnetos.) With engine at idle, turn switch to OFF position momentarily to check magneto grounding.		
10. Check left and right engine static rpm (2700).		
11. Check left and right carburetor heaters for proper operation and cushion.		
12. Check left and right alternator outputs.		
13. Check left and right cowl flap operation.		
14. Check pressure gauge and pressure system output (4.3 to 6.1 psi).		
15. Check both fuel selector valves operation and indexing.		
16. Check heating, defrosting, and ventilating systems for operation.		
17. Check radio for operation.		
18. Check left and right engine idle speed (600 to 650 rpm) and mixture setting.		
19. Check left and right idle cutoff on carburetor for proper operation.		
20. Check ailerons and trim tabs for proper operation.		
21. Check rudder and trim tab for proper operation.		
22. Check elevators and trim tab for proper operation.		
23. Check wing flaps for proper operation.		
24. Check fuel quantity gauges for condition and proper operation.		
25. Check interior lights for proper operation and adjustment.		
26. Check navigation and anti-collision lights for proper operation and landing light for proper operation and adjustment.		
27. Check pitot heat for proper operation.		
28. Check both stall warning devices for operation. (Refer to Chapter 27.)		
29. Inspect engines after ground runup. Flight test and inspect for oil leaks and secure mounting of all components.		

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I. RADIO GROUP	MECH	INSP
1. Inspect radio and electronic equipment for improper installation and insecure mounting.		
2. Check all wiring, bonding, and shielding for improper routing, improper installation, poor condition, and obvious defects.		
3. Inspect all antennas and antenna installations for poor condition, insecure mounting, and improper installation.		
J. GENERAL	MECH	INSP
1. Aircraft cleaned and serviced.		
2. Aircraft conforms to FAA Specifications.		
3. All applicable FAA Airworthiness Directives complied with.		
4. All manufacturer's Service Letters, Bulletins, and Alert Bulletins complied with.		
5. Check for proper Pilot's Operating Handbook availability.		
6. Aircraft papers in proper order. Make log book entry.		
7. This aircraft has been determined to be airworthy after completion of the 100 hour/ annual inspection.		

NOTE: Each person performing an annual or 100-hour inspection shall inspect (where applicable) each installed miscellaneous item that is not otherwise covered by this Inspection Procedures Guideline for improper installation and improper operation.

Signature _____

Certificate Identification _____

END OF INSPECTION

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H. OPERATIONAL INSPECTION (Continued)	MECH	INSP
9. Check operation of left and right engine magnetos (1800 rpm); both on, left off, both on, right off, both on. (Maximum magneto drop 175 rpm with 50 rpm maximum difference between magnetos.) With engine at idle, turn switch to OFF position momentarily to check magneto grounding.		
10. Check left and right engine static rpm (2700).		
11. Check left and right carburetor heaters for proper operation and cushion.		
12. Check left and right alternator outputs.		
13. Check left and right cowl flap operation.		
14. Check pressure gauge and pressure system output (4.6 to 5.4 psi).		
15. Check fuel selector valve operation and indexing.		
16. Check heating, defrosting, and ventilating systems for operation.		
17. Check radio for operation.		
18. Check left and right engine idle speed (600 to 650 rpm) and mixture setting.		
19. Check left and right idle cutoff on carburetor for proper operation.		
20. Check ailerons and trim tabs for proper operation.		
21. Check rudder and trim tab for proper operation.		
22. Check elevators and trim tab for proper operation.		
23. Check wing flaps for proper operation.		
24. Check fuel quantity gauges for condition and proper operation.		
25. Check interior lights for proper operation and adjustment.		
26. Check navigation and anti-collision lights for proper operation and landing light for proper operation and adjustment.		
27. Check pitot heat for proper operation.		
28. Check stall warning device for operation.		
29. Inspect engines after ground runup. Flight test and inspect for oil leaks and secure mounting of all components.		

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I. GENERAL	MECH	INSP
1. Aircraft cleaned and serviced.		
2. Aircraft conforms to FAA Specifications.		
3. All applicable FAA Airworthiness Directives complied with.		
4. All manufacturer's Service Letters, Bulletins, and Alert Bulletins complied with.		
5. Check for proper Pilot's Operating Handbook availability.		
6. Aircraft papers in proper order. Make log book entry.		
7. This aircraft has been determined to be airworthy after completion of the 100 hour/annual inspection.		

Signature _____

Certificate Identification _____

END OF INSPECTION

UNSCHEDULED MAINTENANCE CHECKS – DESCRIPTION/OPERATION**1. General**

Following a hard or overweight landing, certain items and systems of the aircraft should be inspected for subsequent damage. Applicable groups in Figure 201, Section 5-2-1 should be used as a guideline when performing the unscheduled inspection required as a result of unusual circumstances. For example, if the landing gear requires an unscheduled inspection, each procedure listed under the landing gear group should be completed.

UNSCHEDULED MAINTENANCE CHECKS – MAINTENANCE PRACTICES

1. Inspections Following a Hard or Overweight Landing

A. Inspect Main and Nose Landing Gear Assemblies

- (1) Check both landing gear assemblies, using those items listed in Figure 201, Section 5-2-1 as a basic guide. The specific limitations pertaining to damage of various components in the landing gear system have not been established at this time. They will be added to the Maintenance Manual at a later date when this data is developed.

B. Inspect Engine Mounts and Propellers

- (1) Inspect left and right engine mount welded assemblies for cracks or any evidence of deformation.
- (2) Inspect left and right engine attachment fittings at nacelle areas for deformation and security of attachment to nacelles.
- (3) Inspect left and right propeller tips for evidence of ground contact. Inspect blade areas for evidence of damage. Replace a damaged propeller.

C. Inspect Fuselage and Empennage

- (1) Inspect tail cone structure for damage. Buckled or damaged mount flanges can normally be repaired using the procedures in AC43.
- (2) Inspect horizontal and vertical stabilizer, elevator, rudder, and aileron mounting brackets for damage, cracks, and security of mounting (loose bolts or buckled supports).
- (3) Suspect bondlines for evidence of damage or cracks.

2. Bondline Damage, Inspection Procedures, and Repair

A. Identify Types of Bondline Damage

- (1) **Physical Damage** – The most common type of bondline damage is physical damage along the trailing edges of flaps, ailerons, elevators, and rudder. This is usually caused by persons stepping on the inboard trailing edges of flaps and general “hangar rash” on other control surfaces. This type of damage is usually readily visible in the form of joint separation.
- (2) **Corrosion Damage** – A less common type of bondline damage is damage caused by metal corrosion. This type of damage is usually restricted to edges of unfileted bondlines, such as found on the rear spar to skin joints on the trailing edges of wings and stabilizers, particularly if these edges are not well protected by paint. This type of damage is more likely in tropical or sub-tropical climates, particularly where an aircraft is in close proximity to coastal areas.

B. Isolate Most Common Damaged Areas

- (1) Areas which should be given particular attention include flanges of wing and stabilizer rear spars, trailing edges of control surfaces, side lap joints between tail cone and forward cabin section, joints between tail cone top and side skin, and aft tail cone bulkhead joints.
- (2) Inside edges and internal joints which have an undisturbed bondline fillet are generally not affected.

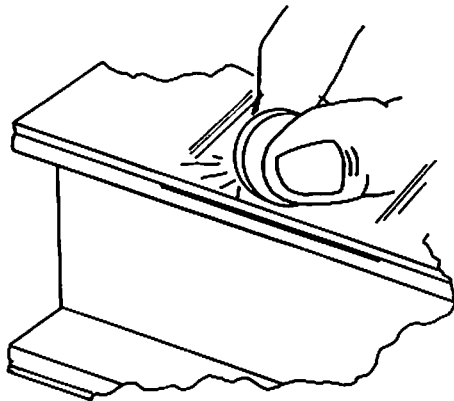
C. Locate and Verify Damaged Areas

- (1) Visual Scanning – Carefully scan the edges of all joints in a well lighted hangar or outside in daylight to determine the existence of hairline cracks between two layers of bonded metal. Figure 201 illustrates the appearance of this condition. Identify the location of any cracks with a grease pencil as shown in Figure 201.
- (2) Tapping – Gently tap the bondline with a coin or similar metal object to verify the existence of a bondline separation. Slowly move along the bondline, while tapping, and listen for a change in tone as the suspect area is traversed. A bondline separation will produce a flat or hollow sound when tapped directly in the damaged area.
- (3) Separation – If the results of item (2) are questionable, attempt to insert a 0.004 inch to 0.006 inch feeler gauge into the bondline to verify that a separation exists.

D. Repair Bondline Damage

WARNING: USE SOLVENTS IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (1) After inspection, if the suspected damage proves to be no actual separation, the hairline should be wiped with Methyl Ethyl Ketone and sealed with paint.
- (2) Seal all bondline edges with paint.
- (3) If the suspected area proves to be actual bondline separation, order Service Kit No. SK-125 from the Grumman American Supply Operations and make repairs accordingly.



Identifying Suspect Areas
Figure 201

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CHAPTER 6

DIMENSIONS AND AREAS

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PRINCIPAL DIMENSIONS

1. **General**

The principal dimensions of the GA-7/Cougar Aircraft are provided in this section.

2. **Principal Dimensions**

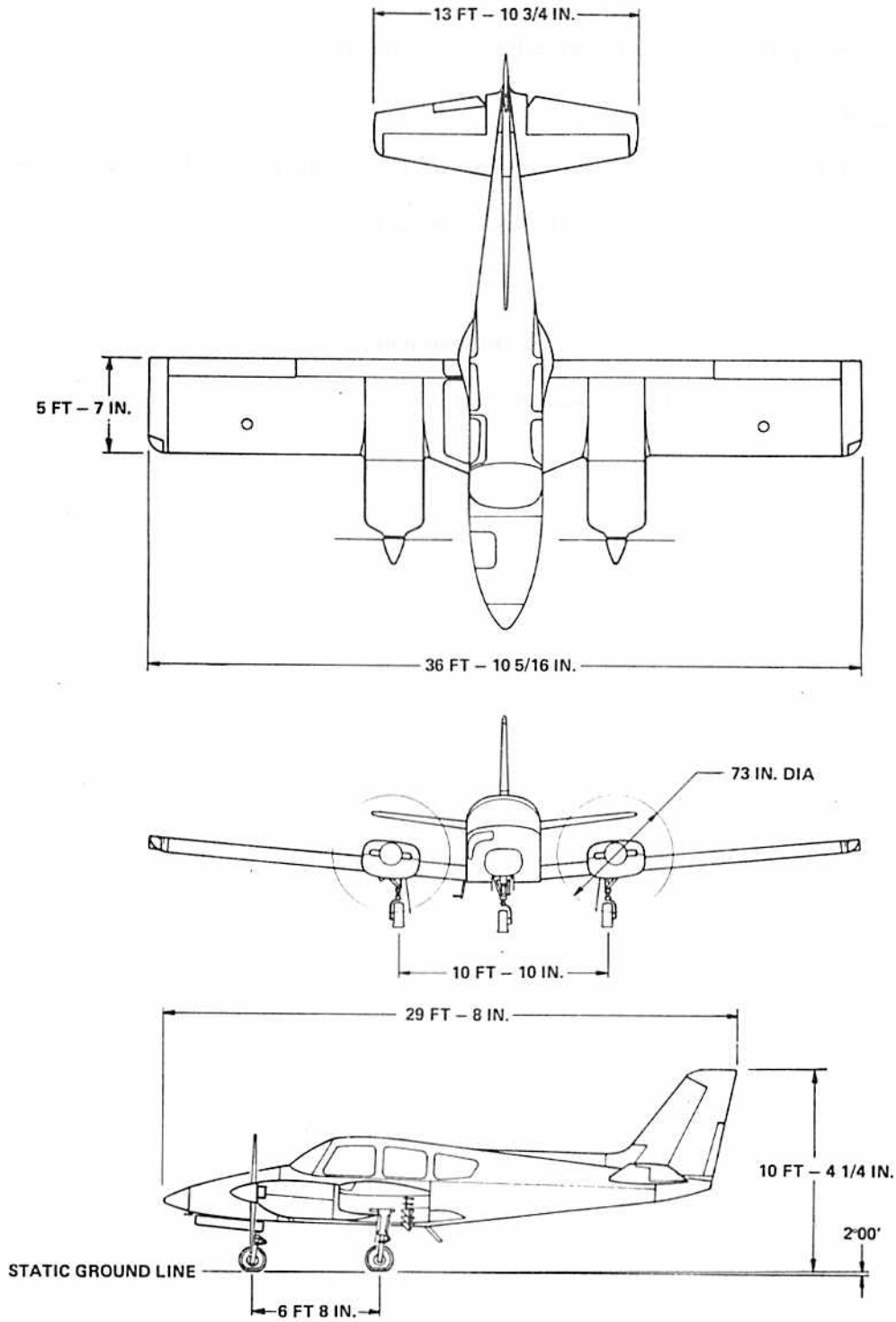
Principal dimensions of the GA-7/Cougar are shown in Figure 1. Propeller tip to ground clearance are as follows:

Static* 10 inches (nominal)

Nose strut
and nose tire
deflated 6 inches (nominal)

*Nose strut and all three tires inflated to recommended pressure.

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Principal Dimensions (GA-7/Cougar Aircraft)
Figure 1

STATION LOCATIONS

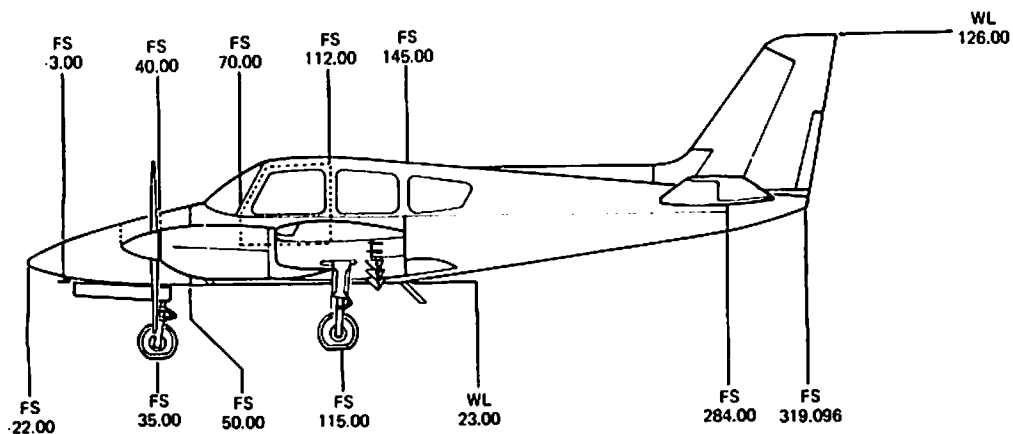
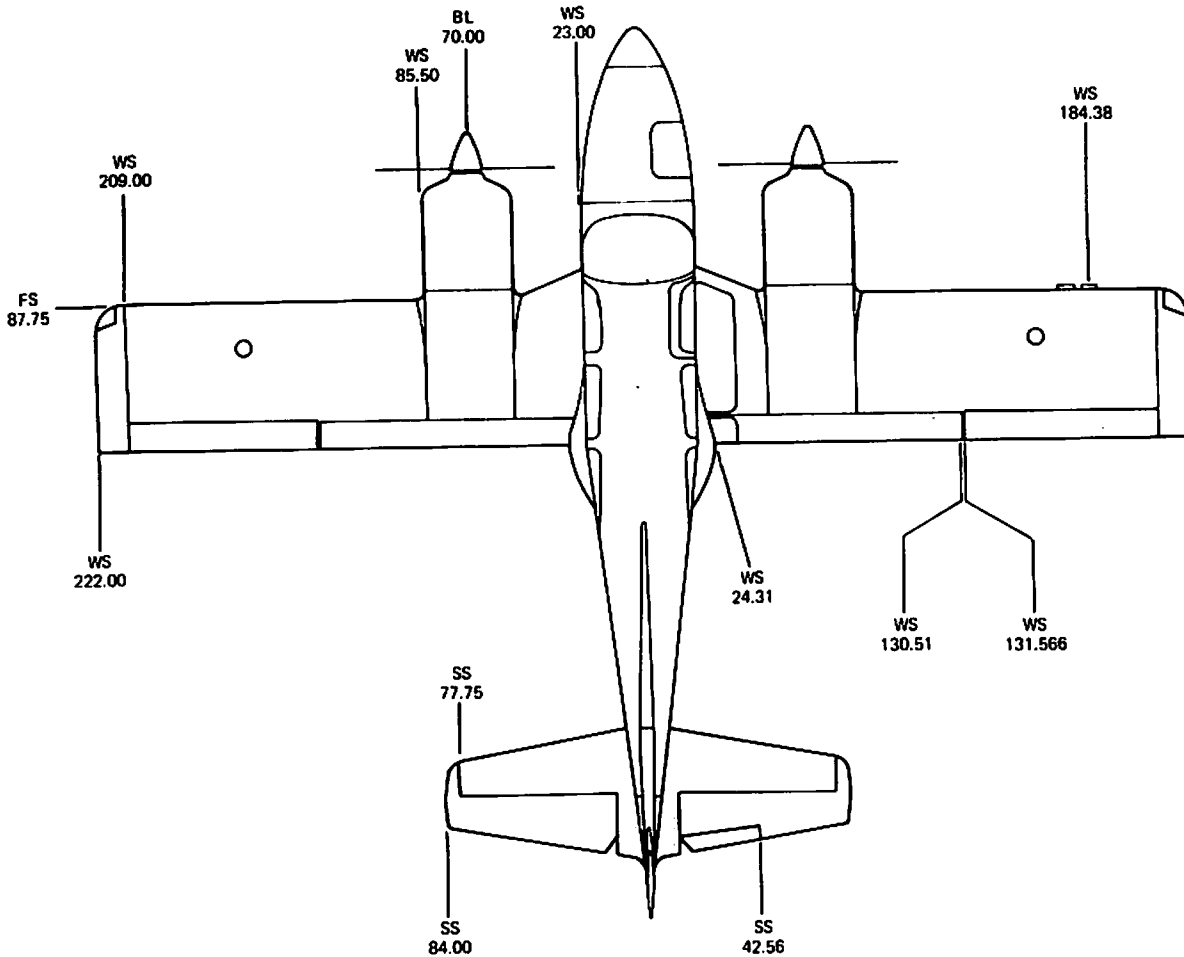
1. General

This section provides station locations for the GA-7/Cougar aircraft.

2. Station Locations

Station locations for the GA-7/Cougar aircraft are shown in Figure 1.

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Station Locations (GA-7/Cougar Aircraft)
Figure 1

6G72-2

SPECIFICATIONS

1. **General**

The major specifications for the GA-7/Cougar aircraft are presented in tabular form below.

2. **Specifications, GA-7/Cougar Aircraft**

A. **Wing**

Span: 37.00 feet
Area: 183.81 square feet
Aspect Ratio: 7.448 to 1
Incidence: 1° 13' 42.4"
Dihedral: 5 degrees 00 minutes

B. **Ailerons**

Span: 78.184 inches
Travel: Up 25 degrees ± 2 degrees
Down 15 degrees ± 2 degrees

C. **Flaps**

Span: 106.88 inches
Travel: Up 0 degrees ± 2 degrees
Down 30 degrees ± 2 degrees

D. **Horizontal Tail**

Span: 14.00 feet
Area: 49.21 square feet
Aspect Ratio: 3.983 to 1
Dihedral: 7 degrees 00 minutes
Incidence: 0 degrees
Elevator Travel: Up 17 degrees ± 1 degree
Down 16 degrees ± 1 degree
Elevator Trim Tab Travel: Nose down trim 4 degrees ± 1 degree T.E. Up
Nose up trim 30 degrees + 2 degrees, -3 degrees T.E. Down

E. **Vertical Tail**

Span: 6.00 feet
Area: 23.375 square feet
Aspect Ratio: 1.487 to 1
Sweep: 31° 53' 24"
Rudder Travel: 40 degrees ± 2 degrees Left and Right
Rudder Trim Tab Travel: 15 degrees ± 1.5 degrees Left and Right

F. **Fuselage**

Height: 49 inches
Width: 46 inches
Length: 341.096 inches
Static Ground Angle: 2 degrees 00 minutes nose up

G. Main Wheels

Brakes: Two-piston, single disc type
Tire Size: 6.00-6, Type III, 6-ply rating
Tire Pressure: 40 ± 2 psi

H. Nose Wheel

Tire Size: 15 X 6.00-6, 4-ply rating
Tire Pressure: 40 ± 2 psi

I. Strut Pressure (Without Load)

Nose Landing Gear: 165 ± 10 psi
Main Landing Gear: 90 ± 10 psi

J. Operating Gross Weights

Takeoff: 3800 pounds maximum
Landing: 3800 pounds maximum
Standard Empty Weight: 2569 pounds
Maximum Useful Load: 1231 pounds
Baggage: 175 pounds aft, 75 pounds nose

K. Power Plant

Engine: Lycoming O-320-DID, 160 hp at 2700 rpm and 28.5 inches mercury
Compression Ratio: 8.50 to 1
Fuel: 100 Minimum Grade Aviation Fuel (green), 100 LL Aviation Fuel (blue) also approved.
Fuel Capacity: (Ambient temperature of 70°F (21°C)) 118 U.S. gallons (98.3 Imperial gallons) (446.6 liters)
Each Tank: 59 U.S. gallons (49.1 Imperial gallons) (223.3 liters)
Total Usable: 114 U.S. gallons (94.9 Imperial gallons) (431.5 liters)
Intermediate Loading: 100 U.S. gallons (80 Imperial gallons) (380 liters) and 80 U.S. gallons (66.6 Imperial gallons) (302.80 liters)
Unusable Fuel: 2 U.S. gallons in each wing
Oil Capacity (Each Engine Sump): 8 quarts (6.66 Imperial quarts) (7.57 liters)
Magnetos: Slick 4051 (LH engine)
4050 (RH engine)

L. Electrical System

Battery: 12 volts, 25 ampere-hours
Starters: Prestolite direct drive 12 volts
Alternators: 14 volts, 60 amperes

M. Propellers

Manufacturer: Hartzell
Model Number: HC-F2YL-2UF/FC7663D-3
Diameter: 73 inches
Type: Constant speed, full feathering, governor regulated, two bladed propellers. An unfeathering accumulator is optional.
Blade Angle at 30 inch Station:
Low Pitch: 11.5° ± 0.1°
Feather: 80° to 82°

CHAPTER 7

LIFTING AND JACKING

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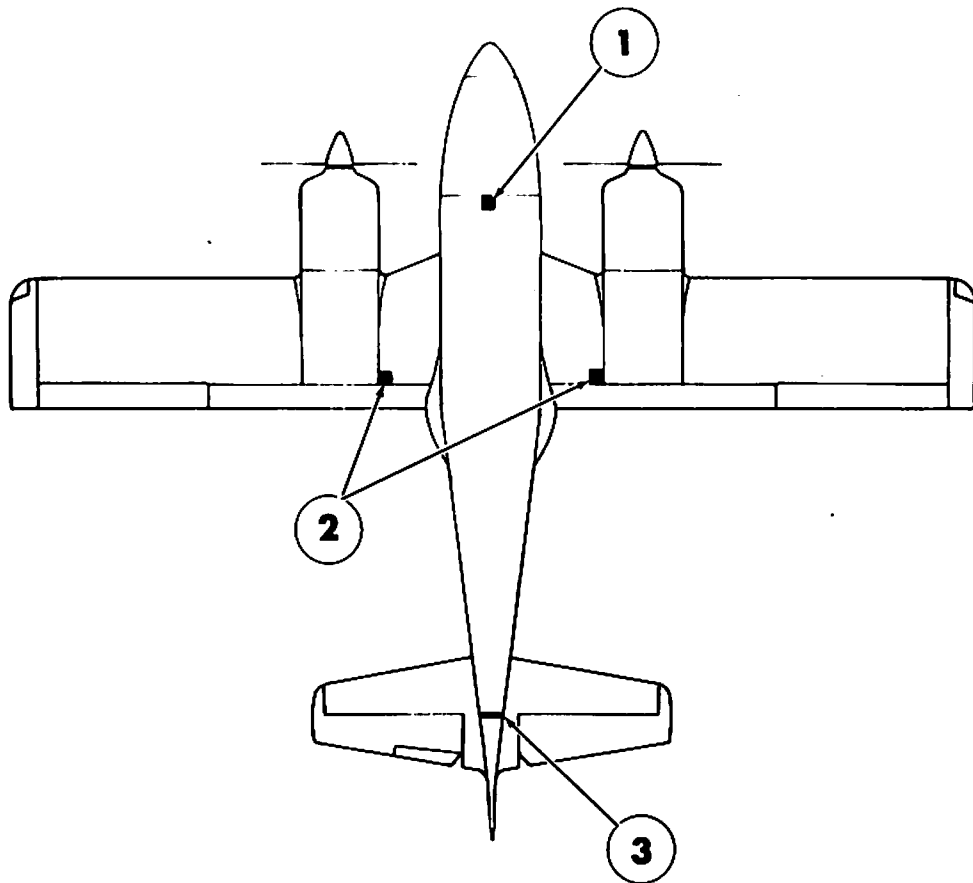
LIFTING AND JACKING POINTS

1. **General**

The jack pads and other points that may be used to lift or jack the GA-7/Cougar Aircraft are identified in this section.

2. **Lifting and Jacking Points**

Lifting and jacking points for the GA-7/Cougar Aircraft are shown in Figure 1.



7G72-1

1. **Forward Jack Pad Fuselage Station 50.00 Left Butt Line 6.0**
2. **Wing Jack Pad Fuselage Station 125.10 Wing Station 51.031**
3. **Aft Support Line Fuselage Station 284.00**

Jacking Points Location
Figure 1

LIFTING AND JACKING PROCEDURES1. General

Recommended procedures for lifting and jacking the GA-7/Cougar aircraft to accomplish maintenance and inspection procedures are included in this section. Since lifting and jacking procedures are dependent on the type of maintenance to be performed and the equipment available to lift or jack the aircraft, the procedures given below are necessarily general in nature.

It is recommended that the aircraft be hangared or placed in an area protected from wind gusts, and prop or jet wash, if it is to be jacked, to reduce the possibility of a jack slipping from the jack pad area and causing damage to the aircraft.

2. Jacking Procedures

CAUTION: LIMIT MAINTENANCE PERFORMED WITH THE AIRCRAFT ON JACKS TO THAT WHICH REQUIRES THAT THE AIRPLANE BE JACKED UP. DELAY OTHER MAINTENANCE UNTIL THE JACKS CAN BE REMOVED.

A. Jacking

- (1) Move the aircraft into a hangar or other level, protected area if possible.

CAUTION: DO NOT JACK THE AIRPLANE IF WIND GUSTS EXCEED 10 MPH OR IN AN AREA SUBJECT TO PROP OR JET WASH.

- (2) Place a minimum 1-ton capacity aircraft jack at each jack pad. The forward jack pad is located beneath the forward fuselage. The wing jack pads are located just inboard of the engine nacelles at the trailing edges of the wings. Refer to Lifting and Jacking Points, Figure 1, this chapter.

CAUTION: THE JACK CAPACITIES SPECIFIED EXCEED THE VERTICAL LOAD REQUIREMENTS OF THE AIRCRAFT TO ALLOW FOR THE ADDED DYNAMIC STRESSES OF GEAR CYCLING, NECESSARY ONBOARD MAINTENANCE PERSONNEL, PLUS AN ADDED MARGIN FOR SAFETY. LIGHTER CAPACITY JACKS MAY RAISE THE AIRCRAFT, BUT THEIR USE IS NOT RECOMMENDED.

- (3) Raise the jacks until they are fully in contact with the aircraft jack pads. Adjust position as necessary to seat the jack pads into the jacks.
- (4) Operate the jacks evenly so that the aircraft remains as nearly level as possible. Raise the aircraft only as high as required for proper maintenance. Install locking devices on the jacks to prevent accidental lowering.
- (5) Limit personnel in the area to those required to perform maintenance. Avoid weight or pressure on aft fuselage, empennage, and wings outboard of the engine while the aircraft is on jacks.

B. Lowering

- **CAUTION:** A DOWN AND LOCKED INDICATION MUST BE OBTAINED FOR ALL THREE LANDING GEAR BEFORE JACKS ARE LOWERED.

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- (1) Place the MASTER switch in the ON position. Make sure the NOSE, LEFT, and RIGHT indicator lights adjacent to the landing gear control are illuminated and that the NOT SAFE indicator light is out before proceeding. Place the MASTER switch in the OFF position.

CAUTION: MAKE SURE THE AREA BENEATH THE AIRCRAFT IS CLEAR BEFORE LOWERING.

- (2) Make sure the parking brake is released. Release the locking devices on the jacks. Lower the jacks evenly to keep the aircraft as nearly level as possible.
- (3) Apply the parking brakes or chock the wheels as required.
- (4) Remove the jacks from beneath the aircraft.

CHAPTER 8

LEVELING AND WEIGHING

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AIRCRAFT PREPARATION

1. General

The procedure for determining the basic weight and moment of the GA-7/Cougar aircraft is contained in this chapter. Sample forms and procedures for their use are provided to enable rapid calculation of weight and moment.

Consult the aircraft log for specific information on weight, arm, moment, and installed equipment. This information is contained in the weight and balance records carried in the aircraft.

2. Preparation Procedures

Prepare the aircraft for leveling and weighing as follows:

- A. Inflate all tires to the recommended operating pressure and service the shock struts (Chapter 12).
- B. Drain all fuel from the tanks and fuel system.
- C. Drain all oil from the oil system.
- D. Place all controls in the neutral position.
- E. Raise flaps to the fully retracted position.
- F. Move adjustable seats to center of travel position.
- G. Remove all objects not a part of the aircraft or its accessories from the cockpit and passenger compartment.
- H. Clear the forward and aft baggage compartments of all baggage and other objects not a part of the aircraft or its accessories.
- I. Release the parking brake. Close and secure all doors.
- J. Remove towbar.

NOTE: Chocks may be put in place if required. If the aircraft is to be weighed, the exact weight of each chock must be known and deducted from the reading of the scale on which it is used.

LEVELING**1. General**

The surface on which an aircraft is to be leveled should be as level and free of surface irregularities as possible. If the leveling is to be accomplished as part of aircraft weighing procedure, the aircraft should be mounted on the scales prior to leveling.

2. Leveling Procedure

A. Prepare the aircraft for leveling and weighing. See Section 8-2.

B. If required, place scales (minimum 1-ton capacity) under each wheel.

NOTE: Release air from the tire on the high end to level airplane.

C. Place a level underneath the fuselage at right angles to the aircraft fore and aft centerline and release air from the main landing gear tires as required to level the airplane laterally.

D. Place a level underneath the fuselage parallel to the aircraft fore and aft centerline and release air from the nose landing gear tire or both main landing gear tires as required to level the aircraft longitudinally.

E. Repeat Steps C and D as required to level the aircraft.

WEIGHING1. General

Aircraft weighing should be done in a hangar or other area sheltered from wind to avoid inaccurate or varying scale readings.

Low-velocity wind gusts and other air movement which would not disturb a parked aircraft can induce rocking and other disturbances which can significantly affect the scale readings obtained. Use only properly calibrated scales of sufficient capacity to support the aircraft.

2. Weighing Procedure

- A. Place the aircraft on scales and level. Refer to Section 8-1-1.
- B. Read each scale and record the indicated weight in the Scale Reading column (Figure 1).
- C. Record the weight of any chocks or other devices used to support the aircraft in the Tare column.
- D. Subtract the tare from the scale reading and enter each result in the Net Weight column.
- E. Add the three entries in the Net Weight column to obtain the Total of Net Weights.

SCALE POSITION	SYMBOL	SCALE READING	TARE	NET WEIGHT
Left Wheel	L			
Right Wheel	R			
Nose Wheel	N			
Total of Net Weights	W			

Aircraft Net Weight Computation Form
Figure 1

MEASURING ARM

1. General

As in any measuring and computation procedure, the accuracy of the results obtained depends upon the care taken in gathering data and in making computations. String and measuring tape should be pulled taut enough to eliminate deflection, and the plumb bob reading should be taken in still air.

2. Measuring Procedure (See Figure 1.)

A. Level the aircraft in accordance with Section 8-2-1.

B. Obtain dimension A as follows:

- (1) Stretch a string laterally across the aircraft from the axle center of one main landing gear to the axle center of the other main landing gear.
- (2) On the aircraft centerline beneath the fuselage, connect a plumb bob so that it hangs from Fuselage Station 50.00. Fuselage Station 50.00 is the forward side of the forward cabin bulkhead.
- (3) Along the aircraft centerline, measure the distance from the plumb bob to the string stretched between the main landing gears. This is dimension A.
- (4) Record dimension A in the Weighing Form (Figure 1).

C. Obtain dimension B as follows:

- (1) Set the nose wheel straight along the centerline of the aircraft.
- (2) Measure the distance from the nose gear axle centerline to the string stretched between the main landing gears. This is dimension B.
- (3) Record dimension B in the Weighing Form (Figure 1).

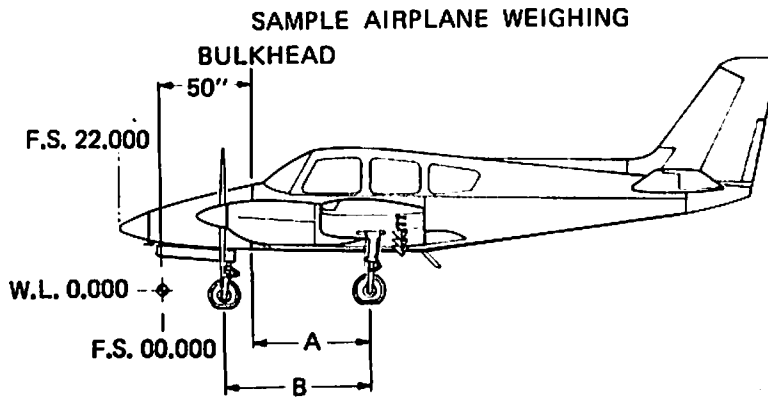
SCALE POSITION	SYMBOL	SCALE READING	TARE	NET WEIGHT
Left Wheel	L			
Right Wheel	R			
Nose Wheel	N			
TOTAL OF NET WEIGHTS W				

Calculate Arm (in inches) as follows:

$$\text{C.G. Arm} = \frac{[(50 + A)(L + R)] + [50 - (B - A)]N}{W}$$

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ITEM	WEIGHT	C.G. ARM	MOMENT/ 1000 LBS. IN.
Aircraft Net Weight (W)	2457.00	94.45	232076.0
Oil, 16 Qts. at 1.875 Lb./Qt. (Total)	30.00	64.40	1.932
Unusable Fuel 1.50 Gal. at 6 LB./Gal.	9.00	112.00	1.008
Equipment Changes			
Aircraft Licensed Empty Weight	2466.00	94.52	233.084



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**Aircraft Weighing (Sample Problem)
Figure 1**

COMPUTING CENTER OF GRAVITY

1. General

The following is a step-by-step computation of aircraft basic weight moment performed using the sample forms shown in Section 8-3-1.

2. Procedure for Computing Center of Gravity

- A. Calculate the total of net weights in accordance with Section 8-2-1.
- B. Obtain dimensions A and B. Refer to Section 8-3-1.
- C. Using the information previously recorded, calculate the aircraft C.G. Arm using the formula given in Figure 1, Section 8-3-1.
- D. Enter the Aircraft Net Weight (W) and C.G. Arm (Step 2.C) into the Aircraft Licensed Empty Weight form.
- E. Multiply weight times C.G. Arm and divide the product by 1000 to obtain the moment. Enter the moment in the Moment/1000 Lbs. In. column.
- F. Add the entries in Moment/1000 Lbs. In. column to obtain the Aircraft Licensed Empty Weight moment.

NOTE: For further information and methods for computing weight and balance, refer to FAR Part 43 and your GA-7/Cougar Pilot's Operating Handbook.

CHAPTER 9

TOWING AND TAXIING

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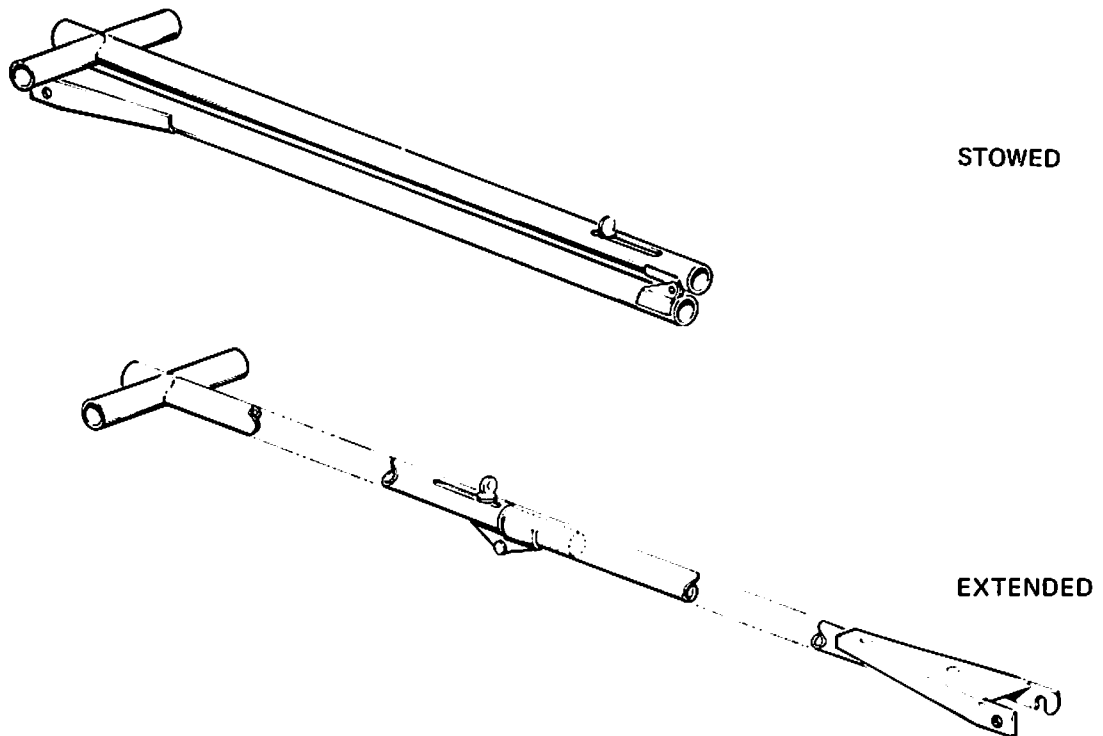
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TOWING1. General

Information for towing the GA-7/Cougar aircraft is contained in this section. A towbar is available for towing and ground handling. Consult your Grumman American Dealer or Illustrated Parts Catalog for further information and part numbers.

2. General Precautions

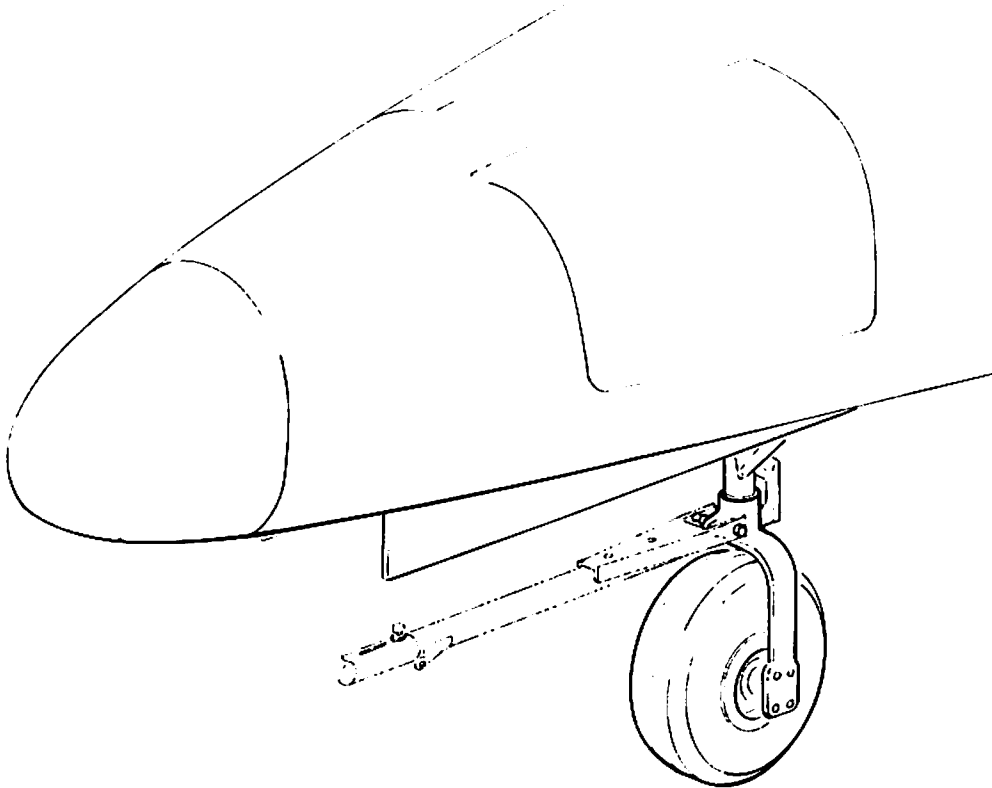
- A. Make sure the parking brake is released and remove any chocks.
- B. Do not use either propeller for ground handling. Serious damage could result, especially if pressure is exerted on the outer ends.
- C. Do not push on flaps, ailerons, on other control surfaces.
- D. When moving the aircraft in a confined area, the use of additional personnel to watch the wingtips and tail is recommended.

3. Towing Procedures (See Figure 1.)

Towbar Assembly
Figure 1

9G72-1

- A. **Unfold the towbar assembly as follows:**
- (1) **Loosen the thumbscrew and slide it as far toward the handle as it will go.**
 - (2) **Unfold the towbar and slide the thumbscrew to the other end of the slot. Tighten the thumbscrew hand tight.**
- B. **Attach the towbar to the towbar attach points on the nose landing gear trunnion and oleo assembly as shown in Figure 2.**



Towbar Attachment
Figure 2

9G72-2

CAUTION: WHEN TURNING THE AIRPLANE, DO NOT EXCEED THE TURN LIMITS (35°) MARKED ON THE TRUNNION. FOLLOW THE PLACARDED INSTRUCTIONS ON THE NOSE LANDING GEAR.

- C. Remove chocks, release the parking brakes, and tow the aircraft by pushing or pulling. Do not exceed a turn angle of 35° either side of the aircraft centerline.**

TAXIING1. General

The rudder controls on the GA-7/Cougar aircraft are coupled to the nose wheel, allowing the rudder pedals to be used for steering while taxiing. Full rudder pedal will result in a corresponding 15 degree deflection of the nose wheel. Differential braking may be used to increase the nose wheel deflection to 35 degrees, decreasing the turning radius. The practice of locking one main wheel to obtain a minimum turn will exceed the turn capability of the nose wheel and scuff the tire. For this reason, tight turns of this type are not recommended.

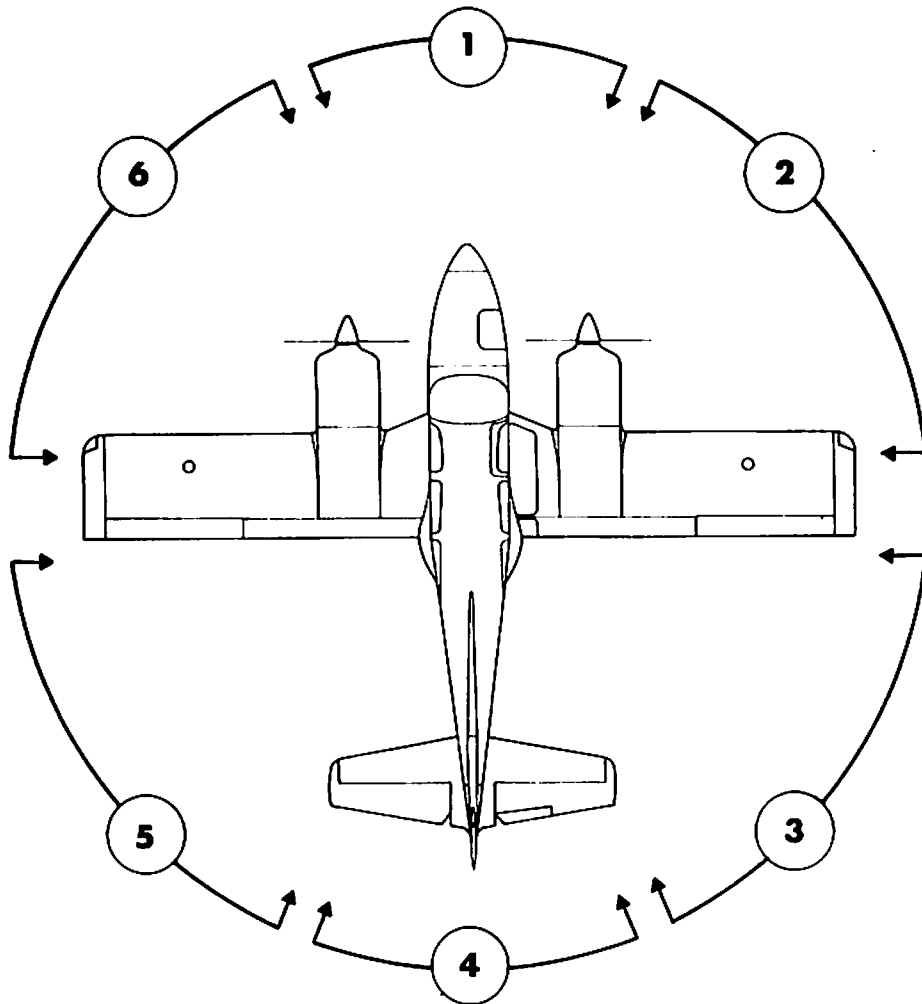
2. Taxiing Technique

All taxiing should be done at slow speed, the rate depending upon ground conditions, proximity of other aircraft, ground obstructions, and wind conditions on the ground.

Controls should be positioned so that the effects of wind gusts are minimized. Refer to Figure 1 for recommended control settings. If at all possible, taxiing in strong crosswinds should be avoided. If taxiing in strong winds must be done, the use of "wing walkers" is recommended.

As with any aircraft, standing or taxiing over gravel, cinders, or other loose material may result in damage to propeller tips, wing leading edges, landing gear, and horizontal surfaces. Avoid warmups and standing in such areas, and taxi at low speeds to minimize damage.

NUMBER	WIND DIRECTION	CONTROL	POSITION
(1)	Fwd	Wheel Neutral	Back
(2)	Fwd RH Quarter	Wheel Right	Back
(3)	Aft RH Quarter	Wheel Left	Forward
(4)	Aft	Wheel Neutral	Forward
(5)	Aft LH Quarter	Wheel Right	Forward
(6)	Fwd LH Quarter	Wheel Left	Back



**Taxiing Diagram
Figure 1**

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CHAPTER 10

PARKING AND MOORING

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PARKING**1. General**

This section contains procedures for parking the aircraft so that the probability of ground damage is held to a minimum. Parking is defined as leaving the aircraft unattended for a short period.

2. Parking Precautions

- A. Do not park the aircraft in an area subject to prop and jet wash.
- B. Do not park the aircraft if moderate to high winds or storms are anticipated. Moor the aircraft in accordance with Section 10-1-1.
- C. If heavy braking has been done in landing, allow the brakes to cool before setting the parking brakes.
- D. Do not set the parking brake when the ambient temperature is near or below freezing. Accumulated moisture may freeze in the brakes, preventing them from being released.
- E. The parking brake is primarily intended for use over short periods of time. Over an extended period, an air temperature rise could cause the hydraulic fluid to expand, damaging the brake system. Use tiedowns and wheel chocks for prolonged parking.

3. Parking Practices

Choose an area free from prop and jet wash, head the aircraft into the wind, and set the parking brakes. Install the control lock.

MOORING**1. General**

This section provides procedures recommended for normal tiedown of the aircraft, and special precautions to minimize the likelihood of damage during severe weather.

2. Normal Tiedown

The best precaution against damage to aircraft by strong or gusty winds is a proper tiedown procedure. Proceed as follows:

- A. Position the aircraft so that the tail anchor point is on the fore and aft centerline of the aircraft and so that the distance from each forward anchor to its respective wing tiedown fitting is as short as possible. The anchor should be forward of the tiedown fitting.

CAUTION: IF THE AIRCRAFT IS TO BE MOORED ON A SMOOTH SURFACE, CLEAT OR TIE EACH PAIR OF CHOCKS TOGETHER TO PREVENT SLIPPING. DO NOT USE CHOCKS THAT WILL CONTACT THE NOSE LANDING GEAR YOKE OR MAIN LANDING GEAR FAIRING.

- B. Chock all three wheels and install the control wheel lock.
- C. Pass 3000-pound tensile strength chain or rope through the tail and wing tiedown fittings and secure. The wing tiedown fittings are located at the inboard edge of the wing tip cap beneath the wing. The tail tiedown fitting is located beneath the fuselage at the forward end of the tail cone.

CAUTION: IF MANILA ROPE IS BEING USED, ALLOW SUFFICIENT SLACK FOR SHRINKAGE WHEN THE ROPE GETS WET AND SUBSEQUENTLY DRIES.

- D. Secure each rope or chain to an anchor point.
- E. Install a pitot tube cover and make sure all doors are closed and latched.

3. Severe Weather Precautions

If severe weather is anticipated, the safest procedure is to fly the aircraft to another airport out of the path of the severe weather, or to hangar the airplane. A good tiedown job affords no protection from windblown debris or hail.

In addition to the procedures given in Paragraph 2 accomplish the following:

- A. Choose tiedown points that are well anchored and do not require long tiedown ropes.
- B. Position the aircraft so that it is headed directly into the anticipated direction of strongest winds.

CAUTION: DO NOT USE CHAIN OR CABLE ON NOSE LANDING GEAR.

- C. Tie a rope (no chains or cables) to the nose landing gear and secure to a tiedown point forward of the nose landing gear.

NOTE: FAA advisory circular No. 20-35 provides additional tiedown information.

CHAPTER 11

PLACARDS AND MARKINGS

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PLACARDS AND MARKINGS**1. General**

This Chapter contains information relating to placards used on the GA-7/Cougar Aircraft which define aircraft limitations and/or flight safety data required by FAA regulations. Also covered in this chapter are placards which provide the pilot, passengers, and maintenance personnel with aircraft operational data.

2. Placard Locations

The appearance, content, and location of all placards are contained in Figure 1 and Figure 2. The exterior placards are covered in Figure 1, while the interior placards are covered in Figure 2.

GRUMMAN AMERICAN

Located on each side of vertical stabilizer



Located on each side of aft fuselage

Exterior Placards
Figure 1 (Sheet 1 of 4)

11G72-1-1

OIL CAPACITY 8 QTS	
TEMPERATURE	GRADE
ABOVE 60°F (16°C)	SAE 50
30°F (-1°C) TO 90°F (32°C)	SAE 40
0°F (-18°C) TO 70°F (21°C)	SAE 30
BELOW 10°F (-12°C)	SAE 20

Located on inside of oil filler access door

SERVICING INSTRUCTIONS
<ol style="list-style-type: none">1. RELEASE AIR PRESSURE2. CLOSE AIR VALVE3. REMOVE FILL VALVE4. EXTEND STRUT-HOLD VERT5. FILL TO OVERFLOW WITH MIL-H-5606 HYD FLUID6. FULLY COMPRESS STRUT TO REMOVE EXCESS OIL7. REPLACE FILL VALVE8. WITH NO LOAD ON STRUT INFLATE WITH NITROGEN OR CLEAN AIR TO - ■ PSIG TIRE PRESS ■ PSIG

Located on landing gear struts


**MAX. BAG COMPARTMENT
CAPACITY 75 LBS
FOR ADDITIONAL LOADING
INSTRUCTIONS SEE WEIGHT &
BALANCE DATA. NET MUST
BE USED TO RESTRAIN
BAGGAGE FROM SHIFTING**

Located on inside of nose baggage compartment door

11G72-1-2

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**GA-7/COUGAR
MAINTENANCE MANUAL**

	GRUMMAN AMERICAN AVIATION CORPORATION SAVANNAH, GEORGIA 31402 U.S.A.
MODEL NO.	_____
SERIAL NO.	_____
TYPE CERT NO.	_____
PROD CERT NO.	_____

Located on fuselage side under left horizontal stabilizer



Located on stall warning switches



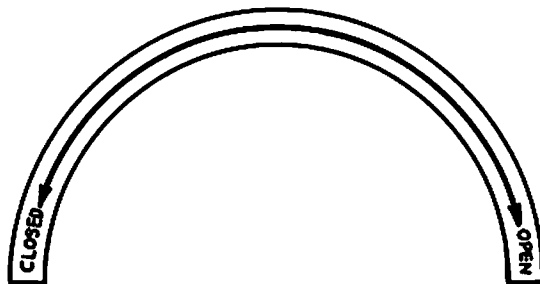
Located on right hand flap next to wing walk

**INSTRUCTIONS FOR MANUALLY ACTIVATING
EMERGENCY LOCATOR TRANSMITTER: REMOVE
ACCESS COVER. MOVE TOGGLE SW TO THE
EXTREME UP POSITION. (TOWARD TOP OF
FUSELAGE.)**

Located on tail section

**CAUTION: 12 VOLT DC ONLY
MASTER SW MUST BE ON
PRIOR TO STARTING ENGINE**

Located next to auxiliary power receptacle (inside of door)



Located on fuselage above upper entrance door latch

**GRUMMAN AMERICAN
AVIATION CORPORATION
SAVANNAH, GA.
PART NO. [REDACTED]
SERIAL NO. [REDACTED]
MODEL [REDACTED] DATE [REDACTED]
CAUTION
FLUID UNDER PRESSURE
READ INSTRUCTIONS IN
SERVICE MANUAL PRIOR
TO SERVICING**

Located on landing gear struts

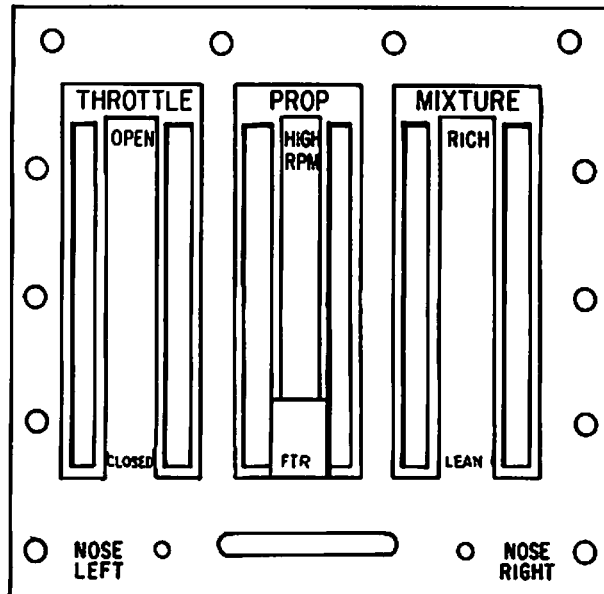
11G72-1-4

PRESS
TO
TEST

Located on instrument panel



Located on control wheels



Located on control quadrant

Interior Placards
Figure 2 (Sheet 1 of 7)

11G72-2-1



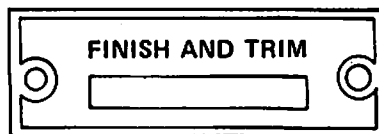
Located on lower instrument panel

NOT USED

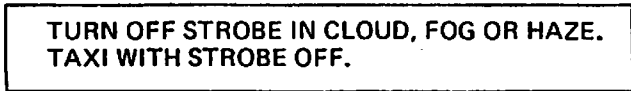
Located on instrument panel



Located forward center lower console



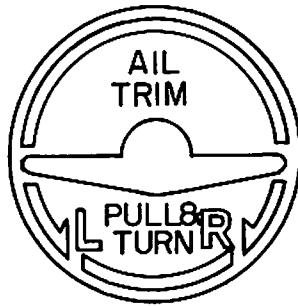
Located on aft cabin bulkhead



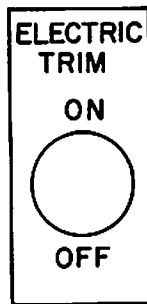
Located in view of pilot on instrument panel



Located on left side of control quadrant



Located on aileron trim control knob



Located on instrument panel (optional)

11G72-2-3

Interior Placards
Figure 2 (Sheet 3 of 7)

340 LBS MAX CARGO CAPACITY

DISTRIBUTE LOAD EVENLY. MAX
DESIGN LOAD 37 LBS/FT²
NO PASSENGERS. FOR ADDITIONAL
LOADING INSTRUCTIONS SEE WEIGHT &
BALANCE DATA

Located on bottom of rear seat

BAGGAGE COMPARTMENT CAPACITY
175 LBS MAX

FOR ADDITIONAL LOADING INSTRUCTIONS
SEE WEIGHT & BALANCE DATA

NO HEAVY OBJECTS ON HAT SHELF

Located on aft cabin bulkhead

**WARNING: TO AVOID DAMAGE
LATCH HANDLE MUST BE IN
OPEN POSITION BEFORE
CLOSING DOOR**

Located on inside of entrance door

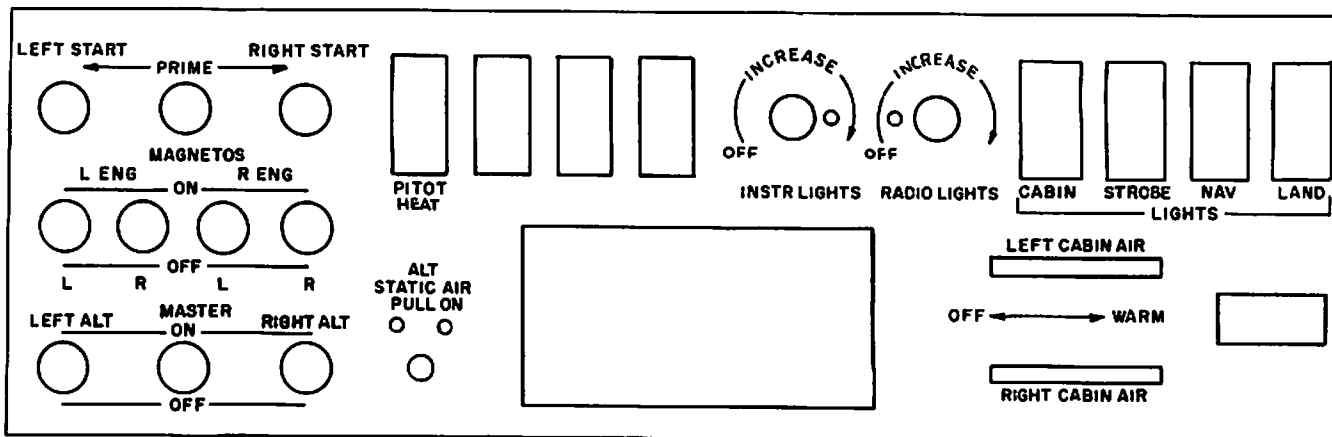
**MAX CHILD SEAT
CAPACITY 120 LBS**

Located on aft cabin bulkhead (optional)

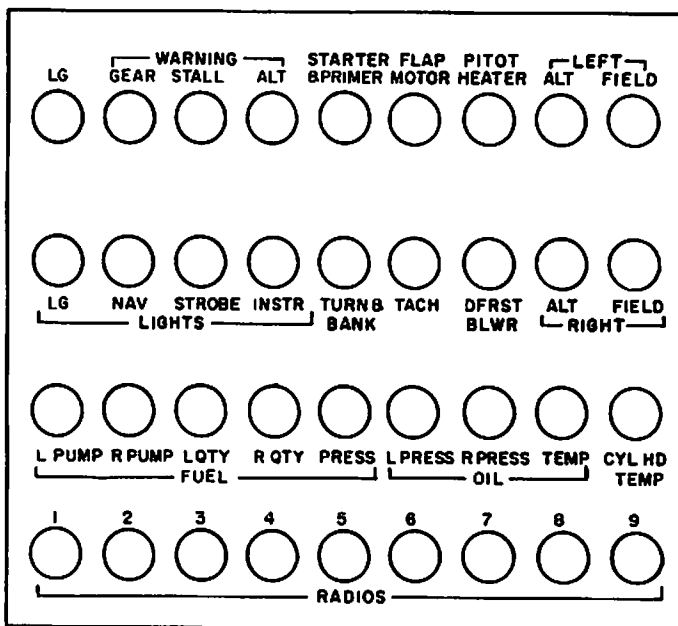
**PUSH TO
RELEASE**

Located on child's seat (optional)

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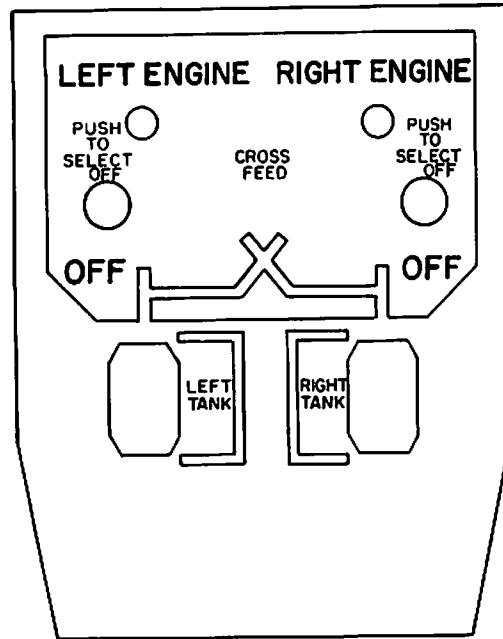
Located on instrument panel



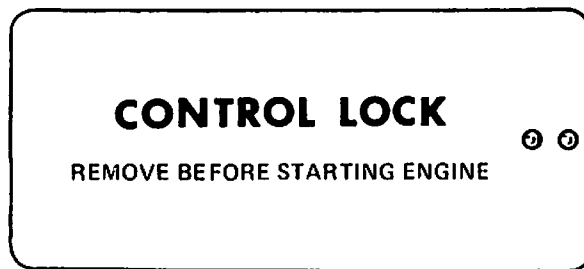
Located on instrument panel

Interior Placards
 Figure 2 (Sheet 5 of 7)

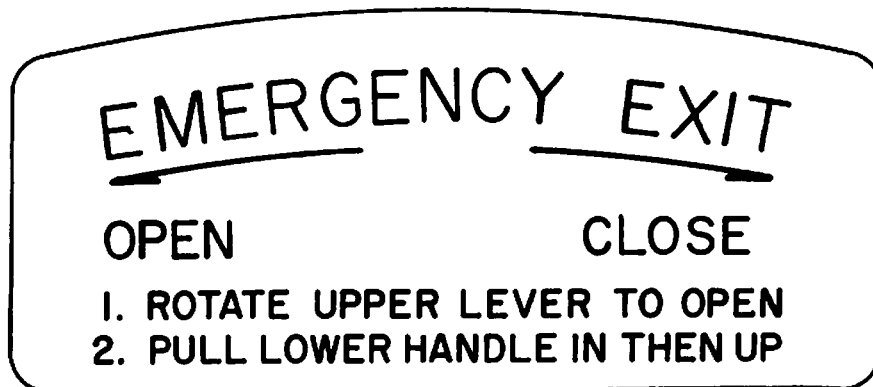
11G72-2-5



Located on aft console



Located on left hand control column



Located on left hand side above emergency exit window



Located on Instrument Panel

11G72-2-7

Interior Placards
Figure 2 (Sheet 7 of 7)

GRUMMAN AMERICAN AVIATION
GA-7/COUGAR
MAINTENANCE MANUAL

CHAPTER 12

SERVICING

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SERVICING**1. General**

This section describes the procedures and precautions necessary for proper servicing of the GA-7/Cougar aircraft. Safety precautions are also presented to acquaint the user with those potential hazards that may not be readily apparent to persons unfamiliar with the aircraft.

2. Servicing Points

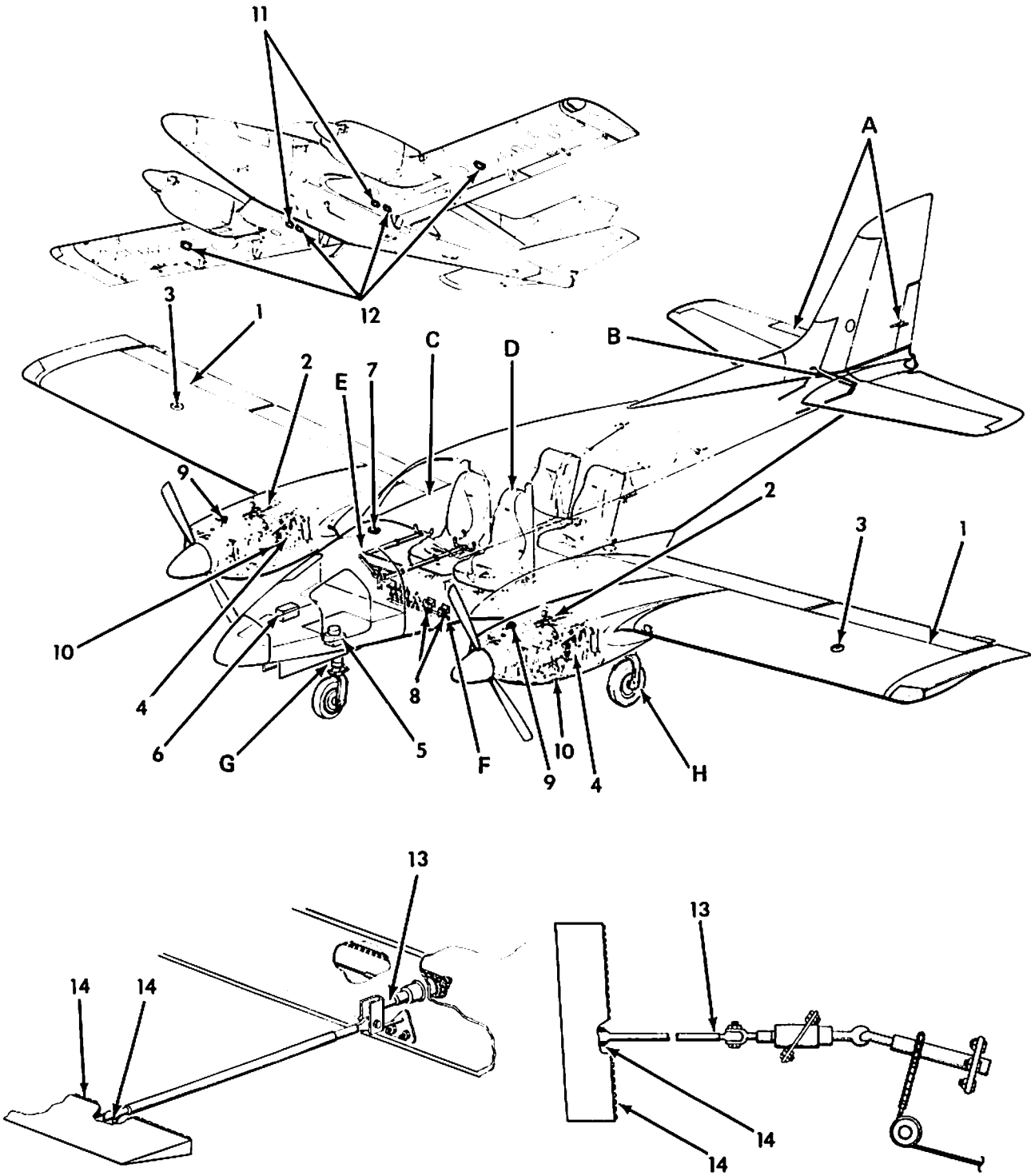
Figure 1 illustrates the locations of the major servicing points on the aircraft. Figure 2 lists approved lubricants.

3. Access and Inspection Provisions

Various openings in the airframe are provided to enable access for inspection or maintenance. In addition to the normal access provided by the engine cowlings, other openings, which are covered by removable plates, are listed in Figure 3.

Access to the interior of the aft fuselage is gained by removal of the access panels at the rear of the baggage compartment bulkhead. Access to the control column interconnect chains and linkages is gained by removing two oval shaped panels on nose baggage compartment aft bulkhead.

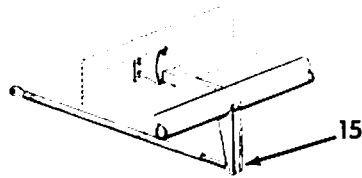
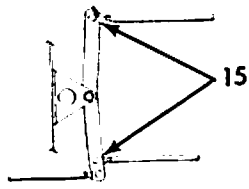
Control cables are exposed by removal of center console cover panels from Fuselage Stations 70.00 to 125.00. Removal of rear seats is required for access to control cables and pulleys from Fuselage Stations 112.00 to 145.00. Removal of baggage compartment floor covering material and floor access panels is required for control cable access at Fuselage Station 145.00.



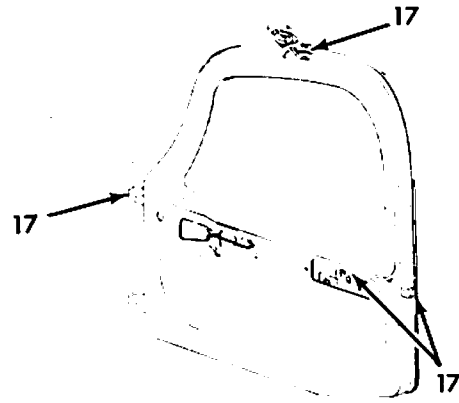
DETAIL A

**Servicing Points
Figure 1 (Sheet 1 of 5)**

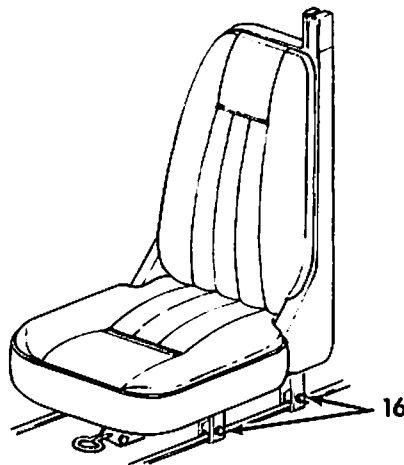
12G72-1-1



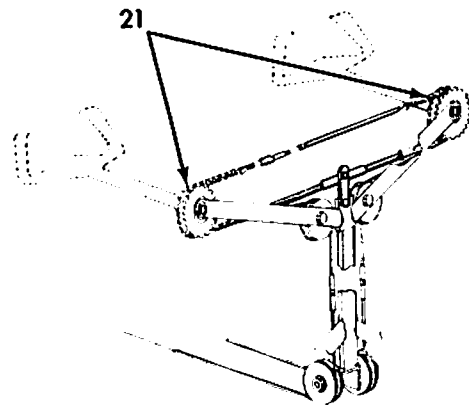
DETAIL B



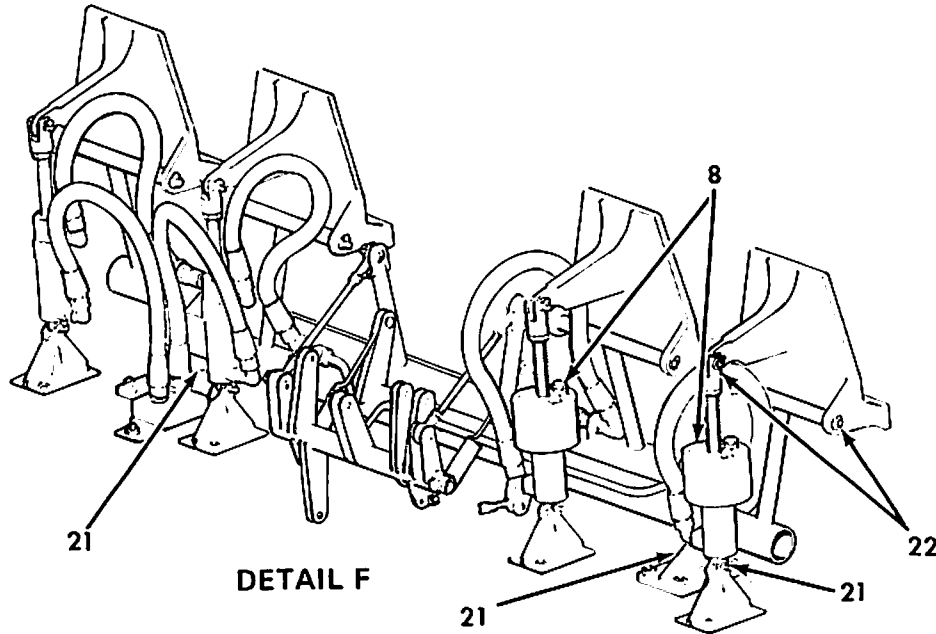
DETAIL C



DETAIL D



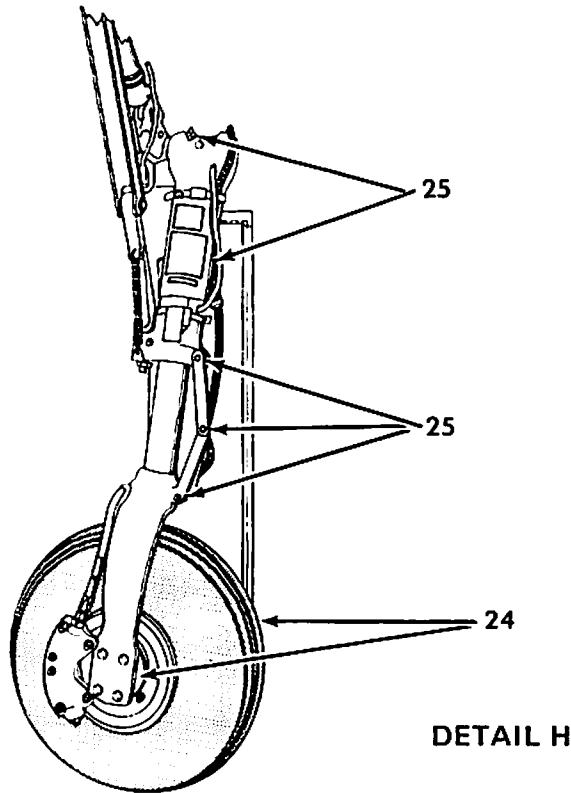
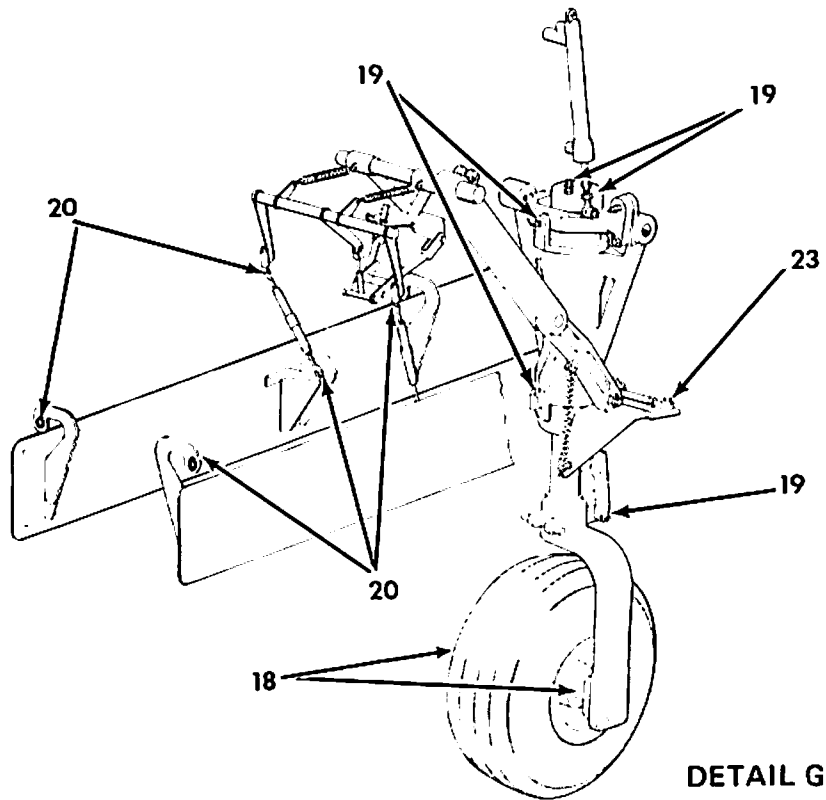
DETAIL E



DETAIL F

**Servicing Points
Figure 1 (Sheet 2 of 5)**

12G72-1-2



**Servicing Points
Figure 1 (Sheet 3 of 5)**

12G72-1-3

1. **ALL CONTROL SURFACE HINGES** – Grease with Aeroshell No. 6 or MIL-G-7711 grease as required. (See Figure 2.)
 2. **PRESSURE SYSTEM PUMP INLET FILTER** – Replace filter element when clogged or dirty.
 3. **FUEL TANKS** – Fill with 100/130 grade (green) aviation fuel. 100 low lead (blue) aviation fuel is also approved.
 4. **CARBURETOR AIR FILTER** – Replace filter element at 300 hours or every 12 calendar months, whichever comes first, or when the filter is torn or 50 percent covered with foreign material. (Note 4).
 5. **HYDRAULIC RESERVOIR (LANDING GEAR)** – Check fluid level and service as required every 50 hours. Remove filler plug and check that fluid is visible up to the bottom of the filler plug hole. If fluid is below the hole, loosen the vent screw and add fluid. Fill with MIL-H-5606 hydraulic fluid (approximately 1 quart) (See Figure 2.) (Note 1).
 6. **BATTERY** – Fill battery cells to top of plates with distilled water as required. Coat battery terminals with VV-P-236 petrolatum as required to prevent corrosion. (See Figure 2) Both vent lines to the battery case must be clean and open.
 7. **PRESSURE SYSTEM INLINE FILTER** – Replace filter every 500 hours, or every 12 calendar months, whichever occurs first, and when a pressure pump is replaced.
 8. **BRAKE RESERVOIRS** – Fill to within 1/4 inch of top with MIL-H-5606 hydraulic fluid as required. (See Figure 2.)
 9. **ENGINE OIL** (See Figure 2.) – Change engine oil every 50 hours on engines without oil filters; with oil filters change at 100 hours. Add oil as required to maintain safe levels.
 10. **CARBURETOR FUEL FILTERS** – Drain carburetor bowl and clean filter every 100 hours.
 11. **AUXILIARY FUEL PUMP FILTERS (Left and Right)** – Clean filter elements every 50 hours.
 12. **FUEL TANK AND SUMP TANK DRAINS** – Drain clear of water and sediment prior to first flight of day. Check seals every 100 hours.
 13. **ALL ACTUATORS** – Grease with MIL-G-7711 grease as required. (See Figure 2.)
 14. **TRIM TAB HINGES AND HORNS** – Oil with MIL-L-7870 oil. (See Figure 2.) (Note 2)
 15. **RUDDER BELLCRANK AND ELEVATOR HORN** – Oil with MIL-L-7870 oil as required. (See Figure 2).
 16. **SEAT TRACKS** – Oil with MIL-L-7880 oil every 100 hours. (See Figure 2.)
 17. **ENTRANCE AND BAGGAGE COMPARTMENT DOOR LATCHES** – Oil with MIL-L-7880 oil as required. (See Figure 2.)
 18. **NOSE WHEEL BEARINGS** – Grease with MIL-G- 25760 grease every 100 hours or as required. (See Figure 2.)
- TIRES, NOSE** – Inflate to 40 ± 2 psi.

19. **NOSE LANDING GEAR STRUT AND RETRACTION MOVING PARTS** – Grease all nose gear moving parts with MIL-G-7711 grease as required. (See Figure 2.) Refer to Note 3 for cleaning piston. Fill nose landing gear strut with MIL-H-5606 hydraulic fluid. (See Figure 2.) Inflate strut to 90 ± 10 psi with clean, dry filtered air.
20. **NOSE WHEEL DOOR HINGES AND PUSHRODS** – Oil with MIL-L-7870 lubricating oil as required. (See Figure 2).
21. **CONTROL COLUMN, RUDDER BAR AND BELLCRANK OILITE BEARINGS** – Oil with MIL-L-7870 lubricating oil (Figure 2) as required. Replace if oilite bearings do not hold oil for more than 50 hours.
22. **RUDDER PEDALS** – Oil with MIL-L-7870 oil (Figure 2) as required.
23. **SHIMMY DAMPENER** – Check each 50 hours and fill with MIL-H-5606 hydraulic fluid as required (See Figure 2.) (Note 3).
24. **MAIN LANDING GEAR WHEEL BEARINGS** – Grease with MIL-G-25760 grease every 100 hours or as required. (See Figure 2.)

TIRES, MAIN – Inflate to 40 ± 2 psi.
25. **MAIN LANDING GEAR STRUT AND RETRACTION MOVING PARTS** – Grease all moving parts with MIL-G-7711 grease. (See Figure 2.) Refer to Note 3 for cleaning piston. Fill gear strut with MIL-H-5606 hydraulic fluid. (See Figure 2.) Inflate strut to 165 ± 10 psi with clean, dry filtered air.

NOTES:

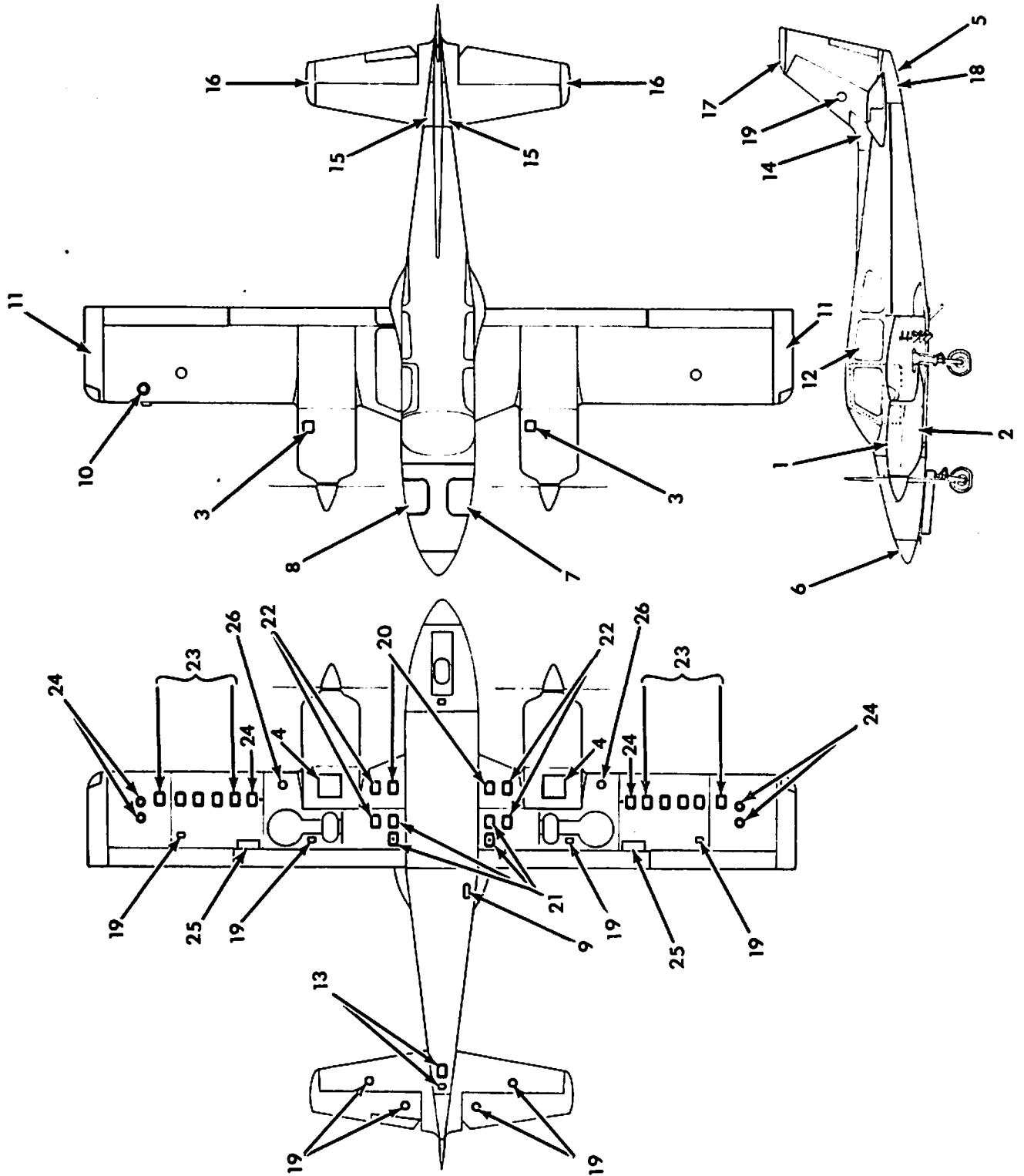
1. Perform a hydraulic fluid contamination check at the first 50-hour and first 100-hour inspections and thereafter at each 500-hour inspection or 1 year, whichever occurs first. Refer to Section 12-2-1 of this Chapter, for contamination check procedures.
2. Acceptable substitute is MIL-G-6711 powdered graphite. (See Figure 2.)
3. Clean the exposed portions of the machined surfaces of the piston to prevent seal damage by wiping with a clean, lint-free cloth moistened with hydraulic fluid or kerosene. Wipe off excessive fluid, leaving a light film to prevent corrosion.
4. Never attempt to clean filter with compressed air, or attempt to wash element in any liquid, or soak in oil. For replacement, use filter assembly, part number 5500015-501 as a replacement.

TRADE NAME	MANUFACTURER
MIL-G-21164 GREASE (Note 1)	
Aeroshell Grease 17 Braycote 664 PED 3350 Grease Royco 64 Grease TG-4727 Grease	Shell Oil Company Bray Oil Company Standard Oil Company Royal Lubricants Company Texaco Inc.
MIL-G-6711 GRAPHITE (Note 1)	
Graphite Graphite Graphite	Dixon Company Electrofilm Company Electro-Graph Company
MIL-H-5606 HYDRAULIC FLUID (Note 1)	
3125 HVD Oil Brayco Micronic 756C PED-3337, -3335 Royco 756A & B XSL 7828 YT-283	Humble Oil & Refining Company Bray Oil Company Standard Oil Company Royal Lubricants Company Shell Oil Company Union Carbide
MIL-L-22851 OIL (Note 1)	
Premium AD 80 Premium AD 120	Texaco Inc. Texaco Inc.
VV-P-236 PETROLATUM (Note 1)	
Braycote 236 Parmo 70 Royco 1R	Bray Oil Company Humble Oil & Refining Company Royal Lubricants Company
MIL-L-7870 OIL (Note 1)	
Brayco 363 Cosmolube 263 Enco Instrument Oil Low Temperature Oil 1692 Royco 363	Bray Oil Company E. F. Houghton Company Humble Oil & Refining Company Texaco Inc. Royal Lubricants Company
MIL-G-25760 GREASE (Note 1)	
Aeroshell Grease 16 Braycote 6605 Royco 60R Supermil ASU No. 06752 TG-4971 Grease	Shell Oil Company Bray Oil Company Royal Lubricants Company American Oil Company Texaco Inc.

Lubricants
Figure 2 (Sheet 1 of 2)

TRADE NAME	MANUFACTURER
MIL-G-7711 GREASE (Note 1)	
Aeroshell No. 6 Regal AFB 2	Shell Oil Company Texaco Inc.
MIL-L-6082B ENGINE OIL (Notes 1 and 2)	
Aeroshell W120* Aeroshell W80* Aeroshell Oil 65** Aeroshell Oil 100** Chevron Aero Oil Grade 120* Chevron Aviation Oil 65** Grade 1100** RT-451* RM-173E* RM-180E* Avrex 101/1065** Avrex 101/1100** TX-6309* Premium AD 120* Premium AD 80* Conoco Aero Oil 1065** Conoco Aero Oil 1100** Chevron Aero Oil Grade 120* Oil E-120* Oil A-100* Oil E-80* Grade 1065** Grade 1100**	Shell Oil Company Shell Oil Company Shell Oil Company Shell Oil Company Standard Oil Company Chevron Oil Company Chevron Oil Company Mobil Oil Company Mobil Oil Company Mobil Oil Company Mobil Oil Company Mobil Oil Company Texaco Inc. Texaco Inc. Texaco Inc. Continental Oil Company Continental Oil Company Standard Oil Company Exxon Company Exxon Company Exxon Company Champlin Oil & Refining Company Champlin Oil & Refining Company
<p>* Ashless Dispersant Oils with additives conforming to MIL-L-22851. ** Straight Mineral Oils.</p> <p>Note 1: The vendor products listed in this chart have been selected as representative of the specification under which they appear. Other equivalent products conforming to the same specifications may be used.</p> <p>Note 2: Oils conforming to the latest revision of Lycoming Service Instruction No. 1014 may be used.</p>	

**Lubricants
Figure 2 (Sheet 2 of 2)**



Access Openings
Figure 3 (Sheet 1 of 2)

12G72-2

1. Engine Upper Cowl
2. Engine Lower Cowl
3. Engine Oil Service Access Door
4. Cowl Flaps
5. ELT Access Panel
6. Nose Cone
7. Hydraulic Reservoir Access (Remove Baggage Compartment Floor Panel)
8. Battery Access (Remove Baggage Compartment Floor Panel)
9. External Power Receptacle Access.
10. Stall Warning Access
11. Wing Tips
12. Emergency Exit Window
13. Elevator and Rudder Controls Access
14. Vertical Stabilizer Fairing
15. Horizontal Stabilizer Fairing
16. Elevator Tips
17. Rudder Tip
18. Tail Cone
19. Control Cable And Bellcrank Access
20. Electric (Aux) Fuel Pump Access
21. Tank Sump Access
22. Fuel Selector Valve Access
23. Fuel Tank Access
24. Fuel Quantity Transmitter Access
25. Aileron Cable Fairlead Access in Cove Skin
26. Cabin Air Duct Access

**Access Openings
Figure 3 (Sheet 2 of 2)**

4. Special Tools and Equipment

The special tools required to service and maintain the flight controls are listed in Chapter 27. Special tools for landing gear rigging are listed in Chapter 32.

REPLENISHING**1. General**

The replenishing procedures contained in this section provide the proper methods for replacing consumed fuel, oil, hydraulic fluid, and battery electrolyte. Also included are methods for inflation of tires, landing gear oleo struts, and nose wheel shimmy dampener.

2. Refueling

Refueling is accomplished by pumping or pouring fuel into the two wing tanks through their respective filler caps. (See Figure 1.) When fueling the aircraft, observe the following:

- A. Never refuel the aircraft with engines running.
- B. Always ensure that the aircraft is properly grounded before refueling.
- C. Ensure that no one is smoking within 100 feet of the aircraft during refueling.
- D. Ensure that all aircraft electrical systems are turned off while refueling.
- E. Ensure that no aircraft radar or other powerful transmitters are operating within 100 feet of the aircraft during refueling.
- F. If fuel is spilled, ensure that the area of spillage is thoroughly flushed with water and that all residual fuel and vapor have dissipated or been neutralized prior to starting aircraft engines.
- G. Ensure that all fuel is from an approved source and that it is free from contamination.

The GA-7/Cougar aircraft must be fueled with the following fuel:

CAUTION: UNDER NO CIRCUMSTANCES SHOULD FUEL OF A LOWER OCTANE RATING THAN THAT SPECIFIED BELOW OR AUTOMOTIVE FUEL (REGARDLESS OF OCTANE) BE USED.

Grade (and color): 100/130 minimum grade aviation fuel (green). 100 low lead aviation fuel (blue) is also approved. Refer to the latest revision of Lycoming Service Instruction No. 1070 and other Lycoming publications for further information concerning fuels.

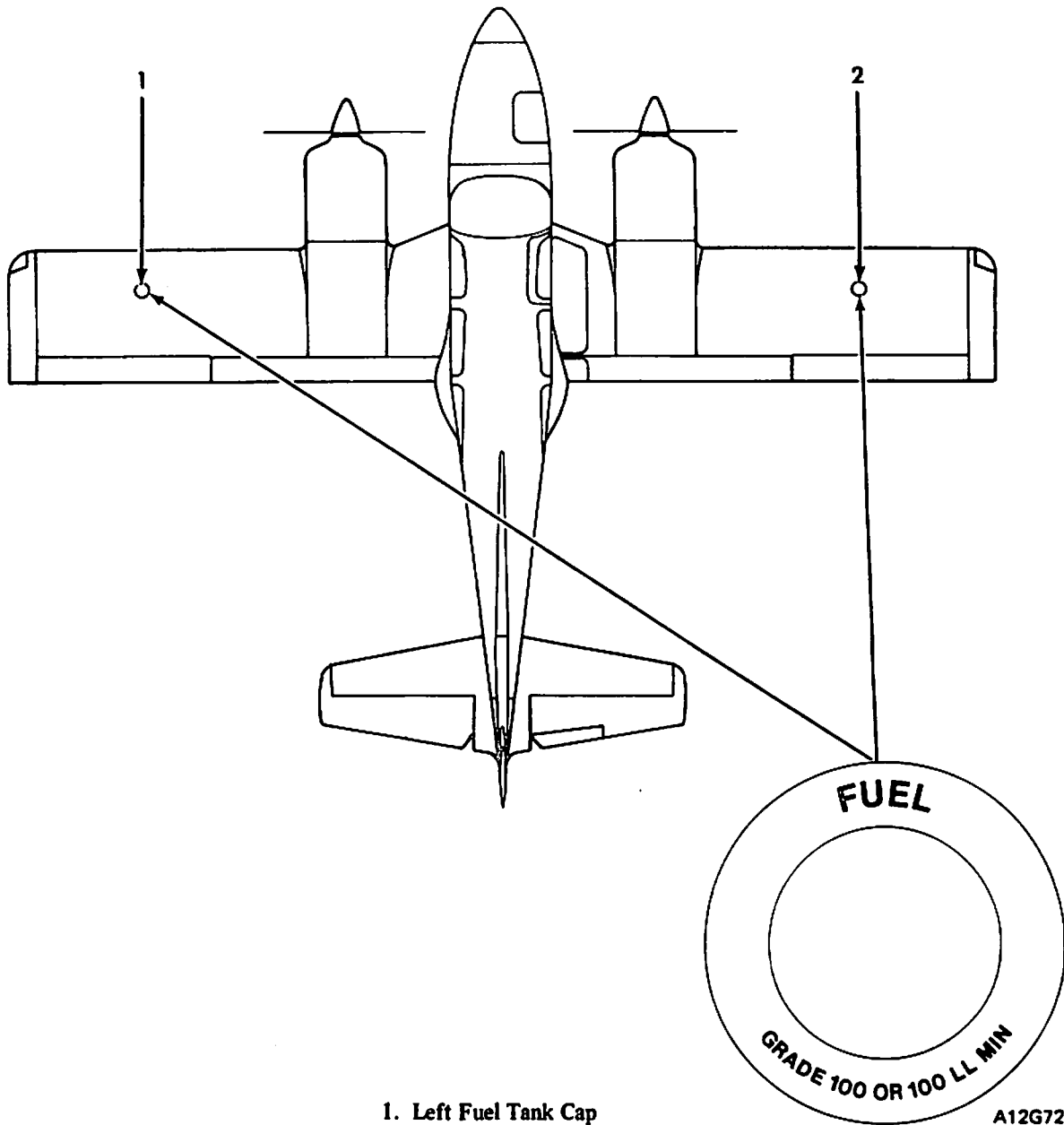
The GA-7/Cougar aircraft fuel system capacities are as follows:

NOTE: The following quantities were measured at an ambient temperature of 70°F. Changes from this temperature will cause a corresponding change in fuel quantities.

	U.S. Gallons	Liters	Imp. Gallons
Total Fuel Capacity, Each Tank	59.0	224.2	47.2
Usable Capacity, Each Tank	57.0	216.6	45.6
Unusable Fuel, Each Tank	2.0	7.6	1.6
Total Net Fuel Capacity, Both Tanks	118.0	448.4	94.4

After refueling, ensure that both fuel tank caps are securely installed prior to flight.

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GA-7/COUGAR
MAINTENANCE MANUAL



Fueling Points
Figure 1

3. Defueling

WARNING: WHEN SIPHONING FUEL FROM THE TANKS, NEVER ATTEMPT TO START SIPHONING BY MOUTH. INTRODUCTION OF EVEN A SMALL AMOUNT OF FUEL INTO LUNGS CAN BE FATAL. USE ONLY SAFETY APPROVED SIPHONING EQUIPMENT.

Defueling is best accomplished by siphoning fuel through a siphon hose introduced into the tank through the fuel filler cap. If the tank is to be completely emptied, the small amount of fuel that cannot be removed by siphoning can be removed through the tank drain beneath the wing. During the aircraft defueling, observe the safety precautions specified in Paragraph 2.

4. Engine Oil Replenishing

Engine oil replenishment is accomplished by pouring oil into the oil filler spout. Oil quantity can be conveniently checked by use of the dipstick attached to the oil filler spout cap.

Oil quantity is checked as follows:

- A. Open oil filler spout access door.
- B. Locate oil filler spout on right-hand side of engine accessory section.
- C. Unscrew oil filler spout cap.
- D. Remove dipstick from engine and wipe oil from dipstick with a clean cloth or paper towel.
- E. Return dipstick into filler spout and tighten finger tight.
- F. Unscrew and remove dipstick. Check oil level on dipstick versus the markings stamped on the dipstick.
- G. Wipe oil from dipstick with a clean cloth or paper towel and replace dipstick in filler spout. Tighten filler spout cap finger tight.

NOTE: When tightening the cap, ensure that it is secure. Do not overtighten, as this may damage the O-ring seal in the cap.

Replenish engine oil using oil of the following specifications.

MIL-L-6082B Aviation Grade Straight Mineral Oil (Refer to Figure 2, Section 12-0) shall be used to replenish oil supply during the first 25 hours of operation and at the first 25-hour oil change. Continue to use this grade of oil the first 50 hours of operation.

NOTE: The aircraft is delivered from the factory with corrosion preventative aircraft engine oil. This oil should be drained after the first 25 hours of engine operation.

MIL-L-22851 Ashless Dispersant Oil. (Refer to Figure 2, Section 12-0.) This specification oil shall be used after the first 50 hours of engine operation.

***Recommended Viscosity**

Average Ambient Air Temperature	Mineral Grade	Ashless Dispersant
Above 16°C (60°F)	SAE 50	SAE 40 or SAE 50
-1°C (30°F) to 32°C (90°F)	SAE 40	SAE 40
-18°C (0°F) to 21°C (70°F)	SAE 30	SAE 40 or SAE 30
Below -12°C (10°F)	SAE 20	SAE 30

***Refer to latest revision of Lycoming Service Instruction No. 1014 and other Lycoming publications for further information.**

Replenish engine oil as follows:

- (1) Open oil access door.
- (2) Locate oil filler spout and unscrew cap.
- (3) Using a clean cloth or paper towel, wipe any oil or foreign material from the edges of the oil filler spout opening. Also wipe oil from the dipstick.

NOTE: When adding engine oil, ensure that no dirt or foreign material is on the edges of the oil filler spout and the cap/dipstick is clean prior to installation.

- (4) Pour oil of proper specification and viscosity into filler spout to achieve desired oil level.

NOTE: When adding engine oil during extremely cold weather, the change in viscosity due to extreme cold may cause the oil to pour very slowly. Keeping the oil in a heated building or warming it prior to use will expedite oil replenishment.

- (5) Replace oil filler spout cap/dipstick and tighten finger tight.

NOTE: Any oil spillage, particularly on exhaust manifolds, should be wiped prior to flight.

- (6) Close oil access door.

The GA-7/Cougar aircraft oil system capacities are as follows:

	U.S. Quarts	Liters	Imp. Quarts
*Total Engine Capacity (Each Engine)	8.00	7.57	6.66
Minimum Safe Quantity	2.00	1.89	1.67

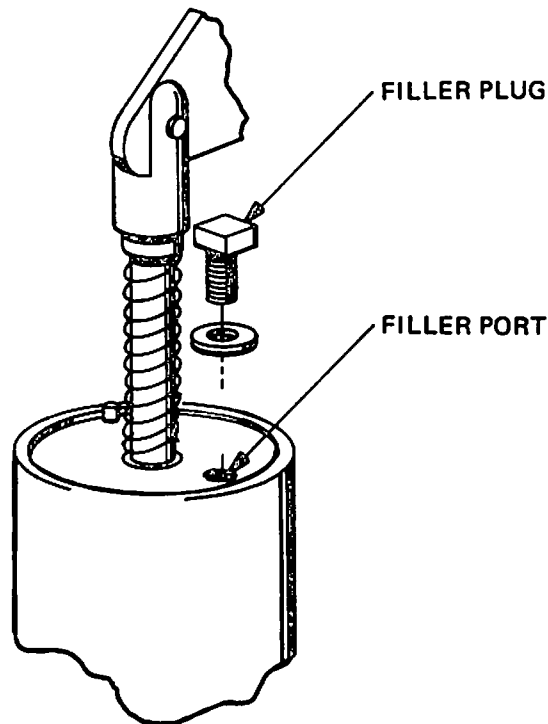
***Does not include one quart (undrainable) in oil cooler.**

5. Brake Fluid Replenishing

Brake fluid replenishing is accomplished as follows:

NOTE: When replenishing brake fluid, ensure that the fluid conforms to Specification MIL-H-5606, (Refer to Figure 2, Section 12-0.) and that fluid is uncontaminated.

- A. Locate brake cylinder reservoirs as shown in Figure 2.
- B. Using a clean cloth or paper towel, wipe any accumulated dirt or foreign material from area around filler plugs.
- C. Remove filler plugs.
- D. Using a syringe, hand pump, or other suitable means, add MIL-H-5605 brake fluid (Refer to Figure 2, Section 12-0.) to the reservoirs through the filler ports until the level of fluid is 1/4 inch from the top of the reservoir.
- E. Replace filler plugs in reservoirs.
- F. Check brake action. (Refer to Chapter 32 for maintenance procedures of brake system.)
- G. If more fluid is required, repeat steps B through F.



**Brake Cylinder
Figure 2**

12G72-4

6. Tire Inflation

WARNING: WHEN INFLATING TIRES, USE REGULATED AIR PRESSURE THROUGH VALVE STEMS.

TIRE PRESSURES ARE AS FOLLOWS:

MAIN LANDING GEAR – 40 ± 2 PSIG

NOSE LANDING GEAR – 40 ± 2 PSIG

7. Battery Fluid Replenishing

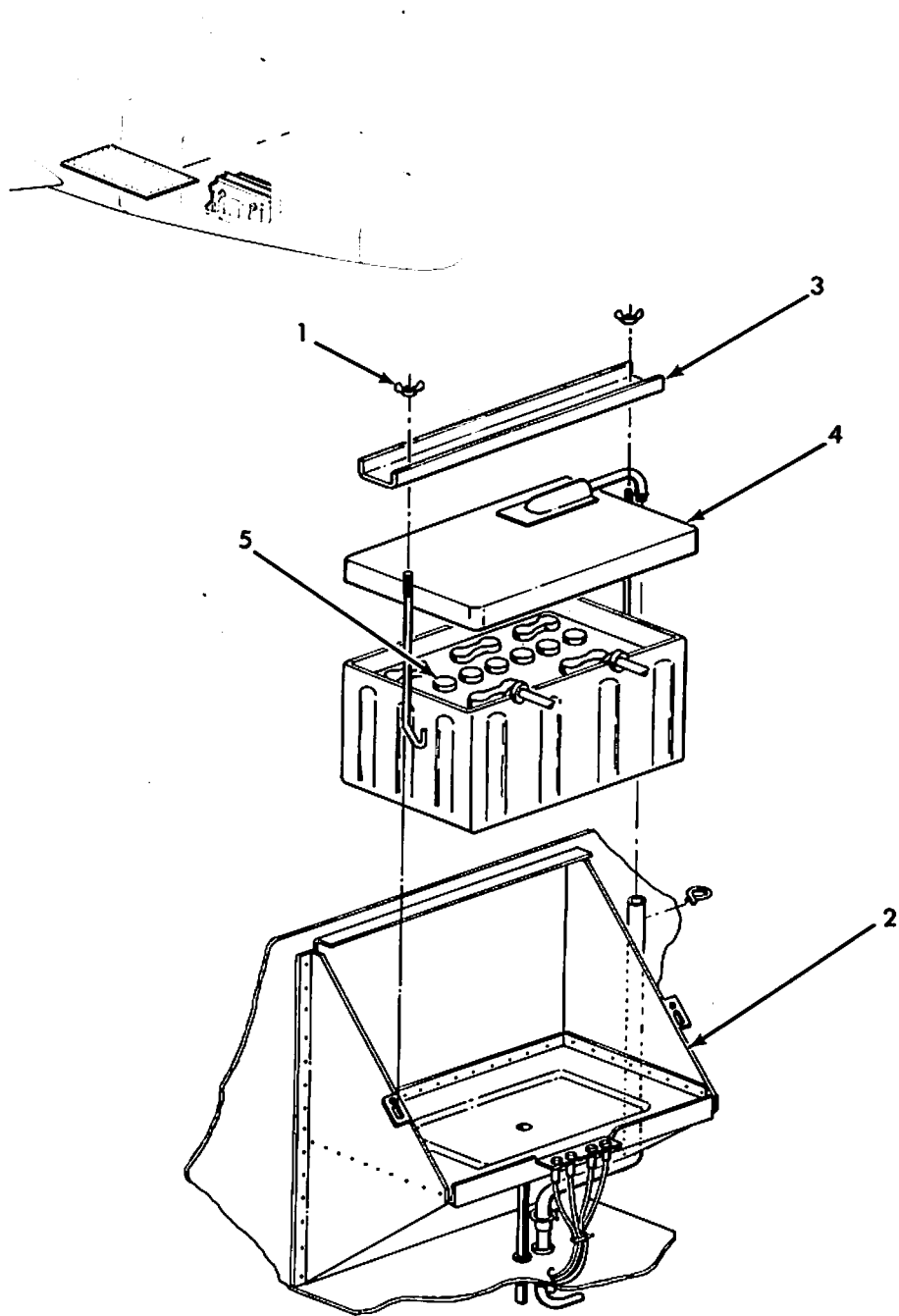
WARNING: THE BATTERY CONTAINS A SULPHURIC ACID ELECTROLYTE SOLUTION. DO NOT ALLOW THE ELECTROLYTE TO COME IN CONTACT WITH CLOTHES OR SKIN. ANY SPILLAGE SHOULD BE FLUSHED WITH WATER OR NEUTRALIZED WITH BAKING SODA IMMEDIATELY.

Replenish battery fluid as follows:

- A. Gain access to battery by opening baggage compartment on upper right side of nose section and removing battery cover panel.
- B. Remove the two wing nuts (1) from the battery box (2) and remove the strap (3), disconnect cooling vent (6), and battery box cover (4) as shown in Figure 3.
- C. Using a clean cloth or paper towel, wipe all dirt and foreign material from the area around the battery filler plugs.
- D. Remove filler plugs (5) and visually check electrolyte level in battery. If electrolyte level is below the bottom of the split rings, add distilled water.

NOTE: When replenishing battery water, use only distilled water. Ensure that the electrolyte level in the battery comes to the bottom of the split rings. DO NOT OVERFILL.

- E. Add distilled water to bring electrolyte level to top of plates.
- F. Replace battery filler plugs.
- G. Replace battery box cover, strap, and cooling vent. Secure with the two wing nuts.
- H. Install battery cover and close baggage compartment access door.



**Battery Servicing
Figure 3**

12G72-5

8. Landing Gear Oleo Struts Replenishing (Servicing)

Replenish main and nose landing gear oleo struts as follows:

- A. Jack aircraft, observing all safety precautions. (Refer to Chapter 7.)

NOTE: Strut replenishing (servicing) must be accomplished with no load on strut.

WARNING: BEFORE WORKING IN ANY WHEEL WELL, ENSURE THAT ALL LANDING GEAR SAFETY DEVICES ARE INSTALLED.

- B. Slowly open air filler valve until air is discharging and wait until all air is discharged.

WARNING: DO NOT LOOSEN BODY WHILE UNIT IS DISCHARGING AIR.

- C. Remove filler plug and compress strut.

- D. Using MIL-H-5606 hydraulic fluid (Refer to Figure 2, Section 12-0.), fill strut to overflowing. While slowly extending strut, continue to fill with fluid.

- E. Slowly compress strut, watching for bubbles at filler hole. Repeat, extending and compressing strut one time to eliminate bubbles in fluid.

- F. If no air bubbles are present, install filler plug and tighten air valve.

- G. Using a pressure gage and a regulated source of clean, dry air, inflate main gear strut to 165 ± 10 psig through air valve. Inflate nose gear strut to 90 psig.

- H. Check for air leaks. If no leaks are evident, increase air pressure on main gear strut to 330 psig for 1/2 hour and check for leakage. Inflate nose gear strut to 180 psig for the same length of time. If no leakage is evident, reduce pressure on main gear strut to 165 ± 10 psig, nose gear strut to 90 psig.

NOTE: During servicing, the struts must be maintained in the vertical position to preserve a trapped amount of air for proper operation.

- I. Lower and remove jacks from aircraft. (Refer to Chapter 7.)

SCHEDULED SERVICING1. General

This section provides the procedures required to perform servicing that is required on a scheduled basis.

2. Engine Oil Servicing

The engine oil should be changed after the first 25 hours of operation. It should be replaced with straight mineral oil conforming to Specification No. MIL-L-6082 (Refer to Figure 2, Section 12-0.). This straight mineral oil should be used until a total of 50 hours has accumulated, then it should be drained and replaced with dispersant oil. This oil should be changed at least every 50 hours or 6 months, whichever occurs first. At the time of each oil change, the engine oil strainers should be removed, cleaned, and inspected for metal particles. A full-flow, disposable type oil filter is available as optional equipment. The filter can increase the oil change interval by 25 to 100 percent, depending on the environmental conditions, and provided the filter assembly is replaced after each 50 hours of engine operation. The full-flow oil filter, if installed, is located at the rear of engine accessory section at approximately the 12 o'clock position. (Refer to Lycoming Operating Manual for further instructions.)

Change engine oil as follows:

- A. Remove upper engine cowl.
- B. Remove lower engine cowl.
- C. Locate engine oil drain plug (See Figure 1.) and cut safety wire securing plug. Remove remaining safety wire from drain plug and wire hole on engine.

NOTE: On aircraft equipped with a quick oil drain, do not cut safety wire at plug. Place a hose over the quick drain and push the fitting up into its detent to drain the oil.
- D. Place a suitable container under the oil drain.
- E. Unscrew the drain plug and allow the oil to drain thoroughly.
- F. Using a clean cloth or paper towel, wipe drain plug and clean area on engine around oil drain.
- G. Reinstall drain plug and safety wire.
- H. Remove, clean, and inspect engine oil strainers in accordance with Lycoming Operator's Manual.
- I. Replace strainers per Lycoming Operator's Manual.
- J. If oil filter is installed and replacement is required, unscrew and discard disposable type filter and install new filter assembly.
- K. Unscrew and remove engine oil filler spout plug.
- L. Pour 8 quarts of oil conforming to Specification No. MIL-L-6082 (Refer to Figure 2, Section 12-0.) or ashless dispersant aviation grade into oil filler spout.
- M. Using a clean cloth or paper towel, wipe oil from dipstick, and reinstall engine oil filler spout plug. Tighten finger tight.
- N. Reinstall lower and upper engine cowl.

O. Run engine. Check for leaks and recheck oil level.

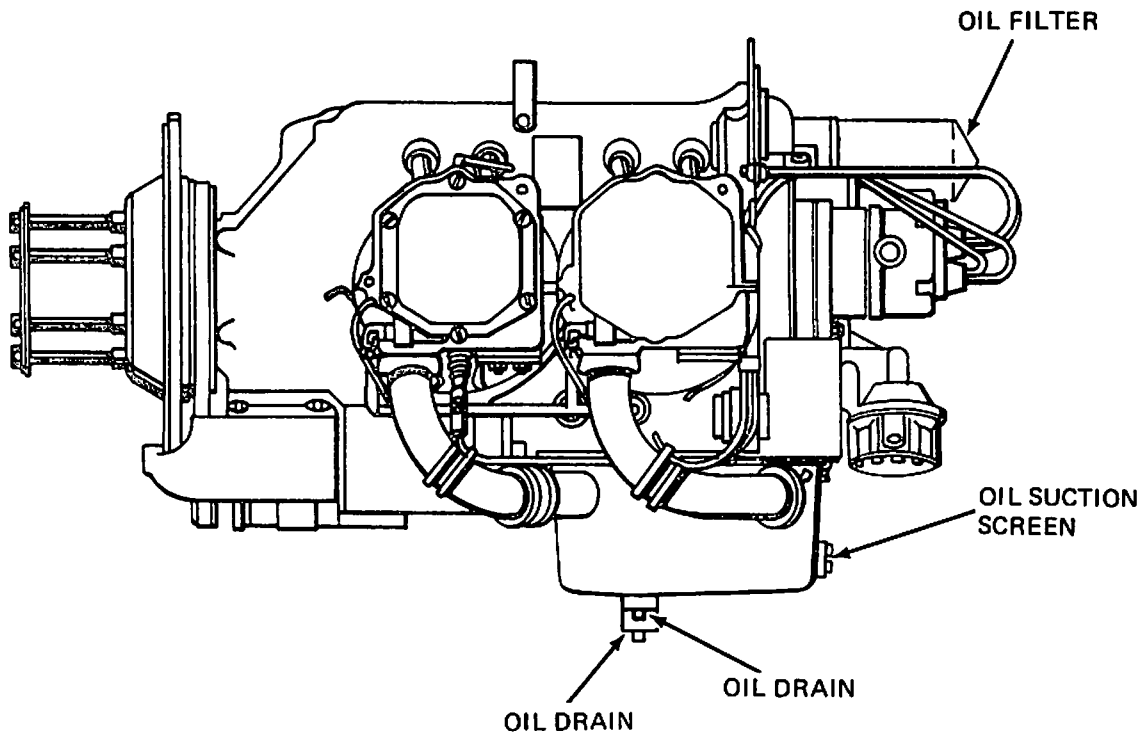
3. Carburetor Air Filter Servicing (See Figure 2.)

The carburetor air filter assembly should be replaced every 300 hours of engine operation, every 12 calendar months, or when torn or 50 percent covered with foreign material. Use filter assembly, part number 5500015-501, as a replacement.

Replace the carburetor air filter assembly as follows:

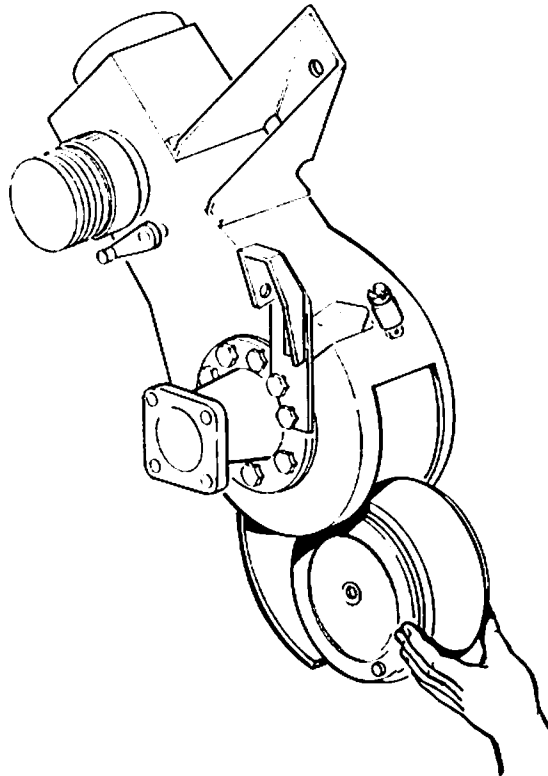
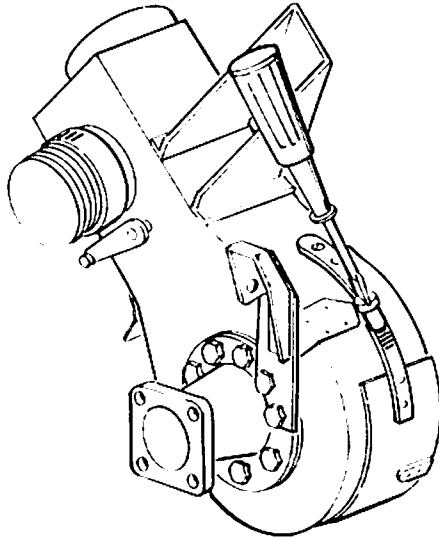
NOTE: Never blow off filter with compressed air or attempt to wash element in any liquid or soak in oil.

- A. Remove upper and lower engine cowl.
- B. Open filter access door (See Figure 2.) on left side of air box/filter housing.
- C. Remove old filter assembly and install replacement.
- D. Close and secure filter access door.
- E. Reinstall upper and lower engine cowl.



Engine Oil Drain
Figure 1

12G72-6



**Carburetor Air Filter
Figure 2**

12G72-7

4. Pressure System Air Filter Servicing (See Figure 3.)

The pressure system inline air filter is located beneath the instrument panel at Fuselage Station 50.00. The pump inlet filter is mounted on the firewall of each engine nacelle. The filter elements of both should be checked periodically to ensure that they are not clogged by dirt or foreign material. If either of the filter elements are dirty or appear to be clogged, they should be replaced. The inline filter should be replaced by part number 1J4-7. The pump inlet filter element should be replaced by part number B3-5-1.

For filter replacement instructions, refer to Chapter 34.

NOTE: Never blow off filters with compressed air or attempt to wash elements in any liquid or soak in oil.

5. Airframe Lubrication

Lubricate the airframe in accordance with Figure 1, Section 12-0. During airframe lubrication, observe the following precautions and procedures.

WARNING: USE CLEANING SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: SYNTHETIC COMPOUNDS SUCH AS THOSE FOUND IN AIRCRAFT OILS AND GREASES CONTAIN ELEMENTS WHICH CAN SOFTEN PAINT, NATURAL RUBBER, NEOPRENE, AND SOME ELECTRICAL INSULATORS. IF THIS TYPE LUBRICANT IS SPILLED ON ANY OF THESE MATERIALS, WIPE IT OFF IMMEDIATELY AND THOROUGHLY WITH A CLEAN CLOTH.

- A. Remove all foreign matter from joints, fittings, or bearing surfaces immediately before application of lubricant. Use a clean cloth saturated with cleaning solvent.
- B. Apply lubricant sparingly to prevent accumulation of contaminants.
- C. Main Gear and Nose Gear Bearings. (See Figures 4 and 5.)

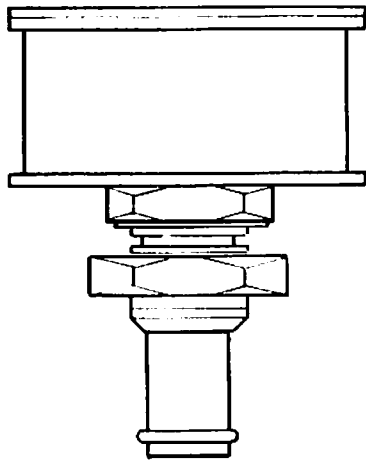
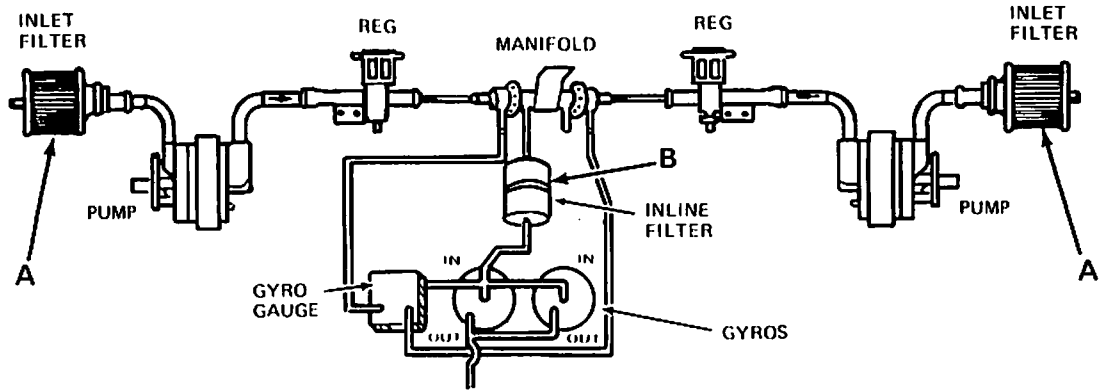
WARNING: USE CLEANING SOLVENTS IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: DO NOT SPIN BEARINGS WHEN DRYING WITH COMPRESSED AIR. WASH BEARINGS IN STODDARD SOLVENT (P-S-661 OR EQUIVALENT) AND DRY WITH A CLEAN, SOFT CLOTH.

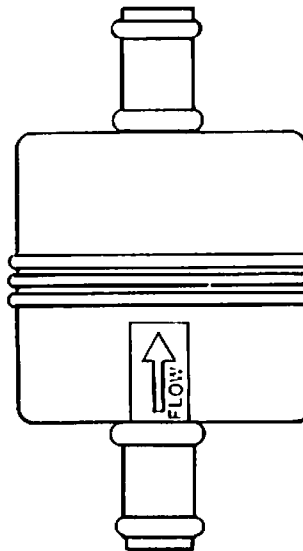
CAUTION: USE A CLEAN, LINT-FREE CLOTH TO CLEAN AND HANDLE BEARINGS. DO NOT USE A DIFFERENT TYPE GREASE IN WHEEL BEARINGS ON THE SAME AIRCRAFT. WHEN GREASE TYPE IS CHANGED, RE-GREASE ALL WHEEL BEARINGS.

- (1) Clean and repack wheel bearings every 100 hours or as required. Remove wheels and bearings (10). Clean wheel bearings and felt seals with Stoddard Solvent (P-S-661) or equivalent and dry with a soft lint-free cloth.

GRUMMAN AMERICAN AVIATION
GA-7/COUGAR
MAINTENANCE MANUAL



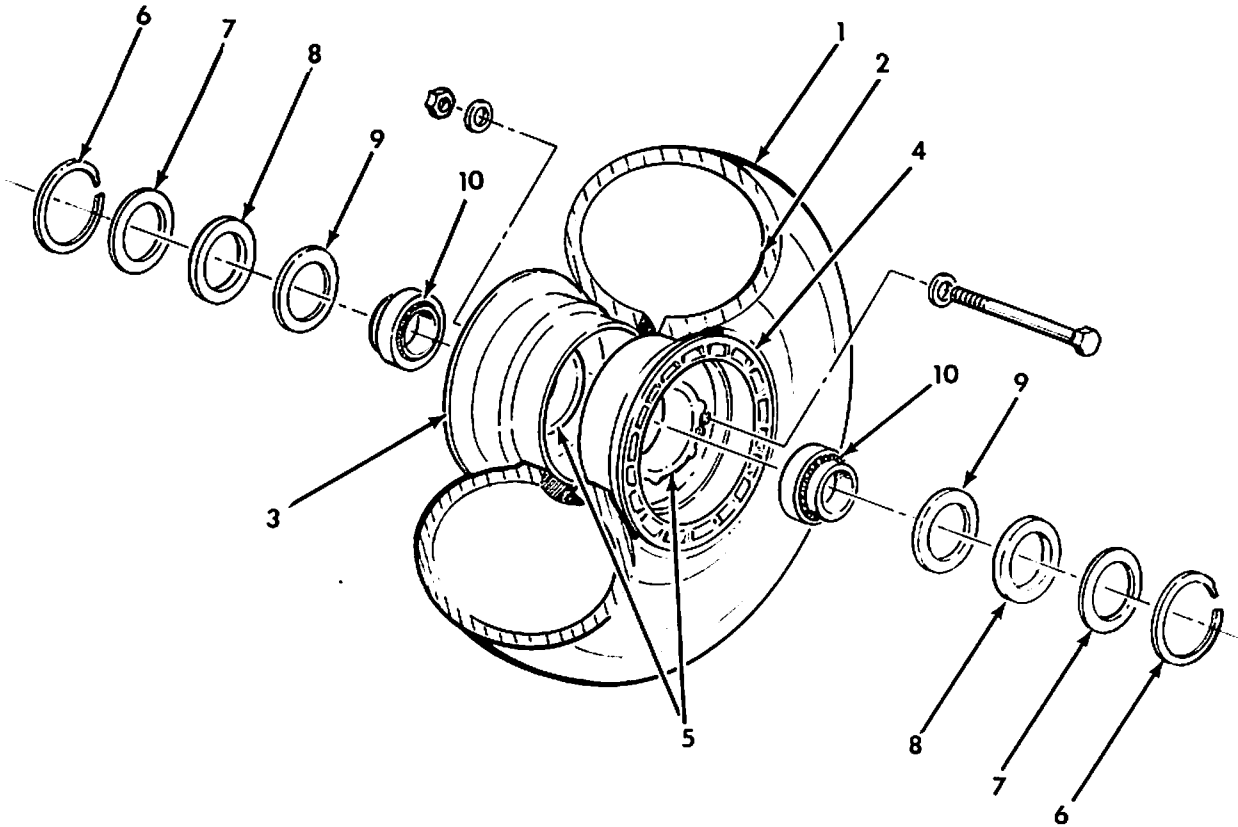
DETAIL A



DETAIL B

Pressure System
Figure 3

12G72-8

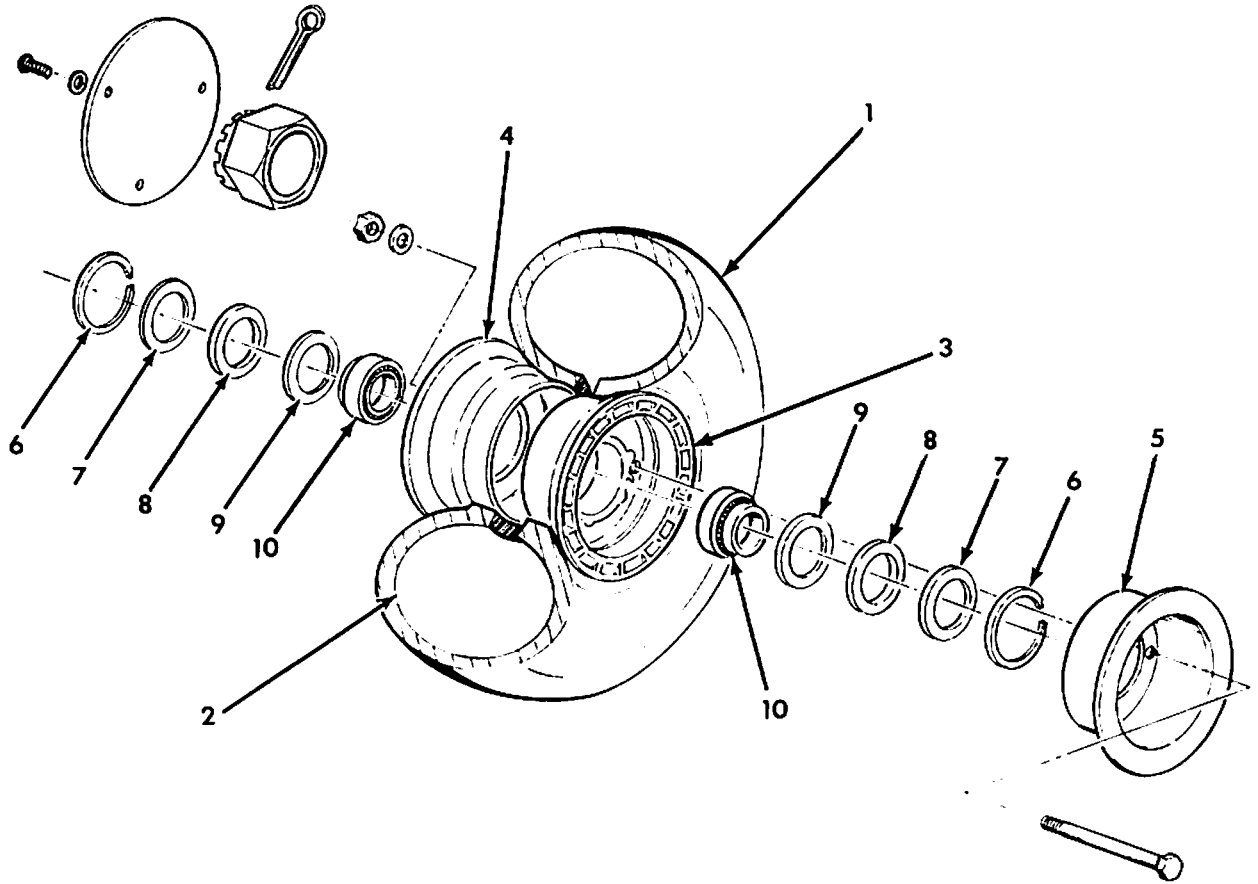


- 1. Tire
- 2. Tube
- 3. Wheel Half
- 4. Wheel Half
- 5. Bearing Cup

- 6. Snap Ring
- 7. Grease Seal Ring
- 8. Grease Seal
- 9. Grease Seal Ring
- 10. Cone Bearing

12G72-9

**Nose Landing Gear Wheel Assembly
Figure 4**



- 1. Tire
- 2. Tube
- 3. Wheel Half, Inner
- 4. Wheel Half, Outer
- 5. Brake Disc Assembly

- 6. Snap Ring
- 7. Grease Seal Ring
- 8. Grease Seal
- 9. Grease Seal Ring
- 10. Cone Bearing

12G72-10

Main Landing Gear Wheel Assembly
Figure 5

- (2) Inspect bearings (10) and races for wear and replace if necessary.

NOTE: For adjustment of nose wheel and main landing gear bearings, refer to Chapter 32.

- (3) Repack bearings only with MIL-G-25760 grease (Refer to Figure 2, Section 12-0.) and lubricate felt seals with MIL-L-7870 oil before installation. (See Figure 2.)

6. Auxiliary Fuel Pump Filter Servicing (See Figure 6.)

Clean the auxiliary fuel pump filter as follows:

WARNING: PRIOR TO REMOVING FILTER FROM FUEL PUMP, DRAIN FUEL TANKS AND ENSURE THAT PUMPS ARE NOT ENERGIZED WHEN FILTER IS REMOVED. ENERGIZING PUMP WITH FILTER REMOVED WILL RESULT IN RAW FUEL BEING PUMPED INTO WING TANK SUMP AREA.

- A. Remove access cover and locate auxiliary fuel pump (1); cut safety wire and remove bottom cover (2) from pump (1) by turning it clockwise using a 5/8 inch wrench.
- B. Remove filter element (3) from fuel pump, and remove magnet (4) and gasket (5) from bottom cover.
- C. Use compressed air and a clean, lint-free cloth to remove foreign material from filter (3), magnet (4), and gasket (5).

NOTE: If excessive amounts of foreign material are found in the filter, the fuel system should be checked for contamination. (Refer to Chapter 28.)

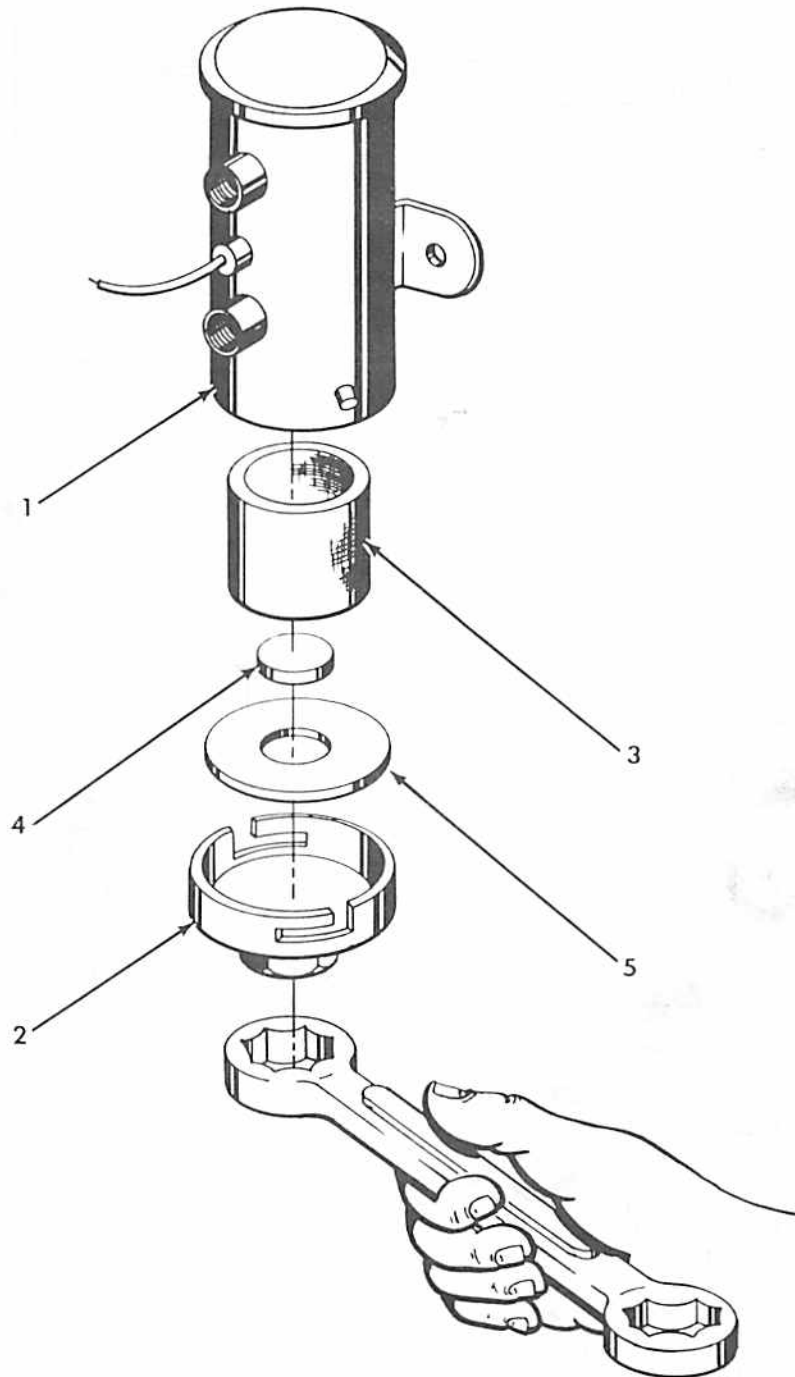
- D. Reinstall filter element (3) in pump (1) and magnet (4) and gasket (5) in bottom cover (2).
- E. Install bottom cover on pump (1) by pressing slots over lugs and rotating cover counterclockwise into detent.
- F. Safety-wire bottom cover on pump with 0.032 inch wire.
- G. Energize auxiliary fuel pump or pumps and check for leakage around bottom cover.
- H. Install access cover.

7. Nose Gear Shimmy Dampener Servicing (See Figure 7.)

Check the shimmy dampener for proper servicing and service as follows:

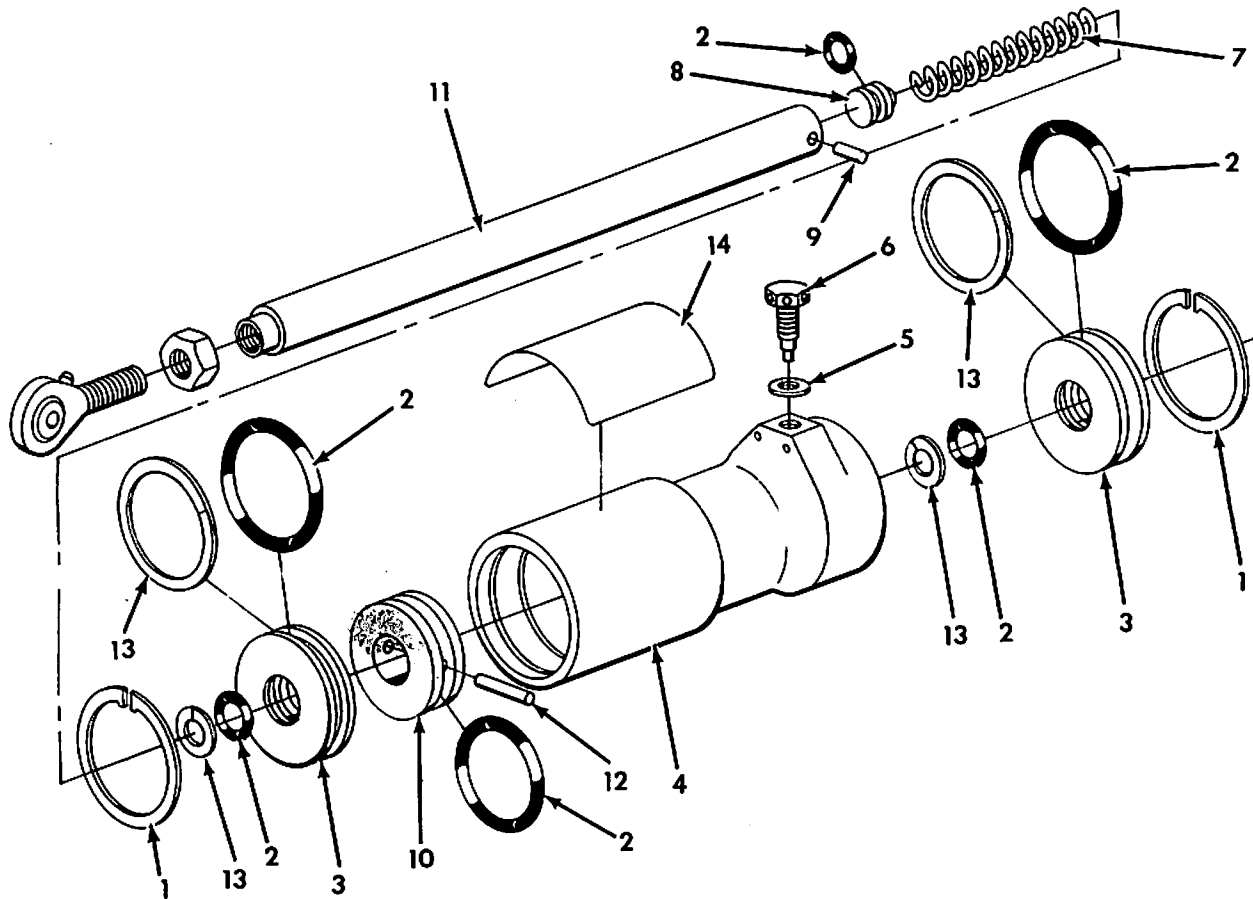
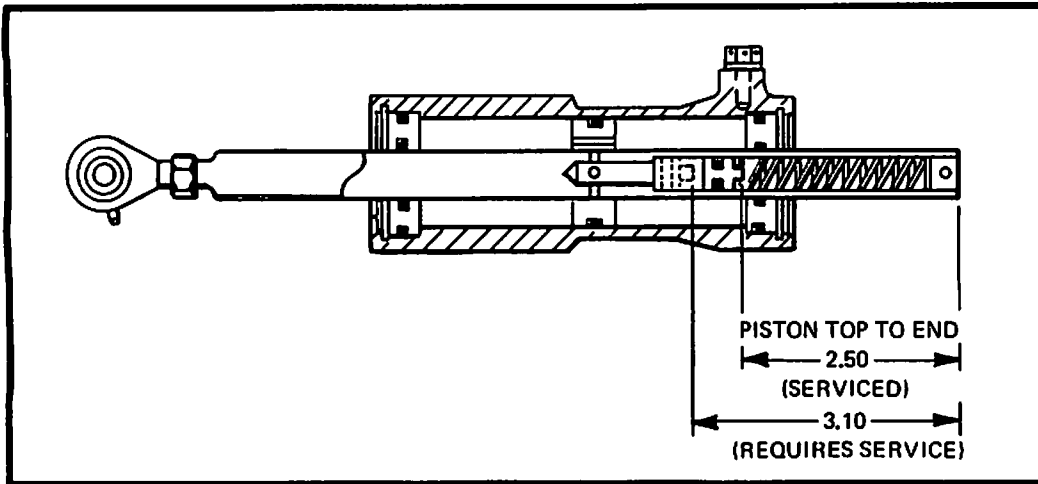
NOTE: The shimmy dampener should be checked at each 50-hour inspection to ensure proper servicing. The shimmy dampener must be filled completely with fluid and free of entrapped air to function properly. In addition, the piston rod must also be partially full of fluid before the temperature compensating mechanism will function properly.

CAUTION: THE FLUID IN THE SHIMMY DAMPENER IS UNDER PRESSURE EXERTED AGAINST THE FLOATING PISTON BY A SPRING. LOOSENING OR REMOVING THE FILLER PLUG WILL RESULT IN LOSS OF FLUID AND NECESSITATE REMOVAL AND REFILLING OF THE SHIMMY DAMPENER AND PISTON ROD.



12G72-11

Auxiliary Fuel Pump Servicing
Figure 6



- | | |
|-------------------|--------------------|
| 1. Retainer Rings | 8. Pressure Piston |
| 2. O-Ring | 9. Roll Pin |
| 3. Bearing Head | 10. Piston |
| 4. Housing | 11. Piston Rod |
| 5. Seal Washer | 12. Pin |
| 6. Bolt | 13. Backup Rings |
| 7. Spring | 14. Nameplate |

**Shimmy Dampener
Figure 7**

12G72-12

- A. Measure the location of the pressure piston (8) to determine if filling is required by inserting a length of music wire into the upper end of the piston rod (11) until it touches the pressure piston (8).

NOTE: Ensure that music wire is ground to a blunt point.

- B. Mark the music wire at the end of the piston rod (11), and measure the music wire for depth of insertion.
- C. If the pressure piston (8) is 3.10 inches or less from the end of the piston rod (11), the shimmy dampener needs filling.
- D. If the shimmy dampener requires filling, remove it from the aircraft. Refer to Chapter 32 for removal instructions.

WARNING: WHEN REMOVING ROLL PIN (9), USE CAUTION SINCE PIN IS UNDER A SPRING LOAD.

- E. Remove safety wire and remove roll pin (9), spring (7), and pressure piston (8) from piston rod (11).
- F. Remove retainer ring (1) and bearing head (3) from housing (4) at housing attach end.
- G. Move piston rod (11) to place piston (10) bottomed out against end of housing (4) opposite open end.
- H. Fill housing (4) through open end with MIL-H-5606 hydraulic fluid (Refer to Figure 2, Section 12-0) and install bearing head (3) and retainer ring (1).
- I. Invert unit to place open end of piston rod (11) up. Fill open end of piston rod with MIL-L-5606 hydraulic fluid (Refer to Figure 2, Section 12-0), then slowly work piston (10) up and down, drawing fluid through orifice and expelling air until area behind piston is solidly filled with fluid and free of entrapped air. Keep piston rod (11) filled with fluid.
- J. After air has been worked out, "top-off" piston rod (11) with fluid.
- K. Insert pressure piston (8) into piston rod (11) and push down until pressure piston (8) is 2.50 inches from open end of piston rod (11).
- L. Remove safety wire and loosen bolt (6) slightly to permit pressure piston (8) to be moved to proper position but tighten as correct dimension is reached.

NOTE: Ensure that the shimmy dampener and hydraulic fluid are at room temperature while filling to the required dimension noted above.

- M. Install spring (7), roll pin (9), and safety-wire.
- N. Safety-wire bolt (6).

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- O. Clean shimmy dampener as required with Stoddard Solvent (P-S-661 or equivalent). Ensure the exposed portions of the machined surfaces of the piston rod are clean to prevent seal damage by wiping off any dirt or grit accumulation with a clean, lint-free cloth moistened with hydraulic fluid or kerosene. Leave a light film of fluid on the machined surfaces of the piston rod to prevent corrosion.
- P. Install shimmy dampener on aircraft. Refer to Chapter 32 for installation instructions.

8. Hydraulic Reservoir (Landing Gear) Servicing (See Figure 8.)

The fluid level in the hydraulic reservoir for the landing gear system should be checked at each 50-hour inspection and whenever fluid level is suspected to be low. Service with MIL-H-5606 hydraulic fluid. (Refer to Figure 2, Section 12-0.)

Service the hydraulic reservoir as follows:

- A. Gain access to hydraulic reservoir (1) by removing access door on upper left side of nose section and removing access panel on nose baggage compartment floor.
- B. Ensure system pressure is depleted by actuation of the hydraulic system emergency dump valve with gear control handle in UP position.
- C. Remove filler plug (2).
- D. Fill to bottom of casting in filler hole with MIL-H-5606 hydraulic fluid. (Refer to Figure 2, Section 12-0.)

NOTE: When checking fluid level, insert a wire through vent hole (3) to ensure that vent is not plugged.

- E. Install filler plug (2) and access panel and access door



Hydraulic Reservoir Servicing
Figure 8

12G72-13

9. Hydraulic Fluid Contamination Check

Perform a hydraulic fluid contamination check as follows:

- A. Ensure aircraft electrical power is off.
- B. In the nose section well on the left side, remove cap from powerpack pressure line, move gear control handle UP and open emergency dump valve.
- C. Drain a small sample of hydraulic fluid into a suitable container.
- D. Replace cap on powerpack pressure line.
- E. Return gear control handles to DOWN position and close emergency dump valve.
- F. Analyze drained hydraulic fluid. If the drained fluid is clean and is not appreciably darker in color than new fluid, continue to use the present fluid.
- G. If the fluid color is doubtful, place fluid sample in a nonmetallic container and insert a strip of polished copper into sample fluid.
- H. Keep copper strip in the sample fluid for 6 hours at a temperature of 70°F or more. A slight darkening of the copper strip is permissible, but there should be no pitting or etching visible up to 20 power magnification.
- I. If copper strip is pitted or etched beyond the above tolerance, drain, flush system, and replace hydraulic fluid.

UNSCHEDULED SERVICING**1. General**

This section provides the procedures required to perform servicing that may be necessitated by environmental or other conditions not anticipated as a part of scheduled servicing.

2. Ice and Snow Removal

Since accumulations of ice and/or snow on the aircraft can constitute both a flight hazard, and/or a danger of damage during ground handling, removal must be properly accomplished. If facilities are available, the best method of snow and ice removal is by parking the aircraft in a heated hangar. This method is particularly desirable since it will result in the melting of undetected ice that could constitute a hazard. Loose snow on the aircraft surfaces can generally be removed by hand, or brushed off with a soft bristle broom. Ice accumulations on the wings or control surfaces create a hazard if flight is attempted without its removal. When ice has accumulated on the aircraft, it should be carefully checked to ensure that accumulations have been removed from the following areas:

- A. Between wings and ailerons and ailerons and flaps.
- B. Between rudder and vertical stabilizer.
- C. Between elevator and horizontal stabilizer.
- D. Between elevator and trim tab.
- E. Around elevator and rudder linkages.
- F. Around brakes, oleo struts, wheels, retracting mechanism, and nose wheel well doors.
- G. Inside prop spinners.

NOTE: Taxiing or towing through snow, slush, etc., can result in ice formation on the wheels, brakes, and inside wheel wells when the aircraft is parked during freezing temperatures.

- H. Pitot tube and static ports.
- I. Fuel tank vents.
- J. Engine oil breather vents.
- K. Pressure system pump air inlets.
- L. Propeller blades.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD ALCOHOL, GLYCOL, OR ANY OTHER PETROLEUM DERIVATIVE BE USED FOR ICE OR SNOW REMOVAL. THESE SUBSTANCES CAN DAMAGE PLEXIGLAS AND REMOVE THE LUBRICATION FROM CONTROL SURFACE HINGES.

- M. Windshield and windows.

3. Battery Servicing and Charging

Refer to Chapter 24 for battery servicing and charging procedures.

4. External Cleaning

The painted surfaces of the aircraft have a long lasting, all-weather finish and should require no buffing or rubbing out in normal conditions. However, it is desirable to wax and polish it to preserve the outstanding exterior finish. It is recommended that wax or polish operations be delayed (at least 60 days after date of certification) to allow proper curing of paint. The paint can be kept bright simply by washing with water and mild soap. Avoid abrasive or harsh detergents. Rinse with clear water and dry with terry cloth towels or chamois. Oil and grease spots may be removed with kerosene or mineral spirits.

NOTE: No commercial paint removers are to be used on any airframe components unless specific prior approval has been received from the manufacturer.

If you choose to wax your aircraft, use a good automotive-type wax applied as directed. The use of wax in areas subject to high abrasion, such as leading edges of wings and tail surfaces, propellers, spinners, and blades, is recommended.

5. Internal Cleaning

Clean the interior regularly with a vacuum cleaner to remove loose dirt from the upholstery and carpet.

If liquid (coffee, etc.) is spilled on upholstery or carpet, blot it up promptly with cleansing tissue or rags. Continue blotting until no more liquid is taken up. Sticky materials may be cleaned with household spot removers, used sparingly.

Before using any solvent, read the instructions on the container and test it on an obscure place on the fabric to be cleaned. Never saturate the fabric with a volatile solvent; it may damage the padding and backing materials.

Soiled upholstery and carpet may be cleaned with foam type detergent, used according to the detergent manufacturer's instructions. To minimize wetting the fabric, keep the foam as dry as possible and remove it with a vacuum cleaner.

WARNING: USE CLEANING SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: NEVER USE GASOLINE, BENZINE, ALCOHOL, ACETONE, CARBON TETRACHLORIDE, FIRE EXTINGUISHER FLUID, ANTI-ICE FLUID, LACQUER THINNER, OR GLASS CLEANER TO CLEAN PLASTIC. THESE MATERIALS WILL DAMAGE THE PLASTIC AND MAY CAUSE SEVERE CRAZING.

The plastic trim, headliner, instrument panel, and control knobs can be cleaned with a soft cloth moistened with Stoddard Solvent, (P-S-661) or equivalent.

6. Windshield and Window Cleaning

CAUTION: NEVER USE GASOLINE, BENZINE, ALCOHOL, ACETONE, CARBON TETRACHLORIDE, FIRE EXTINGUISHER FLUID, ANTI-ICE FLUID, LACQUER THINNER, OR GLASS CLEANER TO CLEAN PLASTIC. THOSE MATERIALS WILL DAMAGE THE PLASTIC AND MAY CAUSE SEVERE CRAZING.

It is recommended that the Plexiglas in the windshield and cabin windows be kept clean and unscratched. The following procedures are recommended:

- A. If large deposits of mud and/or dirt have accumulated on the Plexiglas, flush with cold water. Light rubbing with the hand is recommended to dislodge excess dirt and mud without scratching the Plexiglas.
- B. Wash with soap and water. Use a sponge or heavy wadding of a soft cloth. DO NOT rub, as the abrasive action in the dirt and mud residue will cause fine scratches in the surface.
- C. Grease and oil spots may be removed with a soft cloth soaked in kerosene.
- D. After cleaning, wax the Plexiglas surface with a thin coat of hard polish wax. Buff with a soft cloth.
- E. If a severe scratch or marring occurs, jeweler's rouge is recommended. Follow directions, rub out scratch, smooth, apply wax, and buff.

7. Engine Cleaning

WARNING: USE CLEANING SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: PARTICULAR CARE SHOULD BE TAKEN TO PROTECT ELECTRICAL EQUIPMENT BEFORE CLEANING. SOLVENT SHOULD NOT BE ALLOWED TO ENTER MAGNETOS, STARTERS, OR ALTERNATORS. COVER ANY FUEL, OIL, AND AIR OPENINGS ON THE ENGINES AND ACCESSORIES BEFORE WASHING THE ENGINES WITH SOLVENT. CAUSTIC CLEANING SOLUTIONS SHOULD BE USED CAUTIOUSLY AND SHOULD ALWAYS BE PROPERLY NEUTRALIZED AFTER THEIR USE.

The engines should be cleaned with a suitable solvent, such as Stoddard Solvent (P-S-661) or equivalent, then dried thoroughly. If caustic or emulsifying cleaners are used, they should be flushed with water and neutralized as soon as possible after cleaning is accomplished.

8. Propeller Care

Damage from foreign objects, sometimes referred to as "nicks," may appear in the leading edges of the propellers from time to time. It is vital that these nicks be corrected as quickly as possible since they can result in eventual blade cracking. (Refer to Chapter 61 for minor repair instructions.) Cleaning agents such as mineral spirits are recommended for cleaning the propeller, followed by waxing or coating with a light film of oil.

Ch. 20

Airframe systems
standard practices

CHAPTER 20

STANDARD PRACTICES – AIRFRAME

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AIRFRAME STRUCTURAL REPAIR – DESCRIPTION

1. **General**

The information in this section should be used in conjunction with AC 43.13-1A "Acceptable Methods, Techniques and Practices – Aircraft Inspection and Repair." Information contained herein is applicable to repair of damage where replacement of the damaged assembly is considered unnecessary. If some doubt exists relative to repair not specifically covered, consult the Grumman American Customer Service Department.

Field repairs of bonded structures can be made using rivets. Flush riveted repairs can be made in both sheet metal and honeycomb areas. These repairs are normally covered with an epoxy fairing compound to maintain surface contour and smoothness.

If the customer desires to accomplish repairs by bonding techniques and without the use of rivets, the Grumman American Customer Service Department should be contacted for procedure.

2. **Tools, Jigs, and Fixtures**

Very few special tools are required for normal maintenance on the GA-7/Cougar. Standard shop tools (including a torque wrench and micrometer) are usually adequate. Required special tools, jigs, and fixtures can be procured through your authorized Grumman American Dealer or Distributor.

3. **Materials**

Structural repairs should be accomplished using identical material to that being repaired (i.e., 0.032 inch 2024-T3 clad aluminum). If material shortages make substitution necessary, 2024-T3 in most cases can be substituted for any other aluminum alloys. However, it is important that the 2024-T3 aluminum contain an aluminum coating (designated as "Alclad") for corrosion protection or if 2024-T3 base is used, it must have been precoated with a baked on corrosion inhibited primer.

4. **Service Kits**

Service Kit No. SK-102A is a potting kit for honeycomb repair and Service Kit No. SK-125 is a bondline repair kit used for the repair of delaminated metal-to-metal bond joints. Both kits contain instructions for proper preparation and application and are available through your authorized Grumman American Dealer or Distributor.

5. **Sheet Metal Repairs (Riveted)**

Damage to skin, ribs, and frame areas can generally be repaired using normal sheet metal repair techniques. These techniques are covered in AC 43.13-1A.

Local wing skin damage, except in fuel tank areas, can be satisfactorily repaired using rivets. However, if extensive wing skin damage exists, the Grumman American Customer Service Department should be contacted for information pertaining to damaged area repairs.

6. Honeycomb Panel Repairs (Riveted)

Damage to honeycomb panels can be repaired by removal of the damaged section, sealing of any exposed honeycomb core with PR 1436GB-2 Inhibited Sealant (MIL-S-81733), and splicing in of new repair parts. The splice can be installed with rivets and can be made flush with external surface if desired. Representative repairs for damaged honeycomb panels are discussed in the Approved Repairs section of this chapter.

NOTE: PR 1436GB-2 Inhibited Sealant (MIL-S-81733) is approved and is available through Products Research and Chemical Corporation, 2919 Empire Ave., Burbank, California or through your authorized Grumman American Dealer or Distributor.

Critical honeycomb areas are those areas adjacent to wing mounting area, tail cone, and nose gear area. Minor damage to one face sheet of a honeycomb panel which is confined to an area of 1.0 inch or less in diameter, and located in noncritical area, can be repaired by smoothing sharp edges in the damaged area, sealing any exposed honeycomb core with PR 1436GB-2 sealant (MIL-S-81733), and filling with an epoxy fairing compound.

Minor damage to a critical area which is equal to or less than 1.0 inch in diameter can be repaired by removal of the damaged face sheet, sealing any exposed honeycomb core with PR 1436GB-2 sealant, application of resin filler, and installation of a doubler plate. Service Kit No. SK-102A includes an acceptable resin filler.

Damaged areas greater than 1.0 inch in diameter or including punctures through both face sheets will require removal of the damaged area and insertion of a honeycomb repair section. Typical repairs are shown in the Approved Repairs section of this chapter.

If extensive damage is encountered, contact the Grumman American Customer Service Department.

All riveted honeycomb repairs must include some means of sealing the repair joint from external moisture. This protection is provided by using PR 1436GB-2 Inhibited Sealant. Epoxy fairing compound may be used to smooth the repair prior to painting.

All honeycomb edges and repair faying surfaces should be coated with PR 1436GB-2 sealant. Also, all rivets should be dipped in this sealant prior to installation. After completion of the repair, the repaired area should be coated with zinc chromate primer.

7. Repair of Formed Thermo-Plastic Parts

Repairs of punctures may be accomplished by cutting out the damaged area, removing the paint, and installing an overlapping or flush patch of identical material. A doubler may be added behind the patch if additional strength is required.

The bonding agent can be trichloroethane or a suitable substitute.

WARNING: WHEN USING TRICHLOROETHANE, ENSURE THAT THE WORKING AREA IS WELL-VENTILATED AND THAT PROTECTIVE EQUIPMENT (GLOVES, EYE PROTECTION) IS WORN. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

Cracks or voids may be repaired by applying a filler composed of trichloroethane and shavings of material identical to that being repaired. Upon completion of the repair, sand the area smooth and repaint.

Parts that are, in the opinion of the customer, damaged beyond economical repair, should be replaced.

8. Engine Mount Repair

Engine mount repairs should be accomplished in strict accordance with Part 43 of Federal Aviation Regulations.

9. Control Surface Repair

After repair or repainting of any control surface, it is necessary to check the balance and adjust the mass balance weights as required to bring it within tolerance. (Refer to Chapter 27 for control system balancing and rigging.)

10. Bondline Damage and Repair

A. Types of Bondline Damage

(1) Physical Damage

The most common type of bondline damage is physical damage along the trailing edges of the flaps, ailerons, elevators, and rudder. This is usually caused by persons stepping on the inboard areas adjacent to the wing walkway areas and general damage caused by moving stands, etc., on other surfaces. A typical bondline repair is described in the Approved Repairs section of this chapter.

(2) Corrosion Damage

A less common type of bondline damage is caused by metal corrosion. This type of damage is usually restricted to trailing edges of wings, rudders, elevators, and trim tabs, particularly if these edges are not well protected by paint or have been bumped, causing delamination of the bonded joint and allowing moisture or water to penetrate.

B. Areas Requiring Inspection Emphasis

These areas will be added to the Maintenance Manual as they become apparent through aircraft use and resulting inspections.

11. Rivet Substitution

Rivets of higher strength and with a depth of countersunk head equal to, or less than, those called out, may be used on any structural repair.

12. Primary Structures

The following portions of the aircraft are primary structures.

A. Fuselage

(1) Nose Gear and Nose Gear Attachments

- (2) Nose Section, Aircraft
 - (3) Main Fuselage
 - (4) Horizontal and Vertical Stabilizer Attachments
 - (5) Fuselage and Cabin Honeycomb and Bond Joints
- B. Control System**
- (1) All Components
- C. Wing**
- (1) Wing Main Spar and Rear Spar
 - (2) Nacelle Areas
 - (3) Engine Mounts and Extrusions
 - (4) Main Landing Gear Area and Attachments
- D. Empennage**
- (1) Stabilizer Spars
 - (2) Stabilizer Skin and Ribs (Inboard)
- E. Control Surfaces**
- (1) Support Brackets
 - (2) Balance Weight
 - (3) Torque Tubes

AIRFRAME STRUCTURAL REPAIR – MAINTENANCE PRACTICES

1. Removal/Installation of Nose Section

A. Remove Nose Section at Fuselage Station 50.00 (See Figure 201.)

- (1) Remove rivets securing aft edge of equipment shelf to support angle on forward fuselage bulkhead.
- (2) Remove rivets securing the two lower splice angles to wheel well panels.
- (3) Remove rivets securing the two splice channels to the nose section.
- (4) Remove rivets securing the two upper splice angles to fuselage.
- (5) Remove rivets securing the two splice plates to nose section.
- (6) Place a suitable support under nose section and remove rivets securing nose section to fuselage.

B. Install Nose Section at Fuselage Station 50.00 (See Figure 201.)

- (1) Using a suitable support, position nose section and secure to fuselage with rivets.
- (2) Rivet the two splice plates to nose section.
- (3) Rivet the two splice channels to nose section.
- (4) Rivet the two lower splice angles to wheel well panels.
- (5) Rivet the two upper splice angles to fuselage.
- (6) Rivet aft edge of equipment shelf to support angle on forward fuselage bulkhead.
- (7) Prepare repaired area for painting and paint using matching paint.

2. Approved Repairs

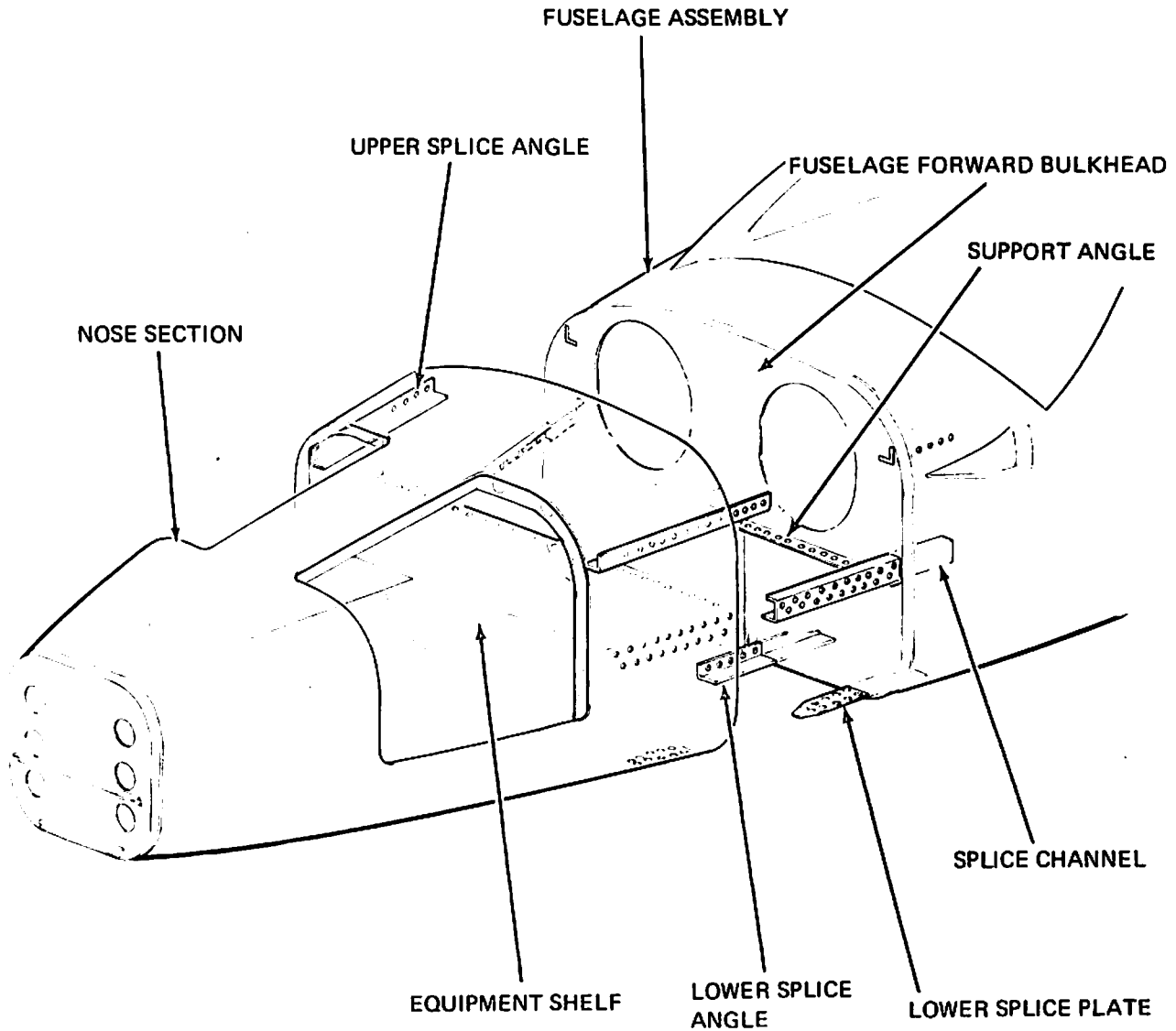
A. Leading Edge Repair

Figure 202 illustrates a typical repair to be employed in patching skin on the wing leading edge. The repair should be made flush with the external surface of the leading edge skin and surface contour must be maintained.

Repair skin as follows:

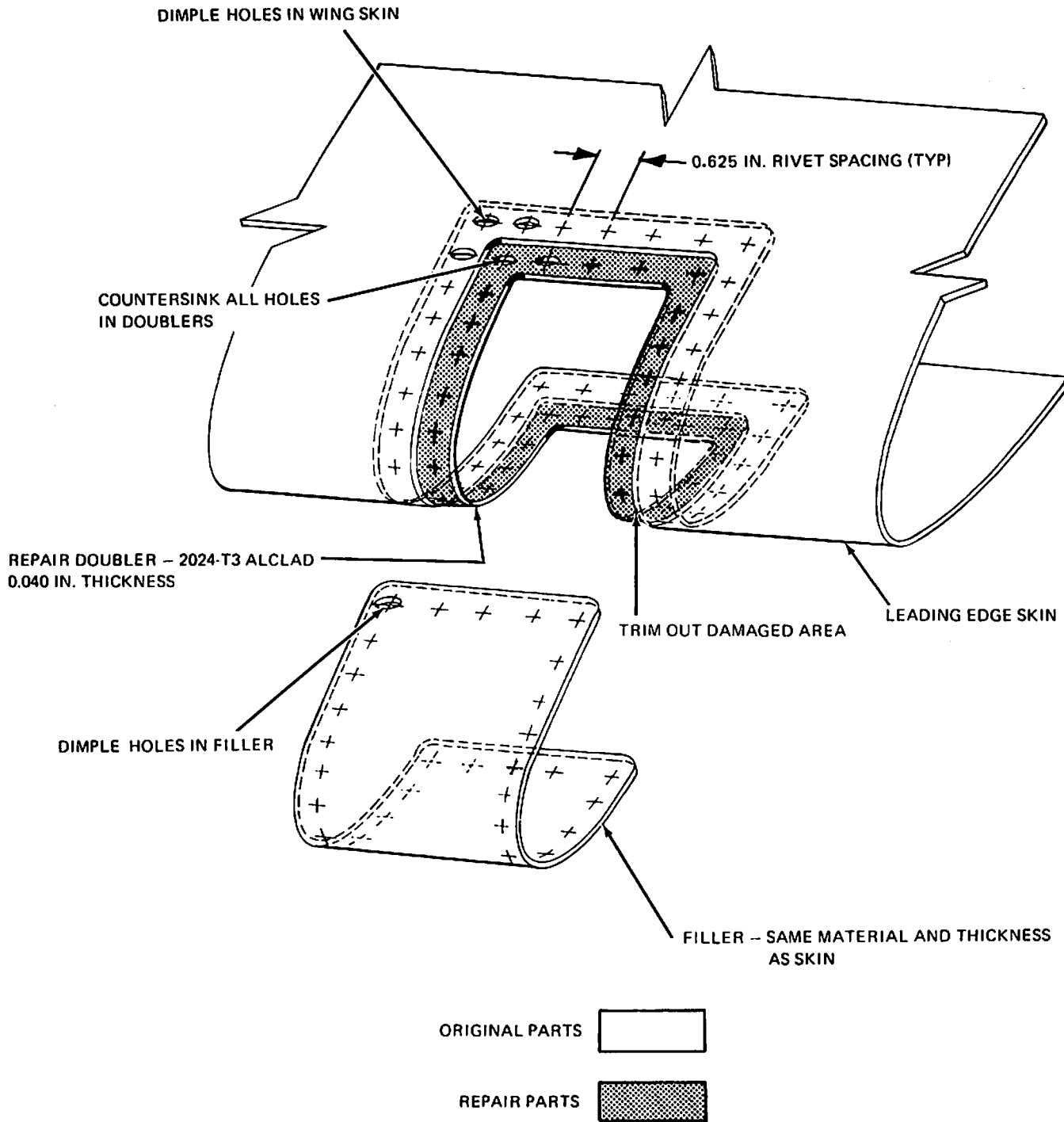
- (1) Trim out the damaged area in a rectangular pattern and deburr.
- (2) Place repair doubler beneath wing skin as shown in Figure 202.

NOTE: Dimensions given in Figure 202 are typical for most leading edge repairs.



Nose Section Removal/Installation
Figure 201

20G72-1



**Leading Edge Repair (Riveted)
Figure 202**

20G72-2

- (3) While holding repair doubler in place, drill dimple holes (1/8 inch diameter) through wing skin, spacing holes 5/8 inch apart (from center of hole to center of adjacent hole).

NOTE: This repair can be completed in the area of wing ribs by installing the doubler in two places, one on each side of the rib flange.

- (4) Secure doubler to wing leading edge with 1/8 inch diameter countersunk Cherry rivets (CR162) or equivalent.
- (5) Place filler flush with the doubler.

NOTE: Filler should be of same material and thickness as skin.

- (6) Holding filler piece in place, drill dimple holes through filler, spacing holes 5/8 inch apart (from center of hole to center of adjacent hole).
- (7) Secure filler to doubler with rivets as specified in Step (4).
- (8) Use an epoxy filler as necessary and sand smooth.

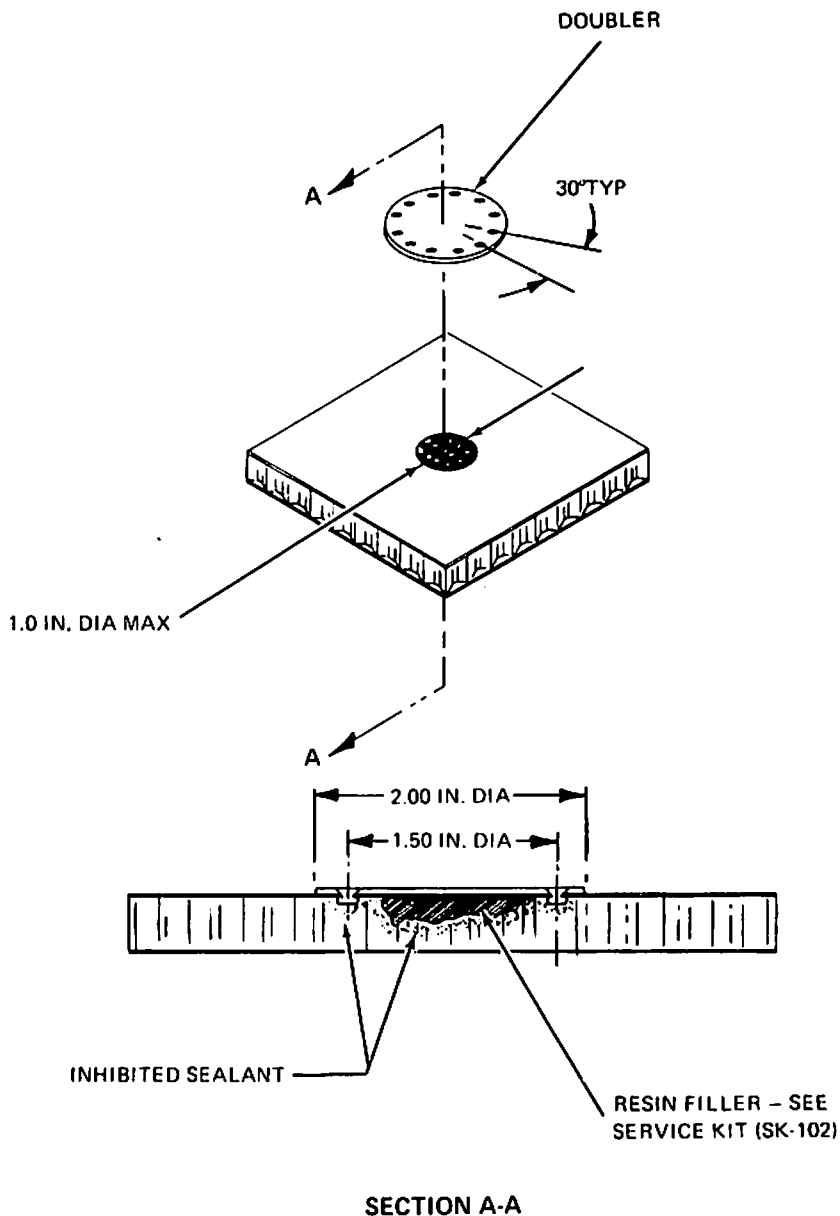
B. Honeycomb Repair, Partial Core Damage

Minor damage extending partially through the core of honeycomb panel and equal to or less than 1 inch diameter (Figure 203) can be repaired with an external doubler as follows:

- (1) Trim out damaged area of face sheet in a circular pattern.
- (2) Thoroughly clean the repair area with fine sandpaper and acetone.
- (3) Coat all repair parts with zinc chromate primer.
- (4) Seal the exposed honeycomb area with PR 1436GB-2 Inhibited Sealant (MIL-S-81733).
- (5) Using Service Kit SK-102A, apply resin fairing compound to area where damaged honeycomb core was removed.

NOTE: Refer to AC 43.13-1 for doubler and rivet pattern dimensions. Dimensions given below are typical for repair of this type.

- (6) Place 2024-T3 alclad aluminum doubler (0.040 inch thick) over repair area and drill out 1/8 inch diameter holes around circumference of doubler.
- (7) Dip all rivets (1/8 inch diameter Cherry rivets, CR162 and CR163) in PR 1436GB-2 Inhibited Sealant (MIL-S-81733).
- (8) Fair external doubler periphery with epoxy fairing compound to maintain a smooth surface.
- (9) Coat repaired area with zinc chromate primer.



**Honeycomb Repair, Partial Core Damage
Figure 203**

20G72-3

C. Honeycomb Repair, Extensive Core Damage

Damaged areas greater than 1 inch diameter or areas in which damage extends completely through the core require removal of the damaged area and installation of honeycomb repairs section. (See Figures 204 and 205.)

- (1) Patch repair, using external and internal doublers. (See Figure 204.)

Repair honeycomb as follows:

- (a) Trim out damaged area in a circular pattern as shown in Figure 204 and deburr.
- (b) Coat all repair parts with zinc chromate primer.
- (c) Seal all exposed honeycomb core areas on the repair section and the panel section with PR 1436GB-2 Inhibited Sealant (MIL-S-81733).
- (d) Place internal and external doublers (2024-T3 Alclad aluminum, 0.040 inch thick) over repair area.

NOTE: Refer to AC 43.13-1 for hole diameter limitations and corresponding rivet patterns.

- (e) Dip all rivets (1/8 inch diameter Cherry rivets, CR162 and CR163) in PR 1436GB-2 Inhibited Sealant (MIL-S-81733) and install through the doubler and repair section (both sides) such that maximum distance between any two rivets is 1.5 inches.
- (f) Fair external doubler periphery with epoxy fairing compound to maintain a smooth surface.
- (g) Coat repaired area with zinc chromate primer.

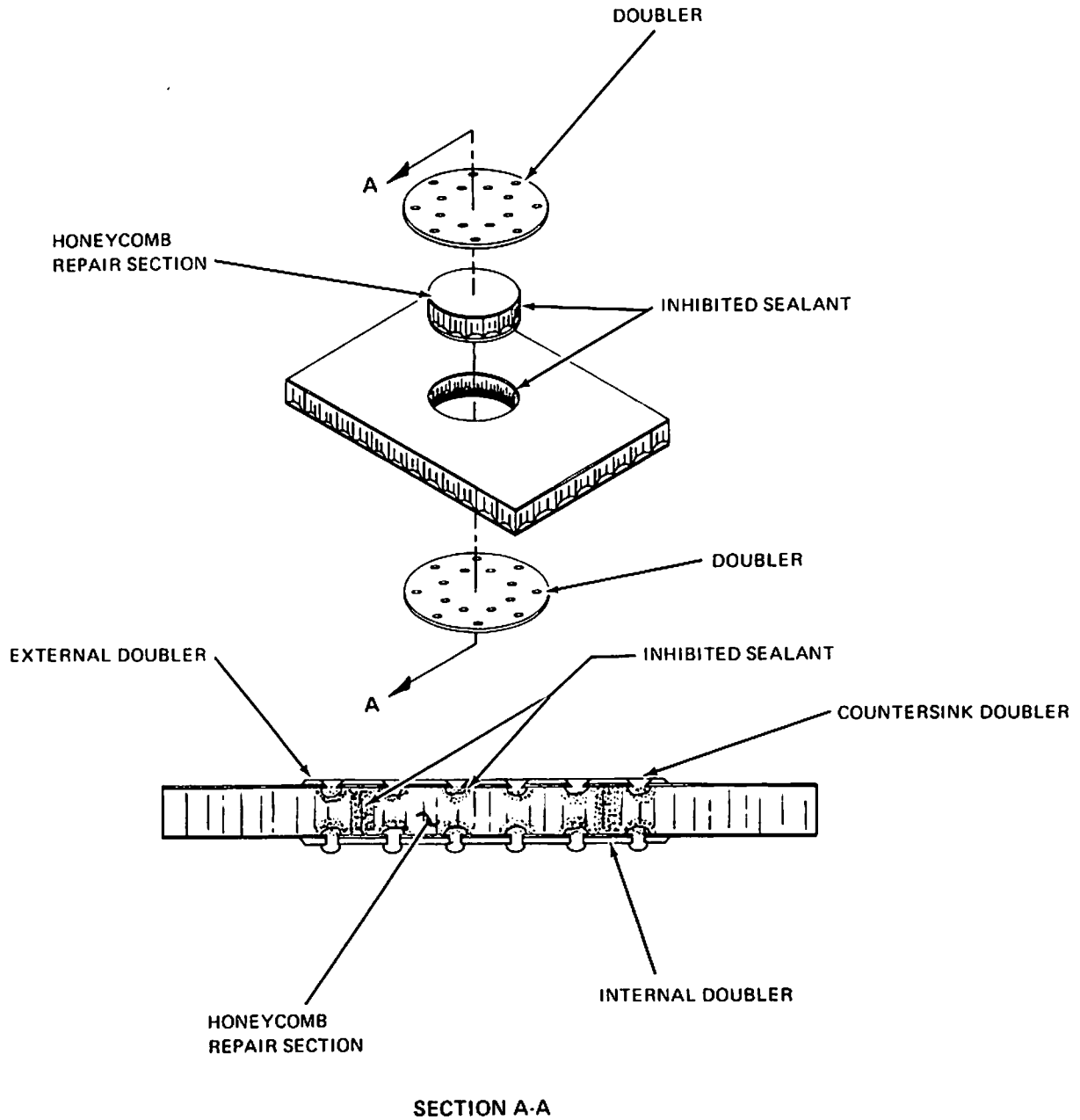
D. Splicing in New Panel Section (See Figure 205.)

This repair is satisfactory for most honeycomb repairs which require new panel sections to be spliced into existing structure. Repair honeycomb as follows:

- (1) Trim out damaged area in a rectangular pattern as shown in Figure 205 and deburr.
- (2) Coat all repair parts with zinc chromate primer.
- (3) Seal all exposed honeycomb core areas with PR 1436GB-2 Inhibited Sealant (MIL-S-81733).
- (4) Place internal and external doublers (2024-T3 alclad aluminum) over repair area. The external doubler shall be 0.040 inch thick, and the internal doubler shall be 0.032 inch thick.

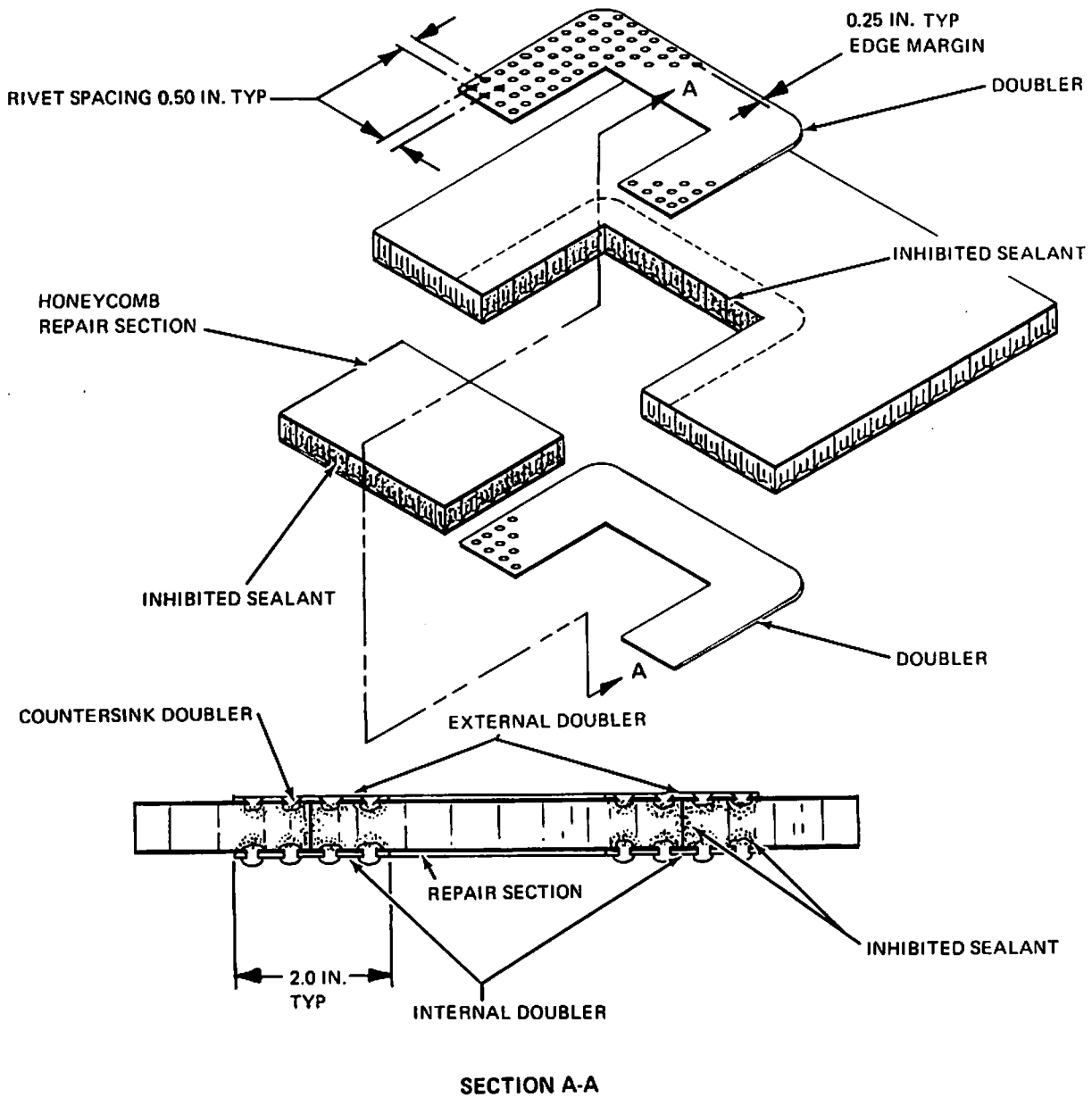
NOTE: Dimensions given in Figure 205 are typical for most honeycomb repairs using external doublers.

- (5) Dip all rivets (1/8 inch diameter Cherry rivets, CR162 and CR163) in PR 1436GB-2 Inhibited Sealant (MIL-S-81733) and install through the doubler and repair section (both sides).



**Honeycomb Patch Repair, External and Internal Doublers
Figure 204**

20G72-4



Honeycomb Repair Using Spliced-In Panel Section
Figure 205

20G72-5

- (6) Fair external doubler periphery with epoxy fairing compound to maintain a smooth surface.
- (7) Coat repaired areas with zinc chromate primer.

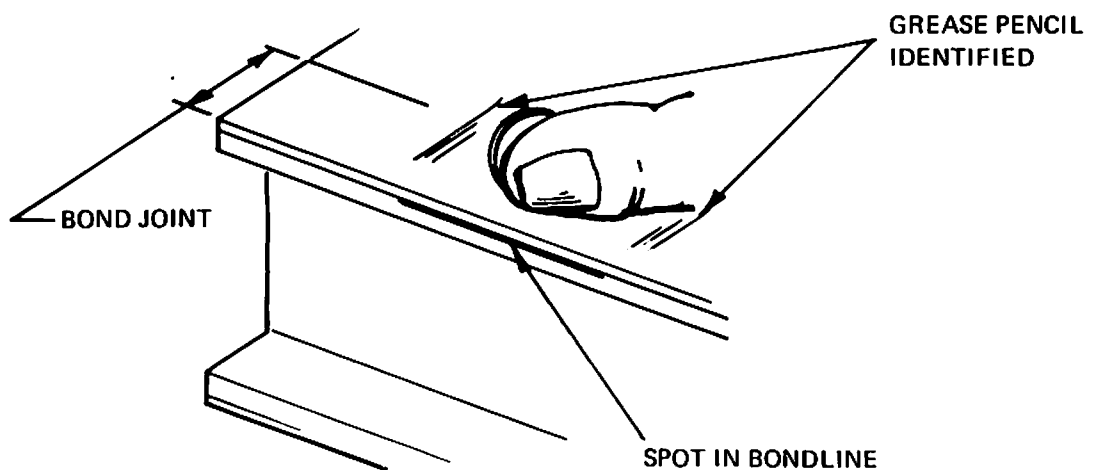
E. Bondline Repair

If inspection of joint edges determines the existence of hairline cracks between two layers of bonded metal, perform the following steps:

- (1) Identify the location of any cracks with a grease pencil as shown in Figure 206.
- (2) Gently tap the bondline with a coin or similar metal object to verify the existence of a bonding separation. Slowly move along the bondline, while tapping, and listen for a change in tone as the suspect area is traversed. A bondline separation will produce a flat or hollow sound when "tapped" directly in the damaged area.
- (3) If the results of Step (2) are questionable, insert a 0.004 to 0.006 inch feeler gauge into the bondline to verify that separation exists.

WARNING: WHEN USING TRICHLOROETHANE, ENSURE THAT THE WORKING AREA IS WELL-VENTILATED AND THAT PROTECTIVE EQUIPMENT (GLOVES, EYE PROTECTION) IS WORN. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (4) If the results of Steps (2) and (3) are negative, the hairline should be wiped with trichloroethane and sealed with paint. Also, any bare bondline edges should be sealed with paint. If the results of either Steps (2) or (3) are positive, order Service Kit No. SK-125 from your authorized Grumman American Dealer or Distributor and make the repairs accordingly.



Identifying Suspect Areas
Figure 206

20G72-6

PREPARATION FOR PAINTING – DESCRIPTION

1. General

The three basic steps involved in the preparation of the aircraft for painting are stripping, cleaning, and priming. The directions given in this section are intended to establish procedures for preparing the aircraft for painting. Procedures for the stripping, cleaning, and application of a metal conditioner are presented in this section.

The requirements specified in this section shall apply to all polyurethane coated aircraft manufactured by the Grumman American Aviation Corporation. Any deviation from or modification of these directions shall be approved by the Customer Service Department.

Because paint strippers are formulated to remove a synthetic substance, it must be understood that they are detrimental to all substances of the synthetic family. For this reason, the following procedure has been prepared and must be carefully followed to ensure against damage to synthetic components on the aircraft.

PREPARATION FOR PAINTING – MAINTENANCE PRACTICES

1. Stripping and Cleaning Procedure

Reference Specifications:

MIL-R-25134B – Paint and Lacquer, Solvent Type Remover.

APS-1057 (GAAC) – Application of Protective and Decorative Coatings.

WARNING: WHEN USING TRICHLOROETHANE, ENSURE THAT THE WORKING AREA IS WELL-VENTILATED AND THAT PROTECTIVE EQUIPMENT (GLOVES, EYE PROTECTION) IS WORN. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: LONG TERM EXPOSURE OF BOND JOINTS TO PAINT STRIPPERS WILL AFFECT THE INTEGRITY OF THE BOND STRENGTH. ALL AREAS MUST BE COMPLETELY SEALED TO PREVENT THE STRIPPER FROM CONTACTING BOND JOINTS OR GETTING INTO INTERNAL AREAS OF THE AIRCRAFT. IF STRIPPER DOES INADVERTENTLY CONTACT THE BOND JOINT, FLUSH THOROUGHLY WITH TAP WATER WITHIN 1-1/2 HOURS.

A. Wipe all bondlines and areas with trichloroethane or a suitable substitute so that they will be free of dust, oily material, wax, cleaning agents, or other foreign material.

CAUTION: APPLY PROTECTIVE TAPE TIGHTLY TO ENSURE AGAINST SEEPAGE OF STRIPPER INTO THE AREAS MENTIONED IN PARAGRAPHS B AND C.

B. Using 2-inch-wide aluminum tape, mask windows, windshield, wing tips, stabilizer tips, engine cowl, tail cone, propellers, main and nose landing gear, drain holes, fasteners, and all bondlines.

C. Encase antennas, lights, beacons, tires, radar domes, windows, windshield, and all Fiberglas or plastic parts in a double layer of aluminum foil.

D. Apply an approved polyurethane stripper with a suitable paint brush with slow easy strokes so as not to apply stripper on any undesired areas. Allow the stripper to work for 5 to 15 minutes.

NOTE: Acceptable material sources for polyurethane strippers per MIL-R-25134B are:

**(1) Strip-prep No. 66
Amchem Products, Incorporated
2300 Gainsboro
Ferndale, Michigan 48220**

**(2) Methylene Chloride Based Paint Stripper No. 3403
W. M. Barr and Company
2336 S. Lauderdale
Memphis, Tennessee 38106**

E. Flush removed paint and excess stripper with tap water, using a pressure nozzle. Be sure that all stripper residue is thoroughly removed.

- F. Remove the aluminum tape and protective foil from all areas. Inspect these areas carefully to be sure all stripper residue has been removed.

NOTE: It is permissible to sand the paint completely from the bondlines; however, for best bondline protection, it is recommended that these areas be lightly sanded.

2. Metal Conditioner Application

- A. Prepare metal conditioner solution using manufacturer's instructions.

NOTE: Acceptable material sources for metal conditioners are:

- (1) DuPont 222 Metal Conditioner
- (2) Magnus No. 852 (wipe off) Metal Conditioner
Economics Laboratory, Incorporated
Magnus Division
Osborn Building
St. Paul, Minnesota 55102

- B. Apply the conditioner by wiping or brushing the solution on all surfaces to be painted. This compound is safe for use on bond joints. Do not allow conditioner to contact the windshield or windows.
- C. Allow the conditioner to work for 2 to 10 minutes, depending on the degree of surface cleanliness.
- D. Remove the conditioner per manufacturer's instructions.

CHAPTER 21

AIR CONDITIONING

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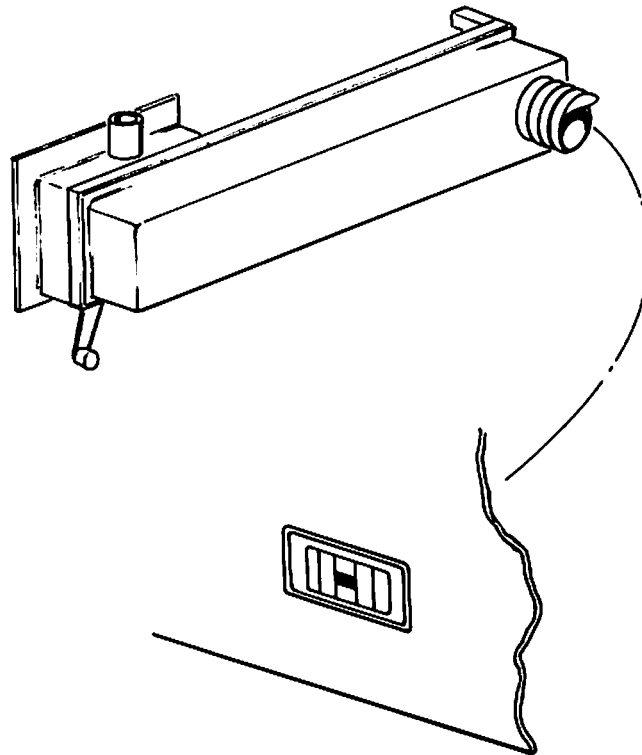
AIR CONDITIONING – DESCRIPTION/OPERATION**1. General**

Air conditioning in the GA-7/Cougar aircraft consists of three systems designed to provide environmental control in the flight compartment and passenger cabin areas. Louvered ventilators in each side of the instrument panel beneath the control columns and optional Wemac air vents in the cabin walls by the rear passenger seats provide outside air. The heating system provides a mixture of heated air from the muffler heat exchanger and unheated outside air for cabin temperature control.

FORWARD FRESH AIR SYSTEM – DESCRIPTION/OPERATION**1. General (See Figure 1.)**

The ventilation system consists of two ram air scoops located forward of the instrument panel on the outside fuselage walls, lever-operated shutoff valves immediately beneath the instrument panel on the inside walls, and louvered ventilators located on the instrument panel beneath the control columns. A flexible duct is used to convey air from the shutoff valve to the ventilator.

The volume of available air is adjustable by means of a lever on the bottom of the air box. The air flow may be directed by means of the adjustable shutters at the ventilators.



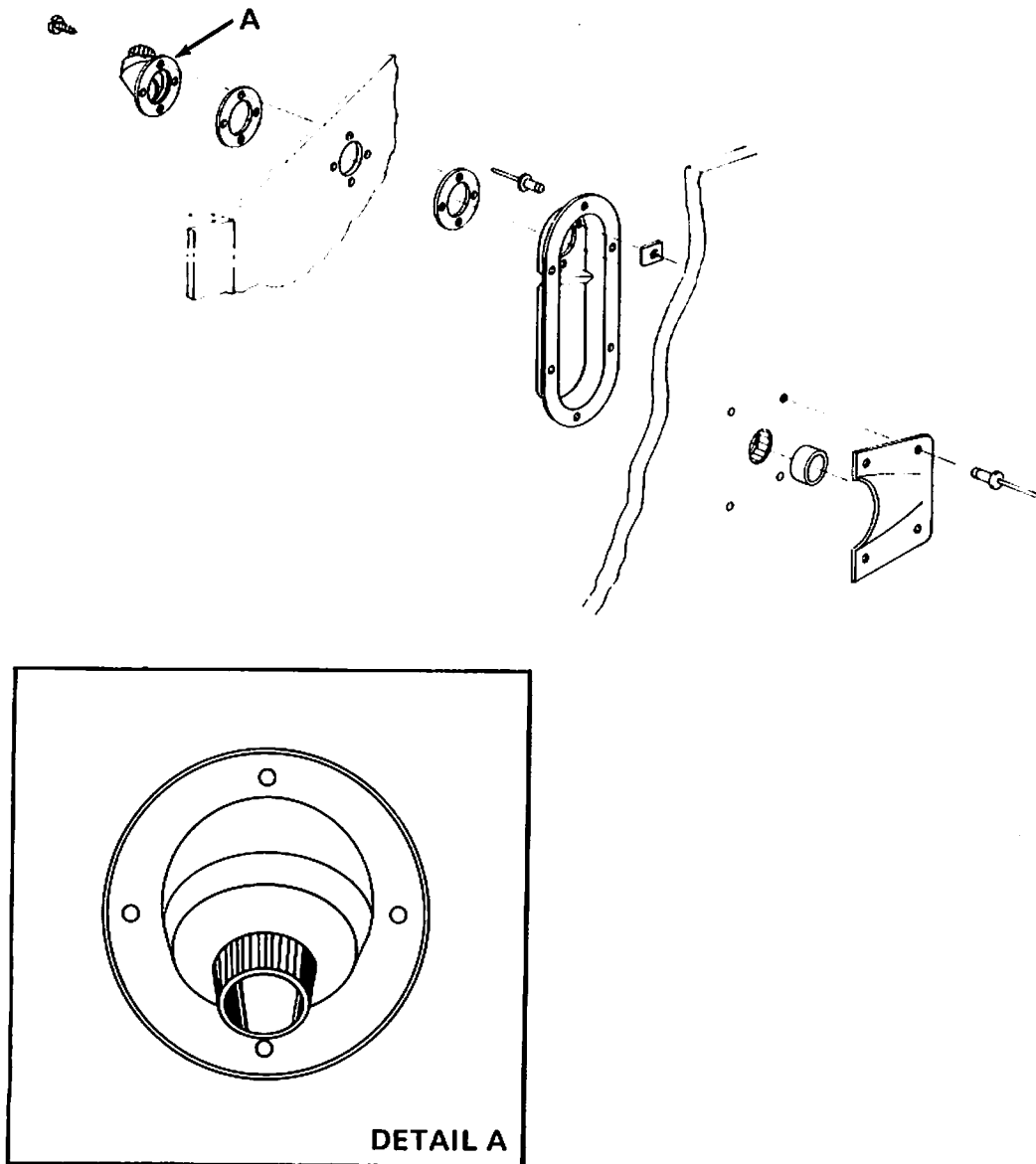
**Ventilation System
Figure 1**

21G72-1

REAR CABIN PASSENGER VENT SYSTEM (OPTIONAL) – DESCRIPTION/OPERATION

1. General (See Figure 1.)

On aircraft equipped with this option, ventilation for the rear cabin passenger area is furnished by two fresh air vents mounted in the cabin walls at either side of the rear seat. The flow of air into the cabin can be directed, regulated, or completely shut off by means of the knurled ring on the outlet valve.



21G72-2

**Rear Cabin Passenger Vent System
Figure 1**

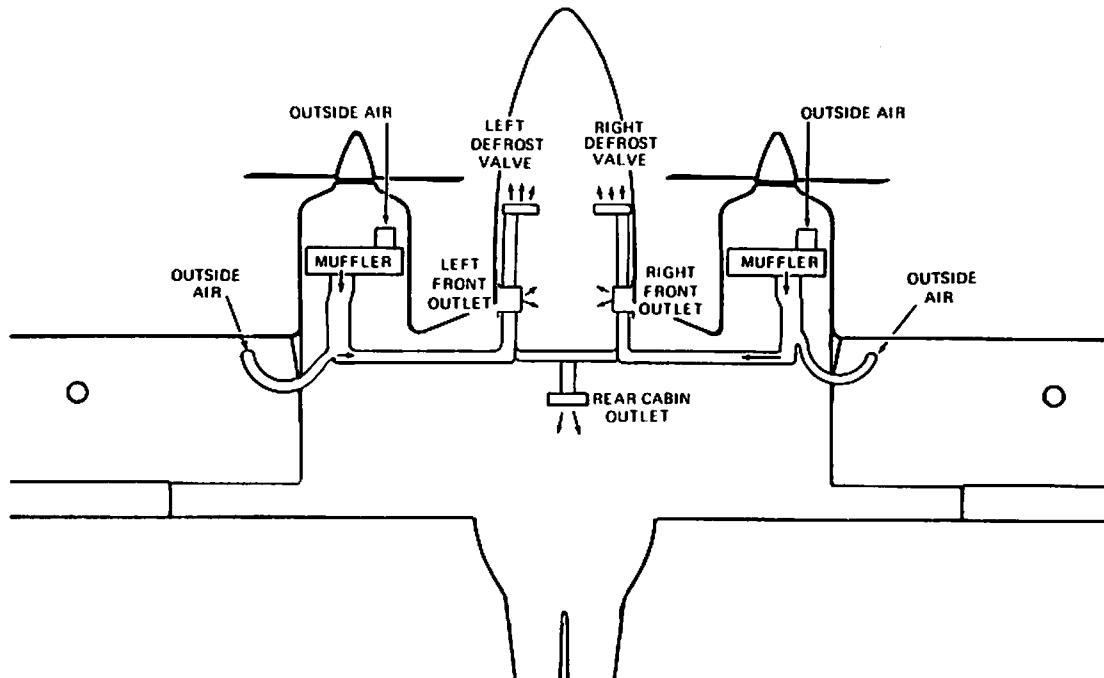
HEATING SYSTEM – DESCRIPTION/OPERATION1. General (See Figure 1.)

Cabin heat is provided by a dual system with separate left and right sources and controls. Ram air is directed into a heat exchanger around the engine exhaust. The heated air is then ducted into the hot air valve. Ram air is also ducted directly to the cold air valve from an inlet beneath the wing.

Air flow from the hot and cold air valves is mixed at a wye behind the firewall and ducted through the wing and into the cabin at Fuselage Station 88.50. The shutters of the hot and cold air valves are connected together by linkage so that one is closed when the other is open. The hot air valve is provided with an outlet and duct to dump heated air overboard when the valve is closed.

In the cabin, the air flow is divided, part being directed into the passenger compartment through a vent at the aft end of the center console, and the remainder being directed forward to a vented duct near the floor at the pilot's station and to the pilot's windshield defogger vent. The blower, located at the cabin side of the left engine firewall, is controlled by the BLOWER – ON/OFF switch on the instrument panel. The defogger vent and the vent at the pilot's station are provided with air valves to control air flow. The L CABIN AIR – OFF/WARM control on the pilot's side of the instrument panel is used to control the cabin temperature by regulating the heated to unheated air mixture in the cabin air valve. Positioning the L CABIN AIR – OFF/WARM control in the minimum (left) end of the range will admit only unheated air into the cabin air valve. The left system will heat or ventilate with or without the blower being in operation. The blower will increase the volume of air entering the cabin and can be used to increase ventilation when the aircraft is on the ground, or boost the heating or ventilation when aloft.

The right hand system is similar to the left hand system. The two systems are joined by a tee at the aft center console.



Heating System
Figure 1

HEATING SYSTEM – TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Insufficient heat.	Duct damaged or disconnected. Loose control cable connection. Air valve damaged.	Replace or connect duct. Tighten control cable connection. Replace air valve.
Control hard to operate.	Control cable binding. Air valve sticking or binding.	Check cable for proper routing and free the cable. Lubricate valve stem bearing and free the valve.
Exhaust fumes in cabin.	Defective muffler.	Inspect muffler and replace if defective.

HEATING SYSTEM – MAINTENANCE PRACTICES

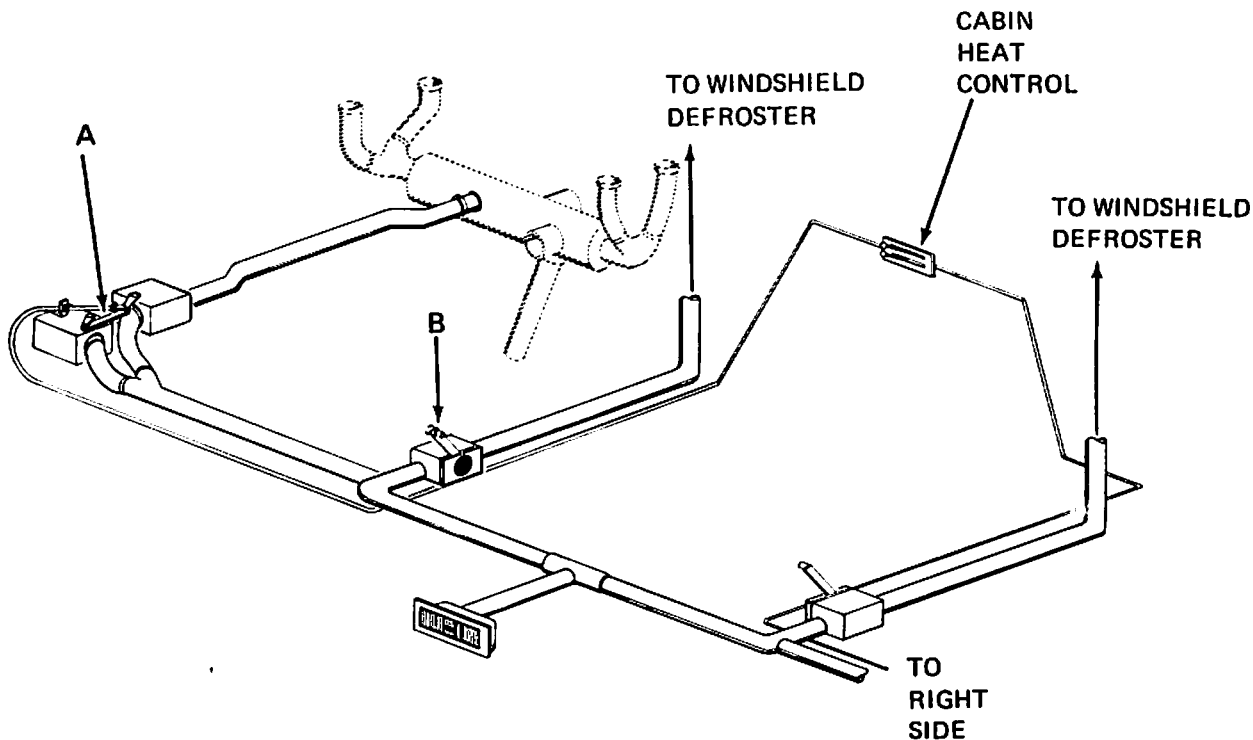
1. General

Maintenance of the heating system (Figure 201) is relatively straightforward, and will be limited to air valve and cable problems, and to replacement of flexible ducting if no longer serviceable. The muffler/heat exchanger, the cabin hot and cold air valves, and associated ducting are located in the respective engine nacelles forward of the firewall. The cold air duct runs from beneath the wing leading edge inlet just outboard of the engine nacelle to a fitting on the cold air valve which is through the firewall. This fitting is accessible through the access panel beneath each nacelle.

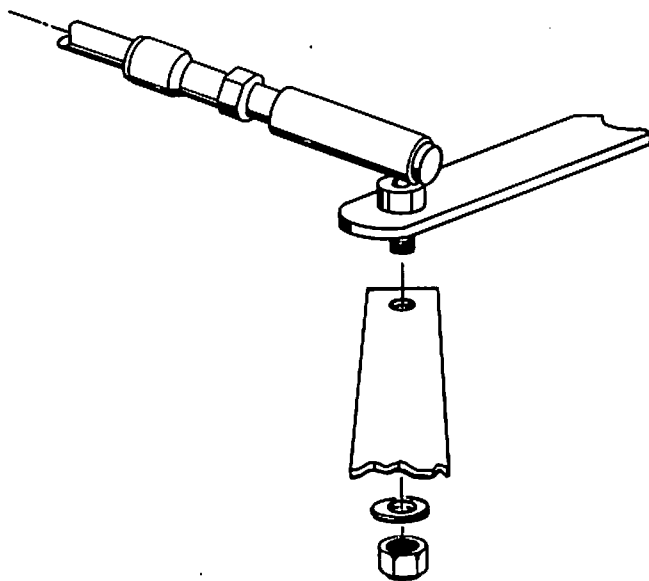
2. Component Locations and Access

Duct from the nacelle to the fuselage is accessible through the two wing access openings beneath the wing inboard of each nacelle. All components in the cabin are accessible along the cabin walls, beneath the instrument panel, or beneath the center aft console.

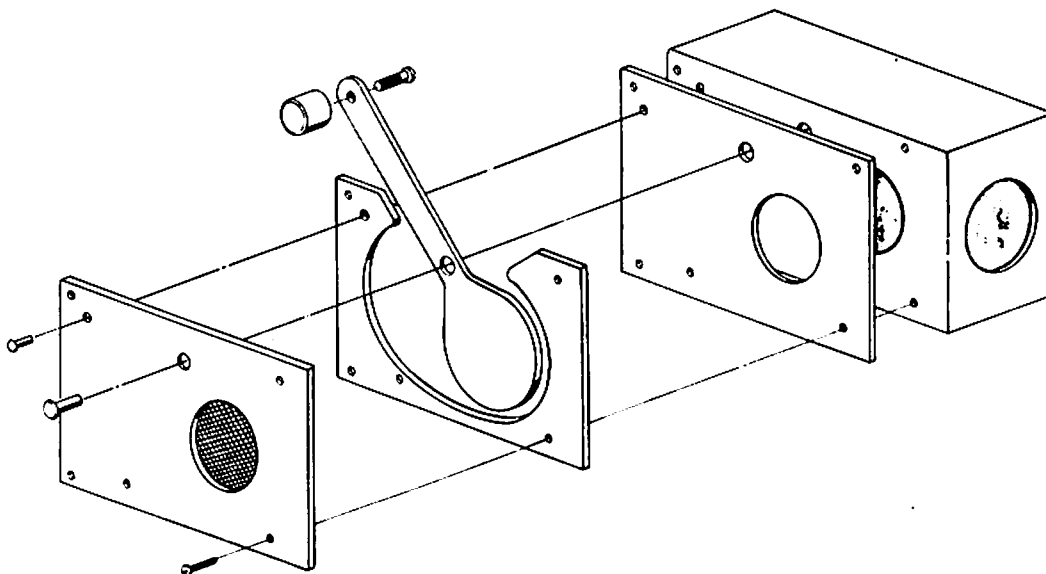
When connecting the cabin heat control cable, disconnect all linkage at the hot air valve and place the heat control on the instrument panel in the minimum heat position. With the hot air valve lever in its maximum aft (closed) position, adjust position of heat control cable at bracket on hot air valve as required to install universal joint fitting into lever. With cold air valve lever in its maximum aft (open) position, adjust linkage as required to install onto universal joint fitting at hot air lever.



Heating System
Figure 201 (Sheet 1 of 2)



DETAIL A



DETAIL B

**Heating System
Figure 201 (Sheet 2 of 2)**

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AUTOPILOT – DESCRIPTION/OPERATION

1. General

The value of the autopilot is apparent as aircraft become more complex and operations more involved. While utilizing the autopilot, more time is available for flight management, navigation, and observance of other traffic.

Autopilots range in complexity from the simple wing-leveler to the complex three-axis autopilot with approach couplers and flight directors. The simple autopilot would consist of a directional gyro, attitude (artificial horizon) gyro, control console, and roll servo. The complex autopilot would add to the simple system a flight director (steering horizon) gyro, radio coupler, glide slope coupler, and automatic pitch trim control. The options available on the GA-7/Cougar vary from the simple to the complex.

The Grumman American GA-7/Cougar utilizes the Edo-Aire Mitchell Century IIB, Century III, Century III with glide slope, or Century IV autopilot for automatic flight control. The installation of the autopilot and the model is at the option of the owner.

2. Edo-Aire Mitchell Century IIB Autopilot System (See Figure 1.)

The Century IIB is a lightweight automatic flight system using advanced electronic design for maximum performance and utility. The Century IIB is a two-axis autopilot that will provide precision roll and heading control. The heart of the system is a solid state computer, operating in the 5000-cycle audio frequency range. The computer analytically determines the control position and motion needed to produce a humanlike, time controlled response to varying flight conditions.

The Century IIB autopilot is comprised of the following components: directional gyro, attitude gyro, roll servo, roll signal filter, and command console. A radio coupler can be added to provide radio navigation and localizer guidance.

The command console provides convenient fingertip control of the autopilot system. Located on the front panel of the console is the A/P ON-OFF switch, Roll Command knob, and HDG ON-OFF switch. With the A/P ON-OFF switch engaged, the autopilot is responsive to the roll command knob. The roll command knob may be used to maneuver the aircraft up to approximately 30° of bank, right or left. The centered position represents approximate wings level flight. With the heading mode switch engaged, the roll command knob is removed from the autopilot circuit. With the HDG ON-OFF switch engaged, the input to the autopilot will be from the directional gyro and from the radio coupler (if installed).

For those systems with the optional radio coupler installed, the autopilot will provide radio navigation and localizer guidance (lateral guidance system). The lateral guidance system contains a completely automatic analog computer that directs the autopilot in both VOR and ILS navigation. The system contains a five-position coupler mode selector switch (radio coupler) which mounts in the instrument panel.

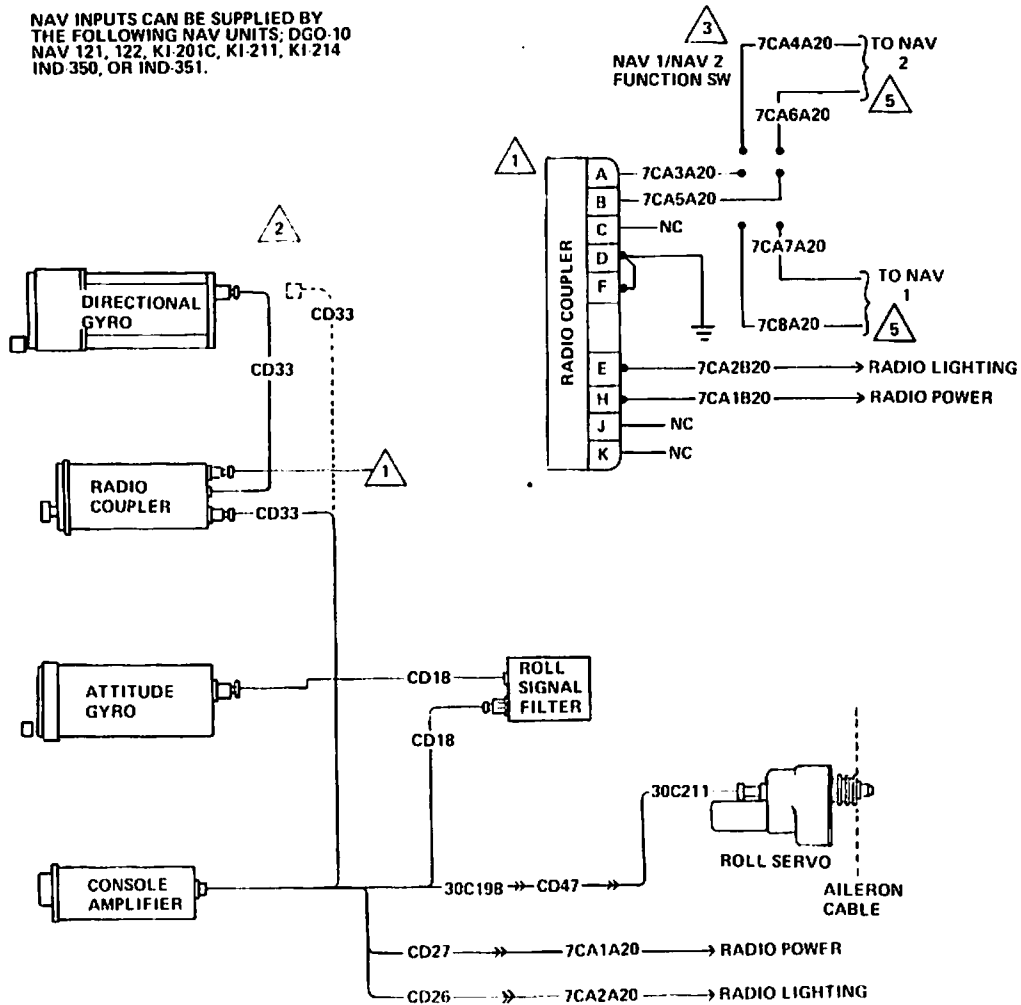
For indepth details and maintenance procedures on the autopilot, refer to the Edo-Aire Mitchell Century IIB manuals.

3. Edo-Aire Mitchell Century III Autopilot System (See Figure 2.)

The Century III is a lightweight automatic flight system utilizing advanced electronic design for maximum performance and utility. The Century III is a three-axis autopilot system, featuring precision heading and altitude hold. This system can cope with uneven fuel loads, directional mistrim, and power changes without the usual directional errors, altitude losses, or command change requirements.

**GA-7/COUGAR
MAINTENANCE MANUAL**

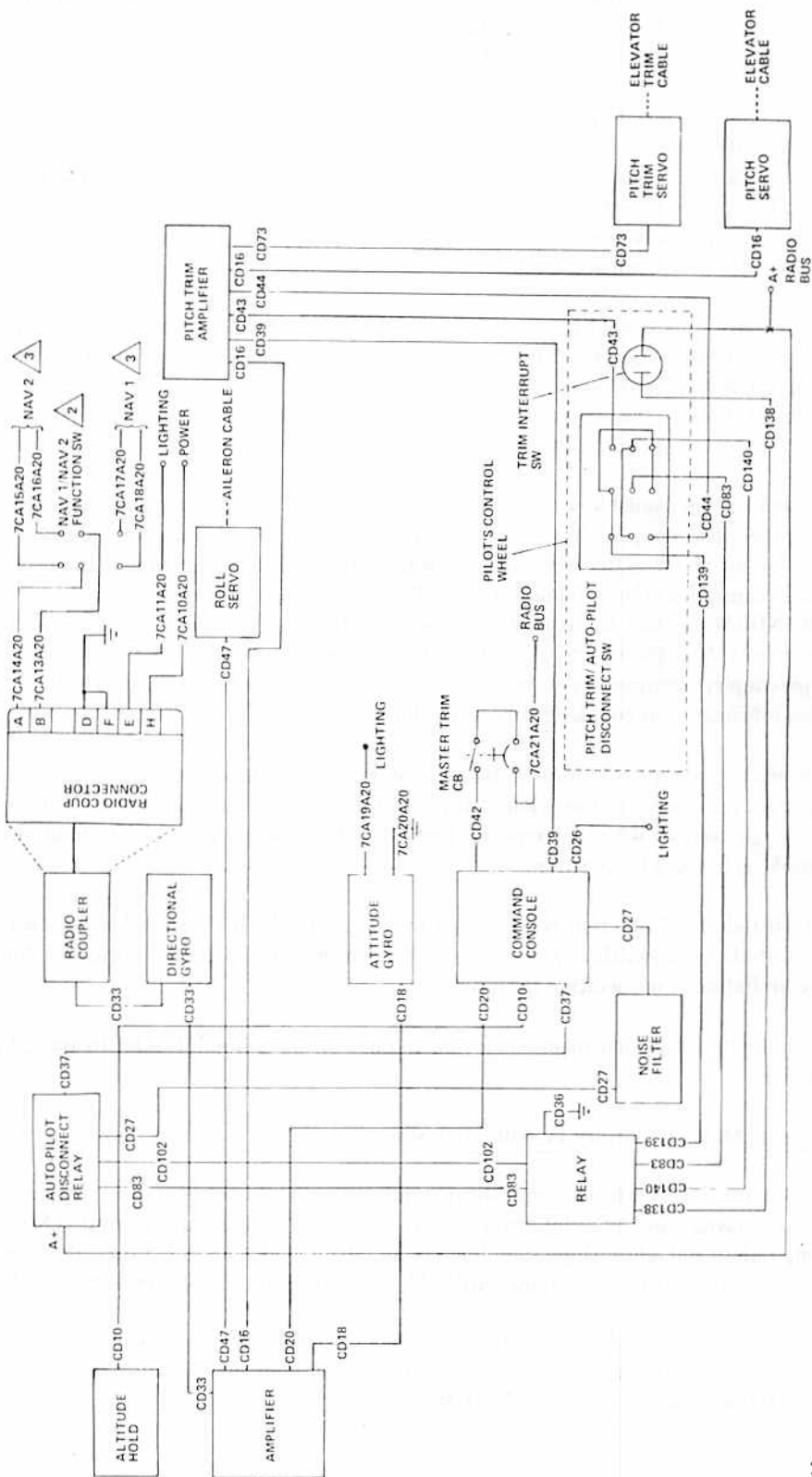
- 1 RADIO COUPLER WIRING CONNECTION
- 2 IF RADIO COUPLER IS NOT INSTALLED DELETE REFERENCE NO. 1 AND CONNECT CD33 DIRECTLY TO DIRECTIONAL GYRO.
- 3 NAV 1/NAV 2 FUNCTION SWITCH IS USED ON DUAL NAV INSTALLATIONS. ON SINGLE NAV INSTALLATION DELETE SWITCH AND SPLICE 7CA3A20 AND 7CA5A20 TO 7CA8A20 AND 7CA7A20 RESPECTIVELY.
- 4 CD18, CD26, CD27, CD33, 30C198, AND 30C211 FURNISHED WITH AUTO PILOT.
- 5 NAV INPUTS CAN BE SUPPLIED BY THE FOLLOWING NAV UNITS: DGO-10 NAV 121, 122, KI-201C, KI-211, KI-214 IND-350, OR IND-351.



**Edo-Aire Century IIB Autopilot Simplified Diagram
Figure 1**

22G72-1

- 1 IF RADIO COUPLER IS NOT INSTALLED CONNECT CD33 DIRECTLY TO DIRECTIONAL GYRO.
- 2 NAV1/NAV2 FUNCTION SWITCH IS USED WITH DUAL NAV INSTALLATIONS. ON SINGLE NAV INSTALLATION SWITCH IS DELETED AND 7CA14A20, 7CA13A20 ARE SPliced TO 7CA17A20, 7CA18A20 RESPECTIVELY.
- 3 NAV INPUTS CAN BE SUPPLIED BY THE FOLLOWING NAV UNITS: DGI 30, NAV 11, NAV 111, PZ, 124, KI 201C, KI 211, KI 214, IND 350, OR IND 351.



Edo-Aire Century III Autopilot – Simplified Diagram
Figure 2

22G72-2

The Century III autopilot is comprised of the following components: directional gyro, attitude gyro, roll servo, pitch servo, pitch trim servo, pitch trim amplifier, altitude hold computer, amplifier, and command console. A radio coupler and glide slope coupler can be added, as options, to provide radio navigation, localizer guidance, and ILS glidepath control.

The command console provides convenient fingertip control of the autopilot system. Located on the front panel of the console are the Roll ON-OFF (Master A/P), Heading, Altitude Hold, ON-OFF, Pitch ON-OFF switches, Roll Command knob, Pitch Command wheel, and trim indicator. The roll ON-OFF switch acts as the autopilot master switch. In this capacity the roll switch must be engaged for the other switches to become operative. With only the roll switch engaged, the autopilot is responsive only to the roll axis of the attitude gyro and the roll command knob.

With the Heading ON-OFF switch engaged, the roll command knob is removed from the autopilot circuit. In this mode of operation the directional heading gyro command and the radio coupler are added as inputs to the autopilot system. For those systems with the optional radio coupler installed, a completely automatic, analog computer directs the autopilot in both VOR and ILS navigation. The analog computer incorporates rate detection, crosswind computing, and position memory circuits for navigation and approach guidance.

Another option available with the Century III autopilot is the glide slope coupler. (See Figure 3.) The use of the glide slope coupler directs the autopilot to intercept and track the approach glidepath automatically. A logic circuit in the glide slope coupler ensures that certain conditions are met before the glide slope information is coupled to the autopilot system. These conditions are: localizer mode switch, on radio coupler, in the LOC NORM position for at least 20 seconds; altitude mode switch, on command console, in the ALT position for at least 20 seconds; and glide slope deviation indicator deflected upward for at least 20 seconds. The glide slope coupler incorporates an instrument-panel-mounted indicator light. This light will be ON when the glide slope information is coupled to the autopilot.

The pitch mode switch, located on the command console, engages the autopilot pitch servo and makes the autopilot responsive to the pitch attitude of the gyro horizon and the command of the pitch control wheel. The pitch control wheel is removed from the circuit when the altitude hold switch, located on command console, is in the ALT position.

The altitude hold function is controlled by the ALT ON-OFF switch located on the command console. With the altitude hold switch engaged, barometric sensors provide precise altitude holding with nominal climb and dive limitations for operation in turbulence.

For indepth details and maintenance procedures on the autopilot, refer to the Edo-Aire Mitchell Century III manuals.

4. Edo-Aire Mitchell Century IV Autopilot System

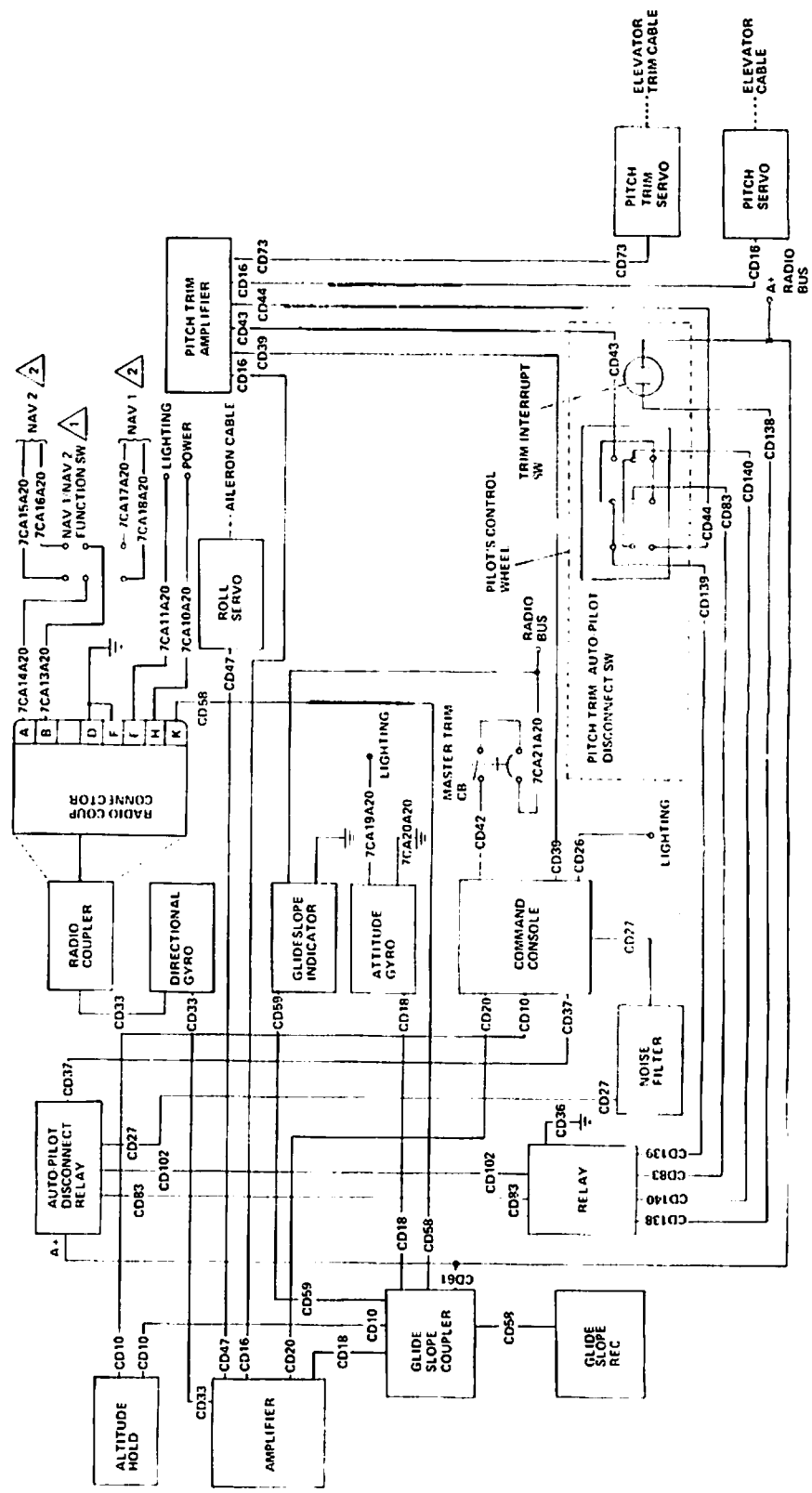
The Century IV is a highly sophisticated automatic flight control system. The autopilot will provide precision enroute navigation, omni intercept and track, smooth station passage, and ILS approaches. Automatic pitch trim, radio, and glide slope coupling are standard in the basic Century IV autopilot system. Substitute a steering horizon for the standard artificial horizon gyro and the system becomes a full-time flight director.

The basic Century IV system includes a flight programmer, directional gyro, and standard artificial horizon gyro. Available options are, yaw damper, remote mini-annunciator, flight director steering horizon, and navigational situation indicator (NSD-360).

1
2

NAV 1/NAV 2 FUNCTION SWITCH IS USED WITH DUAL NAV INSTALLATIONS. ON SINGLE NAV INSTALLATION SWITCH IS DELETED AND 7CA14A20, 7CA13A20 ARE SPliced TO 7CA17A20, 7CA18A20 RESPECTIVELY.

NAV INPUTS CAN BE SUPPLIED BY THE FOLLOWING NAV UNITS: DGO-10, K1:21, K1:22, K1:24, K1:21A, K1:21A, IND-380, OR IND-381.



Edo-Aire Century III Autopilot with Glide Slope – Simplified Diagram
Figure 3

22G72-3

The flight programmer provides convenient pushbutton control of the autopilot system and also functions as the master annunciator. In normal operation, active modes are brightly illuminated and inactive modes are dimly illuminated.

The basic directional input for the Century IV is the DG-360 directional gyro. The DG-360 contains an air driven non-slaved gyro with an electrically driven servo'd heading card. Both air and electric power are required for proper operation. The Century IV may be optionally used with an NSD-360. The NSD-360 (Navigation Situation Display) is an integrated HSI instrument combining an air-driven gyro and an electrically servo'd heading card with VOR/Localizer and Glide Slope information. The NSD-360 has incorporated a heading warning flag to warn of loss of either air or electric power.

The basic Century IV autopilot uses a standard artificial horizon gyro. This conventional attitude gyro incorporates autopilot sensors and provides basic attitude reference in pictorial form. The realistic attitude picture is enhanced with pitch angle reference lines for more accurate pitch control. The conventional attitude gyro can be replaced with a flight director steering horizon.

The addition of the flight director steering horizon changes the Century IV from a basic autopilot to a full time flight director.

For indepth details and maintenance procedures on the autopilot refer to the Edo-Aire Mitchell Century IV manuals.

AUTOPILOT – MAINTENANCE PRACTICES

1. General

The gyros used with the autopilot system are precision devices whose performance and service life are in part dependent upon the quality of the air supply applied to them. Regular gyro filter maintenance is a good investment. See Chapter 34 for proper maintenance procedures of the pressure system.

For those autopilots with the altitude hold capability, proper maintenance of the static system is a necessity. Air leaks and water entrapment can significantly affect altitude hold performance. See Chapter 34 for proper maintenance procedures of the static system.

NOTE: The altitude hold units used by Edo-Aire Mitchell do not have to be disconnected during static system checks. They are designed to withstand such tests without damage.

2. Autopilot Servo – Removal and Installation

A. Roll Servo Removal (See Figure 201.)

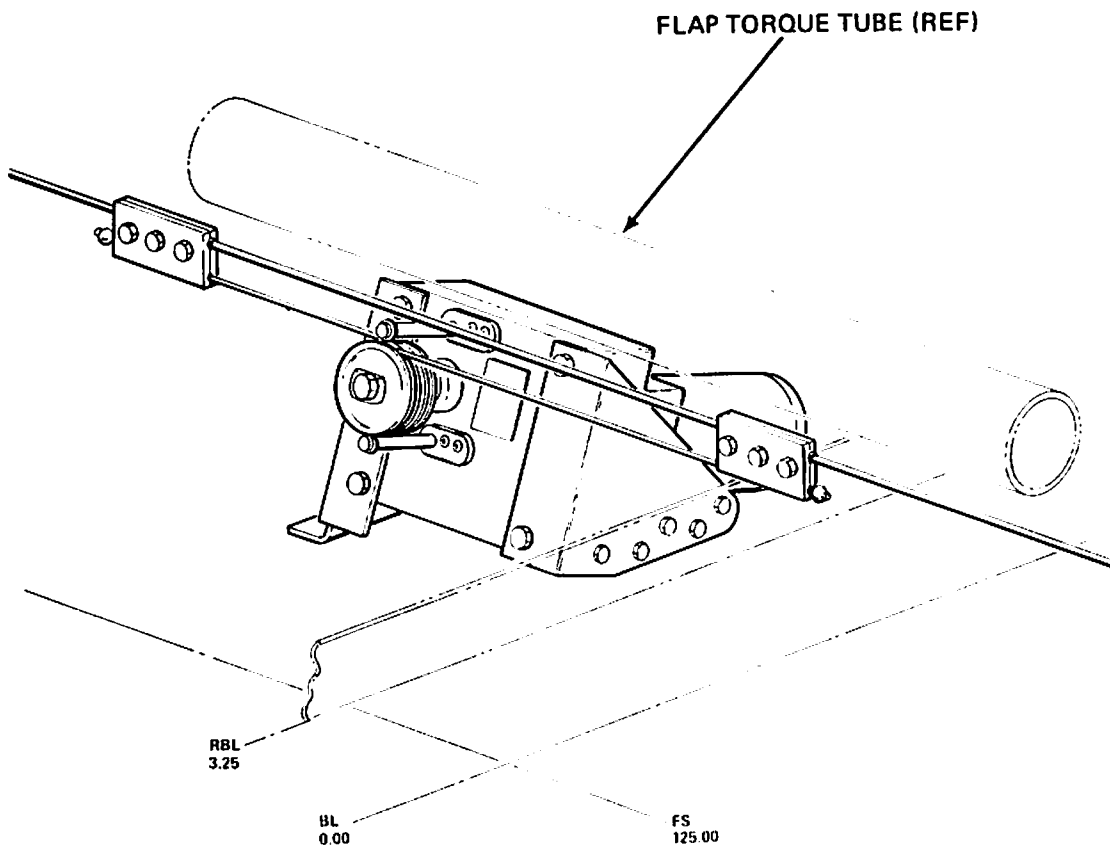
- (1) The roll servo is mounted at Fuselage Station 132.80, just to the right of aircraft centerline. Remove necessary furnishings to gain access to this area.
- (2) Loosen the cable guards on the servo and position them away from servo capstan.
- (3) Remove the clamps which attach the bridle cable to the aileron cable.
- (4) Remove the bridle cable from around servo capstan.
- (5) Disconnect electrical connector from servo.
- (6) Remove hardware which attaches servo to support bracket. Remove servo assembly.

B. Roll Servo Installation (See Figure 201.)

- (1) Place servo assembly on support bracket and secure with attaching hardware.
- (2) Loosen the cable guards on the servo and position away from capstan.
- (3) Rotate the capstan so the bridle cable pin hole is positioned in the 12 O'Clock position.
- (4) Ensure the ailerons are in neutral position.

NOTE: Ailerons must remain in neutral position during servo installation.

- (5) Position the bridle cable so the short end of the bridle cable is pointing outboard. Insert the pin on the bridle cable into the hole on the capstan and tighten the setscrew to secure the cable.
- (6) Wrap each end of the bridle cable 360 degrees around the capstan.



**Roll Servo Removal/Installation
Figure 201**

22G72-4

- (7) Attach each end of the bridle cable to the aileron balance cable with cable clamp.

NOTE: Ensure the aileron cable tension is adjusted to within the correct tolerances. See Chapter 27.

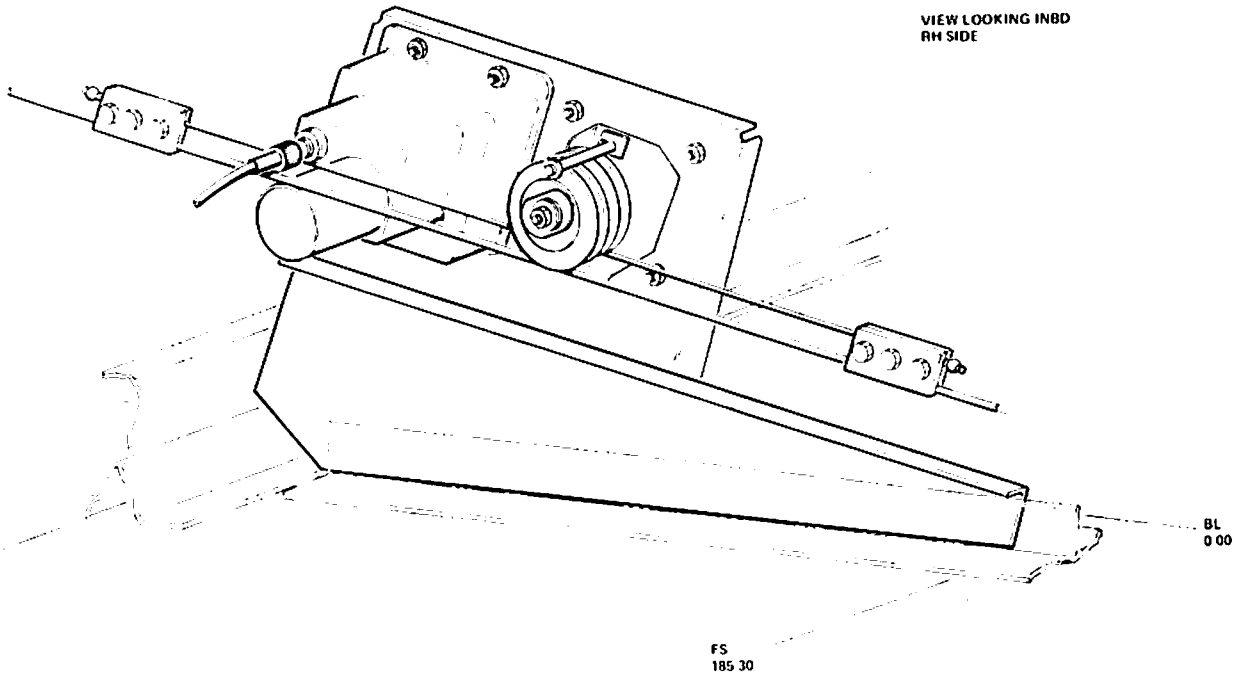
- (8) Tighten bridle cable to same tension as aileron cable, +0/-20 percent. Do not exceed 25 +0/-5 pounds of tension.
- (9) Torque cable clamp bolts to 55 ± 5 inch-pounds with a minimum of .005 inch measured between clamp halves after torquing.
- (10) Position the cable guards to within 1/32 inch of the capstan O.D. and tighten the screws.
- (11) Check bridle cable alignment on servo capstan. The bridle cable should not rub the sides of the capstan grooves. Cable clamps may be rotated to provide proper alignment.
- (12) Operate the aileron system through its full range of travel and check for any restrictions or misalignment.
- (13) Connect electrical connector to servo.
- (14) Replace removed interior furnishings.

C. Pitch Servo Removal (See Figure 202.)

- (1) The pitch servo is mounted in the aft fuselage of the aircraft and forward of Fuselage Station 201.00. Remove aft baggage partition for access to this area.
- (2) Loosen the cable guards on the servo and position them away from servo capstan.
- (3) Remove the clamps which attach the bridle cable to the elevator control cable.
- (4) Remove setscrew that retains bridle cable on servo capstan. Remove bridle cable from servo.
- (5) Disconnect electrical connector from pitch servo.
- (6) Remove the four bolts which attach servo to support bracket. Remove servo assembly.

D. Pitch Servo Installation (See Figure 202.)

- (1) Position the pitch servo as shown in Figure 202. Attach the servo to the bracket with four bolts, washers, and nuts.
- (2) Verify that servo capstan is centered over elevator control cable. Use washers between servo baseplate and bracket assembly in order to position servo correctly.
- (3) Loosen the cable guards on the servo and position away from capstan.
- (4) Move elevator to the full down position.



**Pitch Servo Removal/Installation
Figure 202**

22G72-5

- (5) Rotate the servo capstan until the bridle cable pin hole is 20 degrees aft of the bottom cable guard.
- (6) Position bridle cable so the long end is pointing aft. Insert the pin on the bridle cable into the hole on the capstan and tighten the setscrew to secure the cable.
- (7) Wrap the long end of the cable 340 degrees around the capstan and point aft.
- (8) Wrap the short end of the cable 380 degrees around the capstan and point forward.
- (9) Attach each end of the bridle cable to the elevator control cable with cable clamps.

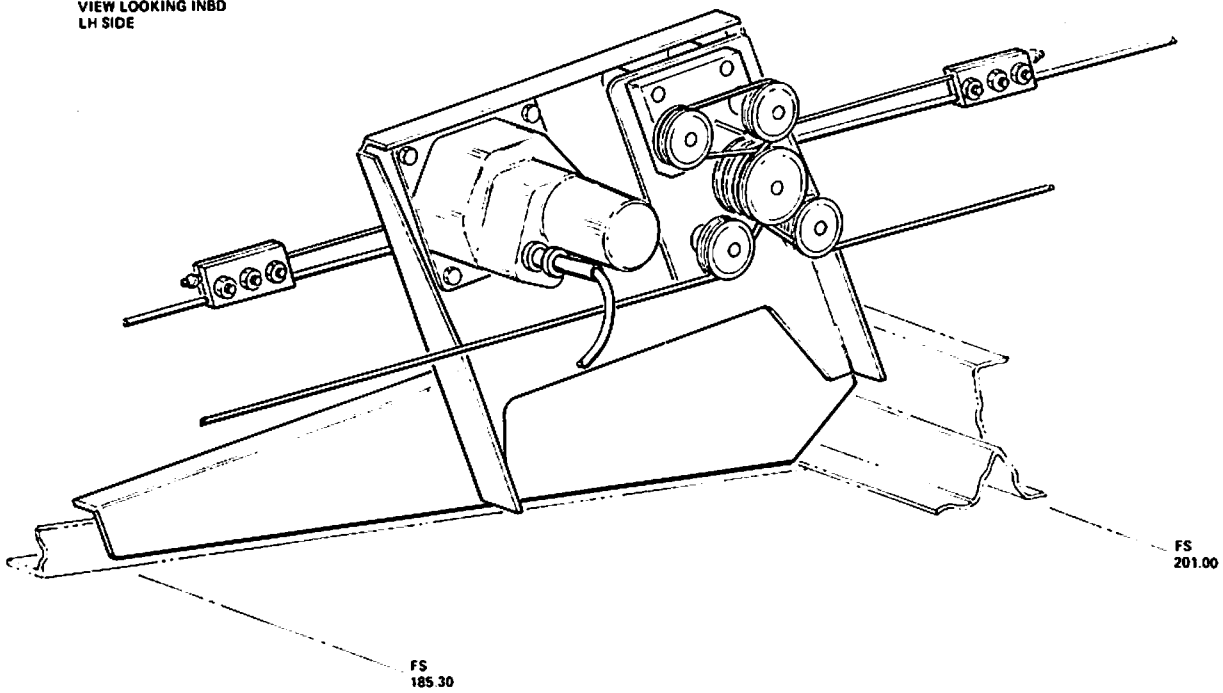
NOTE: Ensure the elevator control cable tension is adjusted to within the correct tolerances. See Chapter 27.

- (10) Tighten bridle cable to the same tension as the elevator control cable, +0/-20 percent. Do not exceed 25 +0/-5 pounds of tension.
- (11) Torque cable clamp bolts to 55 ± 5 inch-pounds with a minimum of .005 inch measured between clamp halves after torquing.
- (12) Position the cable guards to within 1/32 inch of the capstan O.D. and tighten the screws.
- (13) Check bridle cable alignment on servo capstan. The bridle cable should not rub the sides of the capstan grooves. Cable clamps may be rotated slightly to provide proper alignment.
- (14) Operate the elevator through its full range of travel and check for any restrictions or misalignment.
- (15) Connect electrical connector to servo.
- (16) Replace aft baggage compartment partition.

E. Pitch Trim Servo Removal (See Figure 203.)

- (1) The pitch trim servo is mounted in the aft fuselage of the aircraft and just forward of Fuselage Station 201.00, at approximately centerline of the aircraft. It is mounted on the same bracket as the pitch servo. Remove aft partition of baggage compartment for access to this area.
- (2) Loosen cable guards and position away from capstan and pulley.
- (3) Loosen elevator trim cable turnbuckle. Disconnect elevator trim cable from forward end of turnbuckle.
- (4) Remove elevator trim cable from around capstan and pulleys on the servo.
- (5) Disconnect electrical connector from pitch trim servo.
- (6) Remove the four screws and nuts which attach the servo to the support bracket.
- (7) Remove the pitch trim servo assembly.

VIEW LOOKING INBD
LH SIDE



Pitch Trim Servo Removal/Installation
Figure 203

22G72-6

F. Pitch Trim Servo Installation (See Figure 203.)

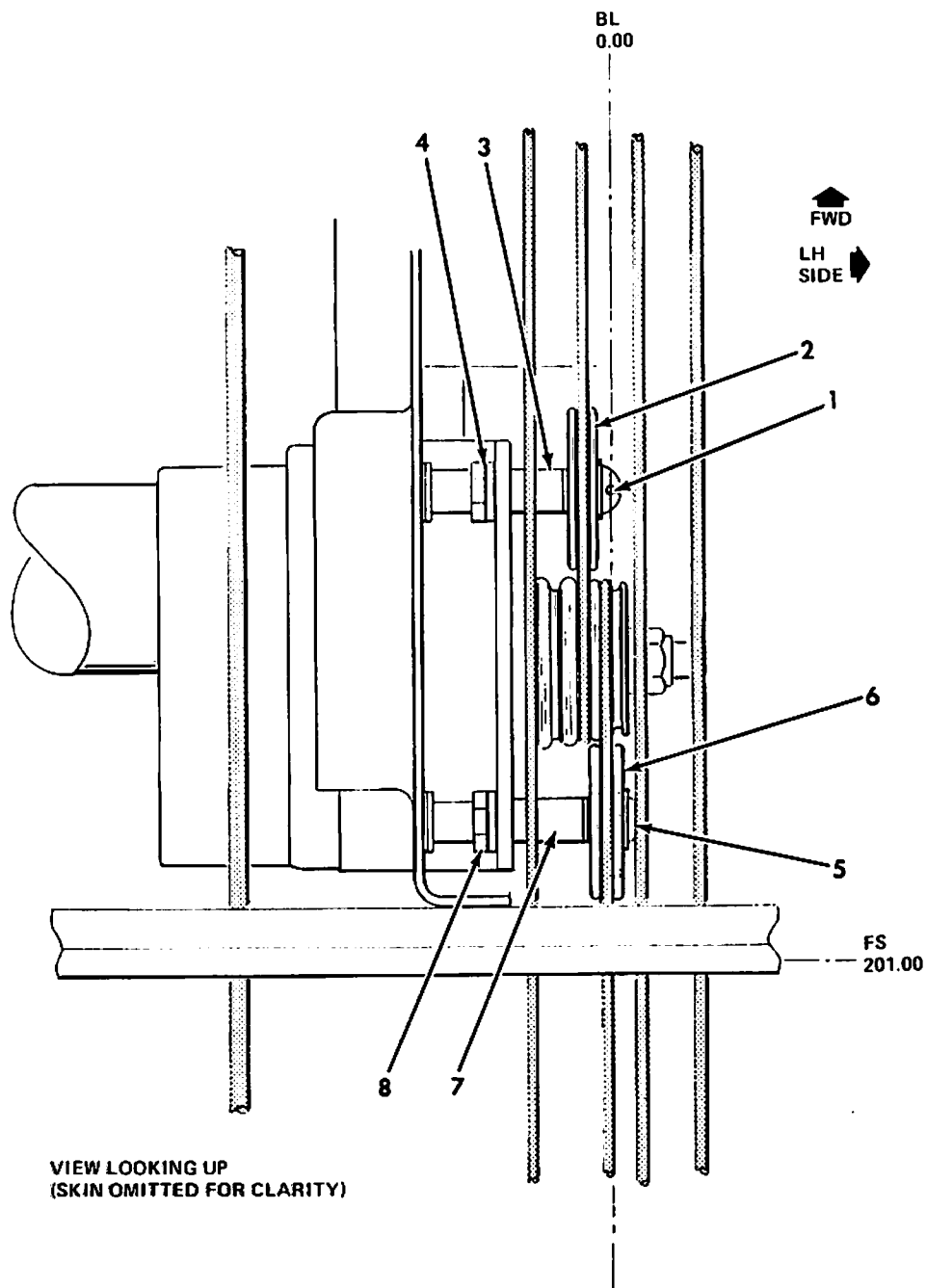
- (1) The pitch trim servo mounts on the same bracket as the pitch servo.
- (2) Before installing the servo, attach the following hardware to the forward and aft attach hole. Lower forward hole: screw (1), pulley (2), spacer (3), and nut (4). Lower aft hole: screw (5), pulley (6), spacer (7), and nut (8). (See Figure 204. Numbers in parentheses refer to callouts on Figure 204.)

NOTE: Notice the difference in size of the two spacers (items 3 and 7). Ensure they are used with the correct hole. Ensure the servo and pulleys are positioned properly.

- (3) Orient the servo as shown in Figure 203 and insert the motor portion of the servo through the aft cutout in the bracket assembly. Motor portion to the left looking aft.
- (4) Attach the servo at the top attach points with 2 screws, 2 spacers, 2 washers, and 2 nuts.
- (5) Attach the servo at the bottom using 2 spacers, 2 washers (see note), and 2 nuts. Attach to the two screws assembled in Step (2).

NOTE: Use washers as required to shim the servo for best pulley alignment with the elevator trim cable.

- (6) Loosen the idler pulleys on the vee-block above the capstan. Route the elevator trim cable around the capstan and idler pulleys as shown in Figure 203.
- (7) Tighten idler pulley screws.
- (8) Connect elevator trim cable to turnbuckle. Using turnbuckle, adjust elevator trim cable tension to correct specifications. See Chapter 27.
- (9) Safetywire the turnbuckle.
- (10) Position the cable guard to within 1/32 inch of capstan and pulley O.D. and tighten attaching screws.
- (11) Operate the elevator trim system through its full range of travel and check for normal operation. Check for restriction and misalignment.
- (12) Verify that elevator trim tab travel is still according to specifications. (See Chapter 27.)
- (13) Replace aft partition of baggage compartment.



**Pitch Trim Servo
Figure 204**

22G72-7

CHAPTER 23

COMMUNICATION SYSTEMS

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COMMUNICATION SYSTEMS – DESCRIPTION/OPERATION**1. General**

All GA-7/Cougar aircraft will not be equipped with identical communications equipment. The aircraft will be equipped as specified by the customer. The equipment installed will meet the requirements as established by the Federal Aviation Administration (FAA). The communication system can contain one or two VHF radios for voice communications, an audio panel for centralized control of the communication/navigation system, microphone, headsets, cabin speaker, and the emergency locator transmitter, for use in emergency situations. The information provided in this maintenance manual is general in content and is to aid the technician in the minor inspection and minor maintenance of the installed communication equipment. The indepth maintenance must be performed in accordance with manufacturer technical data and by a certified and qualified technician.

2. VHF Communications

The VHF communication transceivers operate in the frequency range of 118.000 MHz to 135.975 MHz, with 720 independent channels. The spacing between channels is 25 KHz. The transceivers available for use in VHF communication exist in a variety of makes and models. This manual will describe those available from NARCO, KING, and COLLINS.

3. Audio Integrating System

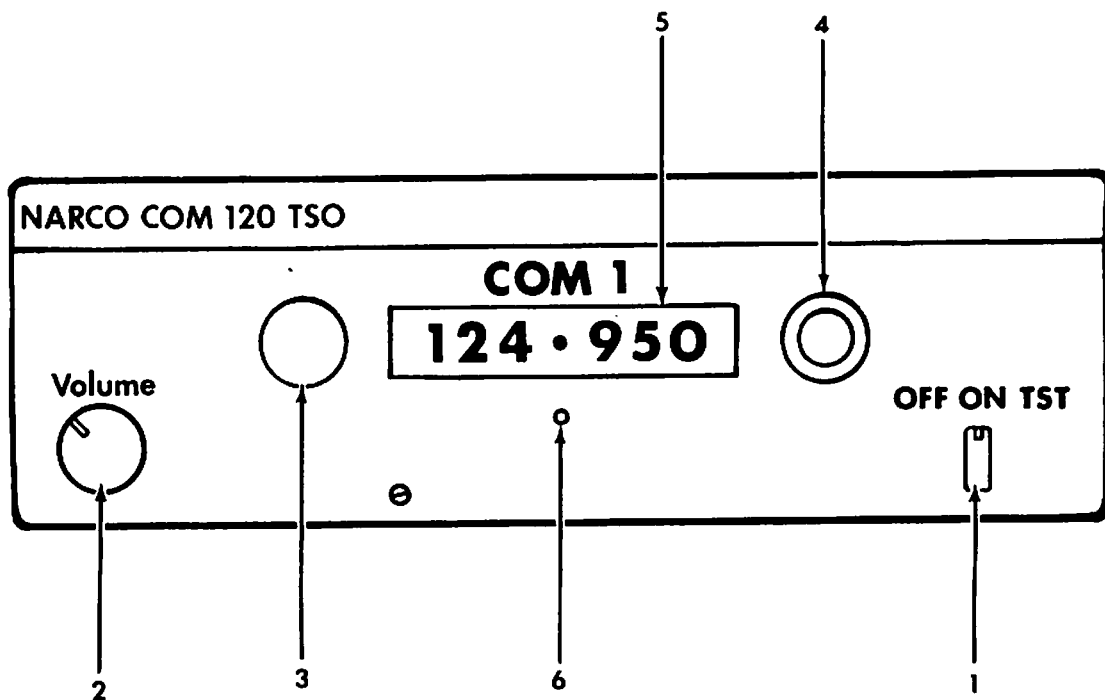
The purpose of the audio integrating system is to provide the audio signals for the pilot and to provide centralized control of the communication/navigation system. The audio integrating system consists of the speaker, headset, microphone, and audio panel. The audio control panel is optional and is used when multiple communication/navigation units are installed. The speaker is mounted in the upper center of the cabin. The microphone and headset plugs into the panel located between the two front seats. The audio panel provides centralized control of the installed communication/navigation equipment.

4. Emergency Locator Transmitter (ELT)

The purpose of the ELT is to act as a radio beacon should the aircraft make an emergency or crash landing. The unit consists of a self-contained dual frequency radio transmitter and battery power supply. The transmitter can be activated by an impact of 5 g's or more, as may be experienced in a crash landing, or by a manual control switch. The ELT can be used as a portable radio beacon should it be desired to leave the vicinity of the aircraft. The unit has its own antenna, battery power supply, and manual activating switch. The ELT transmits an omnidirectional signal on the international distress frequencies of 121.5 MHz and 243.0 MHz.

VHF COMMUNICATION SYSTEM—DESCRIPTION/OPERATION1. NARCO COM 120 Transceiver (See Figure 1.)

The transceiver operates within the frequency range of 118.000 MHz to 135.975 MHz, with a power output of 8 watts minimum (10 to 12 watts typical). The radio can operate on any of 720 independent channels, with 25 KHz spacing between channels. The unit features 6-digit, easy tune, frequency readout and stable automatic squelch. See Table 1 for description of unit controls and indicators.



23G72-1

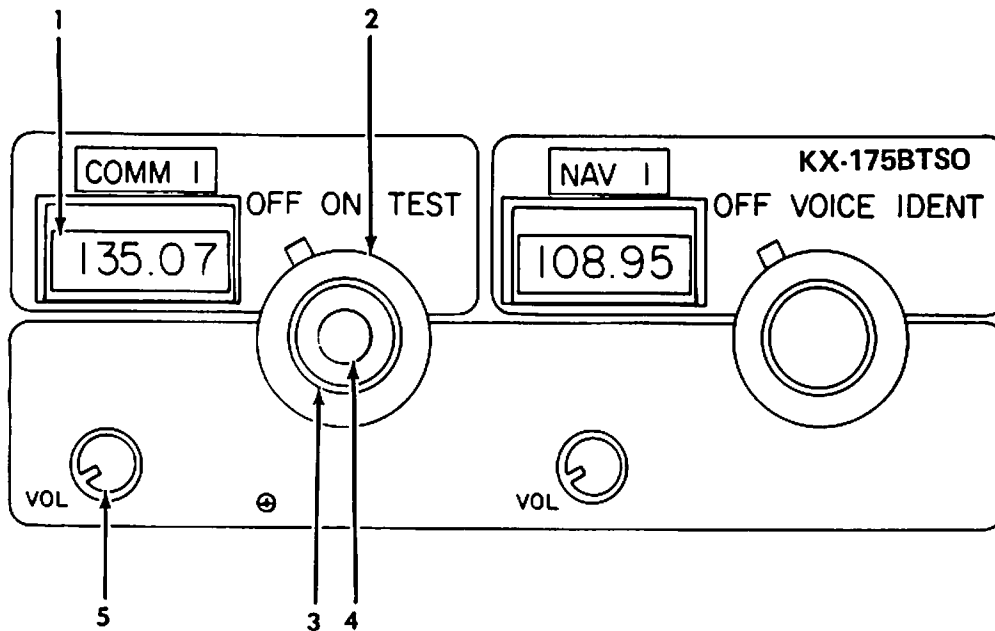
NARCO COM 120 Transceiver
Figure 1

NARCO TRANSCEIVER UNIT CONTROLS AND INDICATORS
TABLE I

INDEX NO. (FIG. 1)	CONTROL OR INDICATOR	FUNCTION
1	Power ON/OFF/TEST	Applies power to unit. TEST - Automatic squelch disabled.
2	Volume	Controls audio volume level.
3	Course Frequency Control	Changes transceiver frequency in 1-MHz steps.
4	Fine Frequency Control	Changes transceiver frequency in 25-KHz steps.
5	Frequency Readout	Indicates operating frequency of transceiver.
6	Transmit Indicator Light	Illuminates when transceiver is transmitting.

2. KING KX-175B Transceiver (See Figure 2.)

The KX-175B unit contains both a transceiver and a navigation receiver. The transceiver operates within the frequency range of 118.000 MHz to 135.975 MHz, with a power output of 5 watts. The transceiver can operate on any of 720 channels, with 25-KHz spacing between channels. See Table 2 for description of transceiver controls and indicators.



KING KX-175B Transceiver
Figure 2

23G72-2

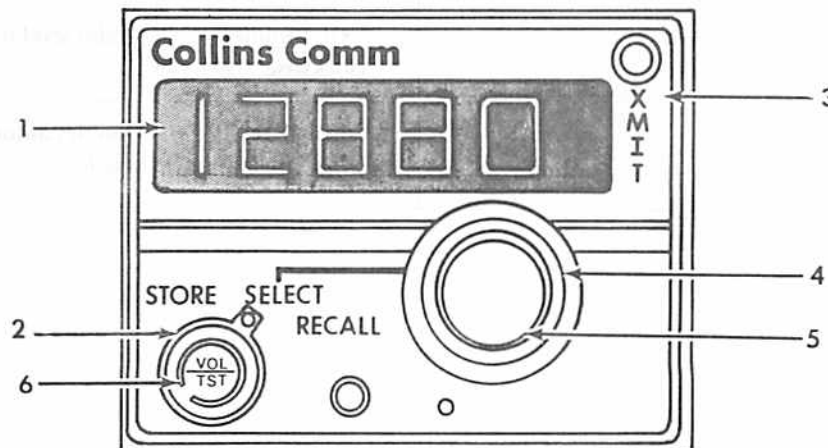
KING TRANSCEIVER UNIT CONTROLS AND INDICATORS

TABLE 2

INDEX NO. (FIG. 2)	CONTROL OR INDICATOR	POSITION	FUNCTION
1	Frequency Indicator		Indicates operating frequency of VHF radio.
2	Power Control Switch	OFF	Removes power from radio.
		ON	Energizes the radio.
		TEST	Disables automatic squelch.
3	MHz Frequency Selector		Selects frequency in 1-MHz steps.
4	Tenths/Hundredths MHz		Selects frequency in 25-KHz steps.
5	Volume Control	Clockwise	Increases audio volume.
		Counterclockwise	Decreases audio volume.

3. COLLINS VHF-251 Transceiver (See Figure 3.)

The VHF-251 Communications transceiver operates within the frequency range of 118.000 MHz to 135.975 MHz, with a power output of 8 watts minimum (10 watts nominal). The transceiver can operate on any of 720 independent channels, with 25-KHz spacing between channels. The unit has the capability of storing and recalling a frequency without changing the frequency controls. See Table 3 for description of unit controls and indicators.



VHF-251 Communications Transceiver,
Controls and Indicators
Figure 3

23G72-3

COLLINS TRANSCEIVER UNIT CONTROLS AND INDICATORS

TABLE 3

INDEX NO. (FIG. 3)	CONTROL OR INDICATOR	POSITION	FUNCTION
1	Frequency Indicator		Indicates operating frequency of transceiver.
2	Store/Select/Recall Control	Select	Allows frequency controls to select operating frequency.
		Store	Stores in memory the frequency selected by select control.
		Recall	Recalls frequency stored in memory.
3	Transmit Indicator		Illuminates when transceiver is transmitting.
4	MHz Frequency Control		Selects frequency in 1-MHz steps.
5	KHz Frequency Control		Selects frequency in 25-KHz steps.
6	ON/OFF VOL/SQUELCH TEST	ON	Power applied to unit.
		OFF	Power removed from unit.
		VOL Clockwise	Audio level increases.
		VOL Counter-clockwise	Audio level decreases.
		Squelch Test (Knob pulled out.)	Disables automatic squelch.

VHF COMMUNICATION SYSTEM – TROUBLESHOOTING

NOTE: On those aircraft with dual transceivers, check operation of both. If neither transceiver works, the trouble is probably in the audio integrating system.

TROUBLE	PROBABLE CAUSE	REMEDY
No reception or transmission.	Open circuit breaker.	Close circuit breaker.
	Dirty or corroded antenna.	Clean or replace antenna.
	Faulty audio panel (dual system).	Replace audio panel.
	Faulty transceiver.	Replace transceiver.
Weak or no transmission.	Faulty microphone.	Replace microphone. (This may require an adjustment of mike gain in the transceiver.)
	Faulty antenna or antenna lead.	Repair or replace antenna or wiring.
	Faulty transceiver.	Replace transceiver.
Weak or no reception.	Faulty speaker or headset.	Replace speaker or headset.
	Faulty transceiver.	Replace transceiver.

VHF COMMUNICATION SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of VHF Communication Antenna

The GA-7/Cougar can have one or two VHF antennas installed. One is located on the turtleback at Fuselage Station 146.670 and the other is located underneath the fuselage at Fuselage Station 83.500.

A. Removal of VHF Antenna Mounted on Turtleback (See Figure 201.)

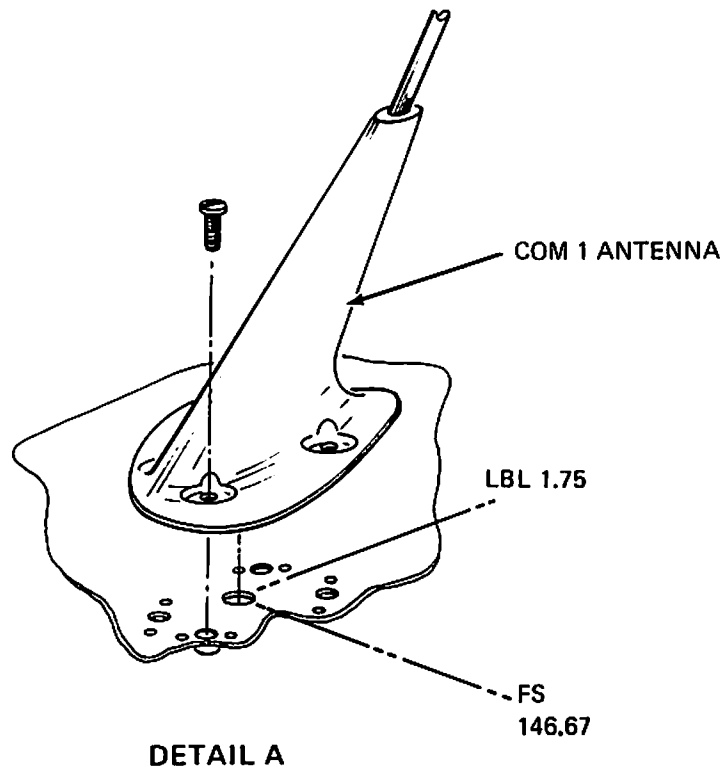
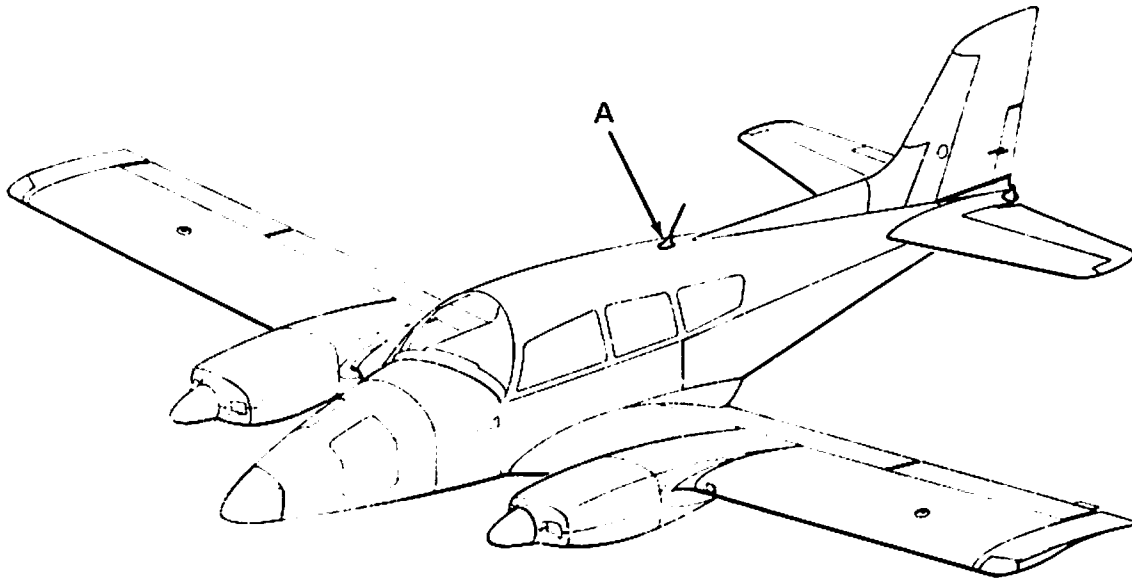
- (1) Prepare the aircraft for safe maintenance.
- (2) Remove the four screws securing the antenna to the aircraft.
- (3) Lift the antenna straight up to gain access to the antenna connector. Disconnect the coax cable from the connector. Secure the coax cable so that it will not slip through the hole and down into the aircraft.
- (4) Remove the antenna and gasket. If gasket adheres to the aircraft, remove it using a phenolic scraper.

B. Installation of VHF Antenna on Turtleback (See Figure 201.)

- (1) Prepare the aircraft for safe maintenance.
- (2) Place the antenna gasket in the correct position.
- (3) Connect the antenna to the coax cable.
- (4) Place the antenna on the gasket and secure with four screws.
- (5) Perform an operational test for the transceiver connected to this antenna. (See test procedure in this chapter.)

C. Removal of VHF Antenna Located Underneath Fuselage (See Figure 202.)

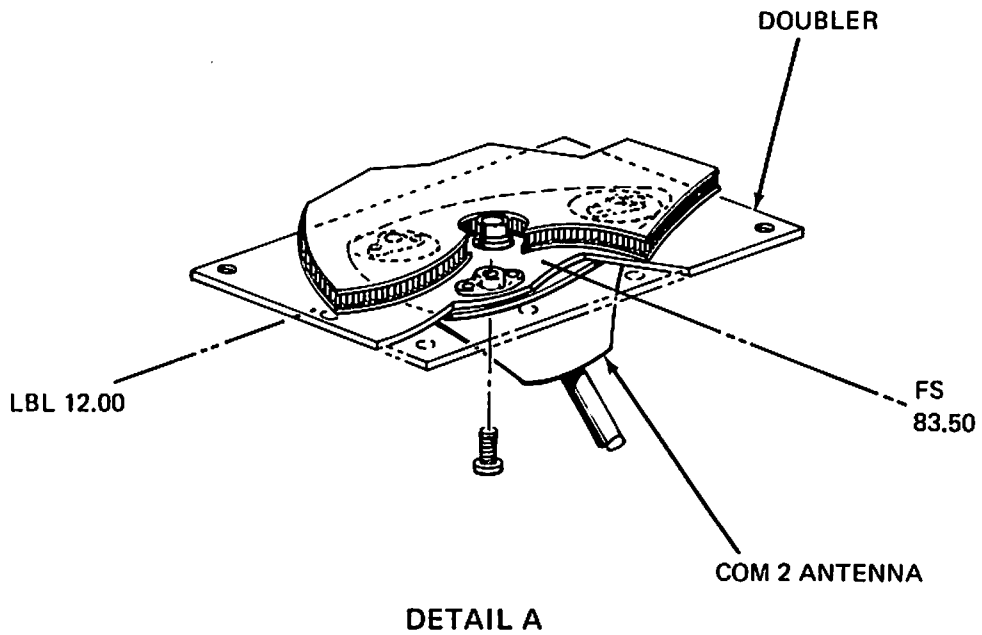
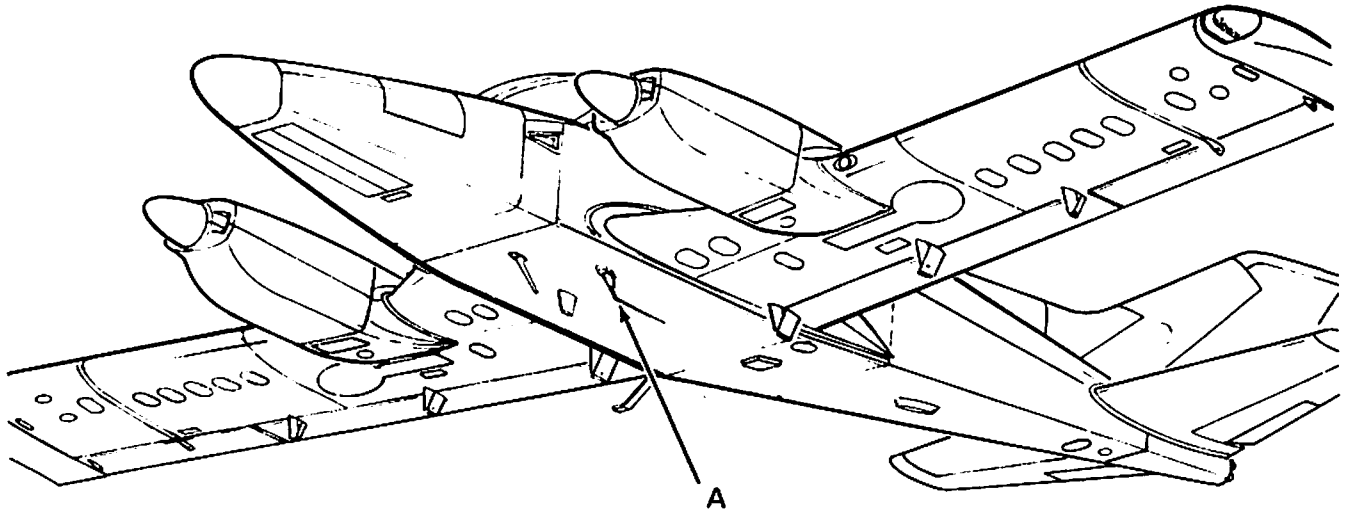
- (1) Prepare the aircraft for safe maintenance.
- (2) Remove, from inside the aircraft, the necessary furnishings and floor panels to gain access to the coax cable that connects to the antenna at Fuselage Station 83.500.
- (3) Remove the sealant from around the coax connector.
- (4) Disconnect the coax cable from the antenna.
- (5) Remove the three screws, from outside the aircraft, holding the antenna to the bottom of the fuselage.
- (6) Remove the antenna.



VHF COM 1 Antenna Installation
Figure 201

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VHF COM 2 Antenna Installation
Figure 202

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D. Installation of VHF Antenna Located Underneath Fuselage (See Figure 202.)

- (1) Prepare the aircraft for safe maintenance.
- (2) Attach the antenna, underneath the fuselage, with three screws.
- (3) From inside the aircraft, connect the coax cable to the antenna.
- (4) Apply 3-M Company, EC-1128 sealant around coax connector.
- (5) Replace any removed furnishings and floor panels.
- (6) Perform an operational test for the transceiver connected to this antenna. (See test procedure in this chapter.)

2. Removal/Installation of Transceiver

The removal and installation of either the NARCO, KING, or COLLINS transceiver is identical.

A. Removal of Transceiver (See 23-2-1, Figure 1, 2 or 3.)

- (1) Ensure DC power is removed from aircraft.
- (2) Loosen the transceiver, from mounting case, by turning locking screw counterclockwise. Use 5/64 inch hex wrench.
- (3) Slide the unit straight forward. Avoid bending the connector pins. A slight left to right movement might help to release transceiver from connector plug.

NOTE: Do not use the front panel controls as handles. This may damage the associated control.

B. Installation of Transceiver (See 23-2-1, Figure 1, 2, or 3.)

- (1) Ensure DC power is removed from aircraft.
- (2) Slide transceiver straight in. Be careful not to bend connector pins.
- (3) Secure transceiver to mounting case by turning locking screw clockwise. Use 5/64 inch hex wrench.
- (4) Perform operational test of transceiver. (See test procedure in this chapter.)

NOTE: The mike gain of the transceiver is normally set for use with the same type of microphone (NARCO, KING, COLLINS) as the transceiver. If a different type of microphone is used, the mike gain control may require adjustment.

3. Transceiver Test/Adjustment**A. Transceiver Operational Test**

- (1) Ensure that the aircraft battery is installed and operational.
- (2) Place master switch to ON.
- (3) Place respective transceiver circuit breaker to ON.
- (4) Place transceiver power control to ON.
- (5) Rotate volume control clockwise to midposition.
- (6) Disable automatic squelch by placing ON-OFF control (NARCO COM 120, KING KX-175) to test position or by pulling VOL. control out (COLLINS VHF-251). Receiver background noise should be heard.
- (7) Return ON/OFF control or VOL. control to normal position.
- (8) Tune the transceiver to a control tower frequency.
- (9) Contact the control tower for a radio check. Adjust the volume control as required. Contact the tower on several (up to five if available) frequencies.
- (10) Place transceiver power control to OFF.
- (11) Place respective transceiver circuit breaker to OFF.
- (12) Place master switch to OFF.

B. Transceiver Microphone Gain Adjustment

CAUTION: THE MINIMUM OF A 2ND CLASS F.C.C. LICENSE IS REQUIRED TO PERFORM THIS ADJUSTMENT.

(1) Microphone Gain Adjustment.

The transceiver microphone gain is normally shop adjusted for use with the same type of microphone (NARCO, KING, COLLINS) as the transceiver in use. If the microphone gain requires adjustment, refer to the maintenance manuals supplied by the manufacturer.

(2) Perform transceiver operational test after adjustment.

(See operational test procedure in this chapter.)

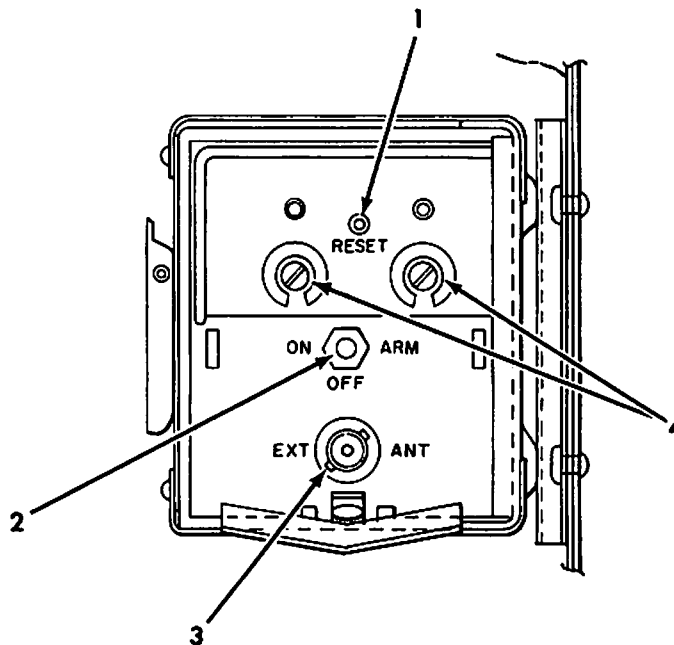
EMERGENCY LOCATOR TRANSMITTER (ELT) SYSTEM – DESCRIPTION/OPERATION

1. **General**

The emergency locator transmitter (ELT) is a self-contained, battery powered radio which transmits a CW signal at 121.5/243.0 MHz to assist in locating a downed aircraft. The ELT is automatically activated by a deceleration of 5 g's along the flight axis of the aircraft. The ELT consists of a transmitter located in the aft fuselage section, just back of the baggage compartment back partition (Fuselage Station 180), along the right side of the aircraft, and a transmitting antenna located on top of the dorsal fin. The ELT can be manually activated by removing the back partition of the baggage compartment and placing the control switch to the ON position.

2. **NARCO ELT 10**

The NARCO ELT 10 is an optional item designed to meet the requirements as established by the FAA. If it is required to leave the area of the aircraft, the ELT unit can be removed from the aircraft and hand carried. In this condition, extend the built-in antenna and place the control switch to ON. Table 1 contains a discussion of the controls and their functions. For location of controls, see Figure 1.



NARCO ELT 10 Control Switch Location
Figure 1.

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NARCO ELT 10() TRANSMITTER CONTROLS**TABLE 1**

INDEX NO. (FIG. 1)	CONTROL	POSITION	FUNCTION
1	RESET button	Depressed	Resets impact switch and stops transmission.
2	Transmission control switch	ON	Electrically activates transmitter.
		OFF	Electrically deactivates transmitter.
		ARM	Energizes crash circuit, automatically transmits after 5 g impact.
3	Antenna connector jack		Connect antenna cable to transmitter.
4	Remote control switch switch connection		Provide remote control.

EMERGENCY LOCATOR TRANSMITTER (ELT) SYSTEM – TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
No transmission.	Faulty transmitter.	Replace transmitter.
	Faulty wiring to antenna.	Repair wiring.
	Faulty battery.	Replace battery pack.
Weak transmission.	Faulty antenna or wiring to antenna.	Replace antenna assembly. Repair wiring.
	Faulty transmitter.	Replace transmitter.
	Faulty battery.	Replace battery pack.

EMERGENCY LOCATOR TRANSMITTER (ELT) SYSTEM – MAINTENANCE PRACTICES**1. Servicing the NARCO ELT 10**

NOTE: The ELT 10 contains nine dry cell batteries in a separate battery pack. Since the batteries are not kept charged by aircraft power, they must be periodically replaced. See NARCO Owner's Manual, 03716-0601, for battery replacement schedule.

A. Removal of Battery Pack

- (1) Set the ON-OFF-ARM switch to OFF. Disconnect antenna.
- (2) Remove the ELT unit from the aircraft.
- (3) Extend the built-in antenna.
- (4) Remove the four screws that attach the battery pack to the transmitter.
- (5) Carefully pull the transmitter away from the battery pack. Do not jerk on the wires.

CAUTION: IN DISPOSING OF THE BATTERY, DO NOT THROW IN FIRE.

- (6) Release the battery pack wires (quick disconnect) from the terminals at the transmitter. Dispose of battery pack.

B. Installation of Battery Pack

- (1) Connect the battery pack wires to the transmitter.
- (2) Insert the transmitter into the battery pack. Be careful not to pinch wires.

NOTE: The battery pack is shipped with a sealant on the inside lip so a watertight seal will be retained. DO NOT REMOVE THIS SEALANT.

- (3) Replace the four attaching screws. If the four holes do not line up, rotate the battery pack 180 degrees and reinsert.
- (4) Slide the built-in antenna into its holding slot.
- (5) Install the ELT unit in the aircraft.
- (6) Attach the antenna lead to the ELT. Make sure the antenna separator prevents contact between the portable antenna finger and the ELT antenna.
- (7) Perform checkout of ELT system. See test section of this chapter.
- (8) After completion of test, depress RESET button.
- (9) Place the ON-OFF-ARM switch to ARM.

2. Removal/Installation of ELT 10 System Components

A. Removal/Installation of ELT 10 Unit

To gain access to the ELT 10 unit, remove the access panel on the aft fuselage beneath the vertical stabilizer. Disconnect antenna lead and remove mounting hardware. Remove ELT 10 unit. Reverse the procedure to install ELT 10 unit.

NOTE: Ensure that the ON-OFF-ARM switch is OFF when removing or installing ELT 10 unit. Depress the reset button and place switch in ARM position after installation.

B. Removal of ELT Antenna (See Figure 201.)

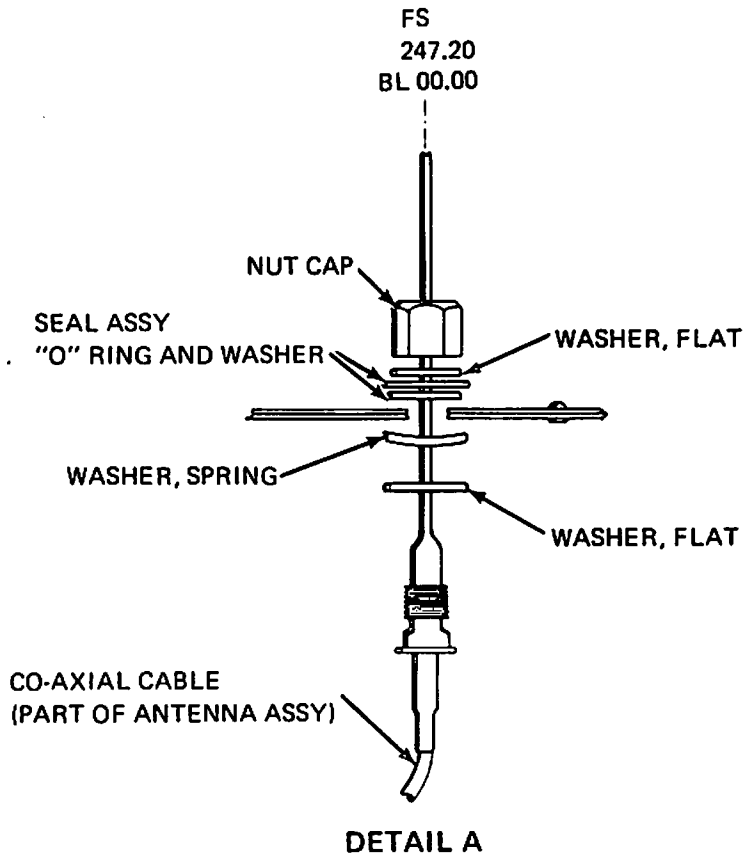
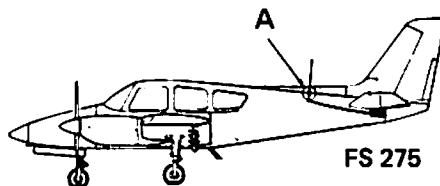
- (1) Locate ELT antenna on top of dorsal fin just forward of rudder.
- (2) Loosen and slide dorsal fin forward, allowing ELT antenna to slip through the antenna opening.
- (3) Loosen and remove nut cap from antenna.
- (4) Remove washers and seal assembly (O-ring and washer) from the antenna.
- (5) Obtain access to the ELT unit. Disconnect antenna.
- (6) Release coax cable from stick clamps.
- (7) Pull the antenna down and through the aircraft structure.

NOTE: The antenna and coaxial lead are furnished as one assembly.

- (8) Remove flat washer and spring washer.

C. Installation of ELT Antenna (See Figure 201.)

- (1) Replace spring washer and flat washer on the antenna.
- (2) Run the antenna through the structure and out through the skin. Be extremely careful not to damage skin of aircraft.
- (3) Attach coax cable to the stick clamps.
- (4) Place the washers and seal assembly (O-ring and washer) on the antenna in proper sequence.
- (5) Replace nut cap and tighten.
- (6) Replace dorsal fin, allowing ELT antenna to slip through antenna opening. Ensure rubber grommet is seated correctly.
- (7) Connect antenna to ELT unit.
- (8) Perform operational test of ELT. See test section of this chapter.



**ELT Antenna Installation
Figure 201**

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- (9) Depress reset button and place control switch to ARM.
- (10) Replace access cover.

3. Adjustment/Test of NARCO ELT 10**A. Test of NARCO ELT 10 System**

WARNING: COORDINATE THIS PROCEDURE WITH LOCAL ATC BEFORE STARTING. THIS PROCEDURE ENTAILS A TEST OF EMERGENCY TRANSMISSIONS, AND A LACK OF COORDINATION MAY LEAD TO AN UNTIMELY DISPERSAL OF EMERGENCY PERSONNEL AND VEHICLES.

- (1) Obtain access to the ELT. (See Figure 201.)
- (2) After coordination, depress the RESET button, then place the ON-OFF-ARM switch to ON. As soon as ATC acknowledges transmission, place switch to OFF. Depress the RESET button, then place switch to ARM.
- (3) Recheck with ATC to ensure there is no transmission from the ELT.
- (4) Monitor for transmission on COM radio by selecting 121.5 MHz.

4. Adjustment/Test of NARCO ELT 10**A. Test of NARCO ELT 10 System**

WARNING: COORDINATE THIS PROCEDURE WITH LOCAL ATC BEFORE STARTING. THIS PROCEDURE ENTAILS A TEST OF EMERGENCY TRANSMISSIONS, AND A LACK OF COORDINATION MAY LEAD TO AN UNTIMELY DISPERSAL OF EMERGENCY PERSONNEL AND VEHICLES.

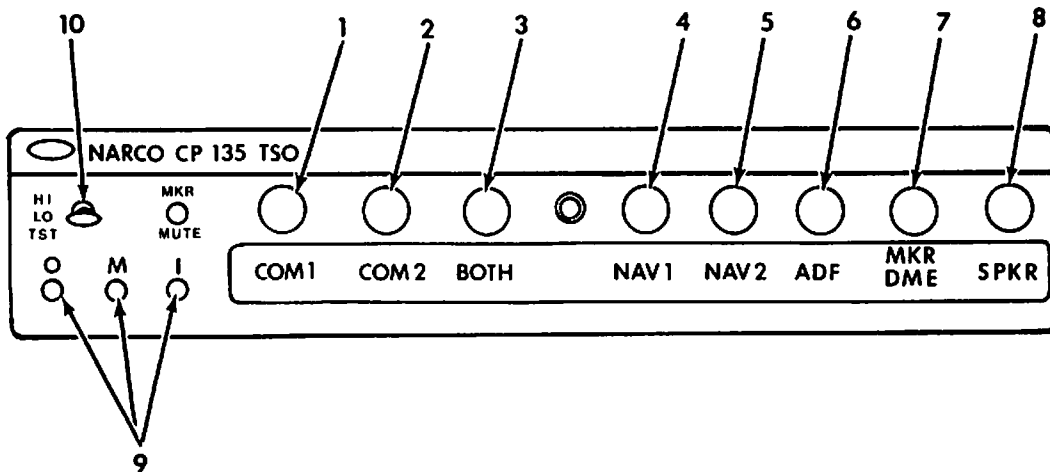
- (1) Obtain access to the ELT. (See Figure 201.)
- (2) After coordination, depress the RESET button, then place the ON-OFF-ARM switch to ON. As soon as ATC acknowledges transmission, place switch to OFF. Depress the RESET button, then place switch to ARM.
- (3) Recheck with ATC to ensure there is no transmission from the ELT.
- (4) Monitor for transmission on COM radio by selecting 121.5 MHz.

AUDIO INTEGRATING SYSTEM – DESCRIPTION/OPERATION

1. General

The audio integrating system consists of the speaker, microphone, headsets, and audio panel. The speaker is mounted in the upper center of the cabin. The microphone is attached to and plugs into the panel located between the two front seats. The headsets plug into the same panel. The audio panel is used on aircraft with dual VHF transceivers and/or multiple navigation systems such as VOR, ADF, or DME. The panel provides a central control point for the operation and monitoring of installed avionics equipment.

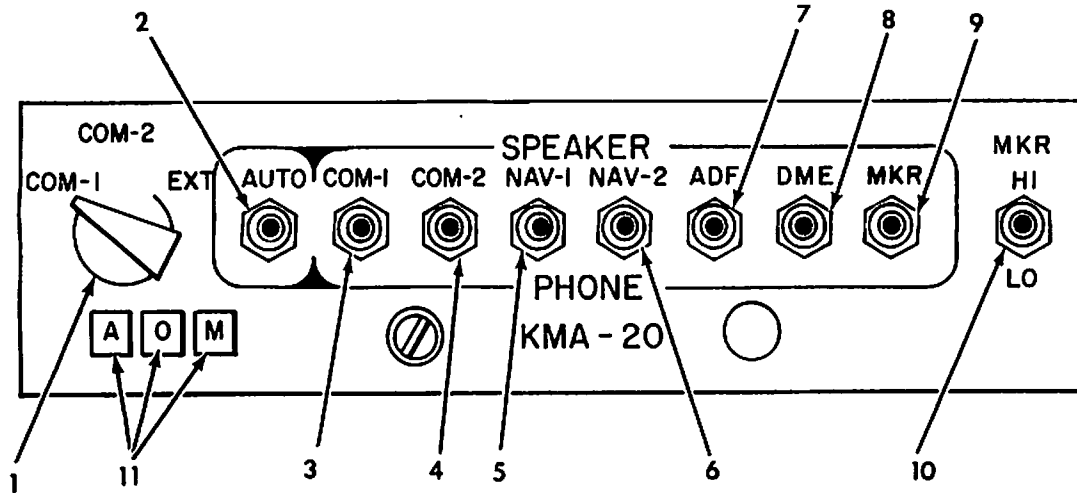
The audio panel can be one of three types; NARCO CP-135, KING KMA-20, or COLLINS AMR-350. All three units are very similar and provide the same control of the communication/navigation system. See Figure 1 (NARCO CP-135), Figure 2 (KING KMA-20), and Figure 3 (COLLINS AMR-350) for description of controls on each unit.



- | | |
|-----------------------|---|
| 1. COM 1 Control | 8. Speaker Control |
| 2. COM 2 Control | 9. Marker Beacon Indicator |
| 3. Both COM Control | O – Outer |
| 4. NAV 1 Control | M – Middle |
| 5. NAV 2 Control | I – Inner |
| 6. ADF Control | 10. Marker Receiver Sensitivity Control |
| 7. Marker/DME Control | |

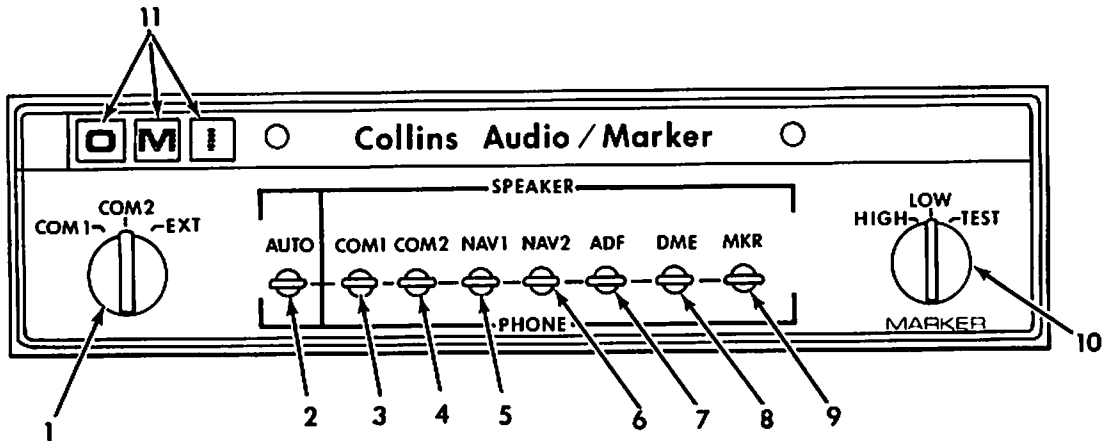
NARCO CP-135 Audio Panel
 Figure 1

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- | | |
|------------------------|--|
| 1. COM 1/COM 2 Control | 8. DME Selector |
| 2. Auto Selector | 9. Marker Beacon Selector |
| 3. COM 1 Selector | 10. Marker Beacon Sensitivity Selector |
| 4. COM 2 Selector | 11. Marker Beacon Indicator |
| 5. NAV 1 Selector | A - Inner |
| 6. NAV 2 Selector | O - Outer |
| 7. ADF Selector | M - Middle |

**KING KMA-20 Audio Panel
Figure 2**



- | | |
|----------------------------|---------------------------------|
| 1. COM 1/COM 2/EXT Control | 8. DME Control |
| 2. AUTO Control | 9. MKR Control |
| 3. COM 1 Control | 10. MARKER HIGH/LOW/TEST Select |
| 4. COM 2 Control | 11. Marker Light |
| 5. NAV 1 Control | O - Outer |
| 6. NAV 2 Control | M - Middle |
| 7. ADF Control | I - Inner |

**COLLINS AMR-350 Audio/Marker Panel
Figure 3**

23G72-9

AUDIO INTEGRATING SYSTEM – TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
No audio in headset or speaker.	Faulty wiring.	Replace wiring.
	Faulty transceiver.	Replace transceiver.
	Faulty audio control panel.	Replace panel.
One communication or navigation system appears inoperative.	Faulty audio panel.	Replace panel.
	Faulty COM/NAV unit.	Troubleshoot COM/NAV unit.
COM/NAV audio not available on the speakers. (Headset audio O.K.)	Faulty speaker.	Replace speaker.
	Faulty audio panel.	Replace panel.
	Faulty wiring to speaker.	Repair wiring.
COM/NAV audio not available at the headset. (Speaker audio O.K.)	Faulty headset.	Replace headset.
	Faulty jack.	Replace jack.
	Faulty audio panel.	Replace panel.
	Faulty wiring to jack.	Repair wiring.
COM/NAV audio O.K. but no transmission.	Faulty microphone.	Replace microphone. (This may require a readjustment of MIKE GAIN in transceiver.) See transceiver section in this chapter for instructions.
	Faulty microphone jack.	Replace jack.
	Faulty wiring to mike jack.	Replace wiring.
	Faulty transceiver.	Replace transceiver.
	Faulty audio panel.	Replace audio panel.

AUDIO INTEGRATING SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of Audio Panel

The removal and installation of the audio panel (NARCO CP-135/KING KMA-20/COLLINS AMR-350) is simple and requires no special instructions. Release the unit from its mounting case by turning the locking screw counterclockwise. To secure the unit after installation, turn the locking screw clockwise. Use 5/64 inch hex wrench. Slide unit straight out and in. Be careful not to damage connector pins.

2. Removal/Installation of Speaker

A. Removal of Speaker

- (1) The speaker is mounted in the upper center of the cabin.
- (2) Disconnect the two wires attached to speaker terminal.
- (3) Remove the four screws that attach speaker to speaker mount.
- (4) Slide the speaker out the back opening of the speaker mount.

B. Installation of Speaker

- (1) Slide the speaker into the back opening of the speaker mount and secure with four screws.
- (2) Attach the two speaker wires to speaker terminal.

3. Removal/Installation of Microphone

NOTE: The microphone must be balanced to the transceiver installed. If a new microphone is installed, the MIKE GAIN control of the associated transceiver may require readjustment. See the transceiver section in this chapter for instructions.

The removal and installation of the microphone requires no special instructions.

4. Adjustment/Test of Audio Integrating System

NOTE: This procedure assumes normal operation of the communication and navigation equipment installed in the aircraft.

A. Operational Test of Audio Integrating System

- (1) Ensure the aircraft battery is installed and operational.
- (2) Place the master switch to ON.
- (3) Select COM transceiver No. 1 as active transceiver.
- (4) Plug the microphone and headset into their respective jacks.

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- (5) Tune the transceiver to a control tower frequency.
- (6) Place COM 1 Speaker/Phone control in Speaker position.
- (7) Contact control tower for radio check. Control tower reply is heard over speaker.
- (8) Place COM 1 Speaker/Phone control in Phone position.
- (9) Contact control tower for radio check. Control tower reply is heard over headset.
- (10) Select COM transceiver No. 2 (if installed) as active transceiver and repeat steps (5) thru (9).
- (11) Check for audio signal from each navigation system installed. Check both speaker and headset positions.
- (12) Turn OFF all transceivers and navigation systems.
- (13) Place master switch to OFF.

CHAPTER 24

ELECTRICAL POWER

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ELECTRICAL POWER SYSTEM – DESCRIPTION

1. General (See Figure 1.)

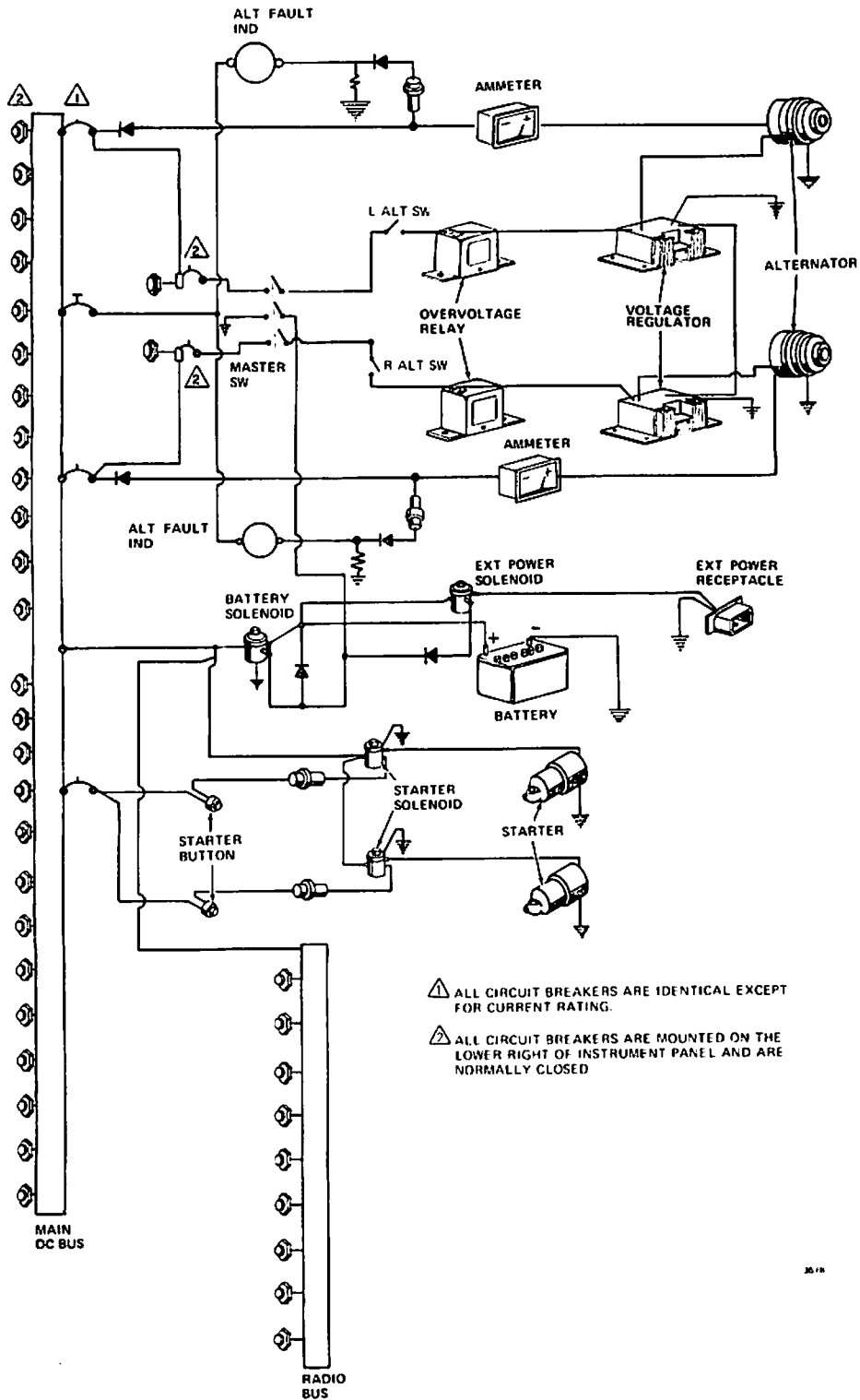
This chapter describes the GA-7/Cougar electrical power system and its operation. This covers the battery system, alternator system, external power system, and electrical load distribution.

Electrical power is supplied by a 14-volt, direct current, negative ground electrical system. A 12-volt, 25 ampere-hour battery is incorporated in the system to furnish power for starting the engines and as a reserve power source in case of alternator failure. The battery is located in the nose section of the aircraft.

The electrical generating system consists of two engine-driven 60-ampere alternators, two solid state regulators, two overvoltage relays, and two current meters. The regulators maintain the system bus voltage at 14 volts and the overvoltage relays prevent the bus voltage from being too high. The current meters indicate the amount of current being drawn by each alternator.

An external power receptacle is offered, as optional equipment, to supplement the battery system for starting and ground operation.

Electrical power is distributed through a split bus bar. One side of the bus bar supplies power to the electrical equipment while the other side supplies the electronic installations.



△ ALL CIRCUIT BREAKERS ARE IDENTICAL EXCEPT FOR CURRENT RATING.

△ ALL CIRCUIT BREAKERS ARE MOUNTED ON THE LOWER RIGHT OF INSTRUMENT PANEL AND ARE NORMALLY CLOSED

**DC Electrical Power, General Diagram
Figure 1**

24G72-1

GENERAL ELECTRICAL INFORMATION – DESCRIPTION

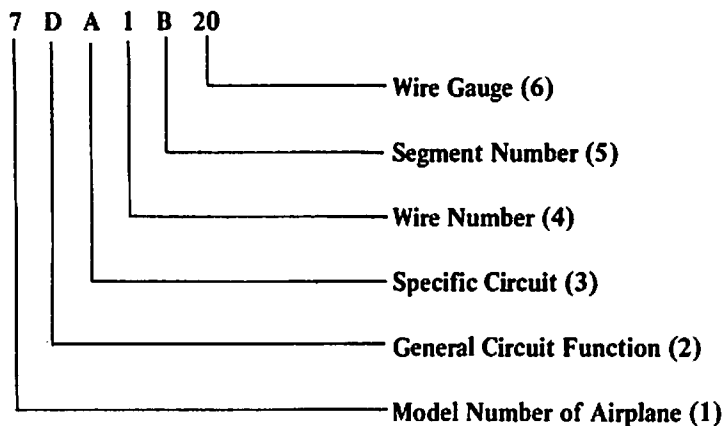
1. General

This section covers general aspects of design and construction common to all electrical systems. Details of actual systems are discussed in their appropriate section of this manual. The following information is intended to lay the groundwork for a basic understanding of the overall electrical system design so that maintenance personnel can better troubleshoot those systems causing difficulty.

2. Wire Identification

There are two schemes employed in assigning electrical wire codes. One scheme is used when several wiring diagrams are used. Another is used for color coding wires in the circuits specified in all radio systems and/or autopilots as applicable.

A. When multiple wiring diagrams are used for a model, the code is as follows:



- (1) A numerical character representing the aircraft model.
- (2) An alphabetical character representing the general circuit function, and assigned in accordance with Paragraph 3.
- (3) An alphabetical character representing the specific circuit within the general circuit function, and assigned in accordance with Paragraph 3.
- (4) A numerical digit or digits (wire number) representing the wires in the circuit that are electrically common. A different number shall be assigned to wires on each side of a circuit element, switch, fuse, relay contact, resistor, diode, etc. that can interrupt the circuit continuity. A splice connector contact pin or common terminal will not require a change in wire number. Wire numbers shall be assigned in numerical order beginning with the wire closest to the power or signal source.
- (5) An alphabetical character or characters (segment letters) to differentiate between individual wires having a common terminal or connection (wire number). Wire segment letters shall be assigned in alphabetical order starting with the wire segment nearest to the power or signal source. The letters "I" and "O" shall not be used as segment letters. Double letters AA, AB, AC, etc. shall be used when more than 24 segments are required. Two permanently spliced wires will not require different segment letters if the splice is used for modification or repair.

(6) A numerical digit or digits denotes the wire size. For coaxial cables and thermocouple wires, the wire size number shall not be used.

3. Circuit Function and Specific Circuit Code Letters

A. General and specific circuit functions are assigned as tabled below:

- | | | |
|----------|----|--|
| A | - | Unassigned |
| B | - | Photographic |
| C | - | Control Surface |
| | CA | Automatic Pilot |
| | CB | Not Used |
| | CC | Wing Flaps |
| | CD | Elevator Trim |
| D | - | Instrument (Other than Flight or Engine Instrument) |
| | DA | Ammeter |
| | DB | Flap Position Indicator |
| | DC | Clock |
| | DD | Voltmeter |
| | DE | Outside Air Temperature |
| | DF | Flight Hour Meter |
| E | - | Engine Instrument |
| | EA | Carburetor Air Temperature |
| | EB | Fuel Quantity Gage and Transmitter |
| | EC | Cylinder Head Temperature |
| | ED | Oil Pressure |
| | EE | Oil Temperature |
| | EF | Fuel Pressure |
| | EG | Tachometer |

- EH - Torque Indicator**
- EJ - Instrument Cluster**
- F - Flight Instrument**
 - FA - Bank and Turn**
 - FB - Pitot Static Tube Heater and Stall Warning Heater**
 - FC - Stall Warning**
 - FD - Speed Control System**
 - FE - Indicator Lights**
- G - Landing Gear**
 - GA - Actuator**
 - GB - Retraction**
 - GC - Warning-Device (Horn)**
 - GD - Limit Switches**
 - GC - Indicator Lights**
- H - Heating, Ventilating, and Deicing**
 - HA - Anti-Icing**
 - HB - Cabin Heater**
 - HC - Cigar Lighter**
 - HD - Deice**
- I - Not Used**
- J - Ignition**
 - JA - Magneto**
- K - Engine**
 - KA - Starter**
- L - Lighting**
 - LA - Cabin**

- LB - Instrument**
- LC - Landing**
- LD - Navigation**
- LE - Taxi**
- LF - Rotating Beacon**
- LG - Radio**
- LH - Deice**
- LJ - Fuel Selector**
- M - Miscellaneous**
 - MA - Cowl Flaps**
 - MB - Electrically Operated Seats**
- N - Unassigned**
- O - Not Used**
- P - DC Power**
 - PA - Battery Circuit**
 - PB - Generator Circuits**
 - PC - External Power Source**
- Q - Fuel and Oil**
 - QA - Auxiliary Fuel Pump**
 - QB - Oil Dilution**
 - QC - Engine Primer**
 - QD - Main Fuel Pumps**
 - QE - Fuel Valves**

- R - Radio (Navigation and Communication)**
 - RA - Instrument Landing**
 - RB - Command**
 - RC - Radio Direction Finding**
 - RD - VHF**
 - RE - Homing**
 - RF - Marker Beacon**
 - RG - Navigation**
 - RH - High Frequency**
 - RK - UHF**
 - RL - Low Frequency**
 - RM - Frequency Modulation**
 - RP - Audio System and Audio Amplifier**
 - RR - Distance Measuring Equipment (DME)**
- S - Radar**
- T - Unassigned**
- U - Miscellaneous Electronic**
- V - Unassigned**
- W - Warning and Emergency**
- X - AC Power**
- Y - Unassigned**
- Z - Unassigned**

B. When color coding is employed, colors are assigned as tabled below:

FUNCTION CIRCUITS	GAUGE	BASE COLOR (or solid)	STRIPE COLOR
A+ Power	16	Red	None
	18	Red	Black
		Red	White
	20	Red	Green
	22	Red	Yellow
Ground	16	Black	None
	18	Black	White
Mike Ground	22	Black	None
Radio Lights Dim	18	Yellow	None
Mike Audio	22	Tan	None
		Tan (shielded)	None
Mike Key	22	White	Black
Radio Speaker	20	Green	None
Headphones	22	Blue	None
Dev + 1	22	Gray	Red
Dev - 1	22	Gray	Green

- NOTES:**
1. "Dev +" and "Dev -" circuits are for use in autopilots and any associated omni indicator circuit to which it connects.
 2. All other color coded wires are for general use in multiconductor radio and autopilot harness assemblies.

GENERAL ELECTRICAL INFORMATION – MAINTENANCE PRACTICES

1. Diode Test

Whenever a solenoid or switch, that uses a diode, is replaced, the corresponding diode should be checked.

NOTE: For accurate test, diode must be disconnected from circuit.

- A. Obtain an ohmmeter and set up on ohms.
- B. Position the test leads across the diode and record the ohmic reading.
- C. Reverse the test leads and again record the ohmic reading.
- D. The first reading must be ten times greater or less than the second reading.
- E. Replace diodes not meeting D above.

DC ELECTRICAL POWER SYSTEM – DESCRIPTION/OPERATION

1. **General**

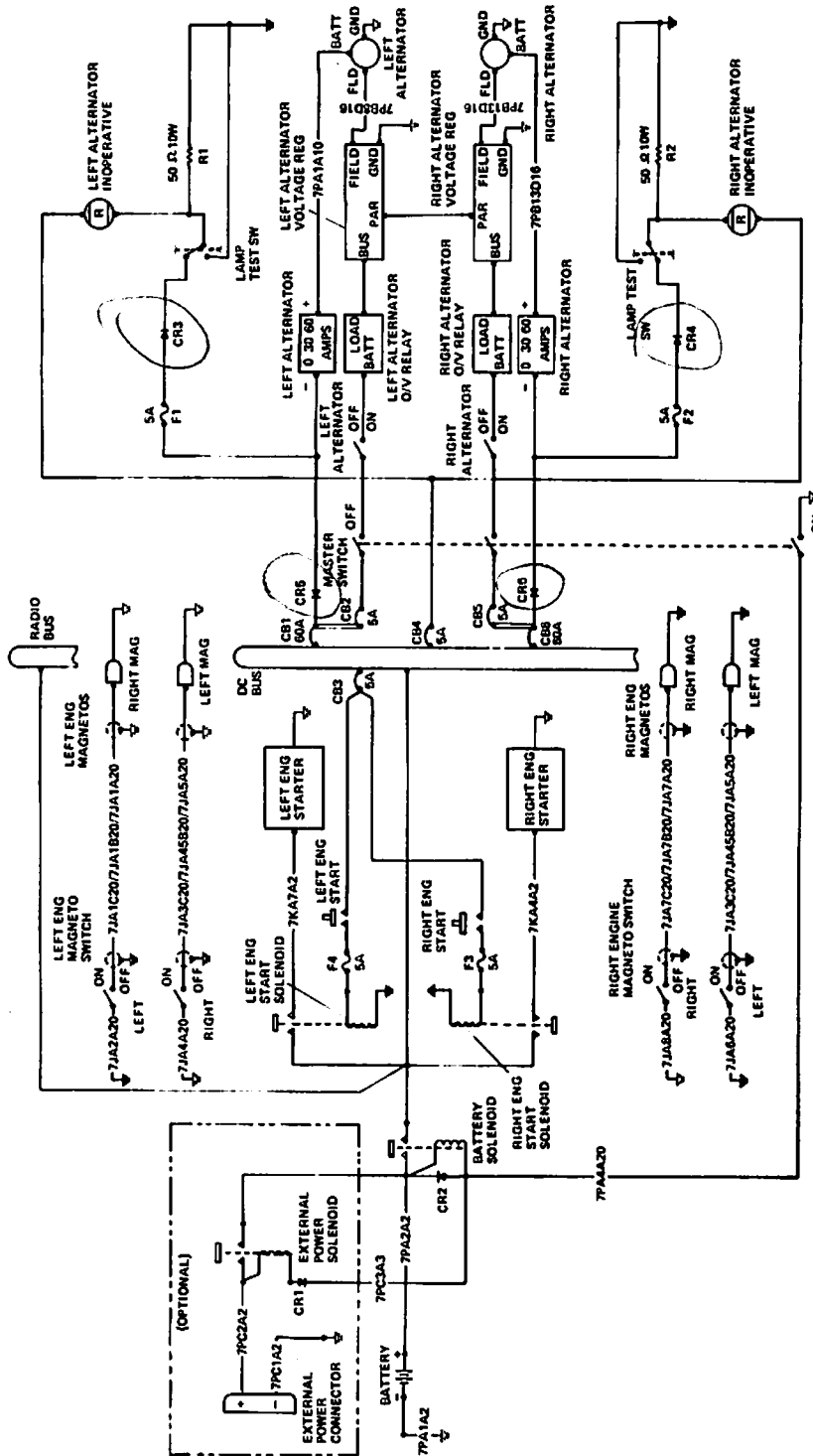
Power for the electrical system is provided by an alternator and/or battery. The alternator serves as the main component to power the electrical system and charge the battery during normal conditions. The battery is used for starting the engine and powering the electrical system when alternator power is not available (engine not running). The battery also powers the electrical system in case of alternator system failure.

2. **Operation (See Figure 1.)**

The operation of the electrical system is controlled by the master switch. The master switch performs three functions. When placed in the ON position it supplies a ground path for the battery solenoid and connects the left and right alternator toggle switches to the main DC bus. The battery solenoid will energize with the master switch in the ON position and the battery voltage will be applied to the main DC bus, radio bus, and to the contacts of the left and right engine starter solenoids. The two voltage regulators, receiving power from the main DC bus via the alternator control switches and the master switch, energizes the two alternator fields. With the alternator fields energized and the engines operating, the alternators will produce an output to the electrical system. The voltage regulators maintain the output of the alternators at the correct level to meet the requirements of the electrical system. An ammeter is incorporated with each alternator to display the load, in amperes, placed on the alternator. With all electrical equipment off (except master switch) the ammeter will indicate the amount of charging current demanded by the battery. Also, incorporated in the alternator system are two overvoltage relays, one for each alternator circuit, which prevent damage to electrical and avionic equipment in case of regulator malfunction. A warning light on the glareshield panel will illuminate if either alternator fails, accompanied by a zero indication on the individual ammeter.

Diodes are used in the aircraft electrical system for protection and isolation of electrical circuits. The diodes can be checked in accordance with the procedure given in Section 24-0-1, Paragraph 1, Diode Test.

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DC Electrical Power System
 Figure 1

24G72-2

BATTERY SYSTEM – DESCRIPTION/OPERATION

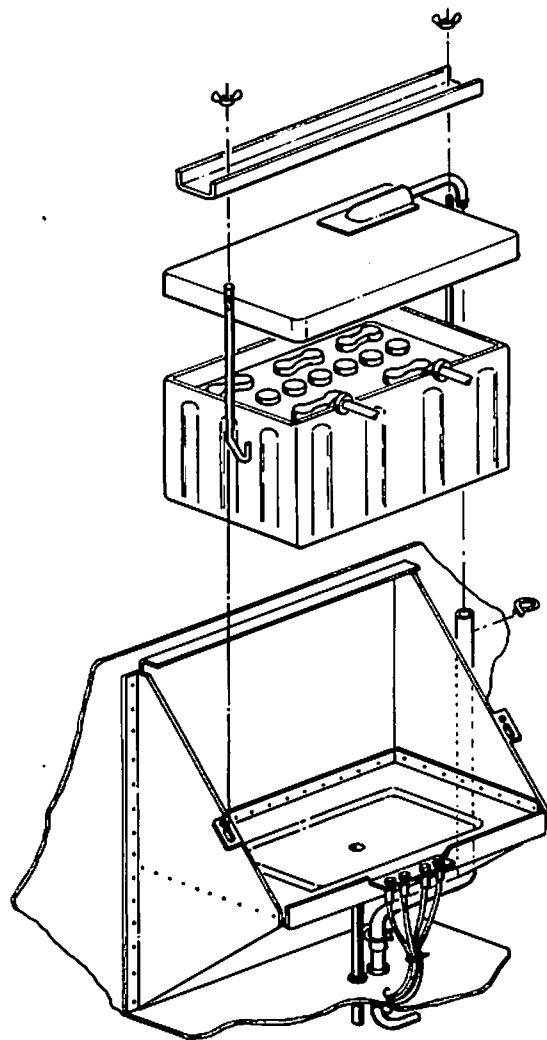
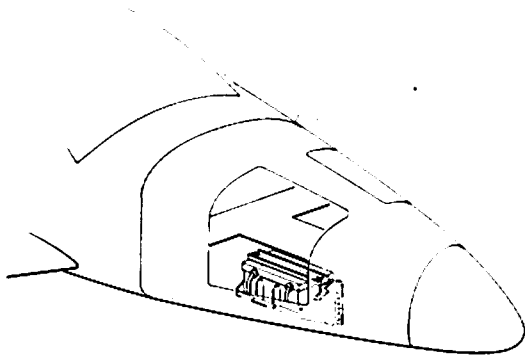
1. **General** (See Figure 1.)

The battery, furnished as standard equipment, is 12 volts and has approximately 25 ampere-hour capacity. The battery is mounted in the nose section, on the right side, and is equipped with non-spill filler caps. The battery is completely enclosed in an acid resistant plastic box. The box has a vent tube which protrudes through the bottom of the aircraft, allowing battery gases and spilled electrolyte to escape. The battery cover has a cooling vent and tube assembly provided to prevent battery overheating. The battery is used to provide engine starts and supply power to the electrical system when alternator power is not available. The battery is also used as an emergency supply in the event of alternator failure.

Under normal use, a battery being charged and discharged will decompose the water from the electrolyte by electrolysis. When the water is decomposed, hydrogen and oxygen gases are formed which escape into the atmosphere through the battery vent system. A loss of water (electrolyte) is caused by the decomposition of the water. Distilled water should be added as necessary to maintain the electrolyte at the correct level.

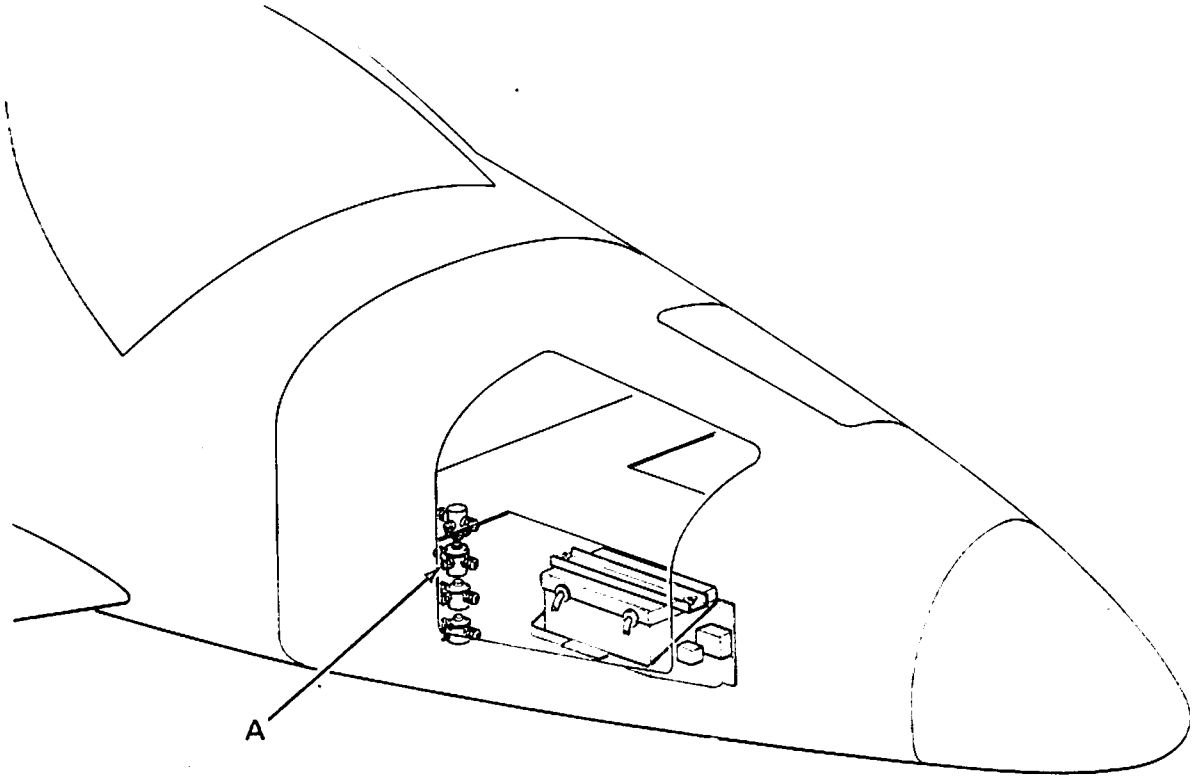
The battery solenoid is located in the nose section, just aft of the battery. (See Figures 2 and 3.) The solenoid is a plunger type solenoid which is actuated by placing the master switch to the ON position. With battery solenoid energized, a circuit is completed from the battery to the main DC bus, radio bus, and contacts of the two engine starter solenoids (not the coil). (See Figure 4.) With the master switch OFF, the battery is isolated from the electrical system. A silicon diode is placed across the coil of the battery solenoid to eliminate spiking as the master switch is turned ON and OFF. This is for protection of the avionics equipment.

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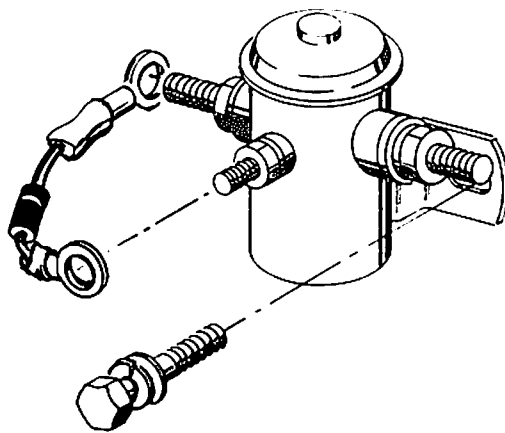


Exploded View of Battery Installation
Figure 1

24G72-3



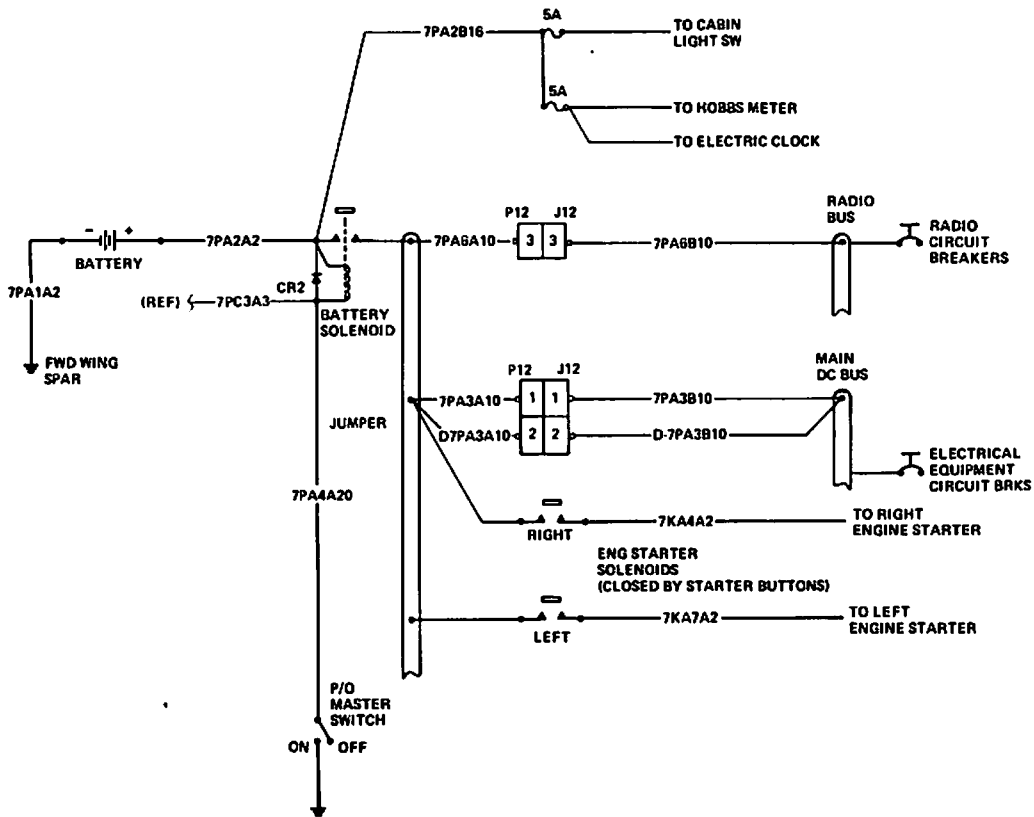
Location of Battery Solenoid
Figure 2



DETAIL A

Exploded View of Battery Solenoid
Figure 3

24G72-4



Battery Circuit – Wiring Diagram
Figure 4

24G72-5

BATTERY SYSTEM – TROUBLESHOOTING

1. Troubleshooting the Battery System

TROUBLE	PROBABLE CAUSE	REMEDY
System not energized when master switch is turned on.	Dead battery.	Recharge or replace.
	Defective wiring.	With master switch OFF, check entire DC power system for open circuit with a continuity tester.
	Defective battery solenoid.	Replace solenoid.
	Defective master switch.	Replace switch.
Short battery life.	Low charging rate.	Adjust or replace voltage regulator.
	Impurities in electrolyte.	Replace battery.
	Battery left standing too long.	Recharge or replace battery.
	Sulfation due to nonuse.	Replace battery.
	Level of electrolyte being below top of plates.	Maintain correct electrolyte level.
Battery uses excessive amount of water.	Charging rate too high.	Adjust charging rate.
	Cracked case.	Replace battery.
	Shorted cell.	Replace battery.
	Shorted diode in alternator.	Test diodes and replace as required.
Battery polarity reversed.	Connected backwards on aircraft or charger.	Battery should be slowly discharged completely and then charged correctly and tested.
Battery freezes.	Undercharged or discharged battery.	Replace battery.
	Water added and battery not charged immediately.	Always recharge battery for 1/2 hour following addition of water in freezing weather.
Battery overheats.	Cooling vents obstructed.	Clean vent lines.

BATTERY SYSTEM – MAINTENANCE PRACTICES

1. Servicing

A. Visual Check

- (1) Remove battery cover. (See Battery – Removal/Installation.)
- (2) Inspect battery terminals for corrosion. If corrosion exists, terminal should be cleaned as described in Paragraph 1.B.
- (3) Inspect for a low water level condition. Distilled water should be added as required to bring the level up to the split rings.
- (4) Inspect for plugged vents and clean if necessary.
- (5) Replace battery cover. (See Battery – Removal/Installation.)

B. Cleaning Battery

WARNING: ENSURE THAT EXTERNAL POWER IS DISCONNECTED BEFORE REMOVING BATTERY.

- (1) Remove battery from aircraft. (See Battery – Removal/Installation.)
- (2) Tighten filler caps and plug vents to prevent cleaning solution from entering battery.
- (3) Wipe down entire battery with a clean cloth dampened with a solution of bicarbonate of soda (baking soda) and water.
- (4) Wipe battery cable ends with same solution used in Step (3).
- (5) Rinse areas being cleaned with clear water and wipe off excess water. Allow battery to dry before installation.
- (6) Use a brass wire brush or emery cloth to finish cleaning on battery cable ends and battery terminals.

C. Determining State of Charge

To determine the state of battery charge, the specific gravity of the battery is checked using a hydrometer. A reading of 1.260 indicates a fully charged battery whereas a reading of 1.225 or below indicates that the battery should be recharged.

D. Battery Charging

WARNING: ALWAYS KEEP SPARKS OR ANY FORM OF IGNITION AWAY FROM BATTERY BEING CHARGED BECAUSE EXPLOSIVE GASES ARE BEING GENERATED DURING THE CHARGING PROCESS.

- (1) Remove battery from aircraft. (See Battery – Removal/Installation.)

- (2) Place battery in a well ventilated area.
- (3) Remove vented caps and check the level of electrolyte. Distilled water should be added as needed to bring level to top of split rings.
- (4) Charge battery as required.
- (5) Replace vented caps and reinstall battery. (See Battery – Removal/Installation.)

E. Battery Box

WARNING: BE CAREFUL WHEN WORKING AROUND BATTERY ACID DEPOSITS. SERIOUS ACID BURNS COULD RESULT IF CONTACT IS MADE WITH ACID DEPOSITS. IF CONTACT IS MADE, WASH IMMEDIATELY WITH SOAP AND WATER.

The battery box cover and drain tube should be inspected and cleaned when the battery is removed. The battery box, cover, and drain tube can be cleaned with a strong solution of bicarbonate of soda (baking soda) and water. After cleaning box, cover, and drain tube, flush them thoroughly with water. Inspect box, cover, and drain tube for physical damage. If damaged, they should be replaced.

2. Removal/Installation of Battery**A. Battery Removal (See Figure 1.)**

- (1) Open nose baggage compartment door. Remove baggage compartment floor panel to gain access to battery.
- (2) Remove the two wingnuts on the battery holddown bracket and remove bracket.
- (3) Disconnect cooling vent and remove the battery box cover.

CAUTION: REMOVE THE GROUND (NEGATIVE) CABLE FIRST TO PREVENT ACCIDENTAL SHORT.

- (4) Disconnect the battery cables.
- (5) Remove the battery and battery box by lifting up and out of the baggage compartment door.

B. Battery Installation (See Figure 1.)

CAUTION: WHEN INSTALLING THE BATTERY, BE SURE TO CHECK FOR CORRECT POLARITY (NEGATIVE TO GROUND) TO PREVENT DAMAGE TO THE ELECTRICAL SYSTEM.

- (1) Place battery into battery box and slide battery box onto battery box support bracket.

CAUTION: CONNECT GROUND (NEGATIVE) CABLE LAST TO PREVENT ACCIDENTAL SHORT CIRCUITING DURING INSTALLATION.

- (2) Connect battery cables and coat terminals with petroleum jelly to reduce corrosion.

- (3) Replace the battery cover and connect cooling vent.
- (4) Replace battery holddown bracket and secure with two wingnuts.
- (5) Close nose baggage compartment door.
- (6) Perform Operational Check.

3. Removal/Installation of Battery Solenoid

A. Battery Solenoid Removal (See Figure 2.)

- (1) Open nose baggage compartment door. Remove baggage compartment floor panel to gain access to battery solenoid.
- (2) Remove ground (negative) cable from battery terminal. Pull cable clear of battery and battery box. (See Battery Removal, Steps (2) through (4).)
- (3) Disconnect wire 7PA2A2 from battery terminal on battery solenoid. (See Figure 4.) Disconnect jumper between battery solenoid and external power solenoid.
- (4) Disconnect wires 7PA4A20 and 7PC3A3 from battery solenoid.
- (5) Disconnect jumper between battery solenoid and left engine starter solenoid. Disconnect wire 7PA6A10 from battery solenoid.
- (6) Remove the two bolts securing battery solenoid to mounting panel. Remove battery solenoid.

B. Battery Solenoid Installation (See Figure 2.)

CAUTION: ENSURE GROUND (NEGATIVE) CABLE IS DISCONNECTED AND CLEAR OF BATTERY TERMINAL BEFORE INSTALLING CONTACTOR.

NOTE: Diode used on contactor should be tested and replaced if necessary before installing contactor. (See Section 24-0-1, Paragraph 1, Diode Test.)

- (1) Secure battery solenoid to mounting panel with two bolts.
- (2) Connect jumper from left engine starter solenoid and wire 7A6A10 to right side connector post.
- (3) Connect wires 7APA4A20 and 7PC3A3 to center connector post.
- (4) Connect diode from left connector post to center connector post. Ensure the cathode of the diode is connected to the left connector post.
- (5) Connect jumper between the battery solenoid left connector post and the left connector post of the external power solenoid.
- (6) Connect wire 7PA2A2 to left connector post of battery solenoid.

- (7) Connect ground (negative) cable to battery. (See Section 24-3-1, Paragraph 2.B., Battery Installation.)
- (8) Perform operational check of battery.

4. Battery Operational Check

A. Operational Check

- (1) Place master switch to ON position. (Engines OFF)
- (2) Place a moderate drain on the battery. This can be accomplished by turning on the navigation and/or landing light.

NOTE: If light is inoperative, ensure all applicable fuses are good and all circuit breakers are closed.

- (3) Check for correct operation of navigation and/or landing light.
- (4) Turn navigation and/or landing light off.
- (5) Turn master switch to OFF position.

ALTERNATOR SYSTEM – DESCRIPTION/OPERATION

1. **General** (See Figure 1.)

The alternator system consists of two alternators, two voltage regulators, two overvoltage protection relays, and their associated circuit breakers. One alternator is mounted on each engine and the voltage regulators and overvoltage protection relays are mounted on the sides of the battery support bracket in the nose section.

2. **Alternator**

The two alternators are 60-ampere, three-phase, delta-connected with integral silicon diode rectifiers. Each is rated at 14 volts, with 60 amperes continuous output. The rotor consists of an axial winding with radial interlocking poles which surround the windings. The stator windings are three-phase, delta-connected and are attached to two diode plates, each of which contains three silicon diodes.

The diode plates are connected to accomplish full-wave rectification of the AC produced by the alternator. The resulting DC output is applied to the main DC bus and radio bus, via the applicable circuit breakers. The DC output is sensed by the voltage regulator. Two 5-amp circuit breakers, one for each alternator, are provided to protect the alternator field circuits.

3. **Voltage Regulator**

The solid state voltage regulator senses the DC bus voltage level and applies a control voltage to the field of the alternator. The level of this DC field voltage controls the DC voltage output of the alternator, hence the voltage level on the DC bus. For the voltage regulators to control the output of the alternator, the following switches/circuit breakers must be closed; master switch, right and left alternator circuit breakers, right and left alternator field circuit breakers, and left and right alternator toggle switches.

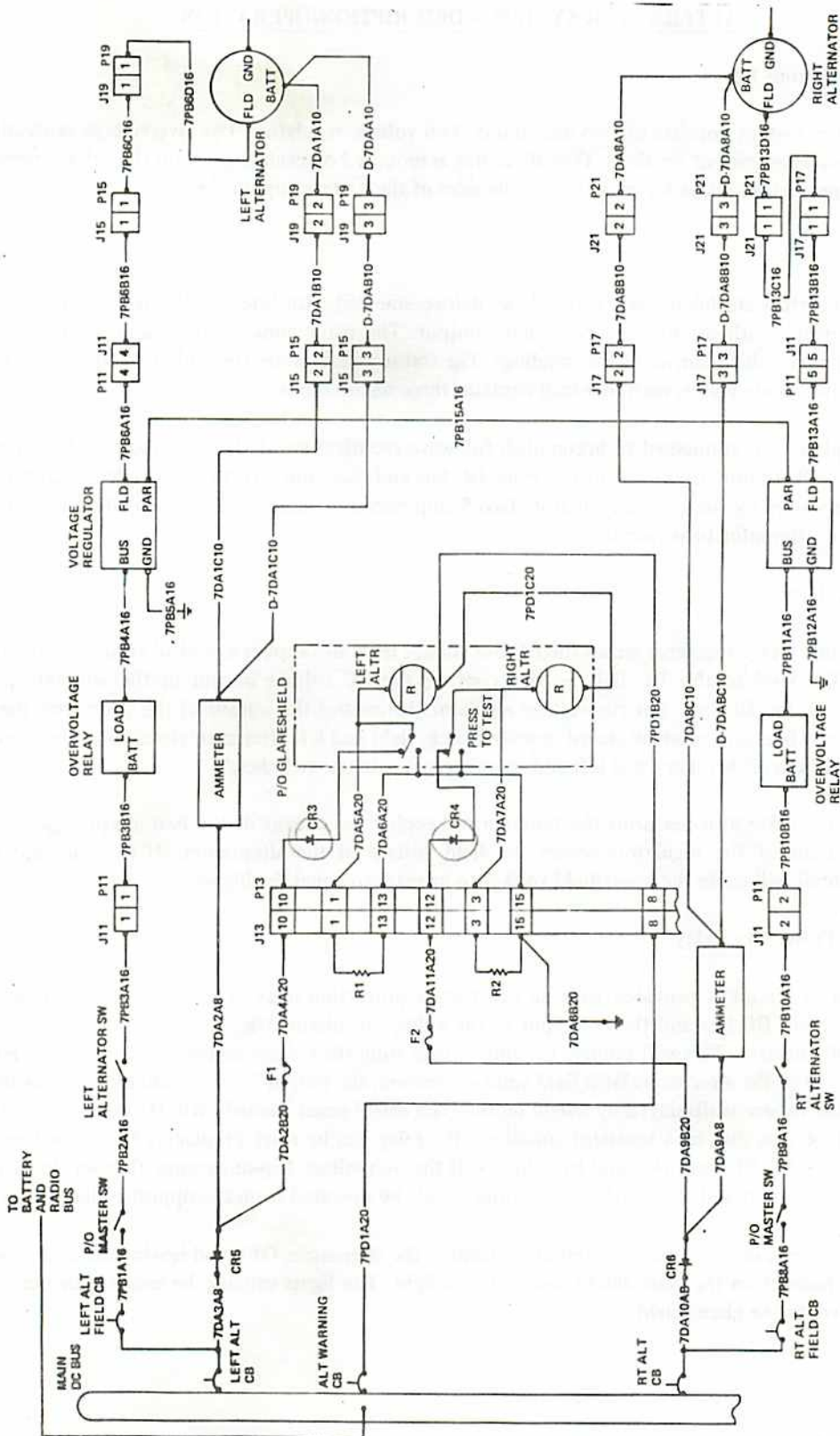
The voltage regulator also performs the function of keeping the output of the two alternators balanced. The balancing circuit of the regulators senses the field voltage of the alternators. If they are not equal, the balancing circuit will cause the lower field voltage to increase to equal the higher.

4. **Overvoltage Protection Relay**

Each alternator circuit is provided with an overvoltage protection relay. The overvoltage relay is connected between the main DC bus and the bus input to the voltage regulator. When an overvoltage condition occurs, the relay will energize. This will remove the bus voltage from the voltage regulator which in turn removes the field voltage from the alternator. With field voltage removed, the output from the alternator decreases to zero. The alternator failure is displayed by a light on the glare shield panel labeled "RIGHT ALT or LEFT ALT." If the overvoltage was due to a transient condition, the relay can be reset by placing the respective alternator toggle switch to the OFF position and back to ON. If the overvoltage trip-out recurs, then an alternator system malfunction is present and all electrical accessories should be operated from the opposite electrical system.

The alternator warning light may be tested by turning the alternators OFF and leaving the master switch ON. Both lights, located on the glare shield panel, should light. The lights can also be tested with the press-to-test switch located on the glare shield.

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Alternator Circuit – Wiring Diagram
 Figure 1

24G72-6

ALTERNATOR SYSTEM – TROUBLESHOOTING

1. Troubleshooting the Alternator System

NOTE: The two alternators are connected in parallel and are balanced to produce equal outputs. In case of one alternator failure, the other will continue to produce the voltage required by the electrical systems. The failed alternator will cause a warning light on the glare shield to light. The two alternator circuits are identical. Troubleshoot the circuit that indicates malfunction.

TROUBLE	PROBABLE CAUSE	REMEDY
Alternator overcharges battery.	Defective or misadjusted regulator.	Adjust regulator for correct bus voltage. Replace regulator if correct output cannot be obtained.
ALT FIELD circuit breaker trips.	Defective overvoltage protection relay.	Replace relay.
	Circuit shorted in wiring.	Use ohmmeter to locate short. Repair as required.
	Defective circuit breaker.	Replace circuit breaker.
	Defective voltage regulator.	Replace regulator.
ALT circuit breaker trips.	Short circuit in alternator.	Replace alternator.
	Circuit shorted between alternator battery connection and circuit breaker.	Use ohmmeter to locate short. Repair as required.
	Defective circuit breaker.	Replace circuit breaker.
Alternator will not charge battery.	Defective battery.	Start engine and adjust for 1500 rpm. Turn off all electrical equipment. Ammeter should show heavy charge rate. Rate should taper off in 10 to 15 minutes. If battery charge rate tapers off very quickly, check battery for malfunction.
	Misadjusted or defective voltage regulator.	Check bus voltage with voltmeter. Should be approximately 14 volts. Adjust to 14 volts if not correct. Replace regulator if output cannot be adjusted.

TROUBLE	PROBABLE CAUSE	REMEDY
Alternator will not charge battery. (Continued)	Defective alternator.	Check resistance from F1 terminal of alternator to alternator case. Normal indication is 3 to 4 ohms. If resistance is not correct, replace alternator.
	Defective wiring.	Observe ammeter reading and alternator indicator lights. If ammeter reading is zero and indicator light is ON, check wiring for the indicated alternator system.

ALTERNATOR SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of Alternator.

A. Alternator Removal (See Figure 201.)

- (1) Remove upper and lower cowling.
- (2) Disconnect the ground (negative) cable from the battery terminal. Pull cable clear of battery and battery box.
- (3) Cut the safety wire and remove the bolt attaching the alternator to the adjustment link.
- (4) Remove the nut from the support bolt and slide the main alternator support bolt out, at the same time removing the drive belt.
- (5) Lower alternator and gain access to the leads. Remove and identify leads from alternator.
- (6) Remove the alternator.

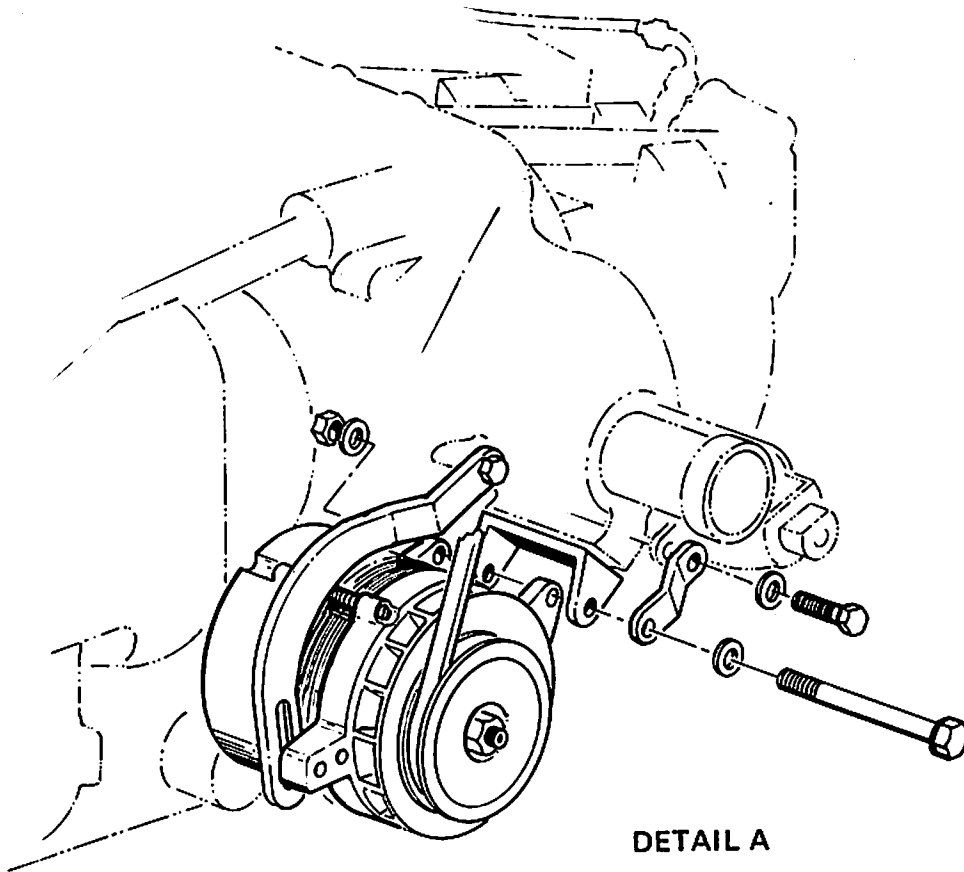
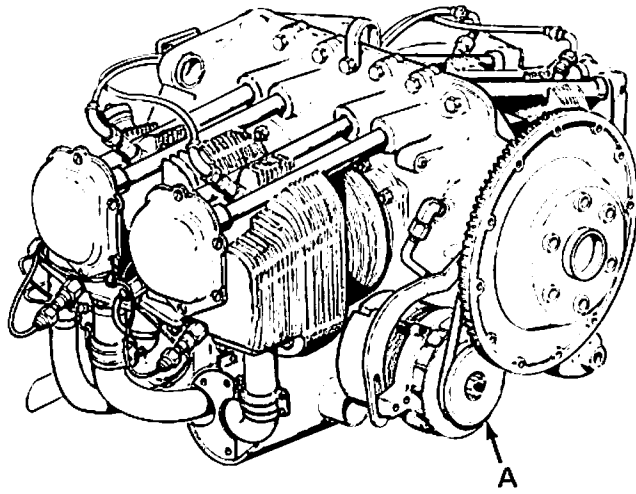
NOTE: Service work performed on the alternator should be in accordance with any manuals or bulletins published by the alternator manufacturer.

B. Alternator Installation (See Figure 201.)

CAUTION: ENSURE GROUND (NEGATIVE) CABLE IS DISCONNECTED AND CLEAR OF BATTERY.

NOTE: When a new belt has been installed, recheck the belt tension within 10 to 20 hours operation.

- (1) Place alternator near mount and connect leads to alternator.
- (2) Slide alternator into mount. At same time, place belt on pulley of alternator.
- (3) Slide main alternator support bolt into position and replace nut.
- (4) Replace bolt attaching the alternator to the adjustment link. Adjust the belt tension to yield a 3/8 inch deflection at the center of the belt when applying a pressure equivalent to 12 pounds.
- (5) Safety-wire bolt attaching the alternator to the adjustment link.
- (6) Connect ground (negative) cable to the battery.
- (7) Replace upper and lower cowling.
- (8) Perform operational check.



**Alternator – Exploded View
Figure 201**

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2. Removal/Installation of Overvoltage Protection Relay

A. Overvoltage Protection Relay Removal (See Figure 202.)

- (1) Open nose baggage compartment door (right side of nose section). Remove floor panel of baggage compartment to gain access to battery area.
- (2) Disconnect the ground (negative) cable from the battery terminal. Pull cable clear of battery.
- (3) Locate the overvoltage protection relay, mounted on the side of the battery holder bracket.

NOTE: There are two overvoltage protection relays, one for each alternator. The one mounted on the left of the battery holder is for the left engine alternator.

- (4) Remove and identify the two leads from the appropriate relay.
- (5) Remove the two screws securing the relay to the battery holder bracket. Remove relay.

B. Overvoltage Protection Relay Installation (See Figure 202.)

- (1) Attach relay to battery holder bracket with two screws.
- (2) Attach the two leads to the relay.
- (3) Connect the ground (negative) cable to the battery.
- (4) Replace nose baggage compartment floor panel and close baggage compartment door.
- (5) Perform an operational check of alternator system.

3. Removal/Installation of Voltage Regulator

A. Voltage Regulator Removal (See Figure 202.)

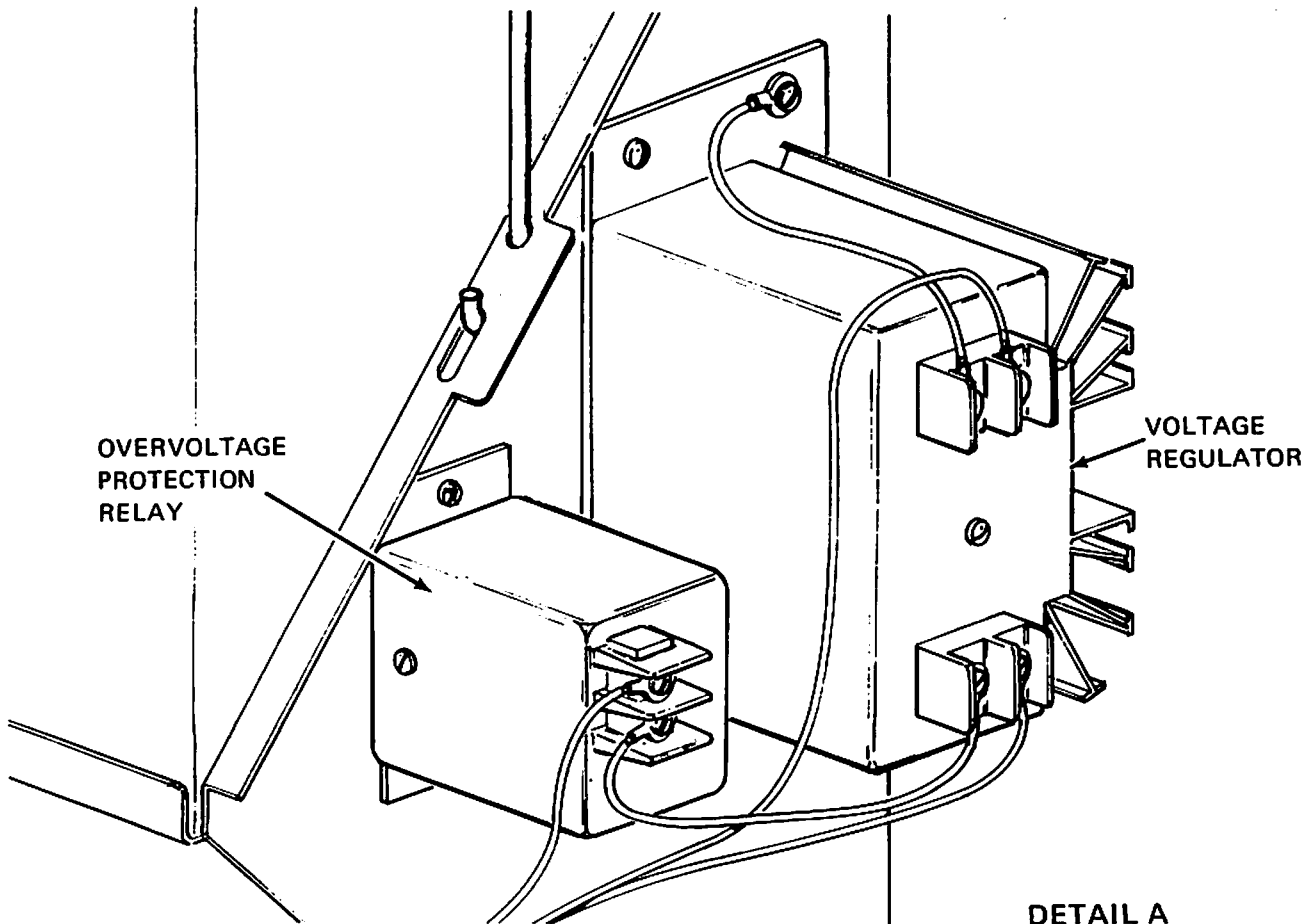
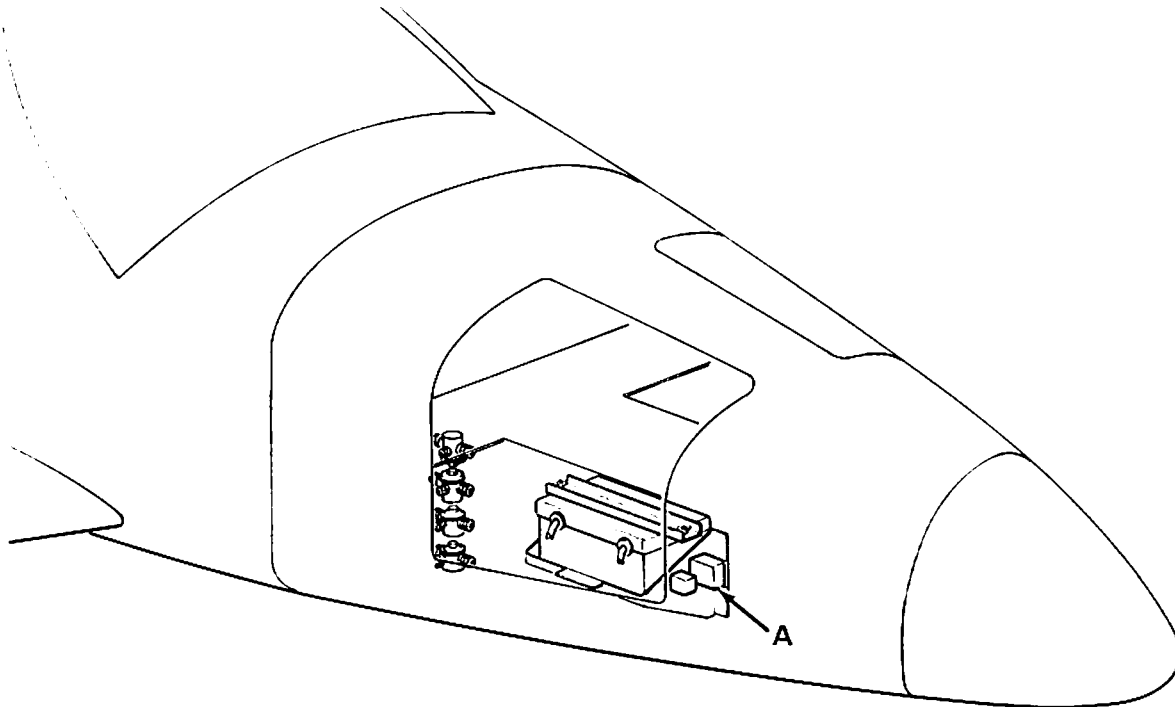
- (1) Open nose baggage compartment door (right side of nose section). Remove floor panel of baggage compartment to gain access to battery area.
- (2) Disconnect the ground (negative) cable from battery terminal. Pull cable clear of battery.
- (3) Locate the voltage regulator, mounted on the side of the battery holder bracket.

NOTE: There are two voltage regulators, one for each alternator. The one mounted on the left side of the battery holder is for the left engine alternator.

- (4) Remove and identify the four leads from the regulator.
- (5) Remove the three screws securing the regulator to the battery holder bracket. Remove regulator.

B. Voltage Regulator Installation (See Figure 202.)

- (1) Attach regulator to battery holder bracket with three screws.



**Overvoltage Protection Relay and Voltage Regulator
Figure 202**

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- (2) Attach the four leads to the regulator.
- (3) Connect the ground (negative) cable to the battery.
- (4) Replace nose baggage compartment floor panel and close baggage compartment door.
- (5) Perform an operational check of alternator system.

4. Alternator System Operational Check and Adjustment

A. Operational Check

WARNING: BEFORE STARTING ENGINES, BE SURE PROPELLER AREAS ARE CLEAR.

- (1) Start engines in accordance with the Pilot's Operating Handbook. Set engines at 1500 rpm.
- (2) Alternator ammeters should indicate a heavy charge rate with all electrical equipment off.
- (3) Observe that charge rate tapers off in 10 to 15 minutes.
- (4) Open Left Alternator toggle switch. Observe that left alternator ammeter reads zero and Left Alternator indicator light (on glare shield) is illuminated.
- (5) Observe that right alternator ammeter still indicates some current draw and the right alternator indicator light is out.
- (6) Close Left Alternator toggle switch. Observe that left alternator ammeter indicates some current draw and left alternator indicator light is out.
- (7) Repeat Steps (4), (5), and (6) using right alternator control switches. Observe right alternator indicators.
- (8) Place moderate load on alternator system by turning on navigation lights and/or other electrically operated units.
- (9) Repeat Steps (4), (5), and (6) for both left and right alternator systems. Observe for proper indications.
- (10) Turn off all electrically operated units.
- (11) Shut down engines in accordance with the Pilot's Operating Handbook.

B. Voltage Regulator Paralleling Adjustment

- (1) Remove right engine starter fuse. Ensure that right engine is inoperative.
- (2) Remove wire from PAR terminal of one regulator.

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- (3) Place Right Alternator toggle switch to OFF.
- (4) Place Left Alternator toggle switch to ON.

WARNING: ENSURE PROPELLER AREA IS CLEAR BEFORE STARTING ENGINE.

- (5) Start left engine in accordance with Pilot's Operating Handbook.
- (6) Operate left engine at 1000 rpm and an alternator loading of 15 to 30 amps for a period of 5 to 10 minutes.
- (7) Connect a precision voltmeter between the battery connection on the left overvoltage relay and aircraft ground. Connect positive lead of voltmeter to relay connection.
- (8) Adjust the left alternator voltage regulator until 14.0 VDC +0.0, -0.5 volts is indicated on the voltmeter.
- (9) Shut down the left engine in accordance with the Pilot's Operating Handbook.
- (10) Place Master switch to OFF.
- (11) Connect a voltmeter, Simpson 260 or equivalent, between the field terminals of the two voltage regulators. Connect positive lead of voltmeter to left regulator field terminal. Meter range is 30 to 50 volts.
- (12) Place Master switch to ON.

WARNING: ENSURE PROPELLER AREA IS CLEAR BEFORE STARTING ENGINE.

- (13) Start left engine in accordance with Pilot's Operating Handbook.
- (14) Place Right Alternator toggle switch to ON.
- (15) Operate left engine at 1000 rpm and an alternator loading of 15 to 30 amps for a period of 5 to 10 minutes.
- (16) If voltmeter is reading downscale (below zero), turn the right alternator voltage regulator voltage adjustment counterclockwise until the reading is on scale.
- (17) Adjust the right voltage regulator voltage adjustment for a reading of 0 to 8 VDC on the voltmeter. Change voltmeter range as required.
- (18) Re-connect the PAR wire disconnected in Step (2).
- (19) Voltmeter reading should be 0.2 to 0.5 VDC and should be stable.
- (20) Wait 5 to 10 minutes and repeat Steps (2), (11), (16), (17), and (18) in that order. The voltage observed in Step (17) may not be stable.



- (21) Shut down left engine in accordance with Pilot's Operating Handbook.
- (22) Replace right engine starter fuse.
- (23) Perform operation check of alternator system.

EXTERNAL POWER SYSTEM – DESCRIPTION/OPERATION

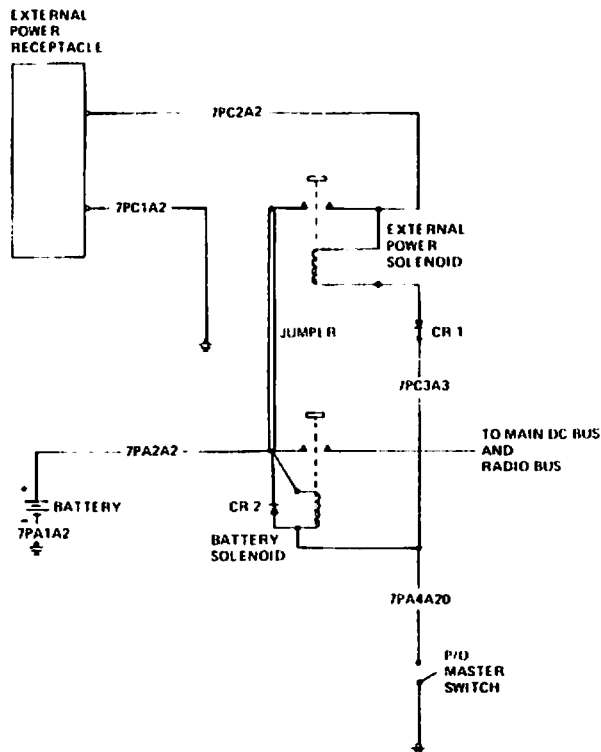
1. General

A ground service receptacle is offered as optional equipment to permit use of external power for cold weather starting or when performing lengthy electrical maintenance. A reverse polarity protection system is utilized whereby ground power must pass through an external power contactor to be connected to the main DC bus. A silicon diode is connected in series with the coil of the external power contactor so that if the ground power source is inadvertently connected with reverse polarity, the external power contactor will not energize. This feature protects the diodes in the alternator, and other semiconductor devices used in the aircraft, from possible damage from reverse polarity.

2. Operation (See Figure 1.)

NOTE: Ensure the Master switch is OFF before connecting external power source.

To apply external power to the aircraft, connect the external power source to the external power receptacle. Place the Master switch to ON. The external power contactor and battery contactor will energize. External power will pass through the contacts of the external power solenoid and the battery solenoid to the main DC bus and the radio (avionics) bus.



External Power – Wiring Diagram
 Figure 1

EXTERNAL POWER SYSTEM – TROUBLESHOOTING

1. Troubleshooting the External Power System

TROUBLE	PROBABLE CAUSE	REMEDY
External power source will not power electrical system.	Defective external power solenoid.	Replace solenoid.
	Defective battery solenoid.	Replace battery solenoid.
	Defective diode (CR-1) (open).	Replace diode.
	Defective Master switch.	Replace switch.
	Defective diode (CR-2) (shorted).	Replace diode.

EXTERNAL POWER SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of External Power Receptacle

A. Removal of External Power Receptacle (See Figure 201.)

- (1) Place Master switch to OFF.
- (2) Disconnect ground (negative) cable from battery terminal. (See Section 24-3-1, Paragraph 2.A., Battery Removal.)
- (3) Remove access panel on left side of baggage compartment floor.
- (4) From outside the aircraft, open the access door to the external power receptacle.
- (5) Remove the two attaching screws.
- (6) From inside the aircraft, remove the two wires from the external power receptacle.
- (7) Remove receptacle.

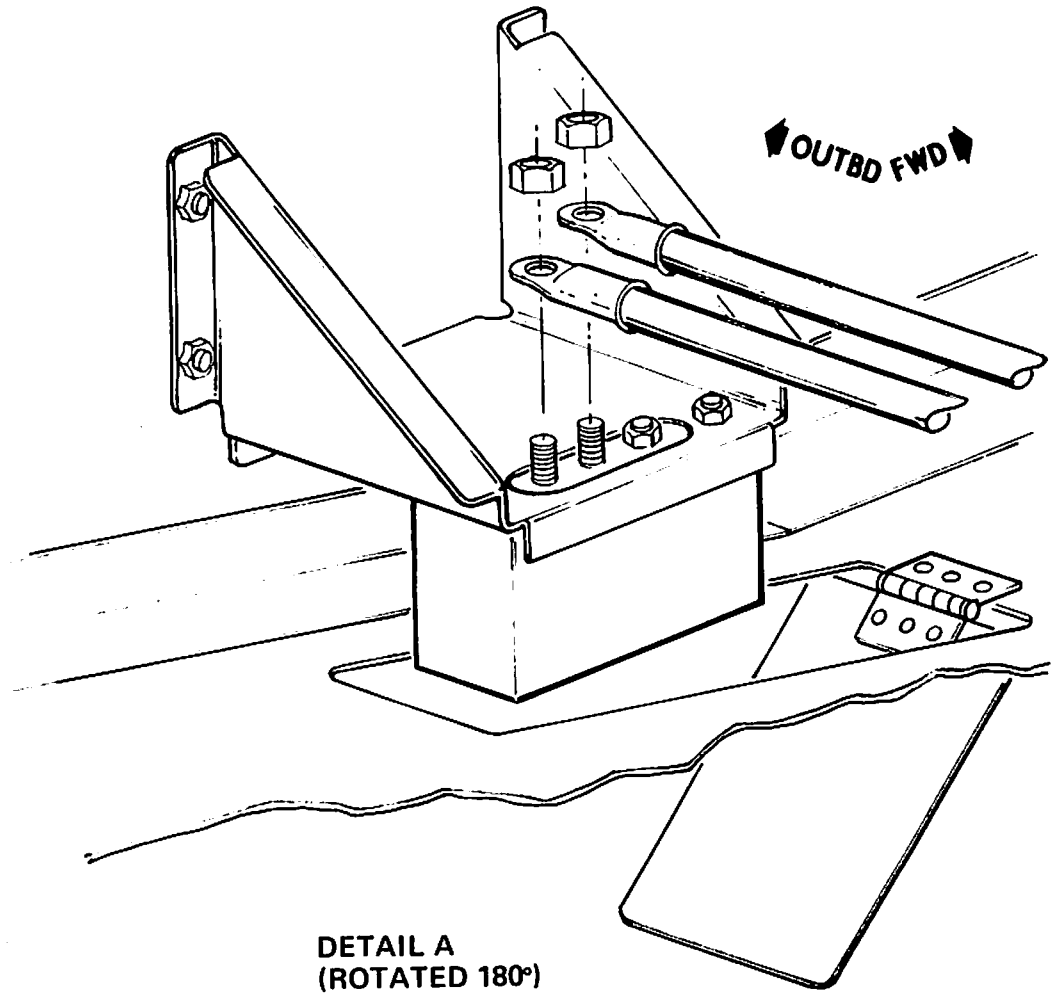
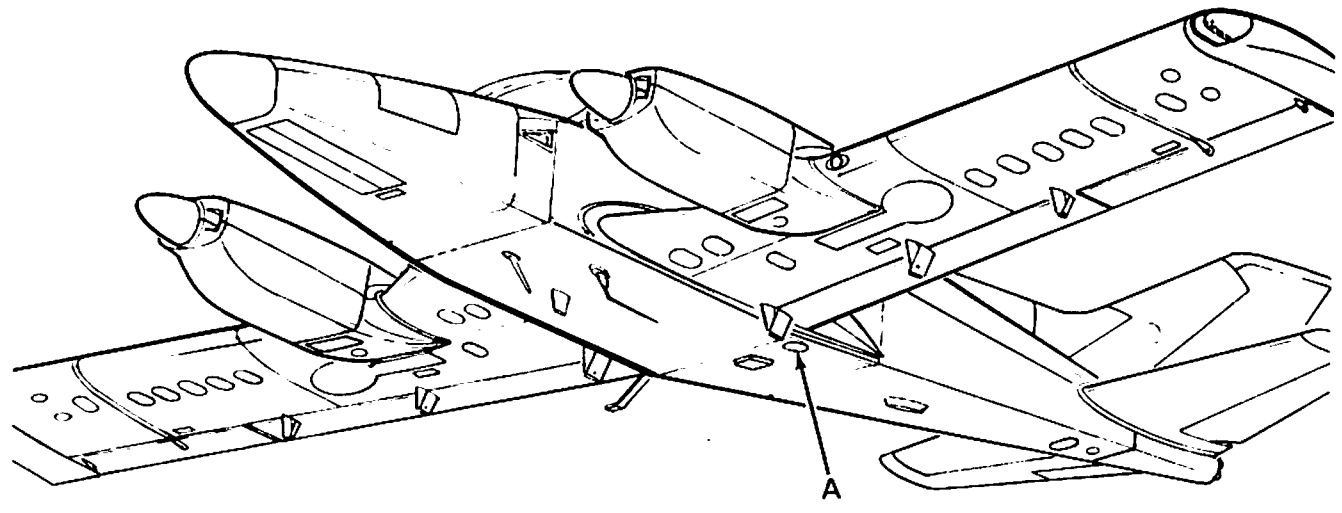
B. Installation of External Power Receptacle (See Figure 201.)

- (1) Ensure Master switch is OFF.
- (2) From inside the aircraft, using the access opening in the floor of the baggage compartment, place the receptacle on the mounting bracket.
- (3) From outside the aircraft, through the access door, secure the receptacle with two screws.
- (4) From inside the aircraft, attach the two wires to the receptacle. Ensure proper polarity is observed.
- (5) Replace access panel in floor of baggage compartment and close access door on outside of aircraft.
- (6) Connect ground (negative) cable to battery terminal.

2. Removal/Installation of External Power Solenoid (See Figure 202.)

A. Removal of External Power Solenoid

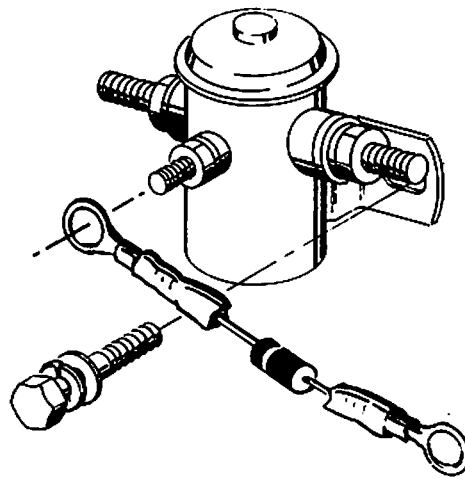
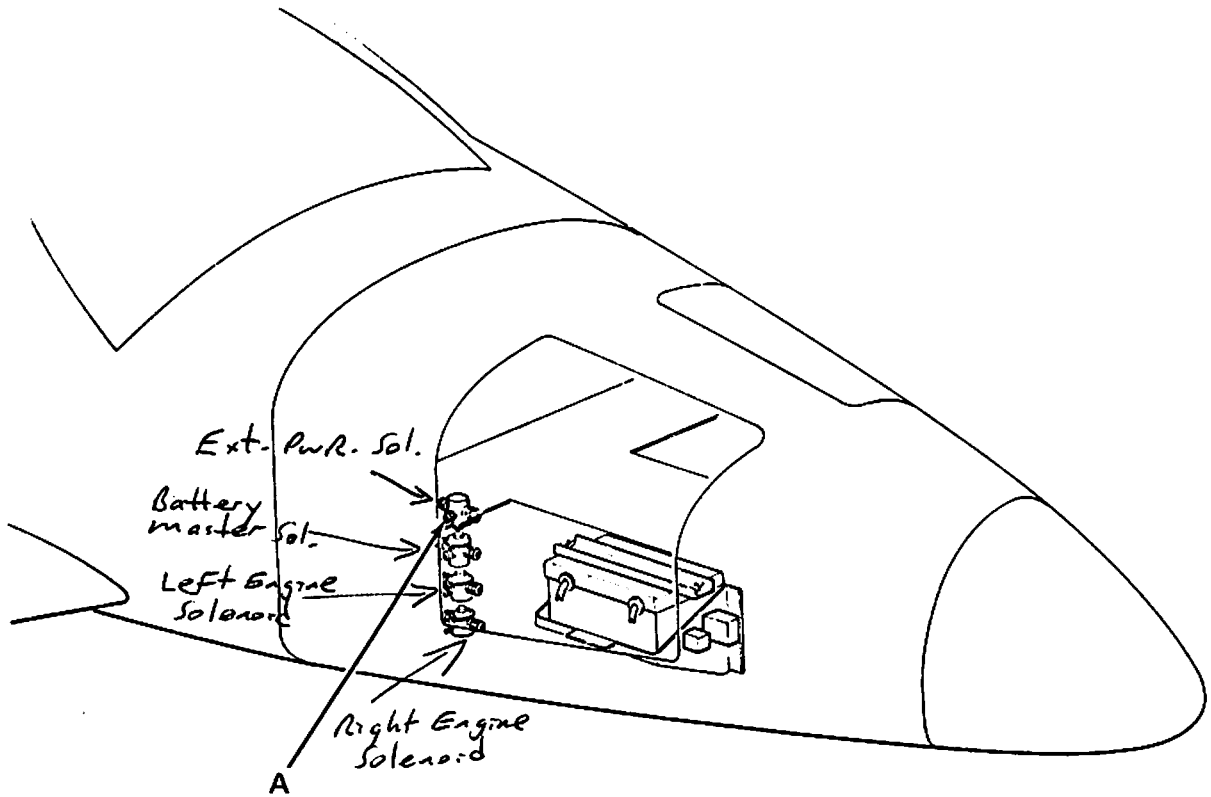
- (1) Open nose baggage compartment door. Remove baggage compartment floor panel to gain access to battery solenoid.
- (2) Remove ground (negative) cable from battery terminal. Pull cable clear of battery and battery box. (See Section 24-3-1, Paragraph 2.A., Battery Removal.)



**DETAIL A
(ROTATED 180°)**

**External Power Receptacle Installation
Figure 201**

24G72-10



DETAIL A

Location of External Power Solenoid
Figure 202

24G72-11

- (3) Disconnect wire 7PC2A2 from terminal on external power solenoid. Disconnect jumper between battery solenoid and external power solenoid.
- (4) Disconnect diode from terminal of external power solenoid.
- (5) Remove the two bolts securing external power solenoid to mounting panel. Remove solenoid.

B. Installation of External Power Solenoid

CAUTION: ENSURE GROUND (NEGATIVE) CABLE IS DISCONNECTED AND CLEAR OF BATTERY TERMINAL BEFORE INSTALLING SOLENOID.

NOTE: Diode used on solenoid should be tested and replaced if necessary before installing solenoid. (See Section 24-0-1, Paragraph 1., Diode Test.)

- (1) Secure external power solenoid to mounting panel with two bolts.
- (2) Connect diode to center connector post. Ensure that the plate of the diode is connected to the center connector post.
- (3) Connect jumper between the battery solenoid left connector post and the left connector post of the external power solenoid.
- (4) Connect wire 7PC2A2 to right connector post of external power solenoid.
- (5) Connect ground (negative) cable to battery. (See Section 24-3-1, Paragraph 2.B., Battery Installation.)

ELECTRICAL LOAD DISTRIBUTION – DESCRIPTION/OPERATION

1. General

Electrical power is supplied through a split bus bar. One side of the bus bar supplies power to the electrical equipment while the other side supplies the electronic (avionics) equipment. When the Master switch is closed, the battery solenoid engages and battery power is supplied to both sides of the split bus bar. Once the engines are started, the output of the alternators supplies power to both sides of the split bus bar. The loads from the electrical bus system are protected by manual-reset type circuit breakers. The circuit breakers are mounted on the lower right of the instrument panel. See Figure 1 in Section 24-0 for typical circuit breaker installation.

2. Electrical Load Analysis

CONTINUOUS LOAD	CURRENT DRAIN (AMPS)
Oil Temperature Gauges	.16
Battery Solenoid	.62
Pitot Heat	6.50
Navigation Lights	3.36
Instrument Lights	1.65
Turn and Bank Indicator	.30
Electric Clock	.10
Hour Meter	.50
Fuel Quantity Gauges	.16
Oil Pressure Gauges	.16
Fuel Pressure Gauges	.16
Tachometer	.15
Console Lights	.66
Fuel Pump Switch Internal Lighting	.20
Strobe Light	7.00
Flap Position Transmitter and Indicator	.08
Compass Light	.08
SHORT TERM LOADS	CURRENT DRAIN (AMPS)
Flap Motor	15.00
Landing Gear Pump	35.00 Max
Landing Gear Solenoid	.60
Landing Gear Down and Locked Position Lights	.99
Landing Gear Unsafe Position Light	.33
Alternator Inoperative Warning Lights	.66
Cabin Dome Lights	.92
Starter	150.00
Starter Solenoid	.60
Landing Lights <i>Alphabram</i>	<i>3.3</i> 7.30
Baggage Light	.33
Step Light	.08
Wing Walkway Light	.08
Cigarette Lighter	6.50
Reading Lights (Rear)	.92
Map Light	.10

AVIONICS EQUIPMENT	CURRENT DRAIN (AMPS)	
	REC	TRANS
NARCO		
COM 120 Transceiver	.76	3.50
NAV 121 Navigation Receiver	.55	—
NAV 122 Navigation Receiver	.55	—
NAV 124 Navigation Receiver	.92	—
CP-135 Audio Control Panel	.41	—
DME-190	3.00	3.00
AT-150 Transponder	1.60	1.60
ADF-140	1.125	—
COLLINS		
VHF-251 Transceiver	.84	4.0
VIR-351 Navigation Receiver	.80	—
IND-350/351 VOR Indicator	.0	.0
AMR-350 Audio Control Panel	.50	—
TDR-950 Transponder	1.0	1.0
IND-650	.0	—
ADF-650	1.9	—
AUTOPILOT		
Century IIB	2	---
Century III	5	---
Century IV	5	---

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SEATS – DESCRIPTION/OPERATION**1. Front Seats (See Figure 201.)**

The GA-7/Cougar airplane is equipped with horizontally-adjustable, independently-mounted front seats. The bucket seats are contoured and feature lumbar cushions for extended comfort during long flights. The seats and backs are covered with a vinyl-fabric combination to harmonize with the cabin interior. Optional headrests are available.

A spring-loaded lever, located beneath the front edge of the seat cushion at the center, is used to release the seat to move forward or aft along the tracks. Detents located at intervals along the tracks are engaged by spring-loaded pins to lock the seat in place.

The front seat backs are hinged to fold forward. Maximum access to the rear seat area can be obtained by moving the right-hand seat full forward and folding the seat back forward and down.

2. Rear Seat (See Figure 202.)

The rear seat is straight and is not adjustable. The cushions are covered with a vinyl-fabric combination to match the front seats. The rear seat cushion is hinged at the forward edge. By moving the front seats forward, the rear seat bottom may be folded forward, providing access to control surface turnbuckles.

If the rear seating space is not to be occupied, additional cargo space may be gained by unsnapping and removing the rear seat back cushions and folding the rear seat back forward and down after releasing the latches. The latches are located on each side of the fuselage behind the rear seat.

SEATS – MAINTENANCE PRACTICES

1. Front Seat Removal (See Figure 201.)

- A. Locate the seat position lever beneath the seat cushion center. Pull the lever up and slide the seat forward as far as it will go.**
- B. Push the control wheel as far forward as it will go. Pull the seat back forward and down.**

NOTE: Cover or remove the rear seat cushions to avoid soiling them.

- C. Locate the stops (Figure 201) on each seat rail. Remove nuts, bolts, washers, and stops.**
- D. Pull the seat position lever up and simultaneously slide the seat forward until the rollers disengage from the track, then aft until the rear rollers disengage from the track. Remove seat from aircraft.**

2. Front Seat Installation (See Figure 201.)

- A. Position the seat aft of the seat tracks so that the aft rollers and retainers engage the seat tracks as shown in Detail A, Figure 201.**
- B. Pull the seat position lever up and move the seat forward, engaging the forward rollers and retainers on the front of the seat tracks. Move the seat aft to the position shown in Figure 201.**
- C. Install one stop on either side of seat track and secure with bolt, washer, and nut.**
- D. Repeat Step C at the other seat track.**

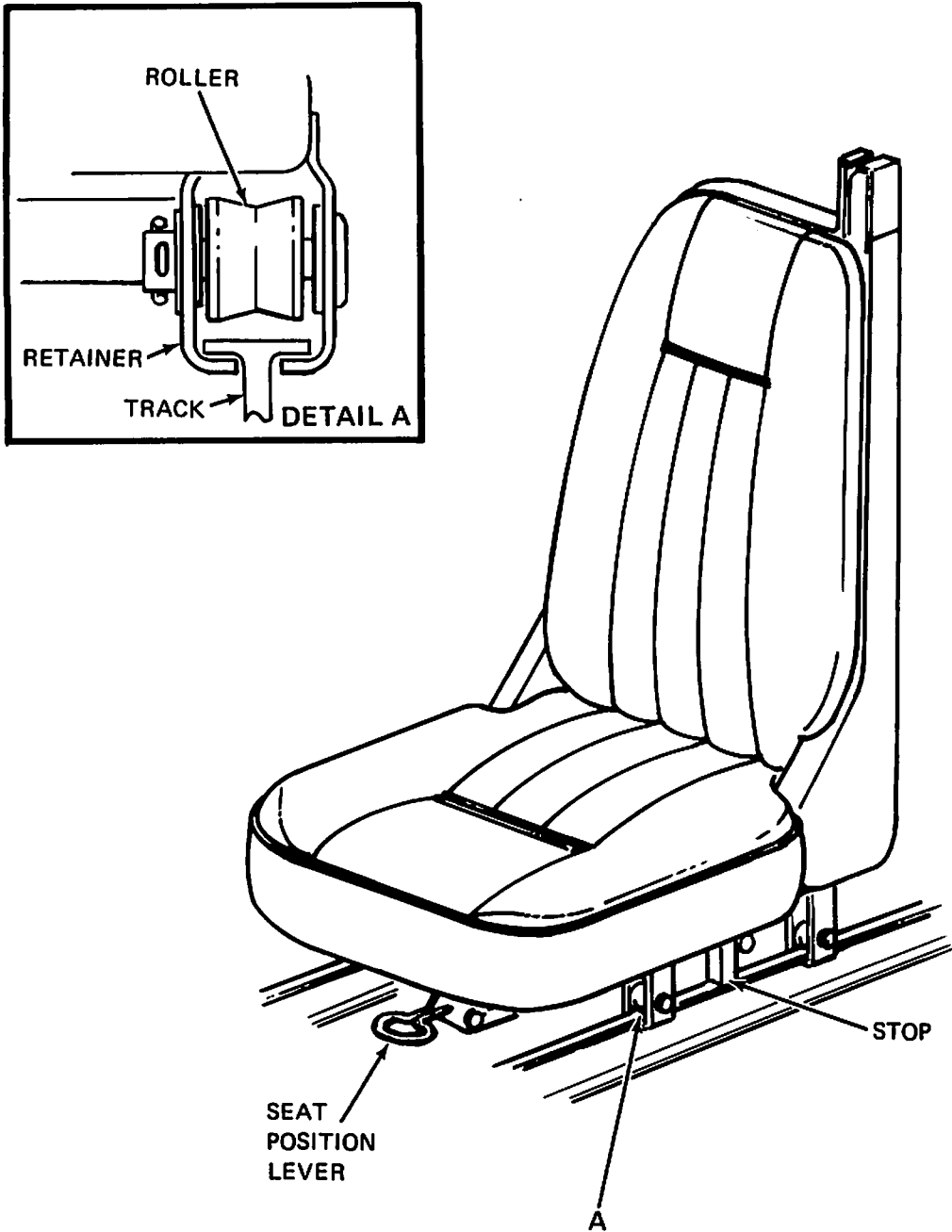
3. Rear Seat Removal (See Figure 202.)

A. Seat Back Removal

- (1) Unsnap and remove the seat back cushions (1).**
- (2) Release the latches at either side of the seat back (2) and fold the seat back forward and down over the seat bottom (8).**
- (3) Remove screws (3) and washers (4). Remove screws (5) and washers (6).**
- (4) Remove seat back (2) from mounting brackets and remove collar assemblies (7) from seat back. Remove seat back from aircraft.**

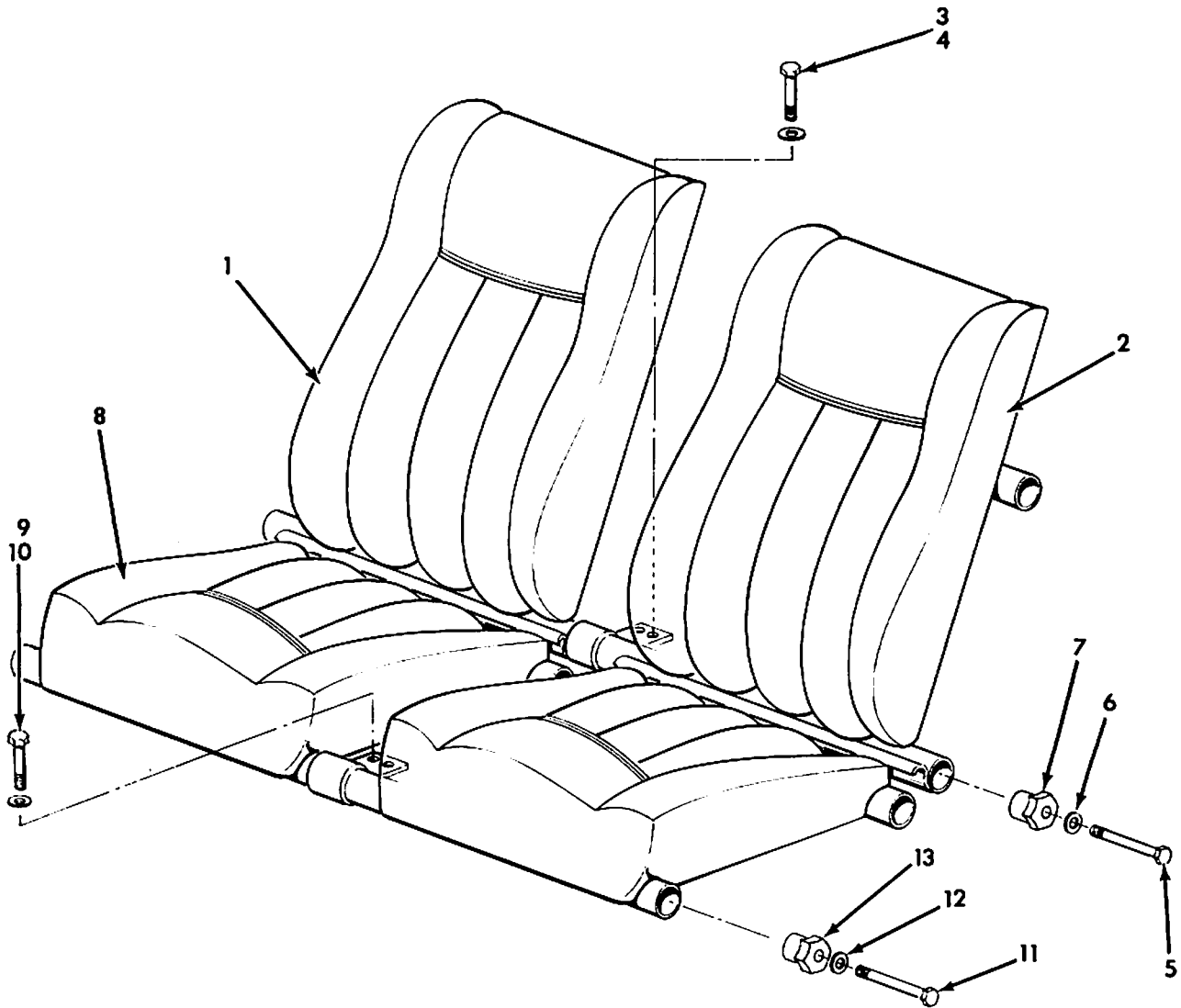
B. Seat Bottom Removal

- (1) Pull the seat bottom (8) up and forward. Remove screws (9) and washers (10).**
- (2) Remove screws (11) and washers (12).**
- (3) Remove seat bottom (8) from brackets and remove collar assemblies (13) from seat bottom. Remove seat bottom from aircraft.**



**Front Seat Installation
Figure 201**

25G72-1



- | | |
|----------------------|---------------------|
| 1. Seat Back Cushion | 8. Seat Bottom |
| 2. Seat Back | 9. Screw |
| 3. Screw | 10. Washer |
| 4. Washer | 11. Screw |
| 5. Screw | 12. Washer |
| 6. Washer | 13. Collar Assembly |
| 7. Collar Assembly | |

**Rear Seat Removal
Figure 202**

25G72-2

4. Rear Seat Installation (See Figure 202.)

A. **Seat Bottom Installation**

- (1) Put seat bottom (8) into aircraft and install collar assemblies (13).
- (2) Position the seat bottom (8) between the brackets and install washers (12) and screws (11).
- (3) Install washers (10) and screws (9).
- (4) Inspect well beneath seat bottom and remove any foreign objects.
- (5) Lower seat bottom into proper position.

B. **Seat Back Installation**

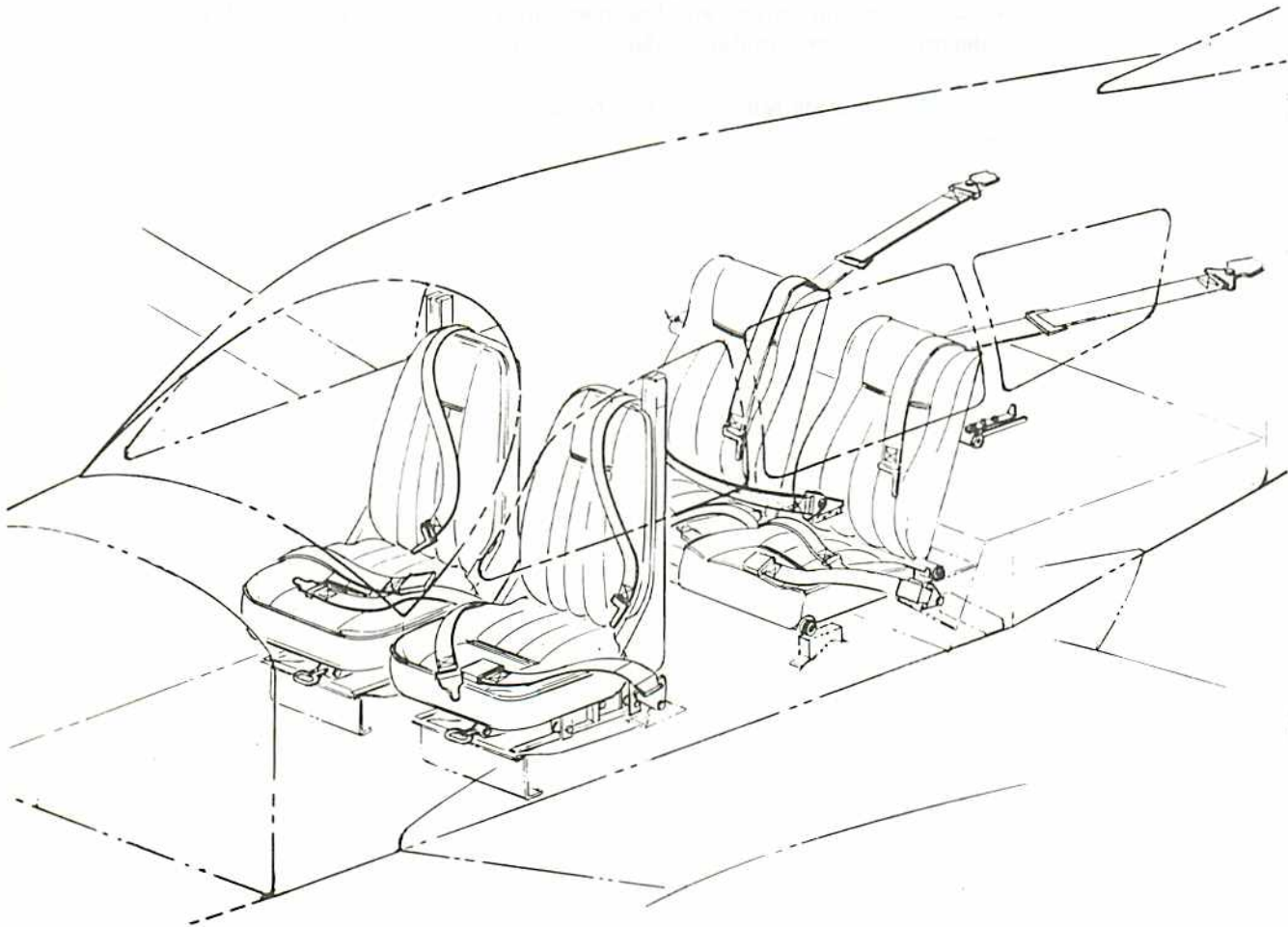
- (1) Put seat back (2) into aircraft and install collar assemblies (7).
- (2) Position the seat back (2) between the brackets and install washers (6) and screws (5).
- (3) Install washers (4) and screws (3). Raise seat back into position and snap seat back cushions (1) into place.

SAFETY BELTS – DESCRIPTION/OPERATION**1. General (See Figure 1.)**

The safety belts for the GA-7/Cougar consist of lap belts and shoulder harnesses at all four seats. The pilot's seat is equipped with an integrated lap belt and shoulder harness assembly. The copilot's seat is equipped with lap belt and detachable shoulder harness. Both front seat belt assemblies are controlled by inertia reels.

The rear seat lap belts are attached to the seat support installations just forward of the baggage areas. The shoulder harnesses for each of the four seats are attached to mounting plates on the fuselage wall at a point aft of its respective seat. Mounting clips are provided on which to stow the shoulder harnesses when not in use.

The rear seat shoulder harnesses and lap belt lengths may be adjusted, by means of slide buckles, to meet the requirements of the wearer.



Lap Belts and Shoulder Harnesses
Figure 1

25G72-3

SAFETY BELTS – MAINTENANCE PRACTICES

1. Front Seat Shoulder Harness Removal

- A. If required, disengage lap belt from shoulder harness.
- B. At cabin wall and Fuselage Station 121.50, remove screw and spacer, and remove shoulder harness.

2. Front Seat Shoulder Harness Installation

- A. Install spacer and washer in hole in shoulder harness end fitting.
- B. Secure shoulder harness end fitting to mounting plate with screw.

3. Front Seat Lap Belt Removal

- A. If required, disengage lap belt from shoulder harness.

NOTE: Observe order in which attaching parts are aligned for installation.

- B. Remove nut, bolt, spacer, and washer from each mounting plate. Remove lap belt.

4. Front Seat Lap Belt Installation

- A. Install washer on bolt head. Install spacer in hole in lap belt end fitting.
- B. Install lap belt end fitting and spacer into proper position. Install bolt and washer.

5. Rear Seat Shoulder Harness Removal

NOTE: Observe order in which attaching parts are aligned for installation.

- A. If required, disengage lap belt from shoulder harness.
- B. At cabin wall and Fuselage Station 180.00, remove screw, washer, spacer, and nut, and remove shoulder harness.

6. Rear Seat Shoulder Harness Installation

- A. Install washer and spacer on screw. Install assembled parts into hole in shoulder harness end fitting.
- B. Insert threaded end of screw through hole in mounting bracket and secure with nut.

7. Rear Seat Lap Belt Removal

- A. If required, disengage lap belt from shoulder harness.

NOTE: Observe order in which attaching parts are aligned for installation.

- B. Remove screw, spacer, and washer. Remove lap belt.

8. Rear Seat Lap Belt Installation

- A. Install washer and spacer on screw.
- B. Install lap belt end fitting into position and secure with screws.

BAGGAGE STRAP ASSEMBLIES – DESCRIPTION/OPERATION

1. **General**

Baggage strap assemblies for the GA-7/Cougar consist of a net in the front compartment tied down to rings, and four strap assemblies, each anchored at one corner of the aft baggage compartment.

The straps in the aft baggage compartment are normally arranged in a crossed position to secure baggage or cargo. Each of the two straps directly behind the rear seat is equipped with a buckle which will accept and clamp in position the strap anchored at the diagonally opposite corner of the aft baggage compartment floor.

The baggage straps in the aft baggage compartment are secured to the floor with spacers, washers, and screws.

CONSOLE ASSEMBLY – DESCRIPTION/OPERATION**1. General**

The center control console is divided into two sections to allow leg room for ease of access to the pilot's seat. The forward control console is mounted beneath the instrument panel and contains the throttle, propeller pitch, and carburetor mixture control levers for each engine. Below these controls, the rudder trim, carburetor heat, and cowl flap controls are found.

The aft console, located between the pilot's and copilot's seats, contains the fuel selector switches, the fuel auxiliary pump switches, the elevator trim wheel, and a map pocket.

CONSOLE ASSEMBLY – MAINTENANCE PRACTICES

1. Forward Control Console Cover Removal

- A. At control quadrant on forward control console, loosen setscrews on throttle, propeller pitch, and carburetor mixture control knobs. Remove control knobs.
- B. Remove attaching screws and forward control console cover.

2. Forward Control Console Cover Installation

- A. Slide slots in forward control console over levers and into position on forward control console. Secure cover with screws.
- B. Remove setscrews from throttle, propeller pitch, and carburetor mixture control knobs. Install knobs on controls.
- C. Apply one drop of Loctite No. 242 to threads of setscrews and install setscrews in control knobs. Tighten setscrews securely.

3. Aft Console Cover Removal

NOTE: The aft console cover is divided into two sections. It is not necessary to remove the fuel selector knobs to remove the aft section of the cover.

- A. Loosen setscrews and remove knobs from fuel selector controls.
- B. Remove screws from either side of aft console covers and remove covers.

4. Aft Console Cover Installation

- A. Install covers and secure with screws.
- B. Remove setscrews from fuel selector control knobs. Install control knobs.
- C. Apply one drop of Loctite No. 242 to threads of setscrews and install setscrews in control knobs. Tighten setscrews securely.

CABIN TRIM, PANELING, AND MOULDING - DESCRIPTION/OPERATION

1. General

The cabin trim, inner paneling, and moulding are formed from thermoplastic material which serves as a covering for insulation and sound deadening material, and also harmonizes with the cabin furnishings. Replacement of trim, panels, and moulding is accomplished by removing rivets, screws, or other fasteners.

MISCELLANEOUS FURNISHINGS – DESCRIPTION

1. Carpeting

The deck in the cabin area and baggage compartment is covered with carpeting which is secured with snap attachments, velcro, or other fasteners to allow easy removal, cleaning, and installation. Refer to Section 25-7-0 for cleaning and other maintenance instructions.

2. Panel Upholstery and Armrests

The side paneling in the cabin interior consists of a vinyl/carpet combination. The armrests are cushioned and covered with vinyl fabric.

3. Hatshelf

The GA-7/Cougar aircraft is equipped with a hatshelf installation on the aft cabin bulkhead above the aft baggage compartment.

4. Glareshield and Deck Assemblies

The glareshield and deck assemblies are mounted to the top of the instrument panel and instrument panel braces. The glareshield projects forward over the instrument panel and prevents lighting from the instruments from reflecting on the windshield. The deck assembly fairs the instrument panel and glareshield to the windshield and fuselage junction and provides a mounting deck for the windshield defroster outlets. The glareshield and deck assemblies may be removed by removing the attaching screws.

5. Sun Visor Assemblies

Plexiglas sun visor assemblies are provided at either side of the windshield. The visors are tinted bronze to remove most of the glare, and yet allow unobstructed vision. The sun visor assemblies are mounted to the fuselage bulkhead aft of the windshield and may be folded upward or to the side of the fuselage when not in use.

6. Map Light, Instrument Lights, and Speaker

Refer to Chapter 33 for map light and instrument lights. Refer to Chapter 23 for speaker.

PORTABLE FIRE EXTINGUISHER – DESCRIPTION/OPERATION

1. **Description**

A portable, dry-chemical fire extinguisher is supplied as optional equipment. The extinguisher is mounted in a quick-release bracket beneath the right front seat and readily accessible by releasing the catch on the mounting strap.

2. **Operation**

- A. Release the catch on the mounting strap to obtain fire extinguisher.
- B. Grasp the ring and pull the safety pin from beneath the operating handle.

WARNING: POINT THE FIRE EXTINGUISHER AWAY FROM FACE AND EYES BEFORE OPERATING. THE POWDER IS RELEASED WITH CONSIDERABLE FORCE.

- C. Aim the nozzle at the base of the smoke or flames and press operating handle down.

PORTABLE FIRE EXTINGUISHER – MAINTENANCE PRACTICES

1. **Removal**

- A. Release the catch on the mounting strap and remove fire extinguisher.
- B. If required, remove bolts, washers, and mounting bracket.

2. **Inspection**

Make sure pointer on gage is within normal limits. Return unit to manufacturer or his authorized service outlet if pointer is above or below normal range.

3. **Installation**

- A. Install mounting bracket and secure with washers and bolts.
- B. Place fire extinguisher into position on mounting bracket and engage the catch.

INTERIOR CARE – MAINTENANCE PRACTICES

1. Cleaning Precautions

- A. Never use gasoline, benzine, acetone, carbon tetrachloride, fire extinguisher fluid, anti-ice fluids, lacquer thinner, glass cleaner, or any petroleum-base solvent as a cleaning agent within the cabin area. These agents are volatile and may cause health and fire hazards if used within the cabin or any enclosed area. These agents will also cause damage to the materials used in the cabin area.
- B. Avoid the use of abrasive cleaning materials. If required, these may be used on opaque plastics, but never on clear plastic, porous plastic, or on fabrics.
- C. Never saturate woven fabric or foam-backed fabric with liquid cleaners. Any residue may damage fabric, padding, and backing.
- D. Use all cleansing agents sparingly. If the one chosen isn't doing the job, large applications probably won't help.
- E. Read the labels or instructions on cleaning agents carefully before using. If the material you need to clean is not specifically mentioned, don't experiment. Follow the manufacturer's recommendations closely.
- F. Leave a light film of lubricant on control wheel shaft and other metal surfaces.

2. Cleaning Procedures

- A. Remove dust, grit, and loose dirt from upholstery and carpeting with a vacuum cleaner. Brushes or brooms only remove surface dirt, and grit left below the surface will accelerate wear.
- B. Periodically remove carpeting and vacuum deck beneath carpeting to remove foreign matter which has sifted through. Vacuum carpet backing thoroughly.
- C. Coffee, soft drinks, milk, and other beverage spills should be blotted up with tissue or rags before they dry. Continue blotting until no more liquid is taken up. Use a cloth wrung out in mild detergent solution, to remove residue from trim and royalite surfaces. Use a foam cleaner on carpet and fabric. Keep the foam as dry as possible and remove it with a vacuum cleaner.
- D. Sticky materials may be removed with a plastic scraper or dull knife. Chill chewing gum with an ice cube before scraping.
- E. Vacuum headliner, cabin walls, trim, control knobs, and other hard surfaces to remove grit and dust. Any residue can normally be removed with a soft cloth dampened in clear water or mild detergent solution. If detergent solution is used, follow with a cloth dampened in clear water.

WARNING: USE SOLVENTS IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- F. Excess lubricant may be removed from control wheel shaft and other metal surfaces with a dry cloth. If required, remove grease from control wheel, knobs, and other plastic or non-metal with Stoddard solvent. Leave a light film of lubricant on control wheel shaft and other metal surfaces.

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FLIGHT CONTROLS – DESCRIPTION/OPERATION

1. General

The flight control system consists of a dual control T-column which operates conventional ailerons and an elevator, rudder pedals which operate the rudder, and an electrically-operated flap system. Aileron, rudder, and elevator controls are augmented by trim systems.

2. Lateral Control System

The lateral control system consists of bellcrank-actuated ailerons positioned by cables extending from the control column. As the control wheel is turned, the chain and sprocket drive actuates the aileron cables. Motion is transmitted from the bellcranks to the ailerons by push rods.

Lateral trim is by means of a spring bungee controlled by a trim knob on the center console.

3. Directional Control System

The directional control system consists of a conventional rudder actuated by a system of rudder pedals, bellcranks, cables, and push rods.

Directional trim is by a hinged trim tab at the rudder trailing edge. Rotary motion of the trim wheel positions the trim tab by means of cables, chain and sprocket, actuator, and push rod. The rudder trim wheel is located on the center console.

4. Longitudinal Control System

The longitudinal control system consists of a conventional dual elevator actuated by bellcranks, push rods, and cables connected to the control column.

Longitudinal trim is by a hinged trim tab at the right elevator trailing edge. Rotary motion of the trim wheel positions the trim tab by means of cables, chain and sprocket, actuator, and push rod. The elevator trim wheel is between the seats at the aft console.

5. Flap System

The flap system consists of two wing flaps, mounted on the wing trailing edges inboard of the ailerons, a torque tube connected by bellcranks and push rods to the flaps, and a flap drive assembly powered by a reversible DC electric motor. Control of the flap system is by a switch on the instrument panel.

6. Gust Lock

The gust lock is a metal pin inserted through the instrument panel collar and the control column to prevent elevator and aileron deflection and possible damage by the wind. The gust lock must be removed to gain access to the master and magneto switches.

7. Rigging Fixtures

To ensure accurate control rigging, the proper rigging fixtures should be used. The following rigging fixtures are available through authorized Grumman American Aviation Dealers:

7YCS10401 – Flap Rigging Fixture

7YCS10402 – Aileron Rigging Fixture

7YCS10403 – Elevator Rigging Fixture

7YCS10404 – Elevator Trim Rigging Fixture

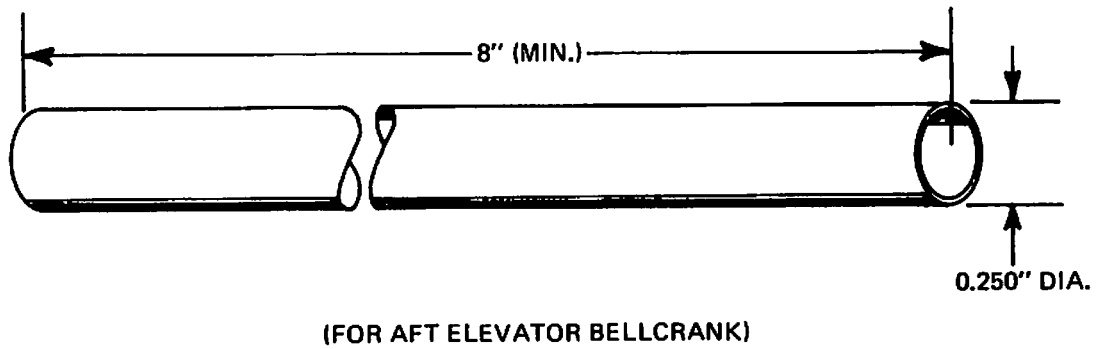
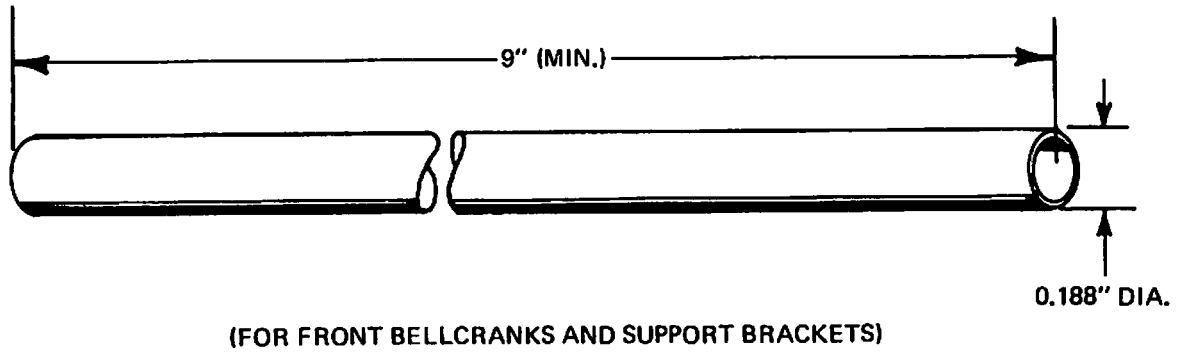
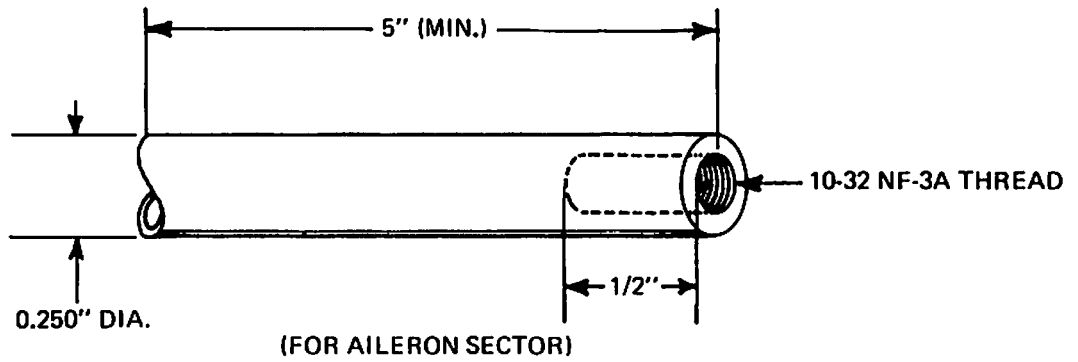
7YCS10405 – Rudder Rigging Fixture

7YCS10406 – Rudder Trim Rigging Fixture

7F10340 – Gust Lock Assembly

8. Rig Pins (See Figure 1.)

Three rig pins are needed to properly rig the GA-7/Cougar. The lengths given are minimum and may be exceeded. Diameters and threading given should be followed closely.



Rig Pins
Figure 1

AILERON AND TRIM – DESCRIPTION/OPERATION**1. Aileron Control System (See Figure 1.)**

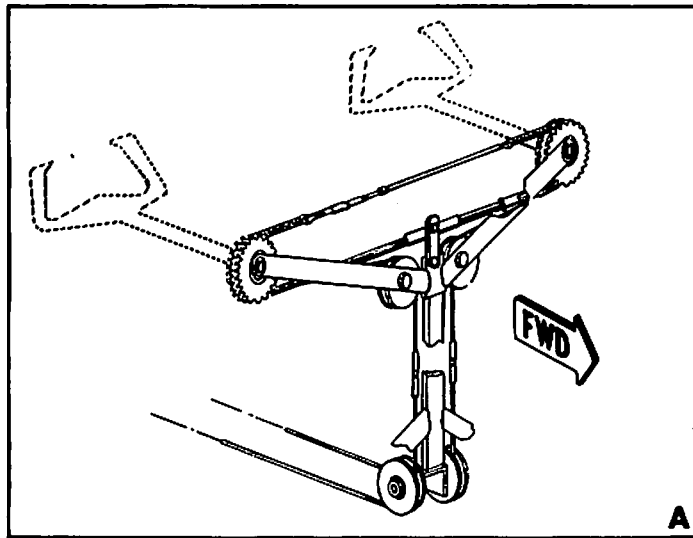
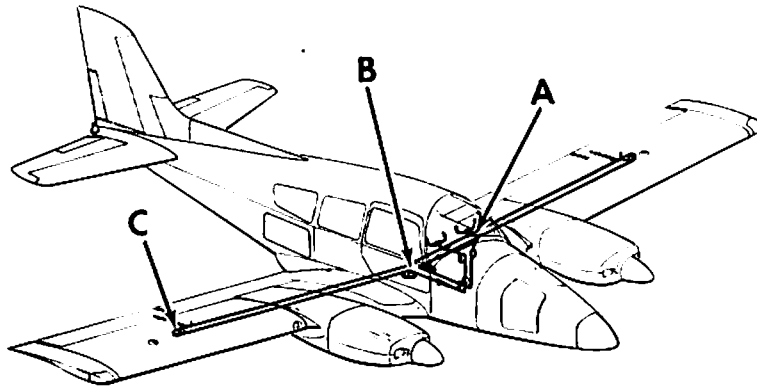
As the control wheel is rotated, its angular displacement is transmitted through a chain and sprocket arrangement on the control column to the aileron sectors located in the wings. Control cables attached to the chain are routed through idler pulleys beneath the center console, and out through the wings to the sectors. The angular displacement of the sector in each wing positions a push rod connected to the aileron. A carry-through cable system, connecting the left and right wing sector together, provides completion of the aileron control and causes one aileron to move up and the other to move down as the control wheel is rotated.

The ailerons are mounted on hinge halves which project beneath the surface of the aileron. The aileron balance weights are located along the aileron leading edge beneath the skin and attached to the rib structure.

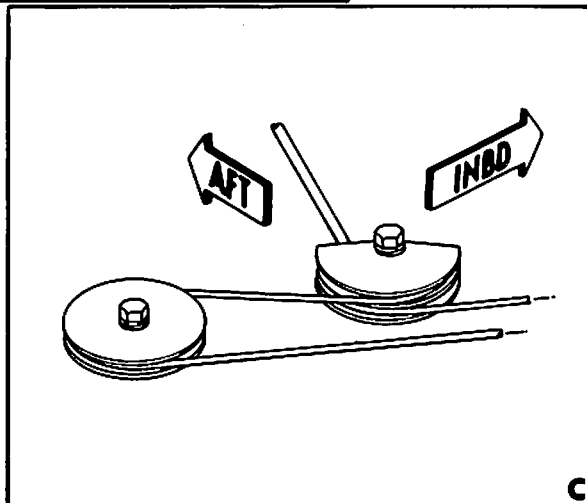
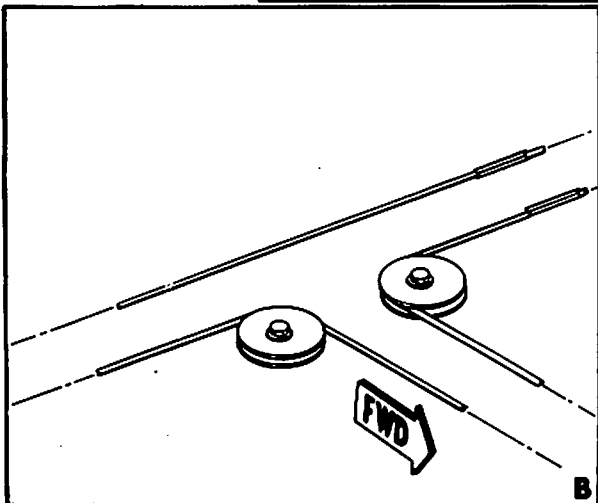
2. Aileron Trim Control System (See Figure 2.)

The aileron trim control system provides a means to trim the aircraft about the roll axis and compensate for variations in attitude caused by passenger and cargo loading. With the aileron trim control knob positioned so that the pointer is in the neutral (vertical) position, the aircraft should be slightly heavy on the left wing when flying solo.

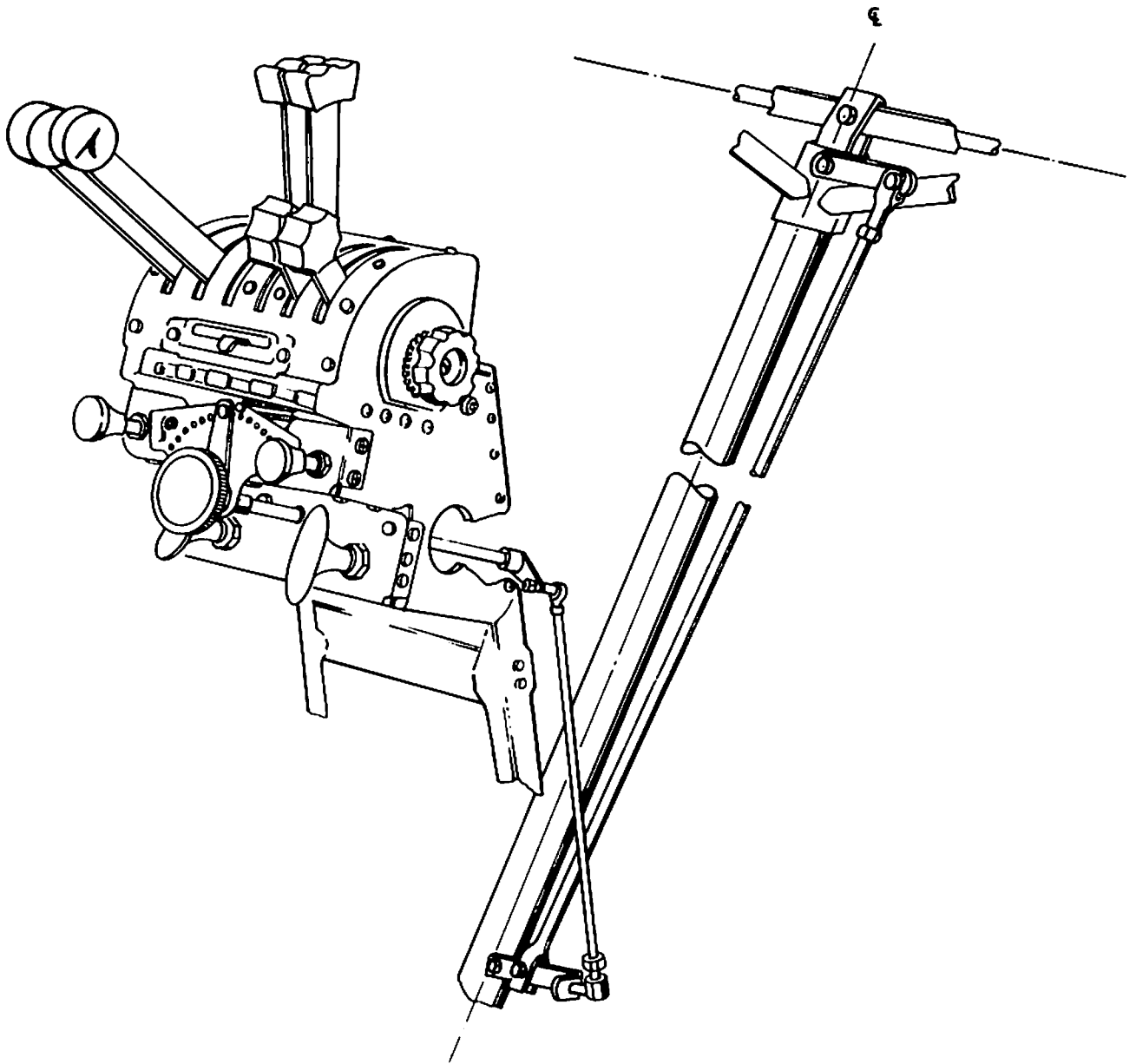
The aileron trim control knob is connected by a system of levers and push rods to a bungee at the top of the control column. With the control knob in the neutral position, spring action in the bungee will return the ailerons to the neutral position each time pressure is released at the control wheel. As the aileron trim control knob is rotated from the neutral position, a corresponding amount of pre-loading is introduced into the bungee, resulting in each aileron being returned to a point slightly away from the neutral position.



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**Aileron Control System
Figure 1**



**Aileron Trim Control System
Figure 2**

AILERON AND TRIM – MAINTENANCE PRACTICES**1. Aileron Removal (See Figure 201.)**

NOTE: To facilitate the removal of ailerons and to reduce the possibility of aircraft structural damage apply a liberal amount of penetrating oil to hinge points and attaching parts 4 hours prior to removal and immediately before removal if signs of corrosion are noted.

A. Install control wheel lock.

NOTE: Aileron can be removed and reinstalled without disturbing rigging as long as length of push rod assembly (18, Figure 201) is maintained. Do not loosen locknuts on push rod.

B. Remove access cover from beneath wing at Wing Station 161.00.

C. Provide suitable support for aileron across hinge points.

D. At aileron push rod in wing, note position and quantity of washers (16) for installation. Remove cotter pin (14), nut (15), and washers (16) under nut.

E. Remove bolt (17). Lower aileron onto support.

CAUTION: MAINTAIN ALIGNMENT OF AILERON AND WING TRAILING EDGE DURING REMOVAL TO AVOID DAMAGE OR MISALIGNMENT OF COMPONENTS.

F. At center hinge, note position and quantity of washers (3 and 4) for installation. Remove cotter pin (1).

G. Remove nut (2) washers (3 and 4) and bolt (5).

H. Repeat steps F and G at outboard hinge.

I. At inboard hinge, note position and quantity of washers (10, 11, and 12) for installation. Remove cotter pin (8).

J. Remove nut (9), washers (10, 11, and 12), and bolt (13). Remove aileron.

2. Aileron Installation (See Figure 201.)

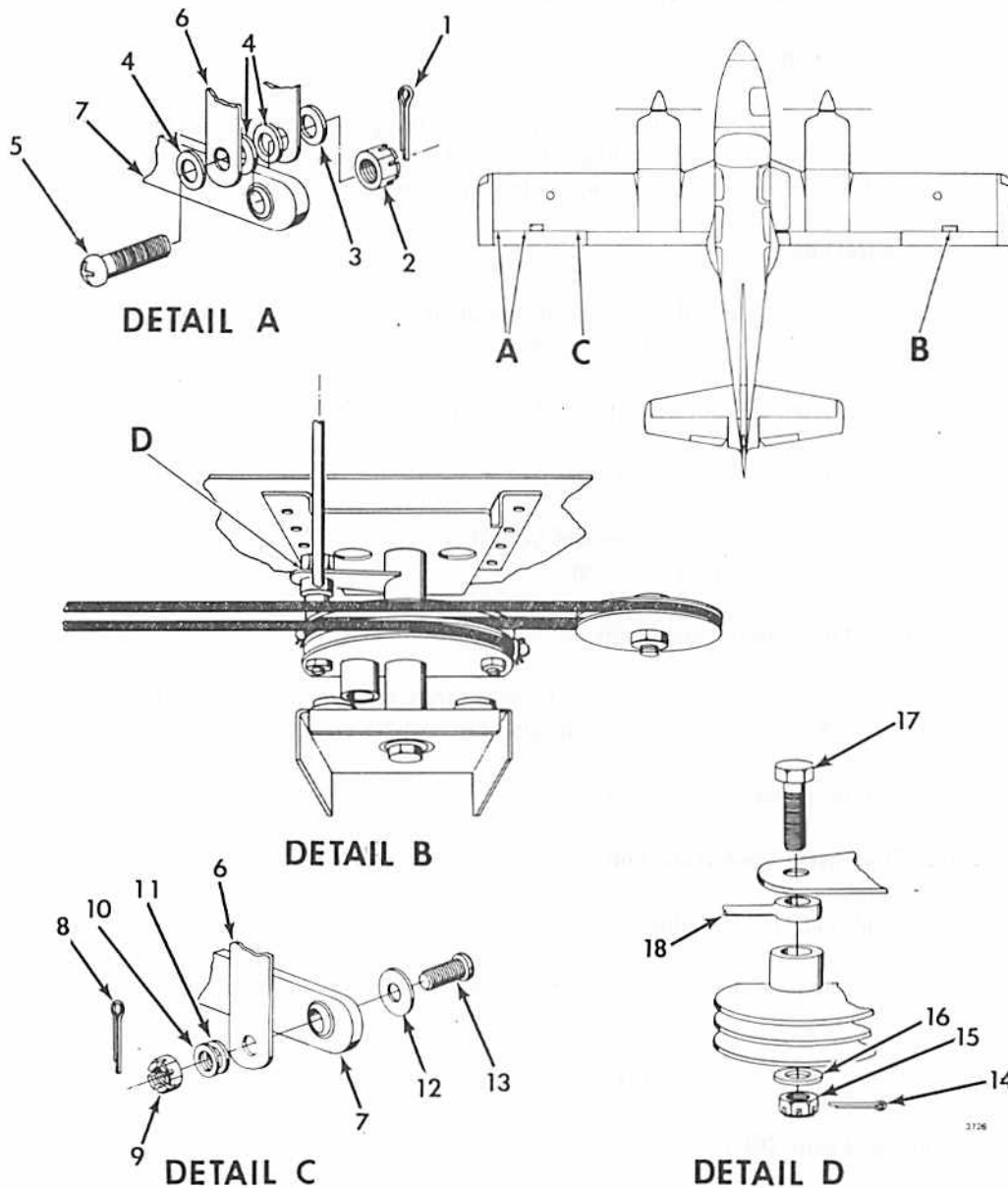
CAUTION: MAINTAIN ALIGNMENT OF AILERON AND WING TRAILING EDGE DURING INSTALLATION TO AVOID DAMAGE OR MISALIGNMENT OF COMPONENTS.

A. Raise aileron into proper position and provide support during installation.

B. At inboard hinge point, install bolt (13, Figure 201), washers (10, 11, and 12), and nut (9). Do not install cotter pin (8) at this time.

C. At center hinge, install bolt (5), washers (3 and 4), and nut (2). Do not install cotter pin (1) at this time.

D. At outboard hinge, install bolt (5), washers (3 and 4), and nut (2). Do not install cotter pin (1) at this time.



- 1. Cotter Pin
- 2. Nut
- 3. Washer
- 4. Washer
- 5. Bolt
- 6. Aileron Assembly
- 7. Wing
- 8. Cotter Pin
- 9. Nut

- 10. Washer
- 11. Washer
- 12. Washer
- 13. Bolt
- 14. Cotter Pin
- 15. Nut
- 16. Washer
- 17. Bolt
- 18. Push Rod Assembly

Aileron Installation
Figure 201

- E. Install push rod assembly (18) into position on sector and secure with bolt (17), washer (16), and nut (15). Do not install cotter pin (14) at this time.
- F. Tighten nut (15) to minimum recommended torque value (Chapter 91). Continue tightening as required to install cotter pin (14). Install cover on wing.
- G. In flight compartment, remove control wheel lock. Rotate control wheel slowly through its full travel, checking for freedom of operation. Install control wheel lock.
- H. At outboard hinge, tighten nut (2) to minimum recommended torque value (Chapter 91). Continue to tighten up to maximum torque value as required to install cotter pin (1).

NOTE: Thin washers (3) may be added or substituted for thick washers (4) as required to allow cotter pin (1) to be installed within recommended torque range.

- I. Repeat Step H at center hinge.
- J. At inboard hinge point, tighten nut (9) to recommended torque value (Chapter 91). Continue to tighten up to maximum torque value as required to install cotter pin (8).

NOTE: Thin washers (10) may be added or substituted for thick washers (11) as required to allow cotter pin (8) to be installed within recommended torque range.

- K. Rig aileron controls in accordance with Paragraph 7.

3. Bearing Inspection and Replacement

- A. Remove ailerons in accordance with Paragraph 1.

NOTE: Due to the man-hours and other costs incurred in thoroughly inspecting small attaching parts, the low frequency of required inspections, and the low cost and availability of the attaching parts, it is suggested that the most economical approach would be to replace bolts, washers, nuts, and cotter pins. If old hardware is to be used, a dimensional inspection must be performed to determine if any corrosion, wear, galling, fretting, or thread damage has progressed beyond acceptable limits.

- B. Inspect hinge fittings and mating fittings for cracks and chafing, paying particular attention to areas adjacent to bearings, attaching parts, and areas of hinge travel. If evidence of cracks is noted, remove paint or finish from suspected areas and perform Zyglo or dye penetrant inspection.
- C. Inspect all attaching hardware for corrosion, galling, fretting, and thread damage.
- D. Inspect bearings for corrosion, damage, freedom of rotation, and general condition.

CAUTION: USE A BEARING PULLER TO REMOVE AND INSTALL BEARINGS. ATTEMPTING TO DRIVE THE BEARING FROM THE HINGE FITTING MAY RESULT IN MISALIGNMENT OR DAMAGE TO WING STRUCTURE.

- E. If required, replace the bearing. Use a bearing press to remove the bearing. Inspect faying surface of hinge for corrosion, cracks, and other damage. Coat inside of hinge fitting and outer ring of bearing with MIL-G-21164 molybdenum disulphide grease. Use a bearing press to install bearing. Stake bearing on each side with four tangential stakes 0.15 inch long, equally spaced on a 0.85-inch circle around bearing.

F. Install aileron in accordance with Paragraph 2.

4. Aileron Control Cable Replacement (See Figure 202.)

A. Carry-Through Cable Removal

NOTE: The following procedures can be used to remove either carry-through cable.

- (1) Install the control wheel lock. Place aileron trim control in neutral position.
- (2) Remove access covers (1) from bottom of both wings at Wing Station 161.00 by removing screws (2).
- (3) Install rigging pins (3) through inboard stops and screw onto bolts (4).
- (4) In passenger compartment, fold rear seat bottom up and forward to gain access to control cables. Remove locking clip (5) and turnbuckle (6).
- (5) Remove cotter pins (7) from pulley brackets (8) at side of fuselage.
- (6) At Wing Stations 166.75, remove cotter pin (9) from idler pulley bracket (10).

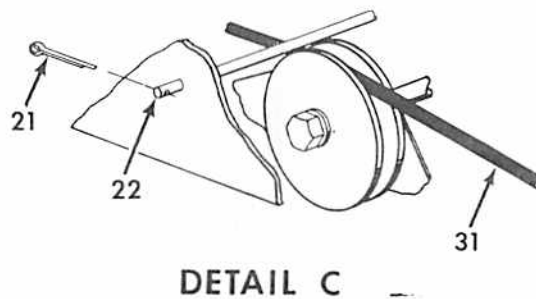
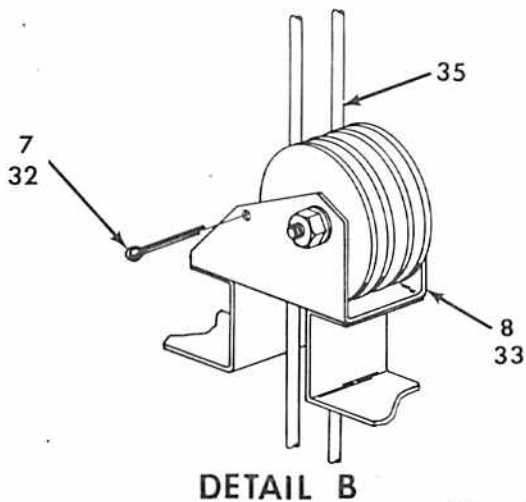
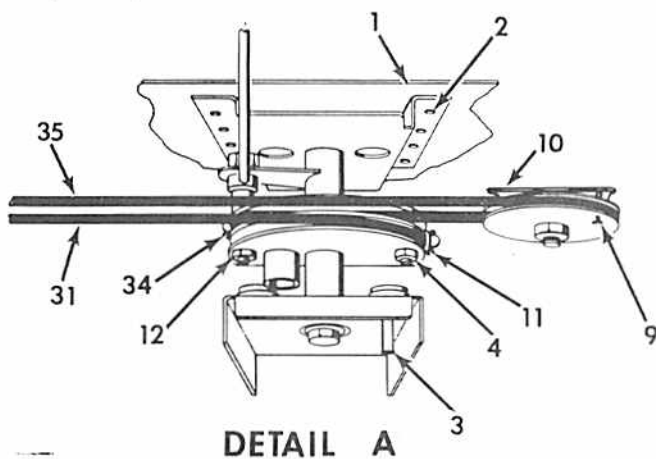
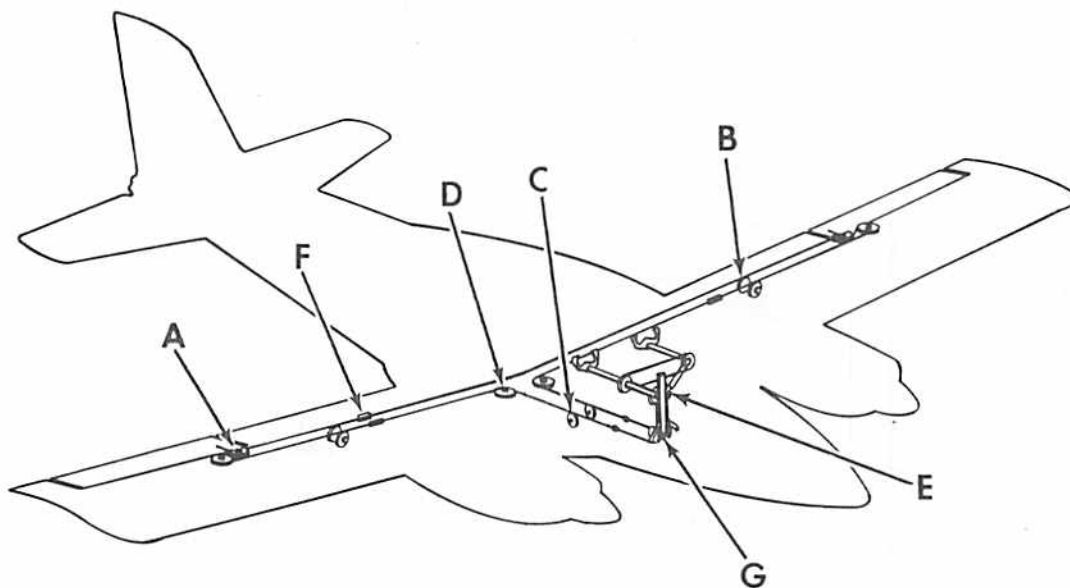
NOTE: Due to the confined wing areas through which the cables pass, a wire or cord should be attached to the outboard cable end and pulled into position as the existing cable is removed.

- (7) Remove cotter pin (11) from sector (12). Attach a wire or cord to outboard cable end.
- (8) Pull cable into passenger compartment. Disconnect wire or cord and leave in place.

B. Carry-Through Cable Installation (See Figure 202.)

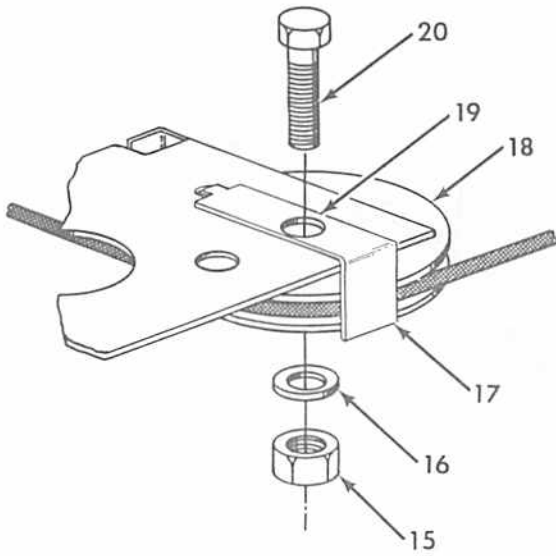
NOTE: Lubricate cables in pulley areas with commercial grade paraffin before installation.

- (1) Slide washer on cable down to ball end terminal and secure in place.
- (2) In rear seat well, secure ball end terminal and washer to pull wire or cord. At Wing Station 161.00, pull carry-through cable into position.
- (3) Route carry-through cable around idler pulley bracket (10) and sector (12). Position washer and ball end at end of sector (12) as shown in Figure 202 and insert cotter pin (11). Bend one end of cotter pin inboard and the other outboard around center plate of sector. Do not install cotter pin completely through sector as other cable will climb on cotter pin in extreme sector travel.
- (4) Route cable through channels in sector (12) and pulley. Install cotter pin (9) through idler pulley bracket (10).

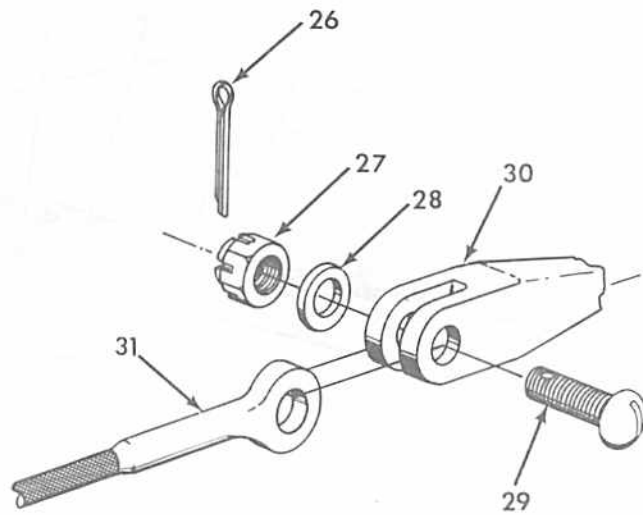


Aileron Control Installation
Figure 202 (Sheet 1 of 3)

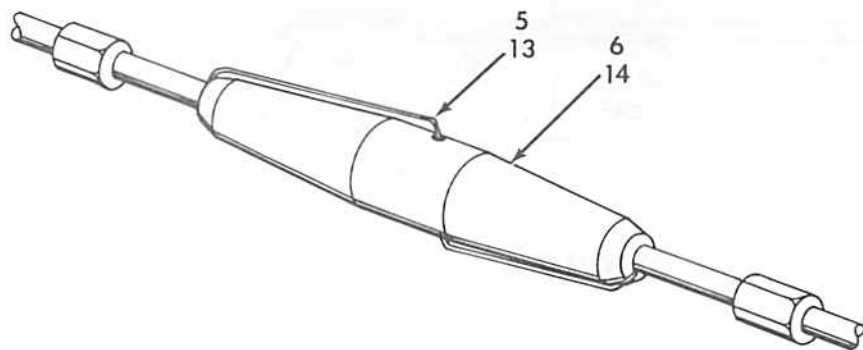
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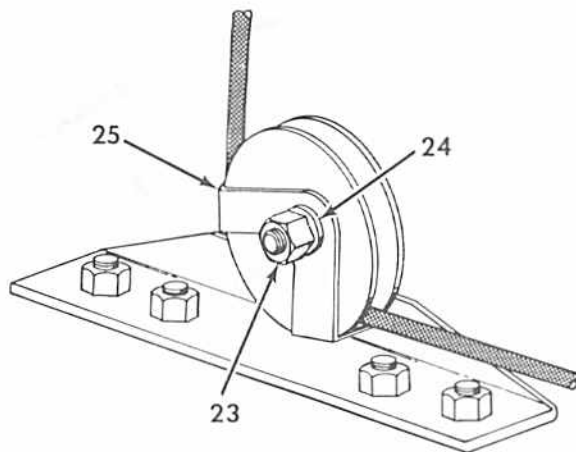
DETAIL D



DETAIL E



DETAIL F



DETAIL G

**Aileron Control Installation
Figure 202 (Sheet 2 of 3)**

- | | |
|--------------------------|---------------------------|
| 1. Access Cover | 19. Bracket |
| 2. Screw | 20. Bolt |
| 3. Rigging Pin | 21. Cotter Pin |
| 4. Bolt | 22. Rod |
| 5. Locking Clip | 23. Nut |
| 6. Turnbuckle | 24. Washer |
| 7. Cotter Pin | 25. Guard |
| 8. Pulley Bracket | 26. Cotter Pin |
| 9. Cotter Pin | 27. Nut |
| 10. Idler Pulley Bracket | 28. Washer |
| 11. Cotter Pin | 29. Bolt |
| 12. Sector | 30. Control Wheel Cable |
| 13. Locking Clip | 31. Forward Aileron Cable |
| 14. Turnbuckle | 32. Cotter Pin |
| 15. Nut | 33. Guard |
| 16. Washer | 34. Cotter Pin |
| 17. Guard | 35. Aft Aileron Cable |
| 18. Pulley | |

**Aileron Control Installation
Figure 202 (Sheet 3 of 3)**

- (5) In passenger compartment, route cables beneath pulley at side of fuselage and install cotter pins (7) in brackets (8).

NOTE: Cable tension should be adjusted at an ambient temperature that is average for the area in which the aircraft is usually operated. If ambient temperature is above or below normal, it is recommended that cable tension be measured and adjusted as necessary when temperature returns to normal.

- (6) Install turnbuckle (6) and adjust cable tension to 25 ± 5 pounds. Install new locking clip (5).
- (7) Remove rigging pins (3) from sector assemblies (12). Remove control lock from control column.
- (8) With an aileron rigging fixture, check for aileron travel of 15 ± 2 degrees up. If necessary, rig ailerons in accordance with Paragraph 7. Refer to Section 27-0 for rigging fixture part numbers.

C. Control Cables Removal

NOTE: The following procedures can be used to remove the aileron cables on either side.

- (1) Install the control wheel lock and place the aileron trim control in the neutral position.
- (2) Remove access covers (1) from bottom of both wings at Wing Station 161.00 by removing screws (2).
- (3) Install rigging pins (3) through inboard stops and screw onto bolts (4).

- (4) In passenger compartment, fold rear seat bottom up and forward to gain access to control cables. Remove locking clip (13) and turnbuckle (14).
- (5) Remove center console covers. (See Chapter 25.)
- (6) Remove nut (15), washer (16), guard (17), pulley (18), and bolt (20) from bracket (19).
- (7) In area beneath elevator trim control wheel, remove cotter pin (21) and rod (22).
- (8) At control column, remove forward two nuts (23) and washers (24). Remove guard (25).
- (9) Remove cotter pin (26), nut (27), washer (28), and bolt (29). Separate control wheel cable (30) from forward aileron cable (31).
- (10) Attach a wire or cord to forward aileron cable (31), beneath control column. Pull forward aileron cable aft. Disconnect wire or cord and leave in place.
- (11) In rear seat well, remove cotter pin (32) and guard (33).
- (12) At Wing Station 161.00, remove cotter pin (34) from outboard end of sector (12).

NOTE: Due to the confined areas through which the cables pass, a wire or cord should be attached to the outboard cable end and pulled into position as the existing cable is removed.

- (13) Attach a wire or cord to outboard cable end and pull cable into passenger compartment. Disconnect wire or cord and leave in place.

D. Control Cables Installation

NOTE: Lubricate cables in pulley areas with commercial grade paraffin before installation.

- (1) On aft aileron cable (35) slide washer down to ball end terminal and secure in place.
- (2) In rear seat well, secure ball end and washer to pull wire or cord. At Wing Station 161.00, pull aft aileron cable (35) into position.
- (3) Route aft aileron cable around sector (12). Position washer and ball end at end of sector as shown in Figure 202 and insert cotter pin (34) in outboard end of sector. Bend one end of cotter pin inboard and the other outboard around center plate of sector. Do not install cotter pin completely through sector as other cable will climb on cotter pin in extreme sector travel.
- (4) In rear seat well, route aft aileron cable through guard (33) and install cotter pin (32).
- (5) Attach forward aileron cable (31) to aft end of wire or cord and pull forward into position beneath control column.
- (6) Install end of forward aileron cable (31) into clevis end of control wheel cable (30). Install bolt (29), washer (28), nut (27), and cotter pin (26).

- (7) Route forward aileron cable (31) through pulley beneath control wheel. Install guard (25), washers (24), and nuts (23).
- (8) In area beneath elevator trim control wheel, route forward aileron cable (31) over pulley. Install rod (22), and cotter pin (21).
- (9) At aft end of center console, install bolt (20) in bracket (19) and install pulley (18) on bolt. Route forward aileron cable (31) around pulley (18). Install guard (17), washer (16), and nut (15).

NOTE: Cable tension should be adjusted at an ambient temperature that is average for the area in which the aircraft is usually operated. If ambient temperature is above or below normal, it is recommended that cable tension be measured and adjusted as necessary when temperature returns to normal.

- (10) Install turnbuckle (14) and adjust cable tension to 35 ± 5 pounds with bob weight supported. Install new locking clip (13).
- (11) Remove rigging pins (3) from sector assemblies (12). Remove control lock from control column.
- (12) Using an aileron rigging fixture, check for aileron travel of 15 ± 2 degrees down, 25 ± 2 degrees up. Refer to Section 27-0 for rigging fixture part numbers. If necessary, rig ailerons in accordance with Paragraph 7.
- (13) Install center console covers. (See Chapter 25.)
- (14) Install access covers (1).

5. Control Surface Balancing Procedures

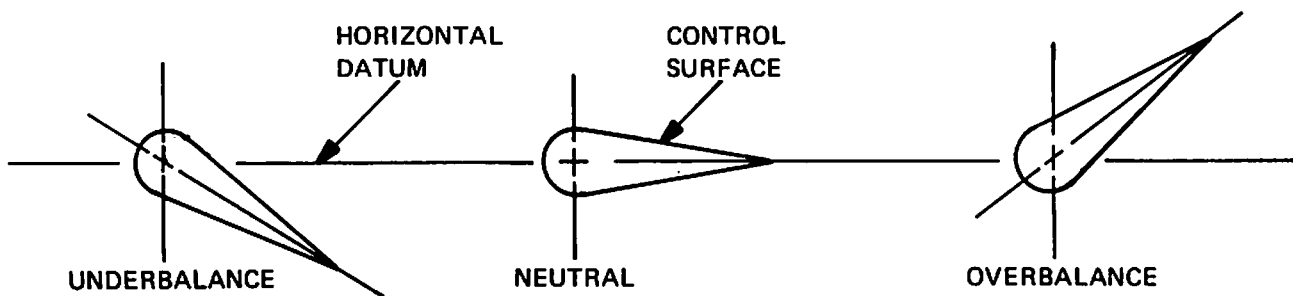
A. Definitions (See Figure 203.)

- (1) Underbalance is defined as the condition that exists if the control surface is trailing-edge heavy, and is symbolized by the plus (+) sign.
- (2) Overbalance is defined as the condition that exists if the control surface is leading-edge heavy, and is symbolized by the minus (-) sign.
- (3) Neutral static balance is defined as the condition that exists if the control surface is neither leading-edge or trailing-edge heavy and the chord line of the control surface is horizontal when placed in the balancing device.

B. General Balancing Procedures

NOTE: The balancing device may be constructed in any manner as long as the requirements given below are met.

- (1) A line drawn through the hinge line support points must be level and perpendicular to the supporting knife edges.
- (2) The supporting knife edges must be horizontal and parallel to each other within the requirements of (1). The knife edges must be designed to allow the control surface to pivot freely about the hinge points.



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**Control Surface Static Balance
Figure 203**

- (3) The control surface must be supported in normal flight attitude or as indicated in the control surface instructions.
- (4) The area in which balancing operations are performed must be free of drafts or other air movements which might disturb the balancing operation.
- (5) Control surfaces equipped with trim tabs must have the tab at neutral (0 degree) position and the push rod must be in place during balancing operation.
- (6) The balancing device must include a means for accurately measuring the distance of the gage weight from the hinge line. The size of the gage weight is not critical as long as its weight in ounces is accurately known; however, if the weight values given in Table I are used, computation of moment will not be necessary.
- (7) Control surface balancing must be the last maintenance operation prior to installing the control surface on the aircraft. Any corrosion coating, painting, striping, or repairs performed will affect the control surface balance.

C. Aileron Balancing (See Figure 204A.)

NOTE: The access cover and all attaching hardware must be installed on aileron before balancing is accomplished.

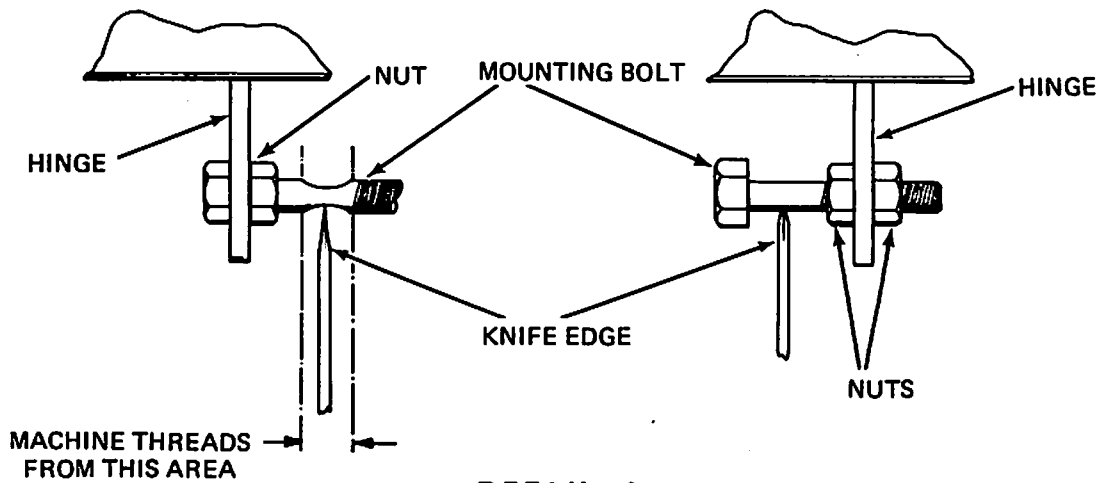
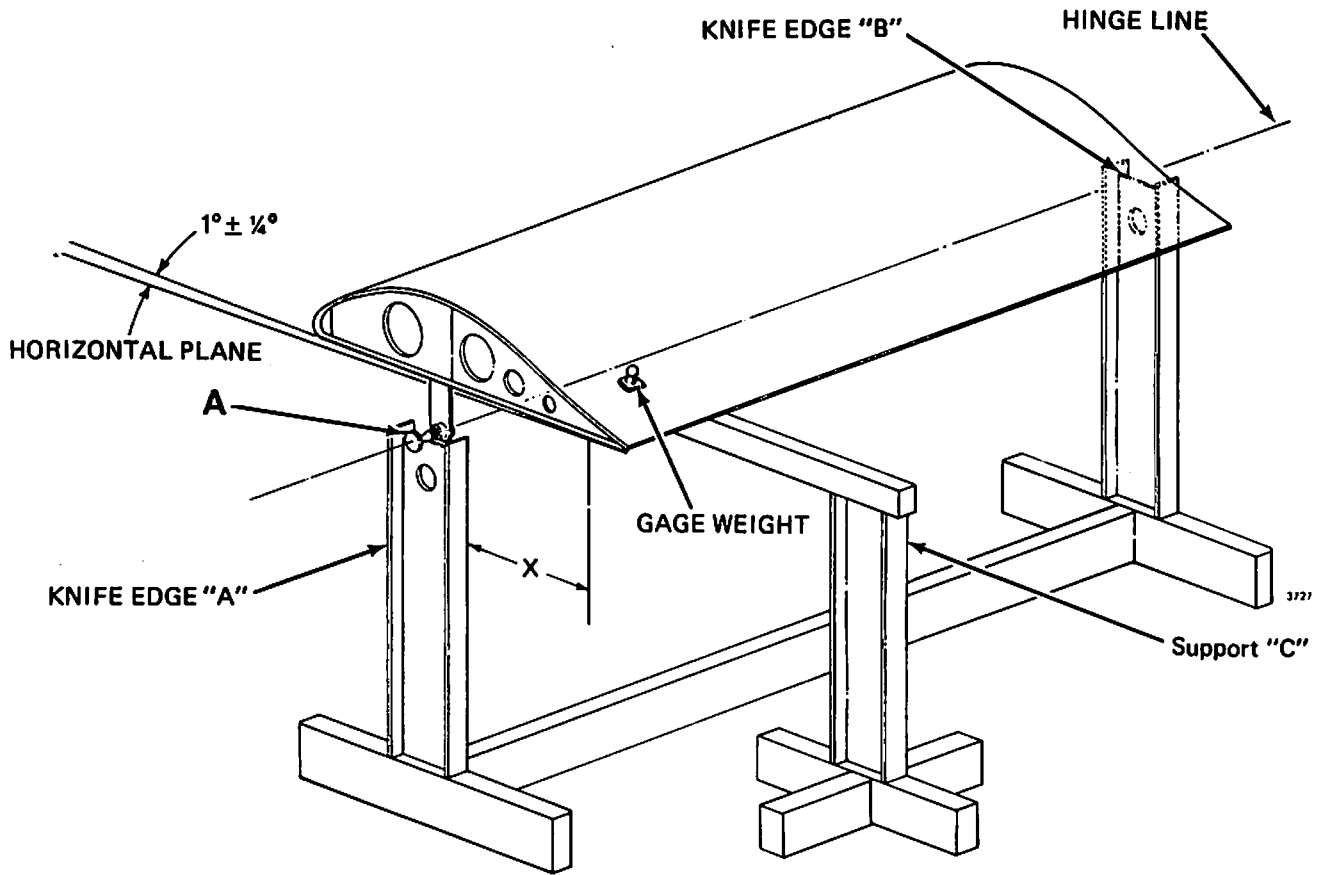
- (1) Devise a bearing surface for the inboard and outboard aileron hinges. Two methods using attaching hardware are shown in Detail A, Figure 204A. The bolts used must fit the mounting holes in the aileron hinge, and the area contacted must be smooth and concentric with the mounting hole.
- (2) Support the aileron on knife edges A and B (not shown), and level the hinge centerline. Rest the aileron trailing edge on support C. Place gage weight aft of hinge line as shown to hold trailing edge down.
- (3) Adjust the height of support C so that the bottom surface of the aileron makes a $1 \pm 1/4$ degree angle with the horizontal plane as shown.
- (4) Move the gage weight toward the aileron leading edge until the point is reached where the trailing edge tends to leave support C.
- (5) Measure and record the distance (X) from the hinge centerline to the gage weight. The gage weight must be within the distance limits given in Table 1.
- (6) If the gage weight is forward of the distance limits given in Table 1, weight must be added to the aileron leading edge. Two threaded holes are provided on the inboard wall of the leading edge access opening to install additional weight.
- (7) If the gage weight is aft of the distance limits given in Table 1, remove the leading edge access cover and drill or shave material from the weight in the leading edge to bring control surface balance within limits.

TABLE 1. CONTROL SURFACE BALANCE DATA

CONTROL SURFACE	MOMENT (IN. OZ)	GAGE WT (OZ)	LIMIT (IN.)	
			FWD	AFT
Aileron	0 to -48	8	0	6.0
Rudder	+48 to -48	8	6.0	6.0
Elevator	0 to -64	8	0	8.0

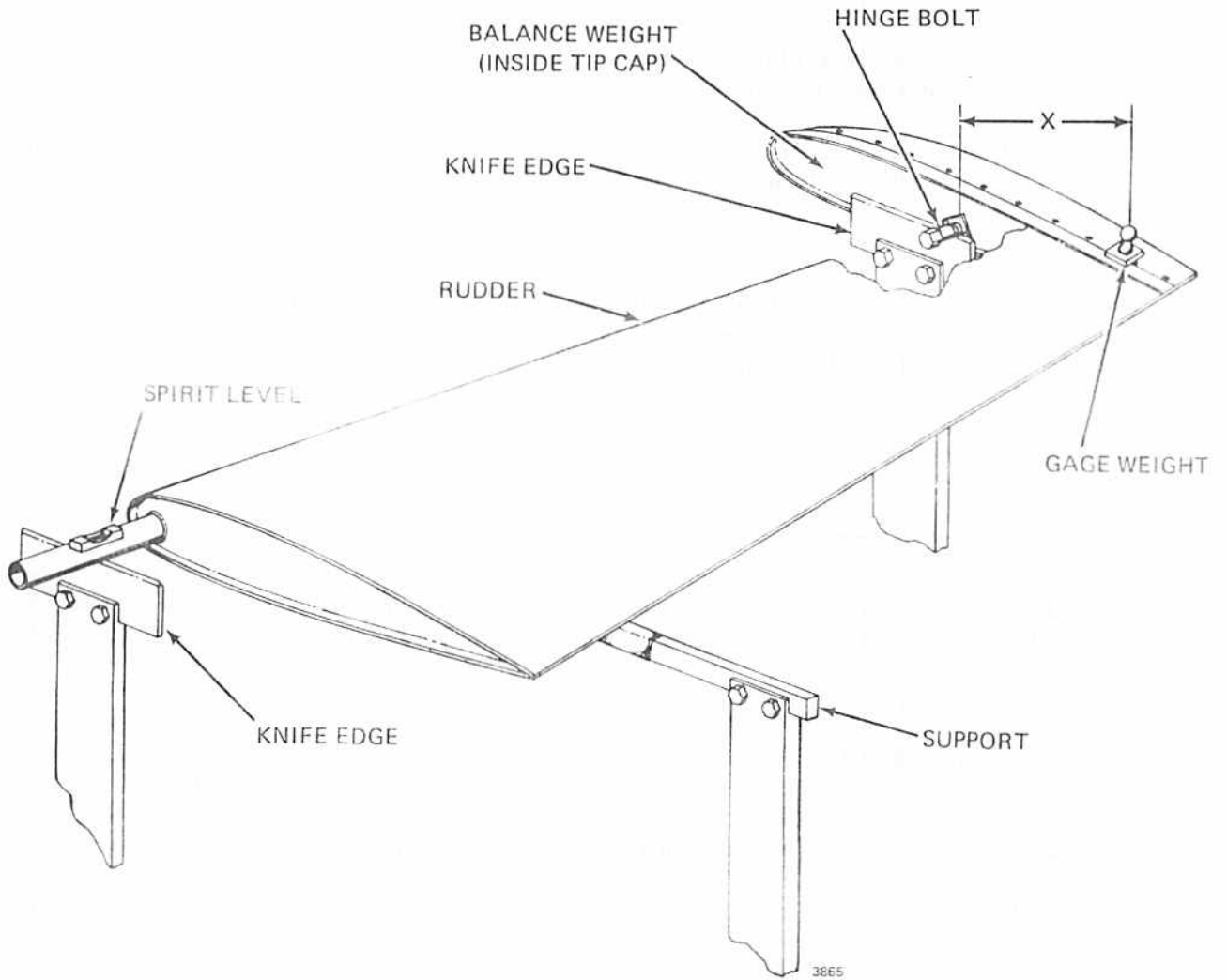
D. Elevator and Rudder Balancing (See Figure 204B.)

- (1) Install the hinge bolt adjacent to the control surface tip cap. Remove bellcranks and horns from torque tube.
- (2) Support the hinge bolt shank and control surface torque tube on knife edges as shown in Figure 204B and level the hinge line.



DETAIL A

Aileron Balancing Setup
Figure 204A



Elevator or Rudder Balancing Setup – Typical
Figure 204B

- (3) Rest the control surface trailing edge on a support. Place the gage weight aft of hinge line to hold the trailing edge down.
- (4) Adjust the height of the trailing edge support so that the trailing edge and the hinge line are in the same horizontal plane.
- (5) Move the gage weight toward the tip cap leading edge until the point is reached where the trailing edge tends to leave the support.
- (6) Measure and record the distance (X) from the hinge centerline to the gage weight. The gage weight must be within the distance limits given in Table 1.

NOTE: Always install tip cap before determining new balance.

- (7) If the gage weight is aft of the distance limits given in Table 1, remove the tip cap and drill or shave material from the weight beneath the forward end of the tip cap as required to bring the control surface balance within limits.
- (8) If the gage weight is forward of the distance limits given in Table 1, the weight beneath the tip cap must be replaced with a heavier weight and drilled or shaved as required to the proper size.

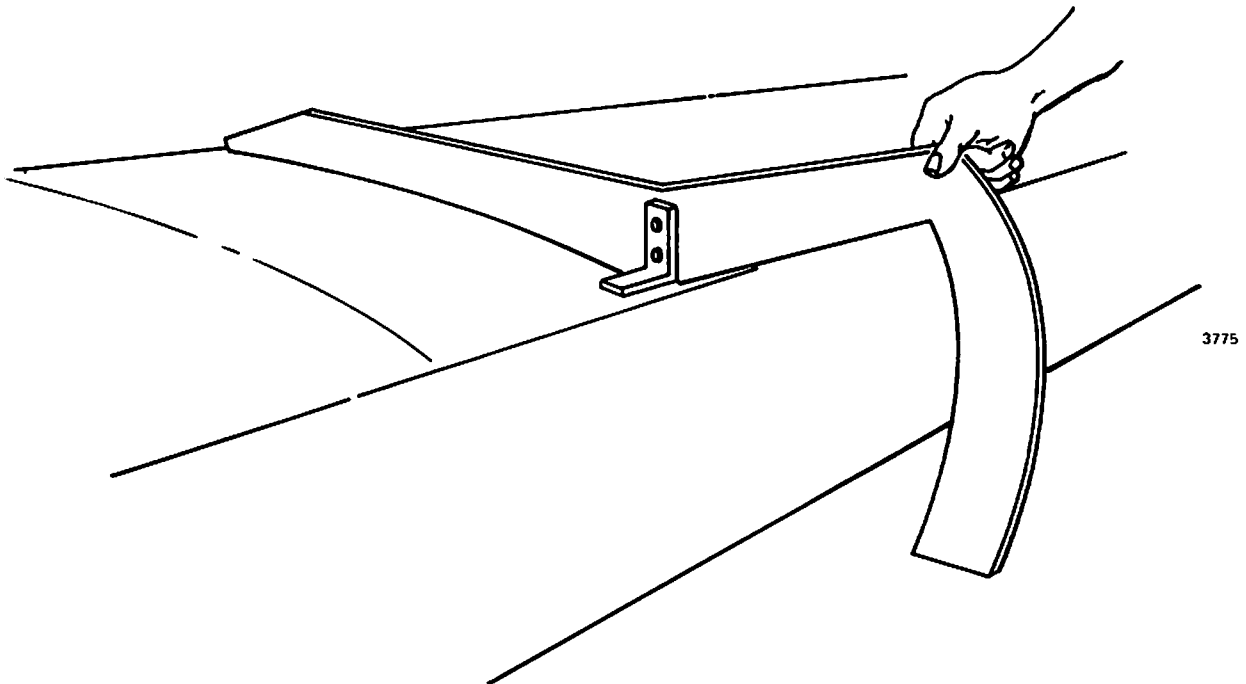
6. Aileron Control System Rigging

Aileron rigging should be performed at an ambient temperature that is average for the area in which the aircraft is usually operated. If rigging must be done with the ambient temperature above or below normal, it is recommended that cable tension be measured and adjusted as necessary when temperature returns to normal.

- A. Rig the control column. Refer to Section 27-3-1.
- B. Install control wheel lock and place aileron trim control knob in neutral position. Install rig pins at control wheel sprockets. Pull rear seat bottom up and forward to gain access to rear seat well.
- C. Remove access covers from beneath both wings at Wing Station 161.00.
- D. Install rigging pins (3, Figure 202) through inboard stops and screw onto bolts (4). If rigging pins cannot be installed, release cable tension as necessary at turnbuckles (6 and 14).
- E. Install the aileron rigging fixture on the right wing as shown in Figure 205. Aileron trailing edge should be at the 0-degree position on rigging fixture. Refer to Section 27-0 for rigging fixture part numbers.

WARNING: MAKE SURE THREADS ARE VISIBLE AT INSPECTION HOLES IN ROD ENDS AFTER PUSH ROD LENGTH IS ADJUSTED. TIGHTEN LOCKNUTS SECURELY.

- F. If required, adjust push rod length to position aileron trailing edge at 0 degree on rigging fixture.
- G. Repeat Steps E and F at left wing.
- H. Measure cable tension on carry-through cable and adjust turnbuckle (6, Figure 202) as required to obtain cable tension of 25 ± 5 pounds.



Aileron Rigging Fixture
Figure 205

- I. Measure tension on left aileron cable and adjust turnbuckle (14) as necessary to obtain cable tension of 25 ± 5 pounds. Repeat procedure at right aileron cable.
 - J. Remove rigging pins (3). Remove control wheel lock from control column.
 - K. With aileron rigging fixture installed, turn control wheel through full travel in both directions, noting trailing edge position at both extremes of travel. Repeat procedure with aileron rigging fixture installed on other wing.
 - L. Aileron travel limits are 25 ± 2 degrees up, 15 ± 2 degrees down. If aileron travel is not within limits, inspect for damaged or worn sector or stops. Replace damaged or worn components.
7. Cleaning and Painting

CAUTION: PAINTING ANY CONTROL SURFACE MAY CAUSE AN UNDERBALANCED CONDITION.
CHECK AILERON BALANCE AFTER PAINTING.

Refer to Chapter 20 for cleaning and painting instructions.

8. Aileron Trim Tab and Linkage

A. Removal

NOTE: Refer to Section 27-3-1 for control column maintenance procedures.

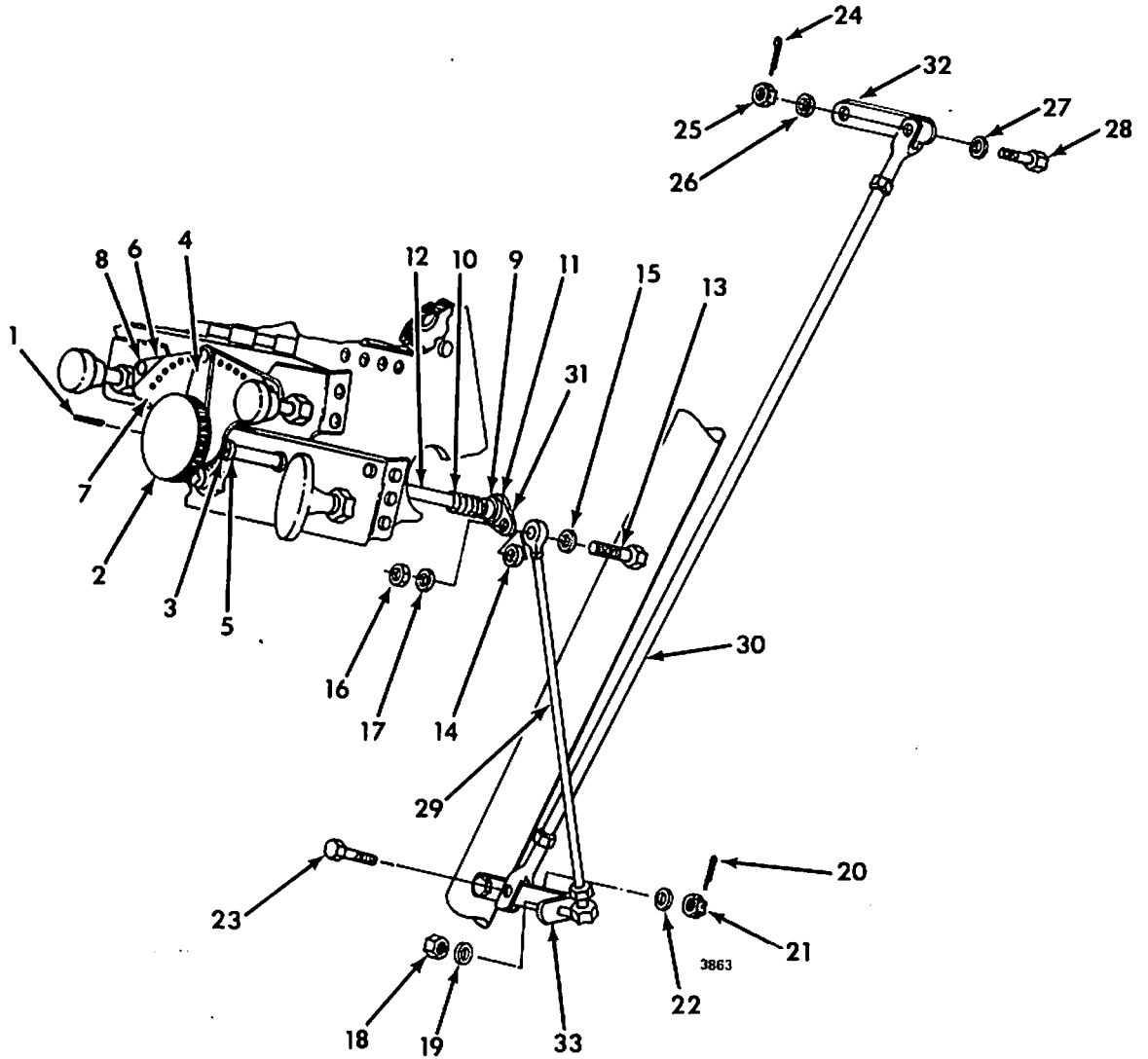
- (1) Install control wheel lock. Install rig pin in front bellcranks forward of the control column. Remove access panels from pedestal.
- (2) In nose baggage compartment, remove screws and access panels on aft wall per Chapter 53.
- (3) Remove pin (1, Figure 206) and knob (2).

NOTE: Pull aft on shaft (12) to relieve tension on lockpin (4) when removing slotted pin (3).

- (4) Remove safety wire, slotted pin (3), and lockpin (4). Remove nylon bearing (5). Remove screws (6), lock plate (7), and stops (8).
- (5) At forward end of shaft (12), remove lockwire and slotted pin (3).
- (6) Pull lever (31) aft. Remove spring (10) and spacer (9). Pull shaft (12) aft and remove.
- (7) Remove bolt (13), spacers (14), washers (15 and 16), and nut (17). Remove lever (31).
- (8) Remove nut (18) and washer (19). Remove push rod (29).
- (9) Remove cotter pin (20), nut (21), washer (22), and bolt (23). At top of control column, remove cotter pin (24), nut (25), and washer (26). Remove bolt (28) and washer (27). Remove push rod (30).

B. Installation

- (1) Place washer (27) onto bellcrank (32) so that the holes align. Place clevis end of push rod (30) over washer and bellcrank and install bolt (28), washer (26), and nut (25). Do not install cotter pin (24) at this time.
- (2) Install clevis end of push rod (30) over hole in lever (33). Install bolt (23), washer (22), and nut (21). Do not install cotter pin (20) at this time.
- (3) Install threaded end of push rod (29) into mounting hole of lever (33). Install washer (19) and nut (18).
- (4) Install shaft (12) into position in forward console. Install bearing (11) over forward end of shaft (12).
- (5) Install spring (10) and spacer (9) over shaft lever (31).



- | | | |
|----------------|----------------|----------------|
| 1. Pin | 12. Shaft | 23. Bolt |
| 2. Knob | 13. Bolt | 24. Cotter Pin |
| 3. Slotted Pin | 14. Spacer | 25. Nut |
| 4. Lockpin | 15. Washer | 26. Washer |
| 5. Bearing | 16. Nut | 27. Washer |
| 6. Screw | 17. Washer | 28. Bolt |
| 7. Lock Plate | 18. Nut | 29. Push Rod |
| 8. Stop | 19. Washer | 30. Push Rod |
| 9. Spacer | 20. Cotter Pin | 31. Lever |
| 10. Spring | 21. Nut | 32. Bellcrank |
| 11. Bearing | 22. Washer | 33. Lever |

**Aileron Trim Linkage
Figure 206**



- (6) Install assembled parts over end of shaft (12). Align holes in lever (31) and shaft (12). Install slotted pin (3).

NOTE: Make sure slotted pin (3) does not protrude from either side of lever (31).

- (7) Slide bearing (11) onto lever, compressing spring (10) until slotted pin (3) is accessible. Lock-wire slotted pin.
- (8) Install lock plate (7) and stops (8). Secure with screws (6).
- (9) Install bearing (5) in lock plate (7). Feed forward end of shaft (12) through bearing.
- (10) Install lockpin (4) over end of shaft (12) and through bearing (5).

NOTE: Make sure holes in lockpin (4) and shaft (12) are aligned so that arm of lever (31) is on LH side of aircraft with lockpin in neutral position. If lever arm is on RH side, trim control knob will give opposite trim to that desired when turned.

- (11) With lockpin (4) in neutral position and arm of lever (31) to left-hand side of aircraft, align holes in shaft (12) and lockpin (4). Install slotted pin (3) and lock-wire.
- (12) Install one spacer (14) on bolt (13). Insert bolt through end of push rod (29), and install remaining spacer (14) and two washers (15). Insert bolt (13) through hole in lever (31) and install washer (17) and nut (16).
- (13) Install knob (2) and secure with pin (1).
- (14) With control wheel lock installed and aileron trim wheel in neutral position, adjust lengths of push rods (29 and 30) so that bungee arm of bellcrank is aligned with centerline of control column.

RUDDER AND TAB – DESCRIPTION/OPERATION

1. General (See Figure 1.)

Directional control for the GA-7/Cougar is by means of a conventional rudder hinged to the trailing edge of the vertical fin assembly. Control of the rudder is provided by rudder-brake pedal assemblies mounted on the floor at the pilot's station. If the dual control option is installed, an additional set of rudder pedals is provided at the copilot's station.

A hinged, adjustable trim tab is mounted in the rudder trailing edge. The trim tab is positioned by means of a trim wheel mounted beneath the engine controls on the control quadrant.

2. Rudder

The rudder is basically a bonded structure composed of ribs, spars, skin, torque tube, bellcrank, tip cap, and a hinged trim tab. The torque tube and skin are joined to the ribs and spars to form a rigid structure that can be positioned by a bellcrank which is bolted to the bottom of the torque tube. The rudder counterweight is located beneath the tip cap at the forward edge.

The rudder is supported at the three hinge points by bearings, one at the bottom of the torque tube, and one each at the top and center ribs. The plastic rudder tip cap is attached to the top rib by clip nuts, screws, and washers.

3. Rudder Controls (See Figure 1.)

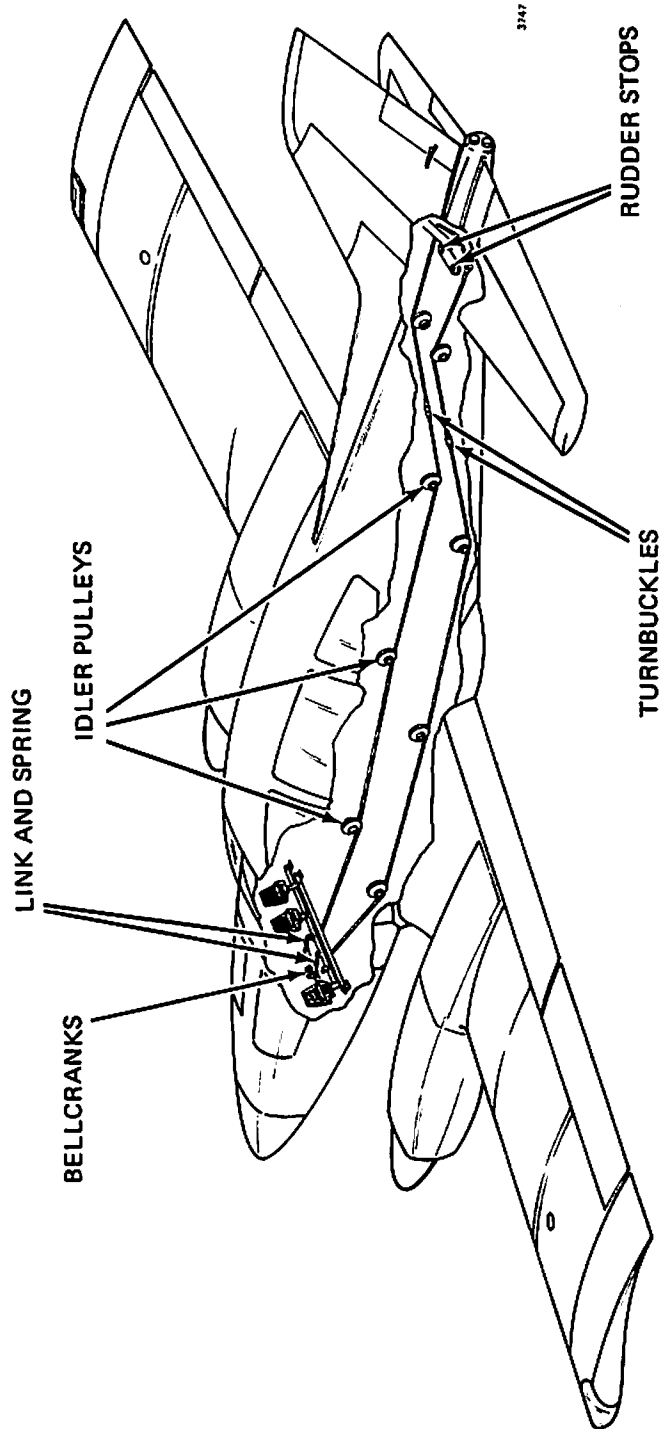
Movement of the rudder pedals is transmitted by push rods, bellcranks, and cables, resulting in a corresponding displacement of the rudder from the neutral position. The rudder pedals are held in position by a link and a spring which are cross-connected between arms on the rudder bars and bellcranks located forward of the rudder pedals. The spring provides constant cable tension regardless of rudder pedal displacement. Rudder travel is limited in either direction by adjustable stops located at the lower hinge point on the vertical fin assembly. The stops are contacted by the arms of the rudder bellcrank as the limits of travel are reached.

4. Rudder Trim Tab (See Figure 2.)

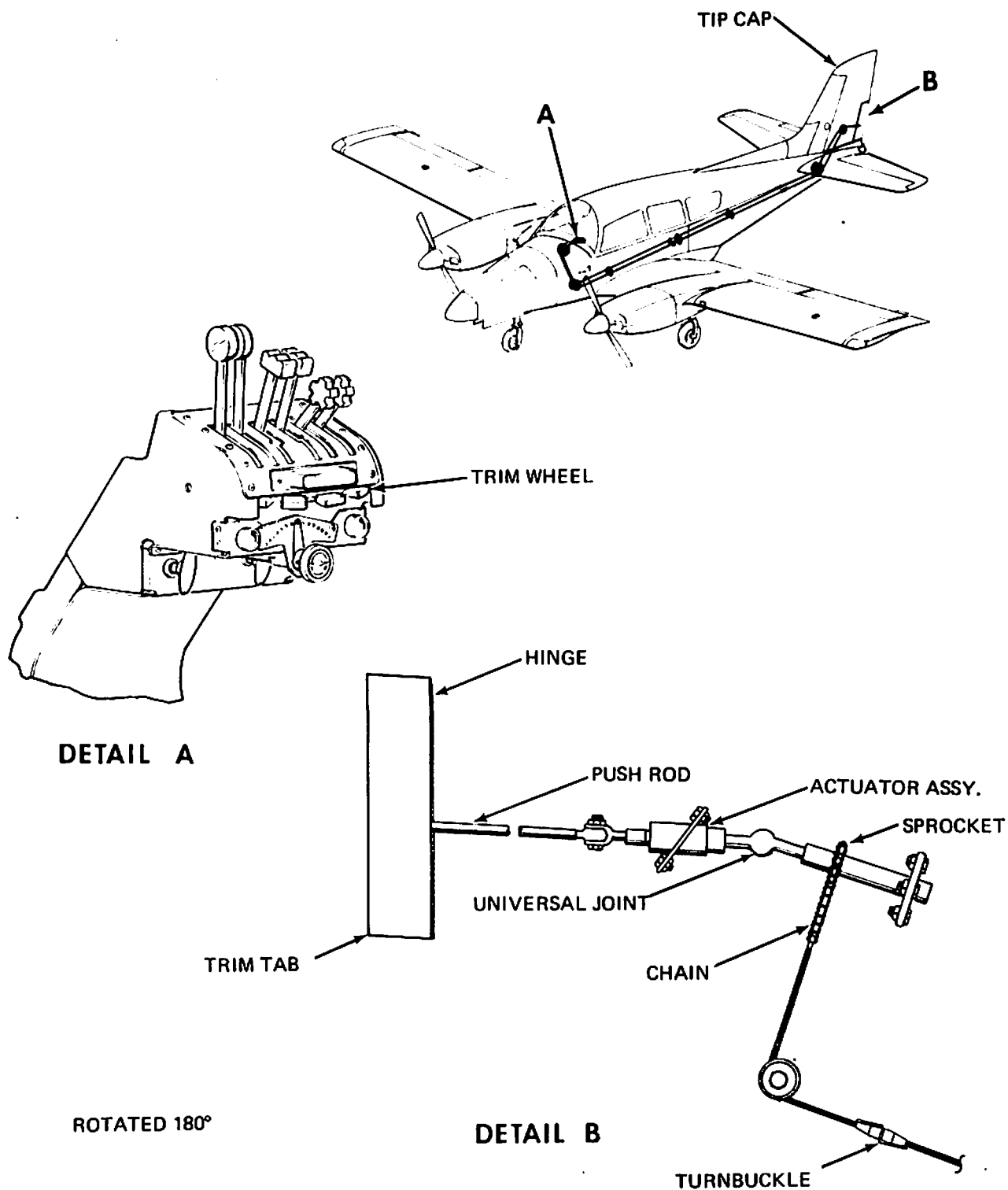
The rudder trim tab is a bonded structure composed of ribs, spars, and skin. The tab is connected to the rudder with a piano hinge, and forms the lower portion of the rudder trailing edge. The trim tab is positioned by a pair of horns extending from the left-hand side which are connected to the control system by a push rod extending through the rudder structure.

5. Rudder Trim Tab Controls

As the rudder trim tab control wheel is rotated, its angular displacement is transmitted to a chain and sprocket located within the vertical fin by a drum, cables, and idler pulleys. The angular displacement of the sprocket changes the effective length of an actuator assembly, positioning the rudder trim tab by means of a push rod in the rudder. Trim tab travel is limited by mechanical stops at either end of the trim tab wheel.



**Rudder System
Figure 1**



**Rudder Trim Tab System
Figure 2**

RUDDER AND TAB – MAINTENANCE PRACTICES

1. Rudder (See Figure 201.)

A. Removal

NOTE: To facilitate the removal of the rudder and to reduce the possibility of aircraft structural damage, apply a liberal amount of penetrating oil to hinge points and attaching parts 4 hours prior to removal and again immediately before removal if signs of corrosion are noted.

- (1) Remove tail cone assembly per Chapter 53.

NOTE: The rudder can be removed and installed without disturbing rigging as long as push rod and control cable lengths and stop positions are not disturbed. Do not loosen locknuts on trim tab push rod (20, Figure 201) or disturb rudder cable turnbuckle settings.

- (2) Turn rudder full left. Install a C-clamp on the right rudder cable at the aft fuselage bulkhead or use other means to secure right rudder cable. Remove cotter pin (1), nut (2), washers (3 and 4), and bolt (5) securing right rudder cable. Separate clevis (6) from bellcrank (7).
- (3) Secure a cord or pull wire to clevis (6) and remove C-clamp from cable.
- (4) Turn rudder to full right rudder position and repeat Steps (2) and (3) at left rudder cable.

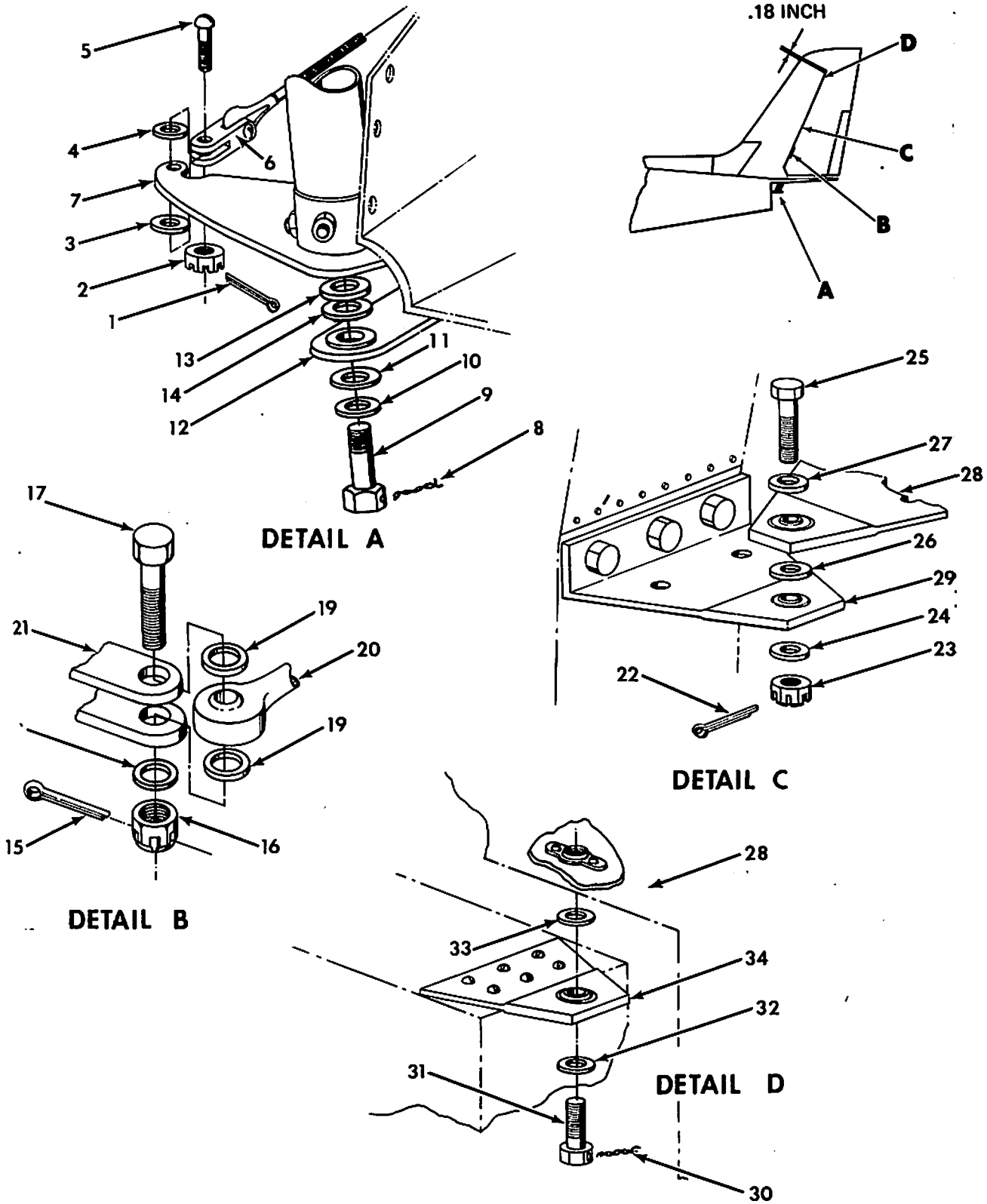
CAUTION: PROVIDE A MEANS OF SUPPORT FOR RUDDER DURING REMOVAL AND INSTALLATION TO AVOID STRESS AND POSSIBLE MISALIGNMENT OR DAMAGE TO HINGE PARTS.

- (5) Note quantity of washers (13 and 14) for use during installation. Support rudder assembly in full right position. Remove safety wire (8), bolt (9), and washers (10, 11, 13, and 14) from bracket assembly (12).
- (6) Remove cotter pin (15), nut (16), bolt (17), and washers (18 and 19). Remove trim tab push rod (20) from actuator clevis (21).
- (7) Remove cotter pin (22), nut (23), washer (24), bolt (25), and washers (26 and 27).
- (8) Remove safety wire (30), bolt (31), and washers (32 and 33). Remove rudder from aircraft.

B. Installation (See Figure 201.)

CAUTION: PROVIDE A MEANS OF SUPPORT FOR RUDDER DURING REMOVAL AND INSTALLATION TO AVOID STRESS AND POSSIBLE MISALIGNMENT OR DAMAGE TO HINGE PARTS.

- (1) Move rudder assembly (28) into position and support. Install washer (32) onto bolt (31). Install bolt through bracket assembly (34) and install washer (33). Install bolt (31) into nutplate in rudder assembly (28) and tighten securely. Do not install safety wire (30) at this time.
- (2) Install washers (10 and 11) on bolt (9). Install bolt through bracket assembly (12). Install thick and thin washers (13 and 14) on bolt (9). Move rudder into position and install bolt (9) into nutplate in bellcrank (7) and tighten securely. Do not install safety wire (8) at this time.



Rudder Removal and Installation
Figure 201 (Sheet 1 of 2)

- | | |
|----------------------|-----------------------|
| 1. Cotter Pin | 18. Washer |
| 2. Nut | 19. Washer |
| 3. Washer | 20. Trim Tab Push Rod |
| 4. Washer | 21. Actuator Clevis |
| 5. Bolt | 22. Cotter Pin |
| 6. Clevis | 23. Nut |
| 7. Bellcrank | 24. Washer |
| 8. Safety Wire | 25. Bolt |
| 9. Bolt | 26. Washer |
| 10. Washer | 27. Washer |
| 11. Washer | 28. Rudder Assembly |
| 12. Bracket Assembly | 29. Bracket assembly |
| 13. Thick Washer | 30. Safety Wire |
| 14. Thin Washer | 31. Bolt |
| 15. Cotter Pin | 32. Washer |
| 16. Nut | 33. Washer |
| 17. Bolt | 34. Bracket Assembly |

**Rudder Removal and Installation
Figure 201 (Sheet 2 of 2)**

- (3) Measure the rudder tip-fin clearance. Minimum allowable clearance is 0.18 inch.

NOTE: Add washers (13 and 14) only as necessary to obtain minimum clearance. If clearance obtained exceeds 0.21 inch, remove one thin washer or substitute a thin washer for a thick one.

- (4) If clearance is less than 0.18 inch, add washers (13 and 14) as required to obtain minimum clearance.
- (5) Install washer (27) on bolt (25). Insert bolt (25) through rudder assembly (28), washer (26), and bracket assembly (29). Install washer (24) and nut (23). Tighten nut (23) and install cotter pin (22).
- (6) Install trim tab pushrod (20) in actuator clevis (21) and install washers (19). Install bolt (17), washer (18), and nut (16). Tighten nut (16) and install cotter pin (15).
- (7) Tighten bolts (9 and 31) and install lockwire. Remove support from rudder.
- (8) Pull left rudder cable clevis (6) into position and remove pull wire. Move arm of bellcrank (7) into position and install bolt (5), washers (4 and 3), and nut (2).
- (9) Tighten nut (2) securely and back off as required to install cotter pin (1).
- (10) Repeat Steps (8) and (9) at right rudder cable clevis (6).
- (11) Perform a rudder and trim system rigging check per Paragraph 15.

2. Rudder Controls

The rudder bars, the rudder bellcranks, and interconnecting components are open and need not be removed as an assembly. Components requiring maintenance can readily be removed by relieving cable and spring tension and removing attaching parts. The procedures below are typical for removal and installation of rudder control components.

3. Brake Cylinders (See Figure 202.)

A. Removal

- (1) At brake pedal link (5, Figure 202), remove cotter pin (1), washer (2), and clevis pin (3). Separate clevis (4) and link (5).
- (2) Repeat procedure at mounting bracket on floor.

NOTE: Cap or cover all open lines and fittings to prevent entry of foreign matter.

- (3) Provide a suitable container for spilled hydraulic fluid. Disconnect and cap flexible lines (6). Remove brake cylinder.

B. Installation

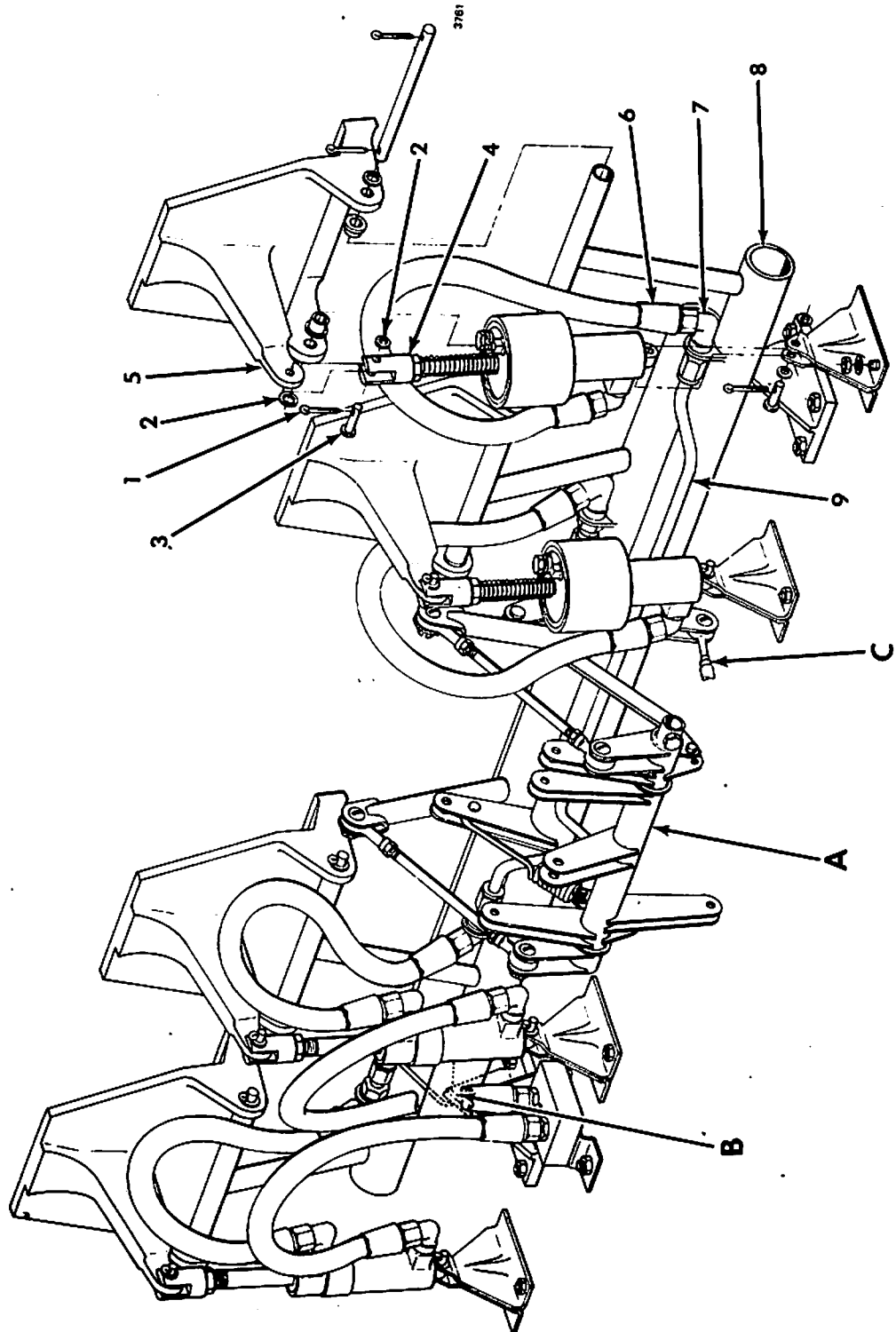
- (1) Connect flexible lines to brake cylinder.
- (2) Install bottom of brake cylinder into mounting bracket on floor and secure with clevis pin (3), washer (2), and cotter pin (1).
- (3) Extend brake to full length by pulling clevis (4). Install clevis (4) on link (5). Temporarily install clevis pin (3) and observe brake pedal for alignment with other pedals. If necessary, remove clevis pin, loosen locknut, and adjust length by turning clevis as required to align pedals.
- (4) Tighten locknut and install clevis pin (3), washer (2), and cotter pin (1).
- (5) Bleed and service brake system per Chapter 12.

4. Brake Lines (See Figure 202.)

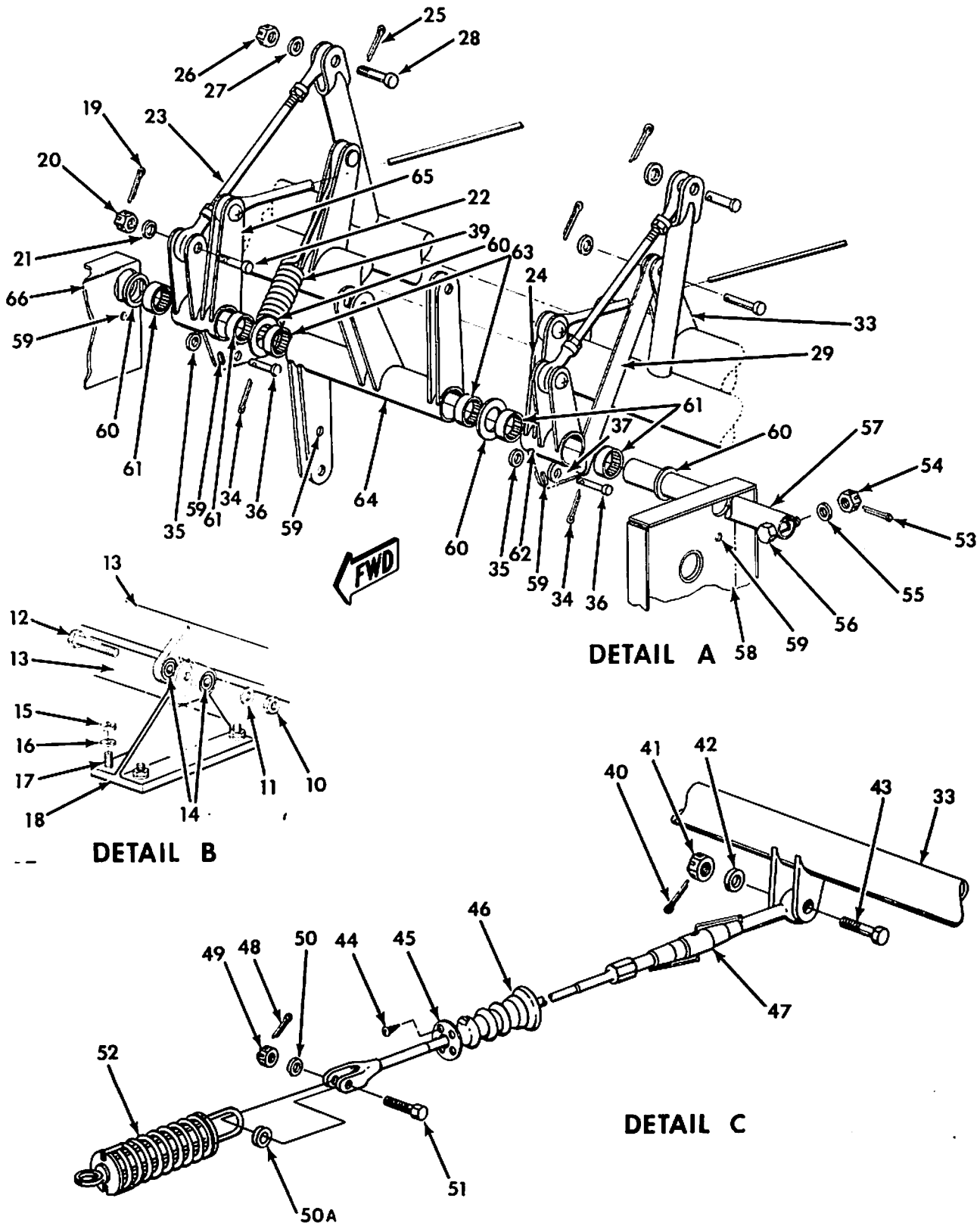
A. Removal

NOTE: Cap or cover all open lines and fittings to prevent entry of foreign matter.

- (1) Provide a suitable container for spilled hydraulic fluid. Disconnect and remove flexible lines (6) at brake cylinder and at elbows (7).
- (2) Loosen coupling nuts and remove brake lines (9). Remove elbows (7).



**Rudder Control System
Figure 202 (Sheet 1 of 3)**



**Rudder Control System
Figure 202 (Sheet 2 of 3)**

1. Cotter Pin	19. Cotter Pin	37. Shackle	54. Nut
2. Washer	20. Nut	38. Not Used	55. Washer
3. Clevis Pin	21. Washer	39. Spring Assembly	56. Bolt
4. Clevis	22. Bolt	40. Cotter Pin	57. Bellcrank Shaft
5. Link	23. Push Rod Assembly	41. Nut	58. LH Bracket
6. Flexible Line	24. Rudder Bellcrank	42. Washer	59. Rig Pin Hole
7. Elbow	25. Cotter Pin	43. Clevis Bolt	60. Bearing
8. Rudder Bar	26. Nut	44. Rivet	61. Bearing
9. Brake Line	27. Washer	45. Retainer	62. LH Rudder Bellcrank
10. Nut	28. Bolt	46. Boot	63. Bearing
11. Washer	29. Link Assembly	47. Steering Cable	64. Elevator Bellcrank
12. Bolt	30. Not Used	48. Cotter Pin	65. RH Rudder Bellcrank
13. Rudder Bar	31. Not Used	49. Nut	66. RH Bracket
14. Bearing	32. Not Used	50. Washer	67. Rudder Cable
15. Nut	33. Rudder Bar	50A. Bushing	68. Cotter Pin
16. Washer	34. Cotter Pin	51. Clevis Bolt	69. Nut
17. Stud	35. Washer	52. Bungee	70. Washer
18. Bracket	36. Clevis Pin	53. Cotter Pin	71. Clevis Bolt

Rudder Control System
Figure 202 (Sheet 3 of 3)

B. Installation

- (1) Install elbows (7). Install brake lines (9) on rudder bars (8).
- (2) Install flexible lines (6) to elbows (7) and brake cylinders.
- (3) Bleed and service brake system per Chapter 12.

5. Rudder Bar Bearings (See Figure 202.)

A. Removal

- (1) Unhook spring assembly (39). Disconnect link assembly (29) by removing cotter pin (34), washer (35), and clevis pin (36).
- (2) Remove nuts (10), washers (11), and bolts (12).
- (3) Remove bearings (14) from rudder bars (13) with a bearing press.

B. Installation

- (1) Press bearings (14) into rudder bars (13). Stake in six places both sides.
- (2) Align bearings (14) with bracket (18) and install bolts (12), washers (11), and nuts (10).
- (3) Connect link assembly (29) with clevis pin (36), washer (35), and cotter pin (34). Hook spring assembly (39) to rudder bar (33).

6. Rudder Bar Support Brackets (See Figure 202.)

A. Removal

- (1) Release spring tension by unhooking spring assembly (39) at rudder bar (33).
- (2) Remove nuts (10), washers (11), and bolts (12).
- (3) Remove nuts (15) and washers (16) from studs (17). Remove brackets (18).

B. Installation

- (1) Install brackets (18) on studs (17). Install washers (16) and nuts (15). Do not tighten nuts at this time.
- (2) Align holes in bearings (14) with holes in bracket (18) and install bolts (12), washers (11), and nuts (10). Align rudder bars so that there is no interference with cables, and so that link and spring are equally spaced between left-hand rudder cable and elevator down cable.
- (3) Hook spring assembly (39) to rudder bar (33).

7. Push Rod Assemblies (See Figure 202.)

A. Removal

- (1) Measure and record length of push rod assembly (23).
- (2) Release spring tension by unhooking spring assembly (39) at rudder bar (33).
- (3) At rudder bellcrank (24), remove cotter pin (19), nut (20), washer (21), and bolt (22).
- (4) Remove clevis end of push rod assembly (23) from rudder bellcrank (24).
- (5) At rudder bar (33), remove cotter pin (25), nut (26), washer (27), and bolt (28). Remove push rod assembly (23).

B. Installation

- (1) Measure length of new push rod assembly (23). If necessary, loosen locknuts and adjust length to the measurement obtained in A(1). Make sure threads are visible in inspection holes after locknuts are tightened.
- (2) Install clevis end of push rod assembly (23) into bellcrank of rudder bar (33). Install bolt (28), washer (27), nut (26), and cotter pin (25).
- (3) Install other clevis end of push rod assembly (23) into rudder bellcrank (24). Install bolt (22), washer (21), nut (20), and cotter pin (19).
- (4) Hook spring assembly (39) to rudder bar (33).
- (5) Observe rudder pedals for proper alignment. Rig rudder control system if rudder pedals are not lined up. Refer to Paragraph 15.

8. Rudder Bellcrank Linkage (See Figure 202.)**A. Removal**

- (1) Release spring tension by unhooking spring assembly (39) at rudder bar (33).
- (2) At right-hand rudder bellcrank (65), remove cotter pin (34), washer (35), and clevis pin (36) securing spring assembly (39).
- (3) At left-hand rudder bellcrank (62), remove cotter pin (34), washer (35), and clevis pin (36) securing link assembly (29).

B. Installation

- (1) Secure link assembly (29) to left-hand rudder bellcrank (62) with clevis pin (36), washer (35), and cotter pin (34).
- (2) Secure spring assembly (39) to right-hand rudder bellcrank (65) with clevis pin (36), washer (35), and cotter pin (34).
- (3) Hook spring assembly (39) to rudder bar (33).
- (4) Observe rudder pedals for proper alignment. Rig rudder control system if rudder pedals are not lined up. Refer to Paragraph 16.

9. Rudder Bar Steering Linkage (See Figure 202.)**A. Removal**

- (1) Release spring tension by unhooking spring assembly (39) at rudder bar (33).
- (2) Remove cotter pin (40), nut (41), washer (42), and clevis bolt (43). Separate clevis of steering cable (47) from bellcrank arms of rudder bar (33).
- (3) In nose wheel well, remove rivets (44), and slide retainer (45) and boot (46) forward along steering cable.
- (4) At aft end of bungee (52), remove cotter pin (48), nut (49), washer (50), and clevis bolt (51). Remove steering cable (47).

NOTE: If replacement of boot (46) is required, remove turnbuckle from steering cable.

B. Installation

- (1) Make sure boot (46) and retainer (45) are installed on steering cable (47) as shown in Figure 202.
- (2) In nose wheel well, install aft end of cable through hole in Fuselage Station 50.00 bulkhead.
- (3) Install boot (46), retainer (45), and rivets (44).

- (4) Install front clevis of steering cable (47) onto bungee (52). Install clevis bolt (51), washer (50), nut (49), and cotter pin (48).

NOTE: Install clevis bolt (43) so that head of bolt is inboard.

- (5) In cabin, install clevis in bellcrank arm of rudder bar (33). Install clevis bolt (43), washer (42), nut (41), and cotter pin (40).
- (6) Hook spring assembly (39) to rudder bar (33).
- (7) Using a towbar or other suitable means, align nose wheel with fore and aft centerline of aircraft. Adjust length of steering cable as necessary to take out any slack. Do not exceed 15 pounds tension.

10. Bellcrank Assembly (See Figure 202.)

A. Removal

- (1) Disconnect elevator push rod and elevator cables at elevator control bellcrank assembly per Section 27-3-1.
- (2) Remove rudder bellcrank linkage per Paragraph 8.
- (3) Remove rudder push rod assemblies per Paragraph 7.
- (4) Disconnect rudder cables (67, Figure 202) by removing cotter pins (68), nuts (69), washers (70), and clevis bolts (71).
- (5) At left-hand bracket (58), remove cotter pin (53), nut (54), washer (55), and bolt (56).
- (6) Slide bellcrank shaft (57) to the right as required to clear left-hand bracket (58).
- (7) Remove bearing (60), left-hand rudder bellcrank (62), bearing (60), elevator bellcrank (64), bearing (60), right-hand rudder bellcrank (65), and bearing (60) from bellcrank shaft (57).
- (8) If required, remove bearings (61), from either end of bellcranks (62, 64, and 65) with a bearing press.

B. Installation

- (1) Install bearings (61) in bellcranks (62, 64, and 65).
- (2) Install bellcrank shaft (57) into right-hand bracket (66). On bellcrank shaft (57), assemble bearing (60), right-hand rudder bellcrank (65), bearing (60), elevator bellcrank (64), bearing (60), left-hand rudder bellcrank (62), and bearing (60).
- (3) Install bellcrank shaft (57) into left-hand bracket (58). Secure with bolt (56), washer (55), nut (54), and cotter pin (53).
- (4) Install rudder cables (67) and secure with clevis bolts (71), washers (70), nuts (69), and cotter pins (68).

- (5) Install rudder push rod assemblies per Paragraph 7.
- (6) Install rudder bellcrank linkage per Paragraph 8.
- (7) Connect elevator cables and elevator push rod at bellcrank assembly per Section 27-3-1.

11. Rudder Cables

A. Removal

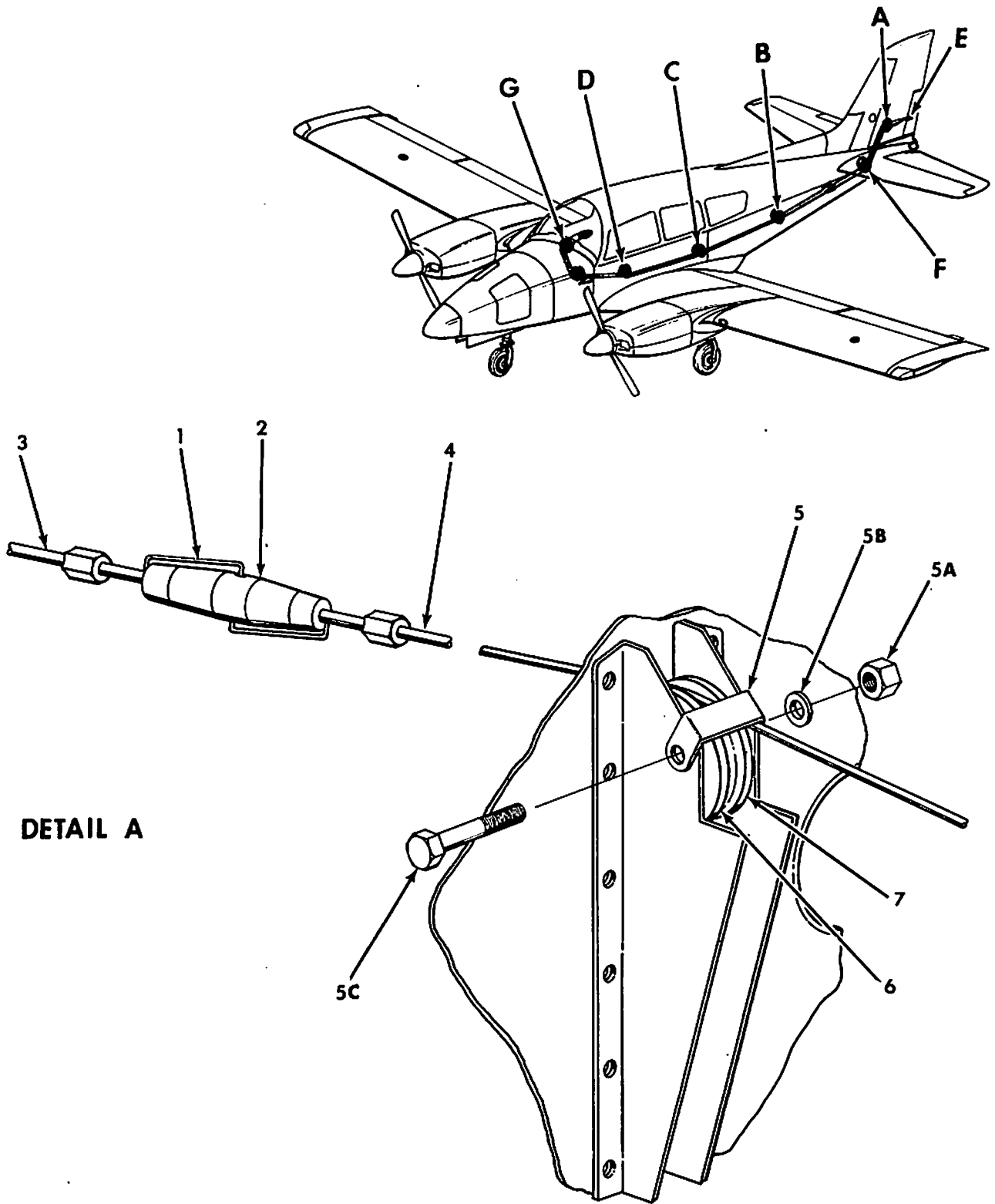
- (1) Install rig pin through front bellcranks and support brackets. (See 59, Figure 202.)
- (2) Remove access covers and panels from center and aft consoles as required to gain access to rudder cables and pulley groups. Refer to Chapter 25.
- (3) Remove tail cone and both aft fuselage covers per Chapter 53.
- (4) Remove lower fuselage access panels per Chapter 53. Locate rudder cables and remove turnbuckle clips (1, Figure 203) from both rudder cable turnbuckles.

NOTE: Due to limited access to the aft fuselage and other areas through which the rudder cables pass, a wire or cord should be attached to the aft cable and pulled into position as the existing cable is removed.

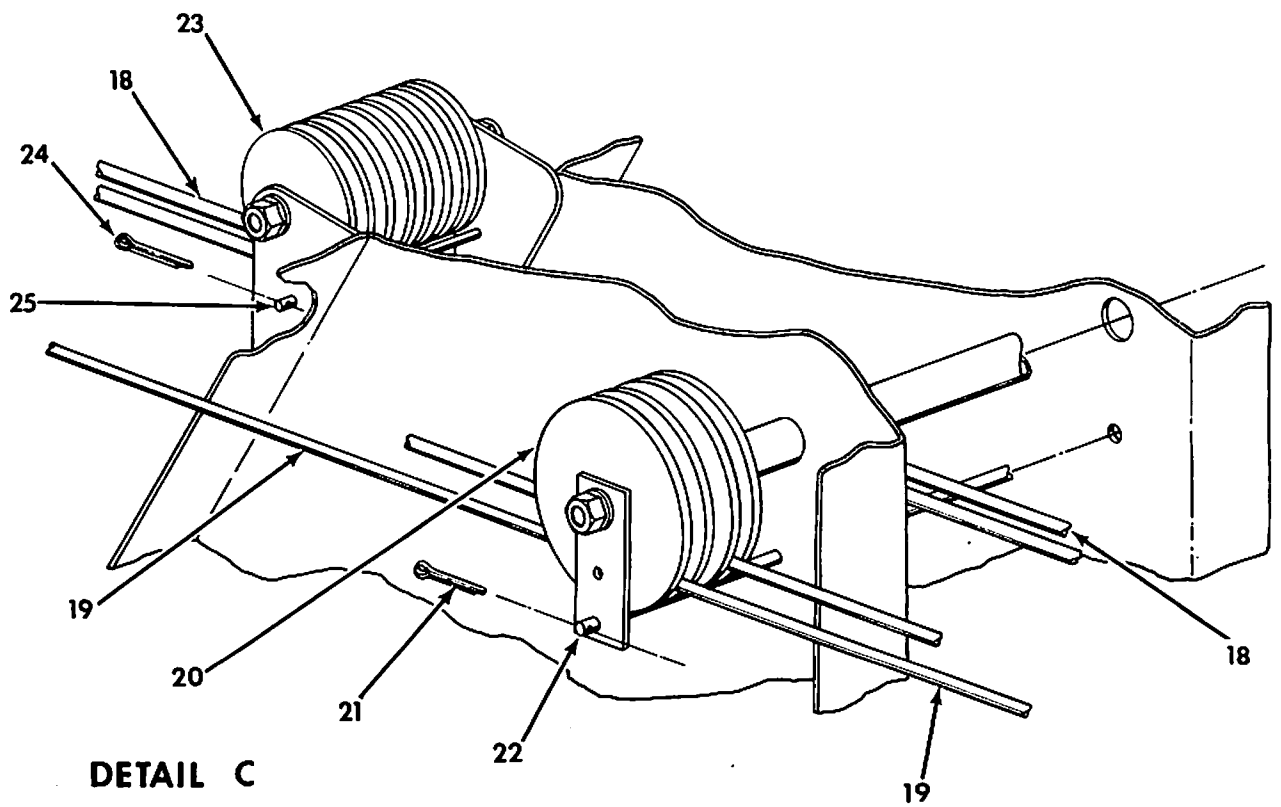
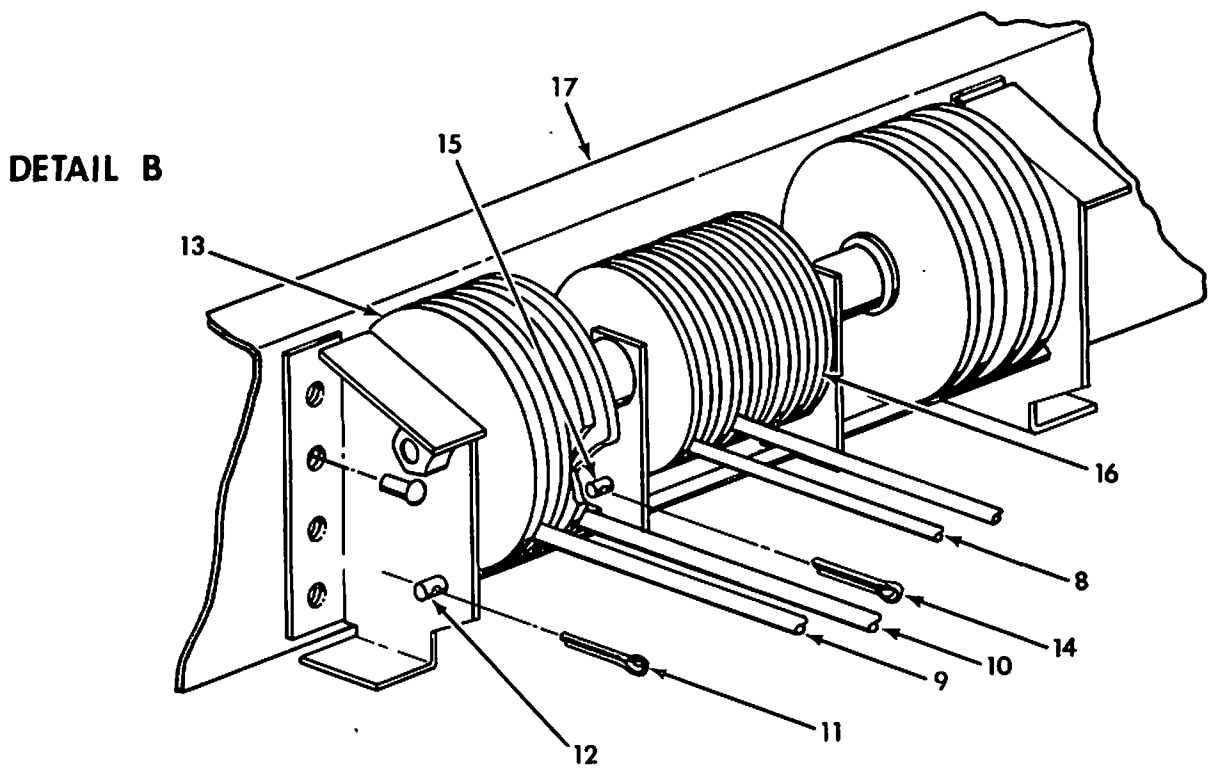
- (5) Attach a pull wire or cord to each forward rudder cable (3). Remove turnbuckles (2).
- (6) At Fuselage Station 266.89, remove nuts (5A), washers (5B), bolts (5C), guards (5), and pulleys (6).
- (7) At rudder bellcrank, remove cotter pin (1, Figure 201), nuts (2), washers (3 and 4), and bolts (5) securing rudder cables to bellcrank. Remove both aft rudder cables (4, Figure 203).

NOTE: Aft cabin bulkhead is secured with Velcro fasteners.

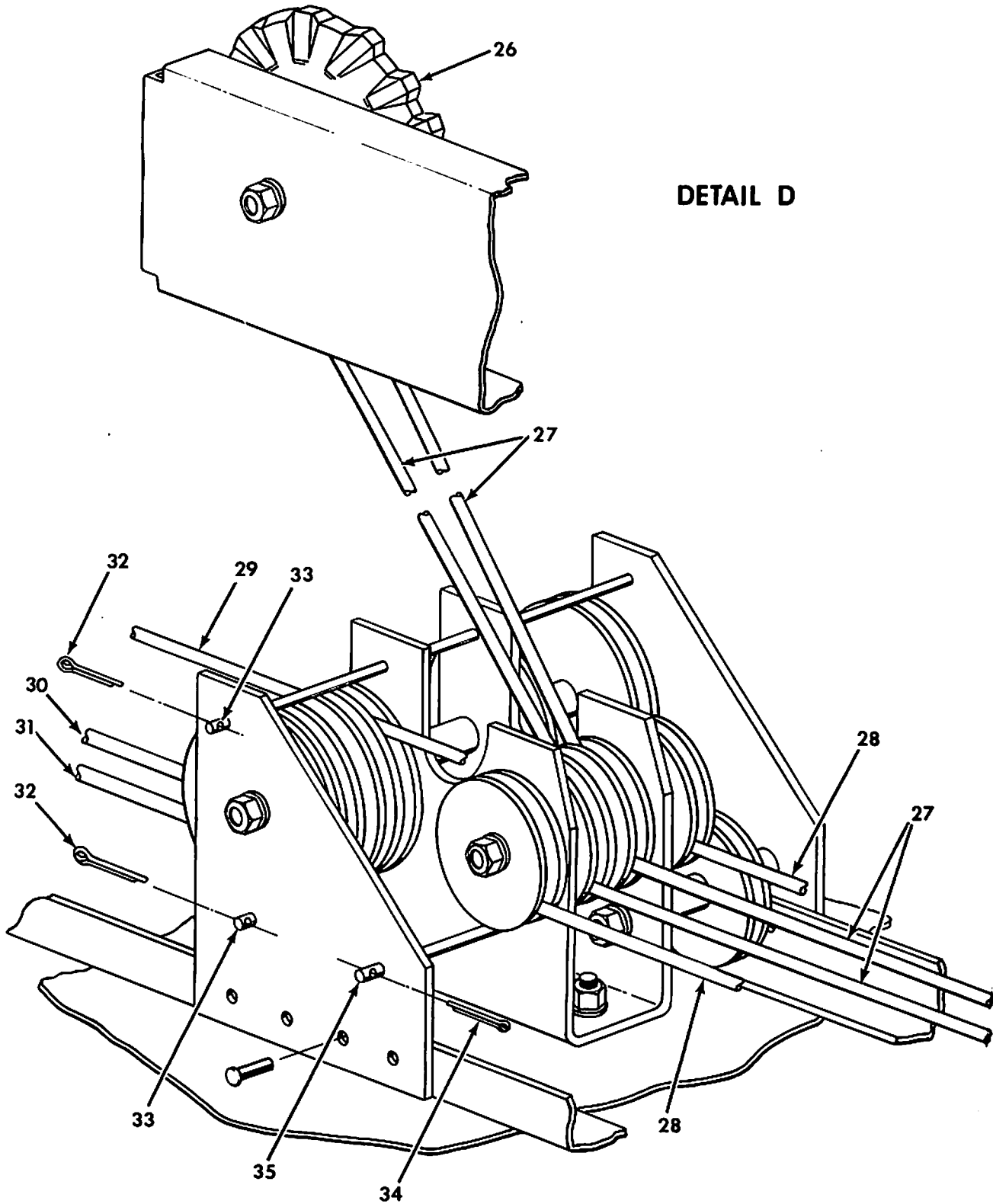
- (8) Remove lower panel of aft cabin bulkhead (17) by pulling forward. Remove cotter pin (11) and cable retainer (12). Pull forward rudder cables (9) free of pulleys (13).
- (9) Pull aft end of passenger seat bottom up and forward to gain access to pulley group at Fuselage Station 143.25. Remove cotter pin (21) and cable retainer (22). Pull forward rudder cables (19) free of pulley (20).
- (10) Beneath elevator trim control at Fuselage Station 88.00, remove cotter pin (32) and cable retainer (33). Pull forward rudder cables (31) free of pulleys.
- (11) At rudder bellcranks (62 and 65, Figure 202) forward of rudder pedals, remove cotter pins (68), nuts (69), washers (70), and clevis bolts (71). Remove rudder cables (67) from bellcranks (62 and 65).
- (12) Pull rudder cables forward into passenger compartment. Disconnect pull wire or cord and leave in place.



Rudder Linkage System
Figure 203 (Sheet 1 of 7)

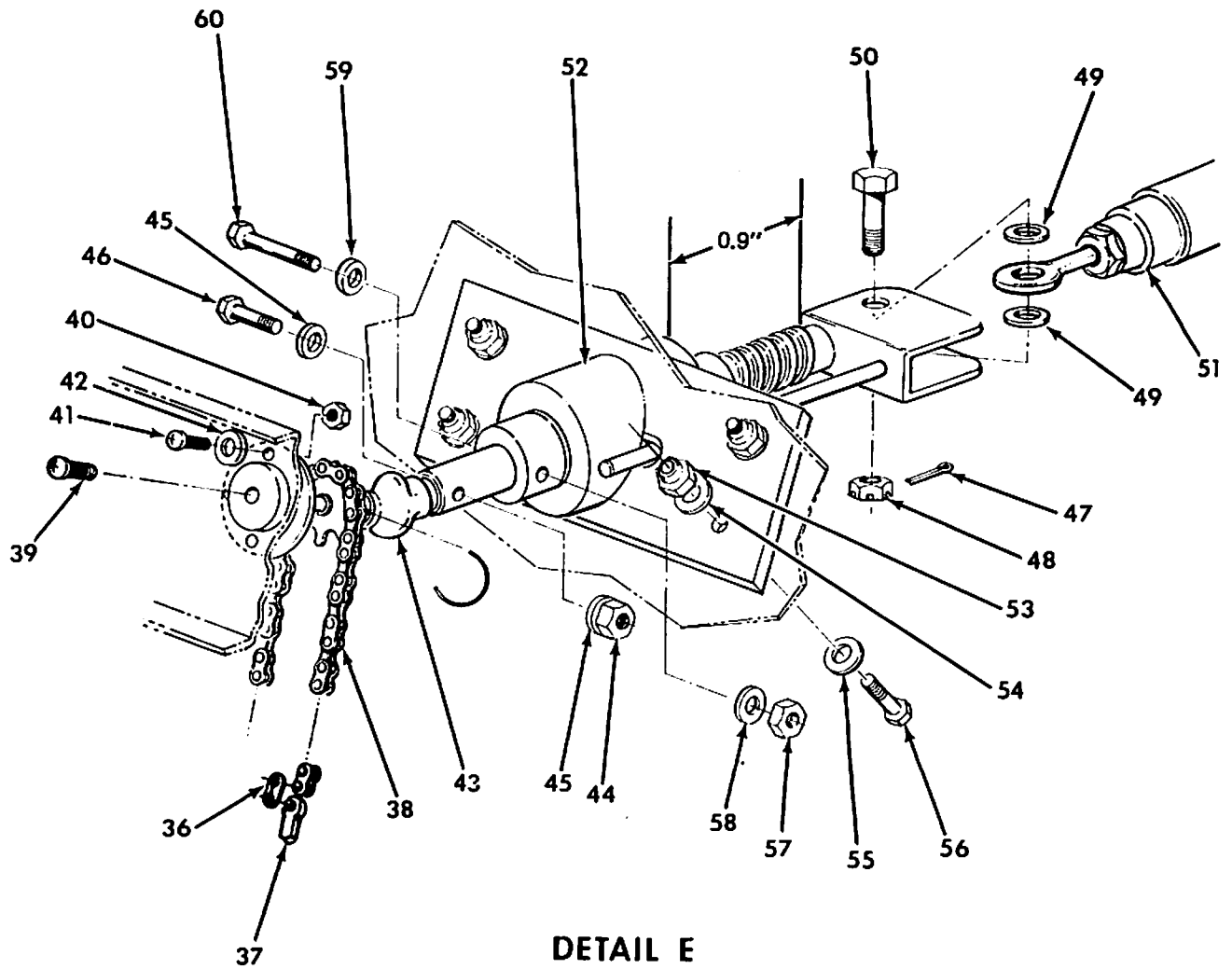


**Rudder Linkage System
Figure 203 (Sheet 2 of 7)**



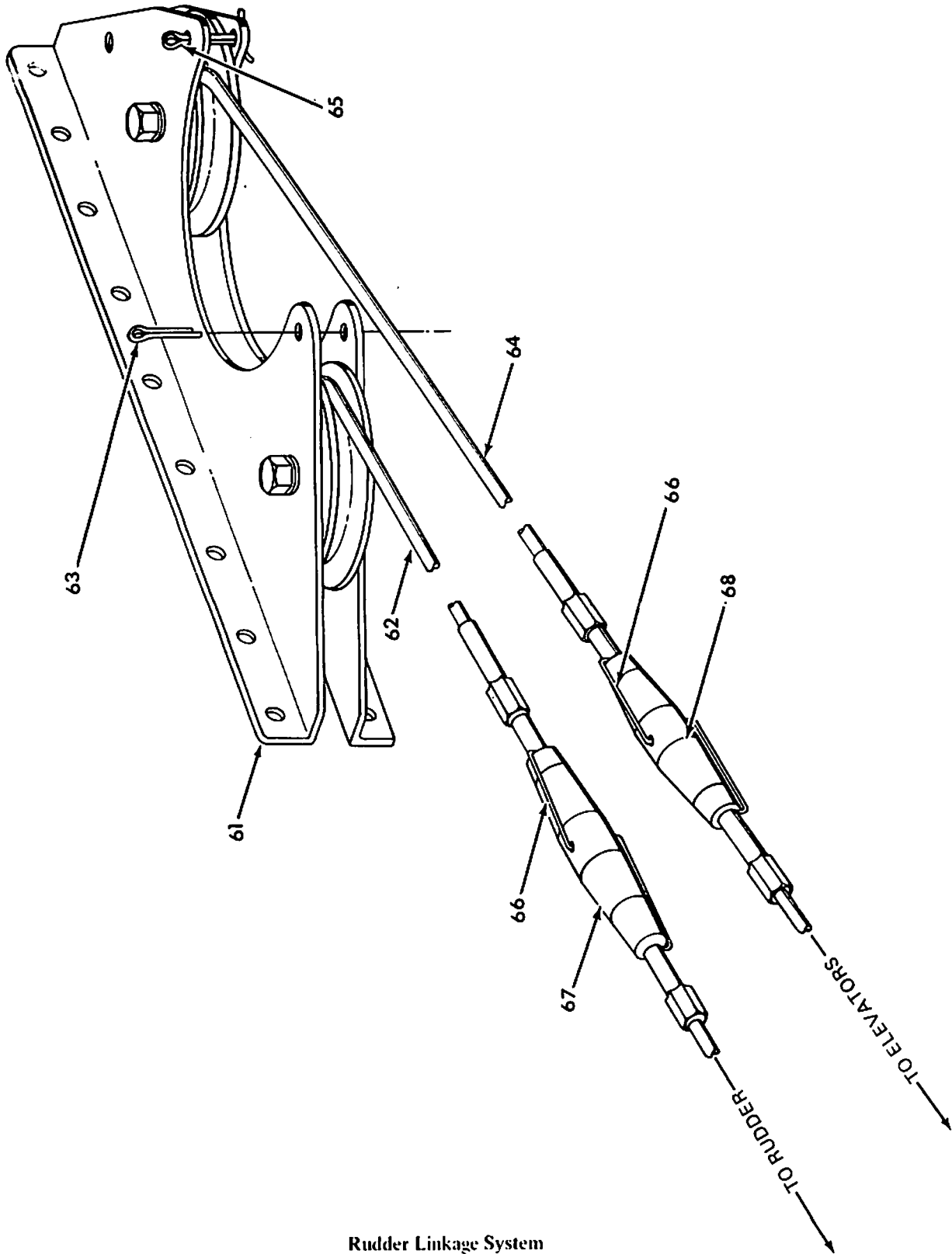
DETAIL D

**Rudder Linkage System
Figure 203 (Sheet 3 of 7)**

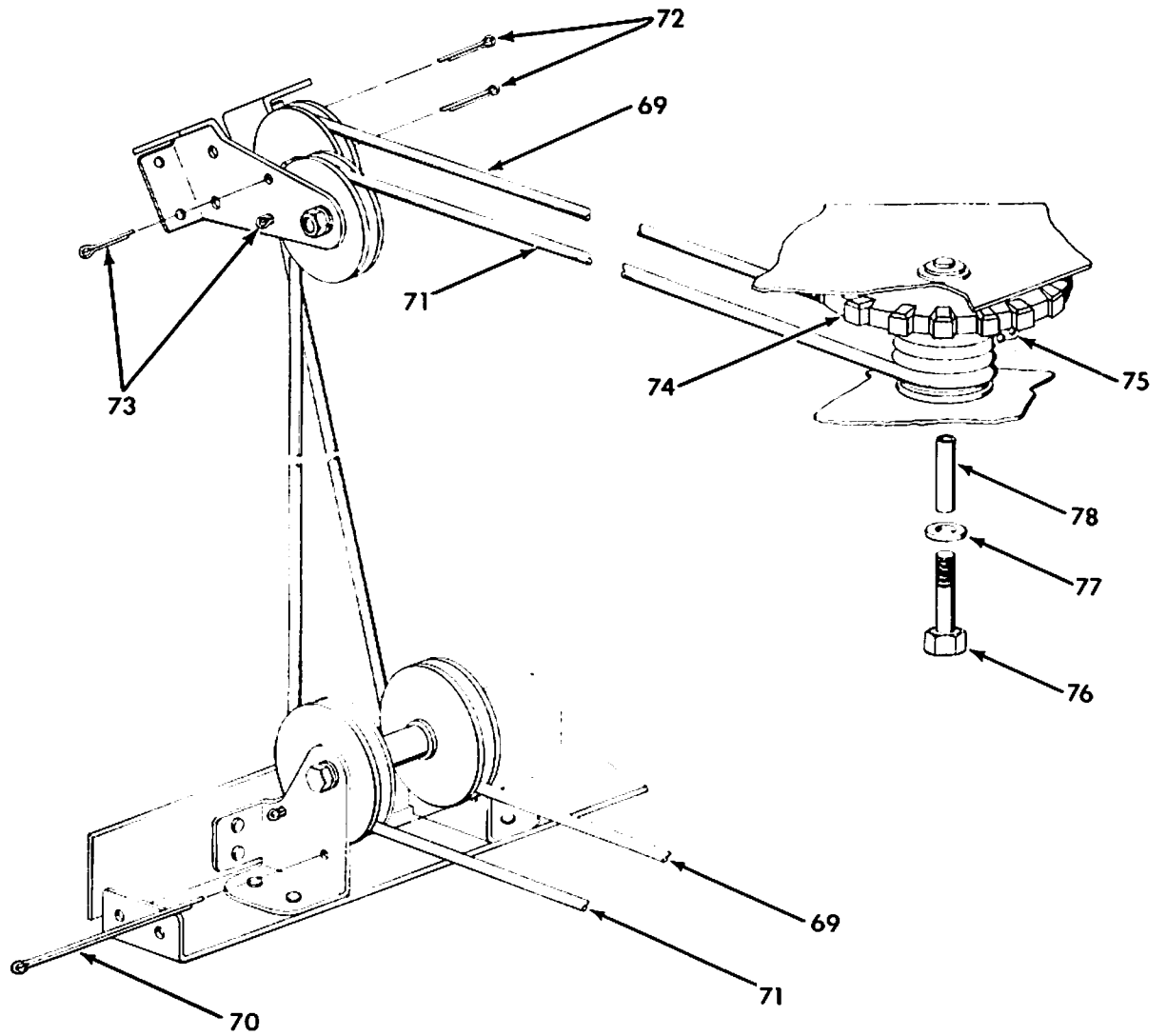


DETAIL E

**Rudder Linkage System
Figure 203 (Sheet 4 of 7)**



**Rudder Linkage System
Figure 203 (Sheet 5 of 7)**



DETAIL G

Rudder Linkage System
Figure 203 (Sheet 6 of 7)

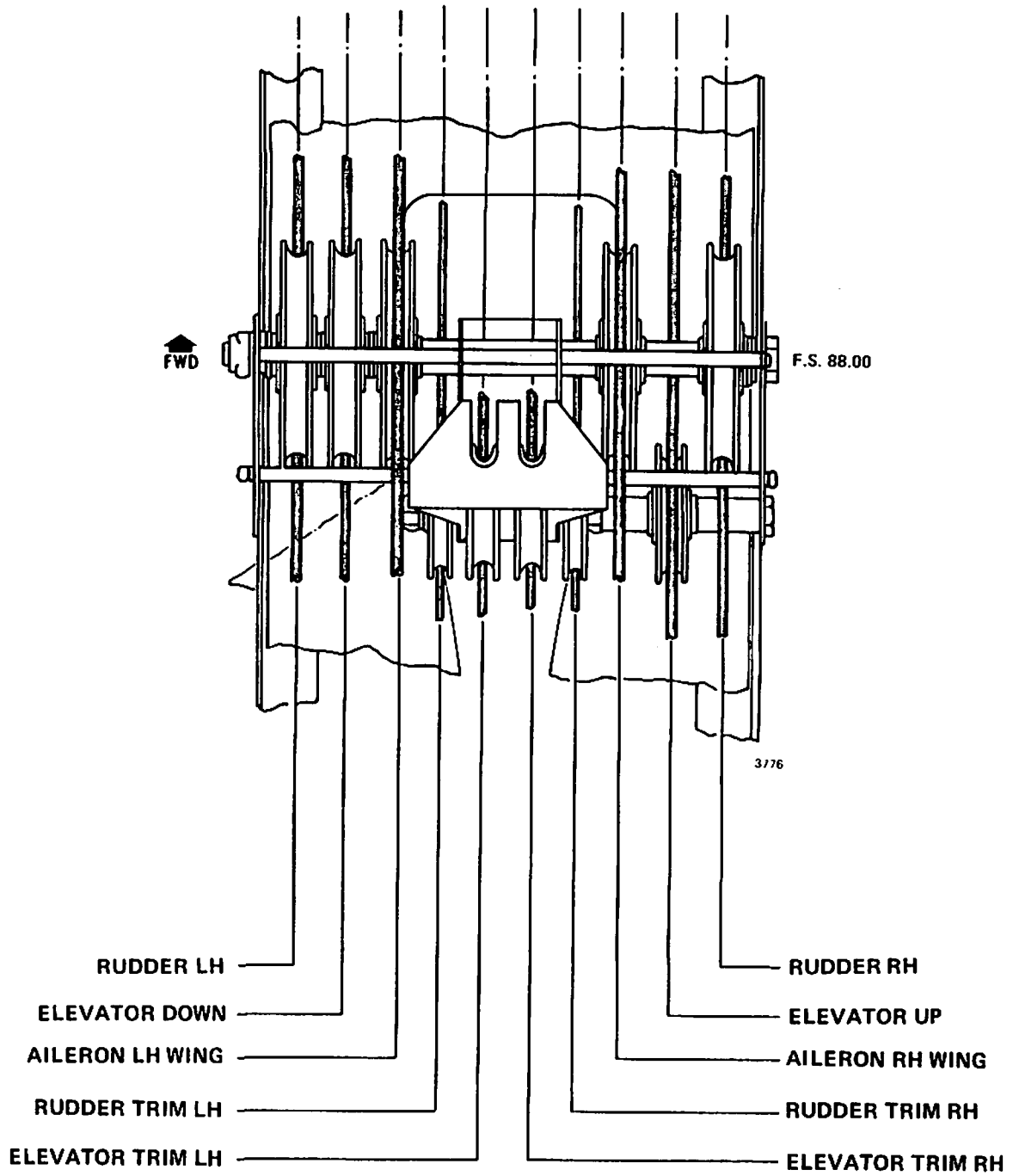
- | | | |
|-------------------------------|----------------------------|------------------------------|
| 1. Turnbuckle Clip | 25. Cable Retainer | 52. Trim Tab Actuator |
| 2. Turnbuckle | 26. Elevator Trim Wheel | 53. Nut |
| 3. Forward Rudder Cable | 27. Elevator Trim Cables | 54. Washer |
| 4. Aft Rudder Cable | 28. Rudder Trim Cable | 55. Washer |
| 5. Guard | 29. Aileron Cable | 56. Bolt |
| 5A. Nut | 30. Elevator Control Cable | 57. Nut |
| 5B. Washer | 31. Forward Rudder Cable | 58. Washer |
| 5C. Bolt | 32. Cotter Pin | 59. Washer |
| 6. Pulley | 33. Cable Retainer | 60. Bolt |
| 7. Pulley | 34. Cotter Pin | 61. Trim Pulley Bracket |
| 8. Rudder Trim Control Cable | 35. Cable Retainer | 62. Rudder Trim Cable |
| 9. Forward Rudder Cable | 36. Clip | 63. Cotter Pin |
| 10. Elevator Control Cable | 37. Rudder Trim Cable | 64. Elevator Trim Cable |
| 11. Cotter Pin | 38. Chain | 65. Cotter Pin |
| 12. Cable Retainer | 39. Chain Guard Screw | 66. Locking Clip |
| 13. Pulley | 40. Nut | 67. Rudder Trim Turnbuckle |
| 14. Cotter Pin | 41. Screw | 68. Elevator Trim Turnbuckle |
| 15. Cable Retainer | 42. Washer | 69. RH Rudder Trim Cable |
| 16. Pulley | 43. Drive Assembly | 70. Cotter Pin |
| 17. Aft Cabin Bulkhead | 44. Nut | 71. LH Rudder Trim Cable |
| 18. Rudder Trim Control Cable | 45. Washer | 72. Cotter Pin |
| 19. Forward Rudder Cable | 46. Bolt | 73. Cotter Pin |
| 20. Pulley | 47. Cotter Pin | 74. Rudder Trim Wheel |
| 21. Cotter Pin | 48. Nut | 75. Retainer |
| 22. Cable Retainer | 49. Washer | 76. Bolt |
| 23. Pulley | 50. Bolt | 77. Washer |
| 24. Cotter Pin | 51. Rudder Trim Push Rod | 78. Spacer |

Rudder Linkage System
Figure 203 (Sheet 7 of 7)

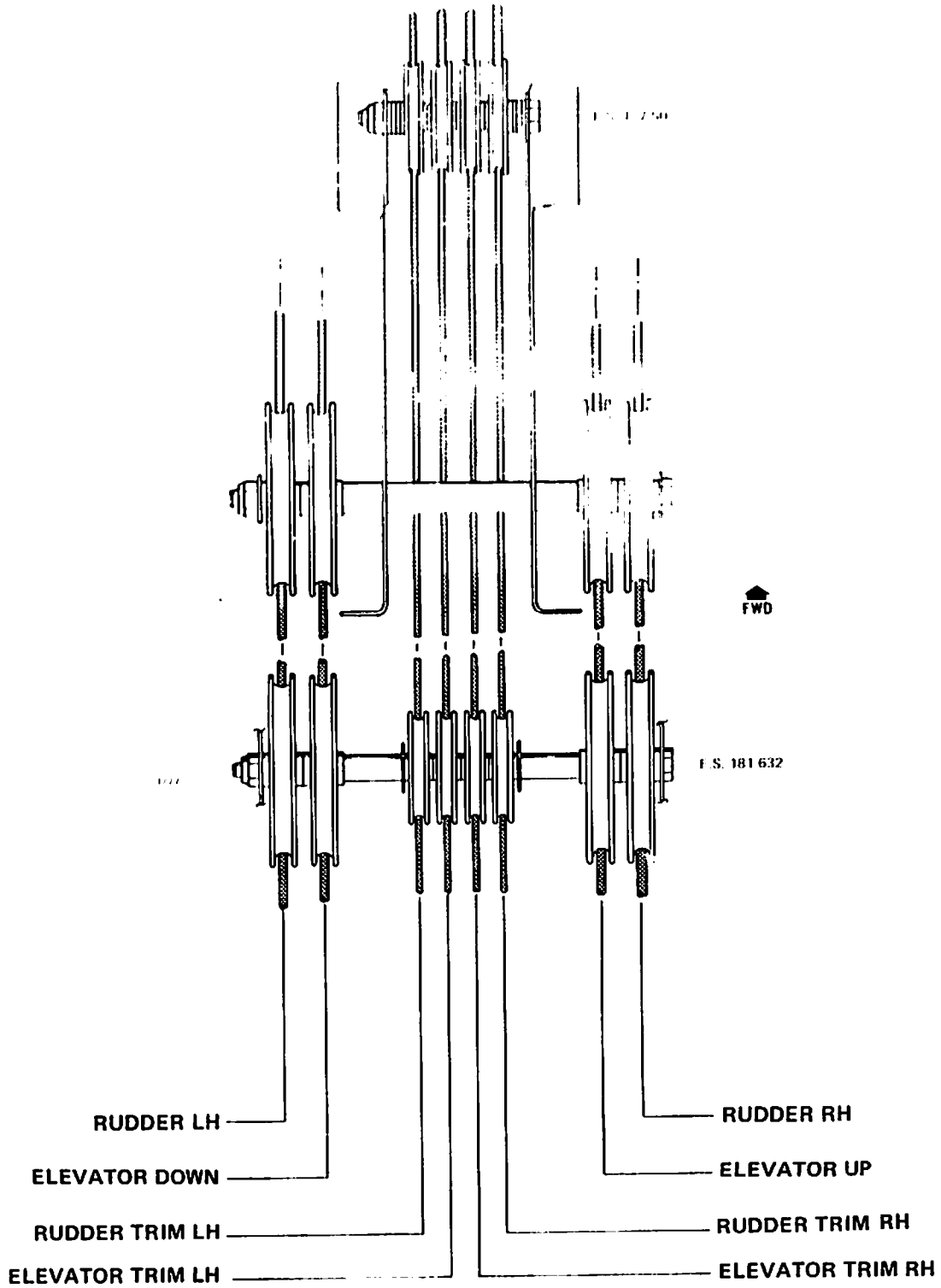
B. Installation

NOTE: Lubricate cables in pulley contact areas with commercial grade paraffin before installation.

- (1) Attach pull wire or cord to rudder cables and pull cables into position.
- (2) At rudder bellcranks (62 and 65, Figure 202) forward of rudder pedals, install rudder cables (67). Secure with clevis bolts (71), washers (70), nuts (69), and cotter pins (68).
- (3) Beneath elevator trim control at Fuselage Station 88.00, position rudder cables into pulleys as shown in Figure 204. With all control cables in proper positions, install cable retainer (33, Figure 203) and cotter pin (32).
- (4) Beneath the rear seat bottom at Fuselage Station 143.25, position rudder cables into pulleys as shown in Figure 204. With all control cables in proper position, install cable retainer (22, Figure 203) and cotter pin (21).
- (5) Aft of rear cabin bulkhead at Fuselage Station 181.632, position rudder cables into pulleys as shown in Figure 204. With all control cables in proper positions, install cable retainer (12, Figure 203) and cotter pin (11).
- (6) Install aft rudder cables (4, Figure 203) into position and route through pulleys (7). Install pulleys (6) and guards (5). Secure with bolts (5C), washers (5B), and nuts (5A).



Control Cable Routing
Figure 204 (Sheet 1 of 2)



**Control Cable Routing
Figure 204 (Sheet 2 of 2)**

- (7) Install turnbuckles (2) on forward and aft rudder cables (3 and 4). Do not install turnbuckle clips (1) at this time.
- (8) At rudder bellcrank (7, Figure 201) install clevises (6) and secure with bolt (5), washers (4 and 3), nuts (2), and cotter pins (1).
- (9) Check rudder and trim tab rigging. Refer to Paragraph 15.

12. Rudder Trim Tab

A. Removal

- (1) Remove rudder per Paragraph 1.
- (2) At left-hand side of rudder, remove cotter pin (1, Figure 205), nut (2), washers (3 and 4), and bolt (5).
- (3) Separate push rod (6) from trim tab bellcrank (7). Remove push rod (6) from rudder.
- (4) At right-hand side of rudder, remove hinge pin (8), and separate rudder hinge half (9) from trim tab hinge half (10).

B. Installation

- (1) At right-hand side of rudder, align trim tab hinge half (10, Figure 205) with rudder hinge half (9) and install hinge pin (8). Stake hinge pin.

NOTE: Make sure to install push rod (6) so that adjustable end is aft.

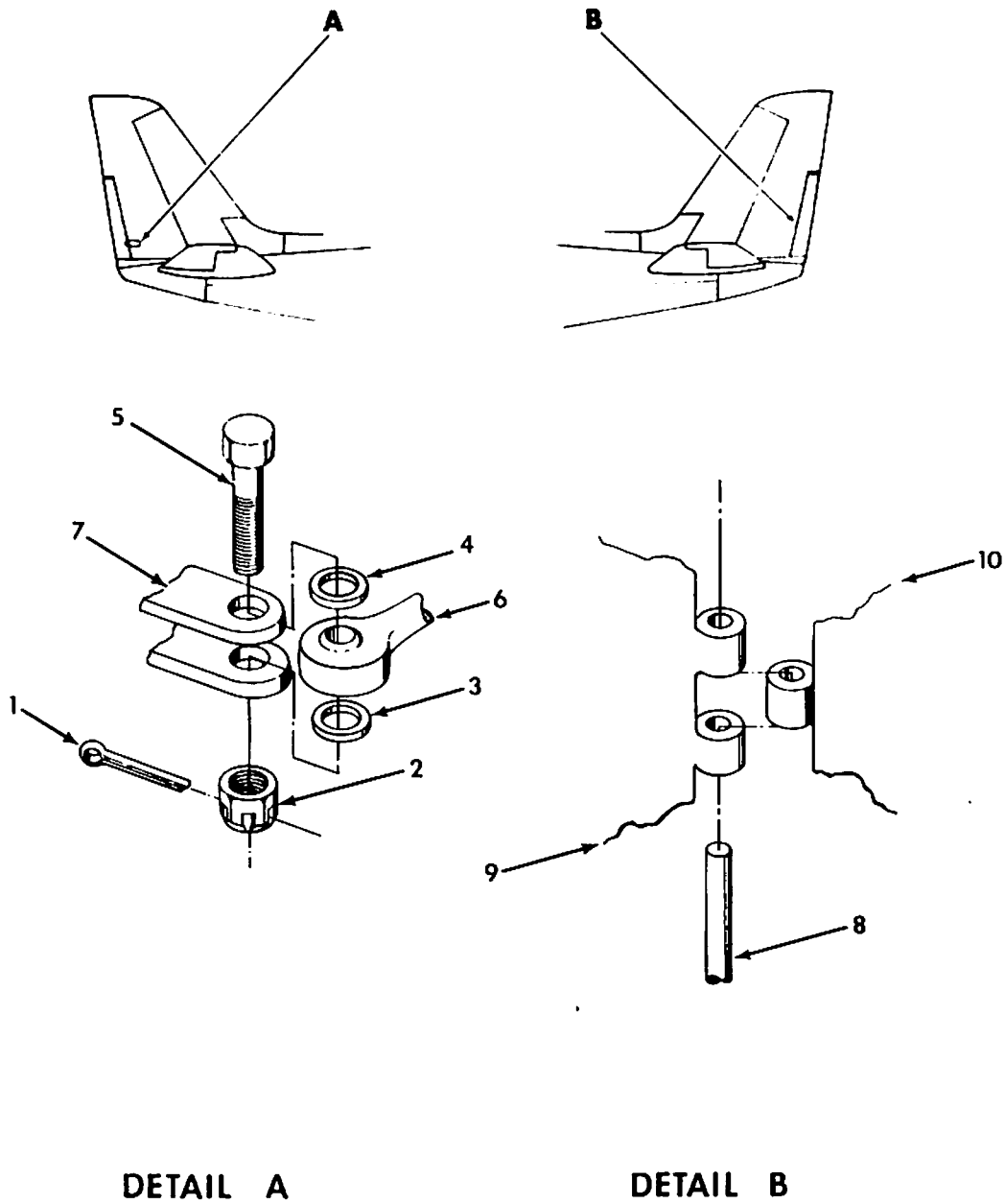
- (2) At left-hand side of rudder, install push rod (6) into rudder and align rod end with trim tab bellcrank (7).
- (3) Install bolt (5), washers (3 and 4), and nut (2). Do not install cotter pin (1) at this time.
- (4) Install rudder per Paragraph 1.
- (5) Install cotter pin (1) after rigging check is complete.

13. Trim Tab Actuator and Drive Assembly

A. Removal

NOTE: The amount of rigging required can be minimized if the procedure below is followed closely.

- (1) Using a rudder rigging fixture, set the rudder and rudder trim tab at 0 degree. Remove the vertical stabilizer access cover (Chapter 55). Mark a link on the chain (38, Figure 203) and a corresponding point on the sprocket for proper orientation at installation.
- (2) Remove rudder per Paragraph 1.
- (3) Remove aft fuselage access covers per Chapter 53. Remove locking clips (66, Figure 203) and loosen rudder trim turnbuckles (67).



- 1. Cotter Pin
- 2. Nut
- 3. Washer
- 4. Washer
- 5. Bolt

- 6. Push Rod
- 7. Trim Tab Bellcrank
- 8. Hinge Pin
- 9. Rudder Hinge Half
- 10. Trim Tab Hinge Half

**Rudder Trim Tab Installation
Figure 205**

- (4) At vertical stabilizer access opening, remove nut (44), washers (45), and bolt (46). Remove nuts (53), washers (54 and 55), and bolts (56).
- (5) Slide trim tab actuator (52) aft and out of vertical stabilizer.
- (6) Remove chain guard screws (39), washers (42), and nuts (40).

NOTE: If removal of chain (38) is not required, a short piece of wire or cord may be looped around chain and secured to structure to hold chain in place.

- (7) Remove rudder trim turnbuckles (67) and cotter pins (63) securing rudder trim cables (62).
- (8) Tie a wire or cord to chain (38). Remove chain from sprocket and pass over free end of universal joint. Lower chain into fuselage. Leave wire or cord in place for use during installation.
- (9) Remove screws (41), washers (42), and nuts (40). Remove drive assembly (43) from aircraft.
- (10) Remove clips (36) to separate rudder trim cables (37) from chain (38).

B. Installation

- (1) Install drive assembly (43, Figure 203) and secure with nuts (40), washers (42), and screws (41).

NOTE: If a new chain (38) is installed, mark corresponding link using old chain as a guide.

- (2) Connect chain (38) to rudder trim cables (37) with clips (36).
- (3) Pull chain (38) into position in vertical stabilizer and pass over free end of drive assembly. Install chain on sprocket using marks on chain and sprocket made in Step A (1) as a guide.
- (4) Turn sleeve end of trim tab actuator (52) until the clevis end dimension of 0.9 inch shown in Figure 203 is obtained.
- (5) Slide trim tab actuator (52) into place in vertical stabilizer, sliding sleeve over universal joint shaft. Install bolts (56), washers (54 and 55), and nuts (53).
- (6) Align holes and install bolt (46), washers (45), and nut (44).
- (7) Install rudder trim turnbuckles (67). Do not install locking clips (66) or cotter pins (63) at this time.
- (8) Check rudder and rudder trim rigging per Paragraph 15.

14. Trim Cables

A. Removal

- (1) Remove aft fuselage access covers per Chapter 53.

- (2) Remove locking clips (66, Figure 203) and rudder trim turnbuckles (67). Remove cotter pin (63).

CAUTION: PULL TRIM CABLE SLOWLY TO AVOID DAMAGE AS STOP IS CONTACTED.

- (3) Pull either rudder trim cable (37) down slowly until stop is contacted. Remove clip (36) and attach a wire or cord to end of chain (38).
- (4) Pull remaining trim cable (37) down slowly until stop is contacted and remove clip (36). Remove trim cables (37).
- (5) In cabin, remove access panels and covers from center and aft consoles as required to gain access to rudder trim control and cables. Refer to Chapter 25.
- (6) Remove lower panel of aft cabin bulkhead (17, Figure 203). Remove cotter pin (14) and cable retainer (15). Pull rudder trim control cables (8) free of pulley.
- (7) Pull aft end of passenger seat bottom up and forward to gain access to pulley group at Fuselage Station 137.50. Remove cotter pin (24) and cable retainer (23). Pull rudder trim control cables (18) free of pulleys.
- (8) Beneath elevator trim control at Fuselage Station 88.00, remove cotter pin (34) and cable retainer (35). Pull rudder trim control cables (28) free of pulleys.

NOTE: Remove aileron trim control knob and linkage components as required to gain access to rudder trim wheel. Refer to Section 27-1-1.

- (9) At bottom of rudder trim wheel, remove safety wire, bolt (76), washer (77), and spacer (78). Pull rudder trim wheel (74) aft and out of forward console.
- (10) Remove safety wire from retainer (75) and release rudder cables (69 and 71). Remove cotter pins (70, 72, and 73).

NOTE: Due to limited access to the aft fuselage and other areas through which the trim cables pass, a wire or cord should be attached to each cable end and pulled into position as the existing cables are removed.

- (11) Tie a wire or cord to each rudder trim cable at forward console.
- (12) At aft fuselage access opening, pull rudder trim cables aft and out of aircraft. Disconnect pull wires or cords and leave in place.

B. Installation

NOTE: Lubricate cables in pulley contact areas with commercial grade paraffin before installation.

- (1) At aft fuselage access opening, attach pull wires or cords to rudder trim cables and pull cables into position. Allow sufficient free cable at forward console for winding on drum of rudder trim wheel (74, Figure 203).

- (2) In forward console, install left and right rudder trim cables (69 and 71) into pulleys and secure with cotter pins (70, 72, and 73).
- (3) Beginning at top of trim wheel, wind free end of right-hand rudder trim cable around drum 3-1/4 coils in a clockwise direction when viewed from top of trim wheel. See Detail G, Figure 203.
- (4) Beginning at bottom of trim wheel, wind free end of left-hand rudder trim cable around drum 3-1/4 coils in a counterclockwise direction when viewed from top of trim wheel. See Detail G, Figure 203.
- (5) Install cable ends into retainer (75, Figure 203) and secure with lock wire.
- (6) Install spacer (78) in rudder trim wheel (74). Install rudder trim wheel in proper position and secure with washer (77) and bolt (76).
- (7) Beneath elevator trim control wheel at Fuselage Station 88.00 (26, Figure 203), route rudder cables as shown in Figure 204. Install cable retainer (35, Figure 203), and cotter pin (34).
- (8) Pull aft end of passenger seat bottom up and forward to gain access to pulley group at Fuselage Station 137.50. Route cables as shown in Figure 204. Install cable retainer (25) and cotter pin (24).
- (9) At Fuselage Station 181.632, route rudder cables as shown in Figure 204. Install cable retainer (15, Figure 203) and cotter pin (14).
- (10) At aft fuselage access, route rudder trim cables (62) through pulleys in trim pulley bracket (61) and secure with cotter pin (63).
- (11) Secure rudder trim cable (37) to chain (38) with clip (36).

CAUTION: PULL WIRE OR CORD SLOWLY TO AVOID DAMAGE TO STOP.

- (12) Pull wire or cord, Step A (3) down until stop is contacted. Remove wire or cord and secure other rudder trim cable (37) to chain (38).
- (13) Secure right and left rudder trim cables together with turnbuckles (67 and 68). Do not install locking clips (66) at this time.
- (14) Rig rudder and rudder trim system per Paragraph 15.

15. Rudder and Trim System Rigging Check

A. Rudder Control System

- (1) With the nose wheel parallel to the aircraft centerline, inspect the steering cables and bungees for slack or excess tension. No slack should be evident and cable tension should not exceed 15 pounds.

NOTE: Rigging fixture part numbers are given in Section 27-0.

- (2) Using a rudder rigging fixture, set the rudder trailing edge at 0 degree. Rudder should remain at 0 degree when rudder pedals are released and rudder pedals should be aligned with each other.

- (3) Depress left rudder pedal until stop is contacted and note reading on rigging fixture. Reading should be 40 ± 2 degrees.
- (4) Depress right rudder pedal until stop is contacted and note reading on rigging fixture. Reading should be 40 ± 2 degrees.

B. Rudder Trim System

NOTE: Rudder must be clamped at 0 degree before trim tab readings are taken. Refer to Section 27-0 for rigging fixture part numbers.

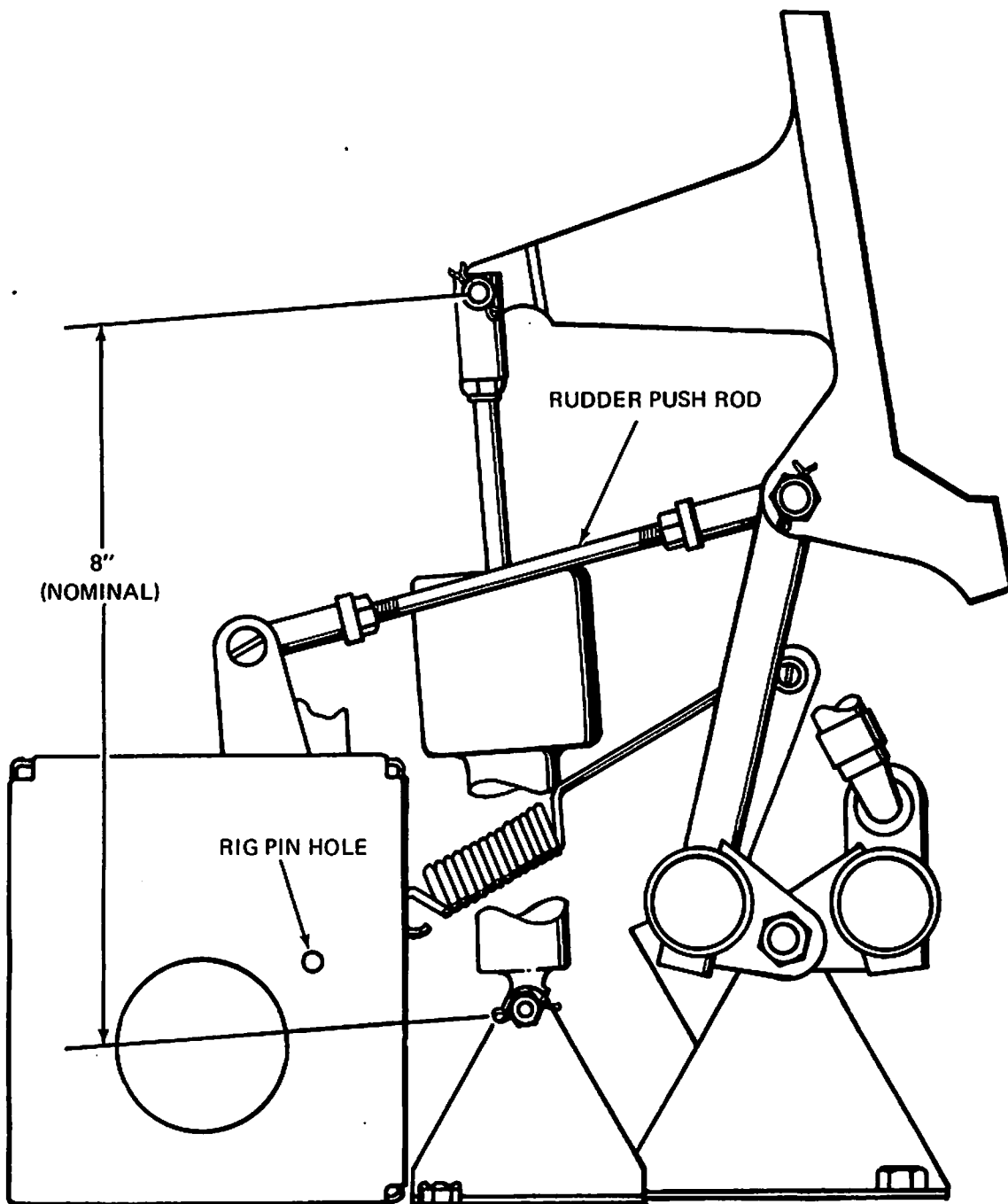
- (1) Using a rudder rigging fixture, set the rudder trailing edge at 0 degree.
- (2) Rotate the trim wheel until the stop is contacted. Trim tab reading should be 15 ± 1.5 degrees.
- (3) Rotate the trim wheel until the other stop is contacted. Trim tab reading should be 15 ± 1.5 degrees.

16. Rudder and Trim System Rigging Procedures

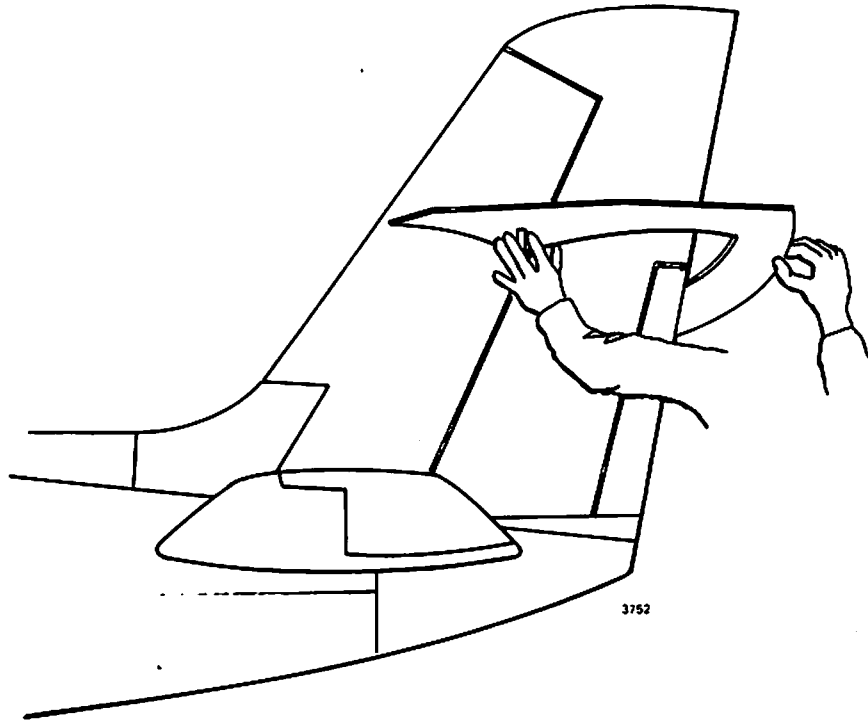
Rudder and trim rigging should be performed at an ambient temperature that is average for the area in which the aircraft is usually operated. If rigging must be done with the temperature above or below normal, it is recommended that cable tension be measured and adjusted as necessary when temperature returns to normal. Refer to Section 27-0 for rigging fixture part numbers.

A. Rudder Control System

- (1) Remove aft fuselage access covers and tail cone per Chapter 53.
- (2) With link assembly attached, pull right-hand pedal to stop, align left-hand pedal bar, and adjust push rods to match.
- (3) Install a rig pin through rig pin holes in mounting brackets and both rudder pedal bellcranks. See Figure 206.
- (4) With the nose wheel parallel to the aircraft centerline, adjust the steering bungee turnbuckles in the nose wheel well as necessary to take out the slack or reduce tension to less than 15 pounds. The tension on the two steering cables should be approximately equal.
- (5) Adjust clevis ends of brake cylinders as necessary to align pedals. Nominal distance between mounting holes is 8 inches. See Figure 206.
- (6) With rig pin still installed, use a rudder rigging fixture (Figure 207) to measure rudder position. If required, loosen rudder turnbuckles (2, Figure 203) and set rudder at 0 degree.
- (7) Using a tensiometer, set rudder cable tension at 25 ± 5 pounds. Make sure rudder is still at 0 degree. Install turnbuckle clips (1, Figure 203).
- (8) Remove rig pins installed in Step (2).



**Rudder and Brake Control Rigging
Figure 206**

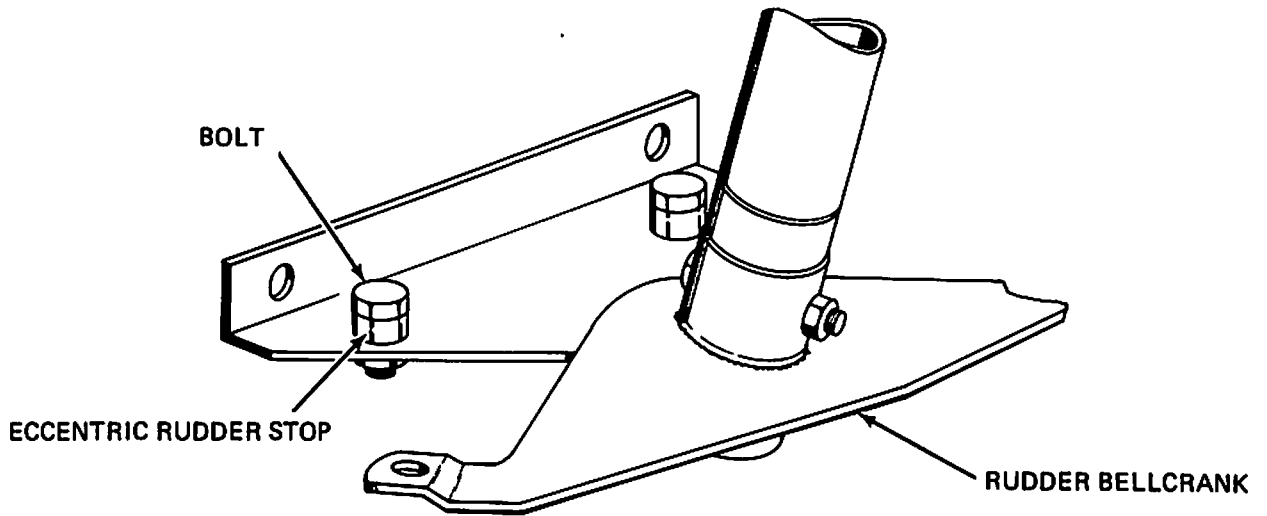


**Rudder Rigging Fixture
Figure 207**

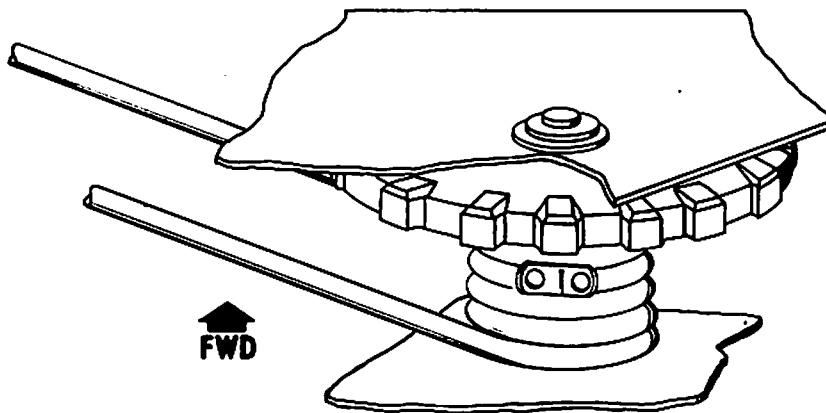
- (9) With rudder rigging fixture installed, deflect rudder until rudder bellcrank arm contacts stop as shown in Figure 208. Note reading on rigging fixture. Reading should be 40 ± 2 degrees.
- (10) If rudder travel is not within limits, loosen bolt and nut securing eccentric rudder stop. Turn stop to a position that will limit rudder travel to 40 ± 2 degrees.
- (11) Repeat Steps (9) and (10) above with rudder deflected in opposite direction.
- (12) Install tail cone and aft fuselage access covers per Chapter 53.

B. Rudder Trim System

- (1) Rig rudder control system per Steps A (1) through (11).
- (2) Remove cover from rudder trim wheel housing. Rotate trim wheel until stop is contacted.
- (3) Rotate trim wheel in opposite direction 2-1/2 turns to the position shown in Figure 209. Make sure the cable coils lie evenly as shown and do not cross each other. There must be 3-1/4 turns of cable above and below retainer.



**Rudder Bellcrank Stops
Figure 208**



NOTE: CLIP MUST FACE AFT.

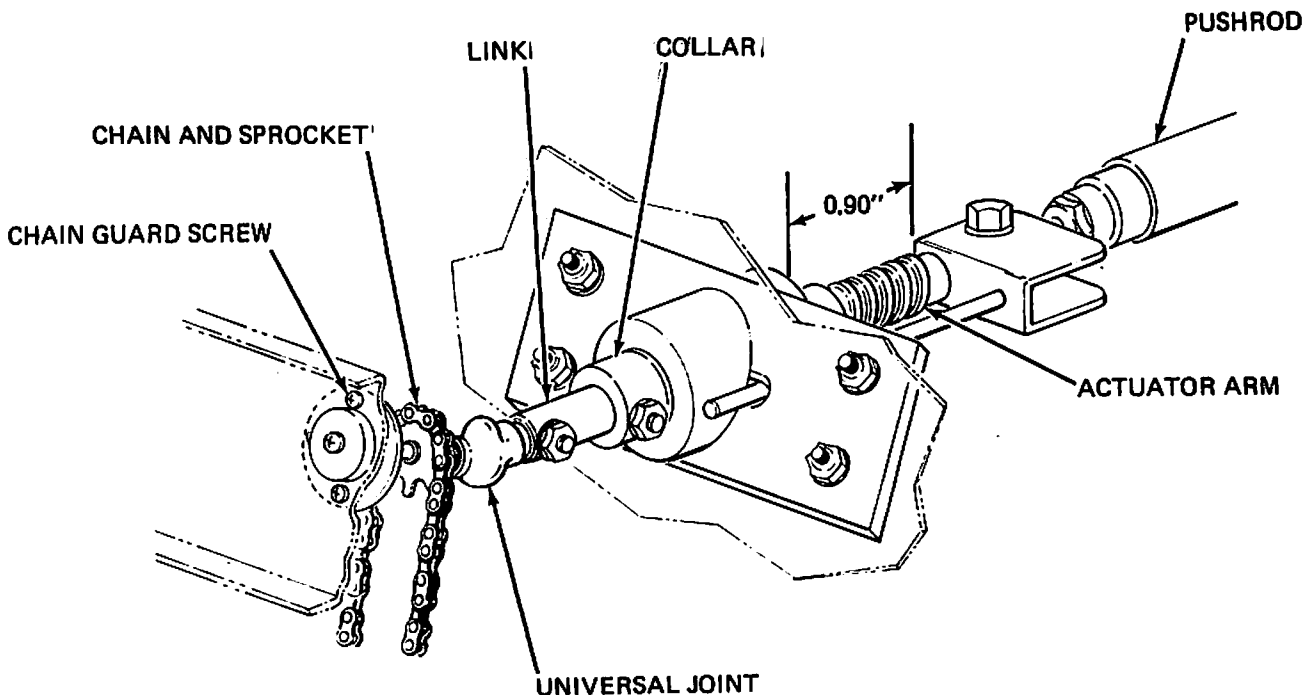
**Rudder Trim Wheel Neutral Position
Figure 209**

GRUMMAN AMERICAN AVIATION
GA-7/COUGAR
MAINTENANCE MANUAL

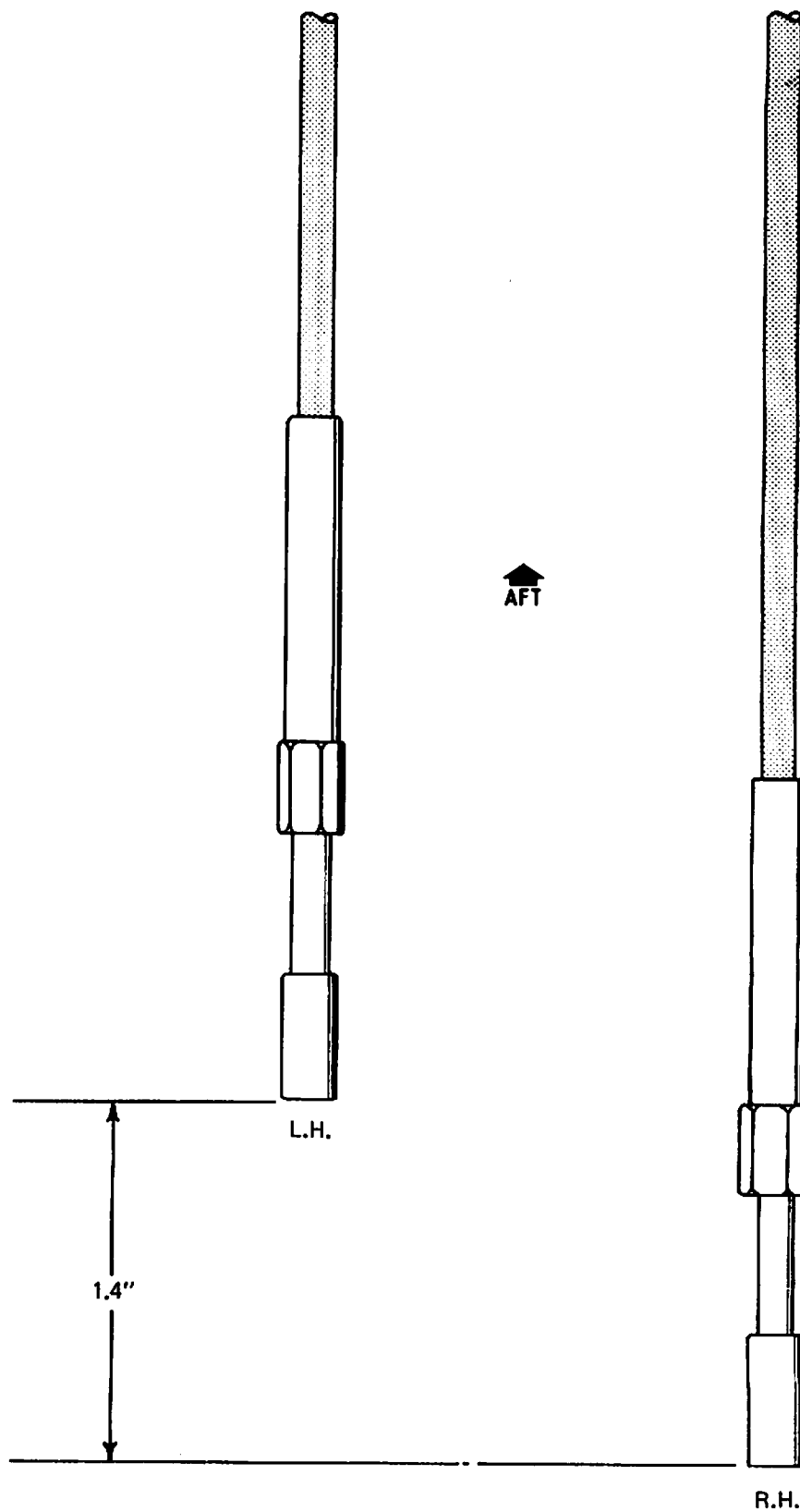
- (4) At aft fuselage access opening, remove locking clips (66, Figure 203) and rudder trim turnbuckles (67). Tie a cord or wire to free end of each aft rudder trim cable.

NOTE: Cut a piece of aluminum, phenolic, welding rod, or other suitable material to a length of 0.90 inch to position actuator.

- (5) With the rudder in the full right position, determine the length of actuator arm. See Figure 210.
- (6) If required, remove access cover from vertical stabilizer and rotate chain and sprocket to obtain an actuator arm measurement of 0.90 inch.
- (7) At aft fuselage access opening, hold aft rudder trim cables together and measure offset at cable ends as shown in Figure 211.
- (8) If required, remove chain guard screws (Figure 210) and reposition chain on sprocket to obtain an offset of 1.4 inches. Do not allow sprocket to turn while repositioning chain.
- (9) Install rudder trim turnbuckles (67, Figure 203). Tighten turnbuckles equally to obtain a reading of 15 ± 3 pounds on a tensiometer. Install locking clips (66).



Rudder Trim Actuator
Figure 210



Rudder Trim Cables – View Looking Up
Figure 211

- (10) Install a rig pin through rig pin holes in mounting brackets and both rudder pedal bellcranks as shown in Figure 206.
- (11) Use a rudder trim tab rigging fixture to determine the rudder trim tab position. Adjust length of rudder trim tab push rod as required to obtain a reading of 0 degree.
- (12) Rotate rudder trim wheel to both extremes of travel, noting reading at both stops. Readings should be 15 ± 1.5 degrees.
- (13) Install access covers on vertical stabilizer and aft fuselage. Remove rig pin from rudder pedal bellcrank. Install cover on rudder trim wheel.

17. Cleaning and Painting

**CAUTION: PAINTING ANY CONTROL SURFACE MAY CAUSE AN UNDERBALANCED CONDITION.
CHECK BALANCE AFTER PAINTING.**

Refer to Chapter 20 for cleaning and painting instructions.

18. Bearing Inspection and Replacement

- A. Remove rudder in accordance with Paragraph 1.
- B. Inspect bearings per Section 27-1-1.
- C. Install rudder in accordance with Paragraph 1.

19. Rudder Balancing Procedures

Refer to Section 27-1-1 for control surface balancing procedures.

ELEVATOR AND TAB – DESCRIPTION/OPERATION**1. General (See Figure 1.)**

Pitch control for the GA-7/Cougar is by means of two conventional elevators hinged to the trailing edges of the horizontal stabilizers. Control of the elevators is by fore-and-aft motion of the control wheel. If the dual control option is installed, an additional control wheel is provided at the copilot's station.

A hinged, adjustable trim tab is mounted in the trailing edge of the right-hand elevator. Trim tab position is controlled by means of a trim wheel mounted in the aft console between the pilot's and copilot's seats.

Counterbalance for the elevator control system is provided by a bob weight and down spring installation located beneath the left-hand floor in the nose baggage compartment.

2. Elevators

Each elevator is basically a bonded structure composed of ribs, spars, skin, torque tube, and tip cap. The trailing edge of the right-hand elevator contains the hinged trim tab. The torque tube and skin are joined to the ribs and spars to form a rigid structure that can be positioned by a bellcrank which is bolted to the inboard end of the torque tube. The elevator counterweight is located beneath the tip cap at the forward edge.

Each elevator is supported at three hinge points by bearings, one each at the outboard, center, and inboard ribs. The plastic elevator tip cap is secured to the outboard rib by clip nuts, screws, and washers.

3. Elevator Controls

As the control wheel is moved fore and aft, the displacement is transmitted by a push rod to the elevator control bellcrank located forward of the rudder pedals. The elevator control bellcrank in turn operates the up and down elevator cables which transmit the control wheel displacement to the aft elevator bellcrank located in the aft fuselage. Two push rods, connected to the aft elevator bellcrank, transmit the motion to a corresponding horn attached to each elevator.

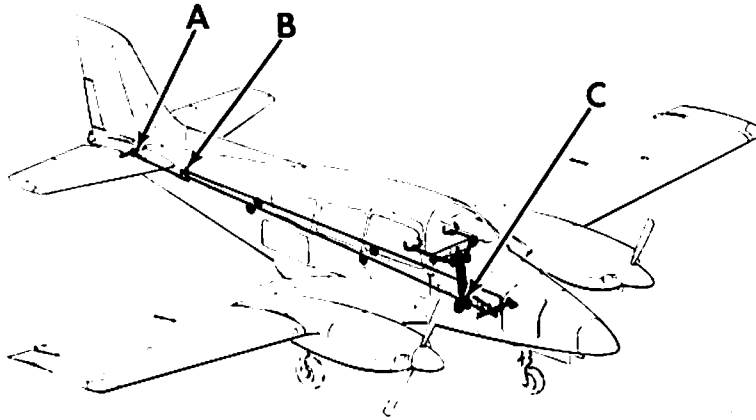
A system of pulleys routes the elevator cables fore and aft. Two turnbuckles, accessible through the aft fuselage access panels, provide a means to adjust cable tension. Adjustable control stops are provided at the elevator horns to permit adjustable limits for elevator travel. Two rig pin positions are provided as an aid in elevator system rigging; one at each elevator bellcrank.

4. Elevator Trim Tab (See Figure 2.)

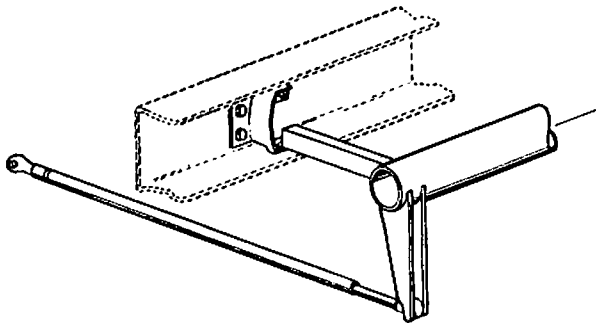
The elevator trim tab is a bonded structure composed of ribs, spars, and skin. The trim tab forms the inboard portion of the elevator trailing edge, and is connected to the elevator with a piano hinge. A pair of horns extending from the under side of the trim tab are connected to the control system by an adjustable push rod extending through the elevator structure.

5. Elevator Trim Tab Controls (See Figure 2.)

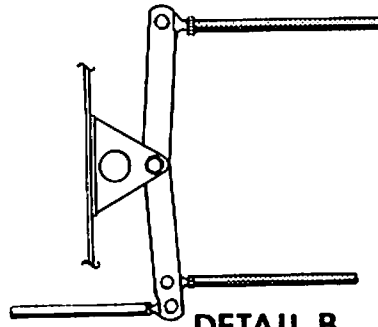
As the elevator trim tab control wheel is rotated, its angular displacement is transmitted to a chain and sprocket located within the right-hand fin by a drum, cables, and idler pulleys. Rotating the sprocket changes the effective length of the actuator assembly, and positions the trim tab by means of a push rod in the elevator. Trim tab travel is limited by stops at either end of the trim tab wheel travel.



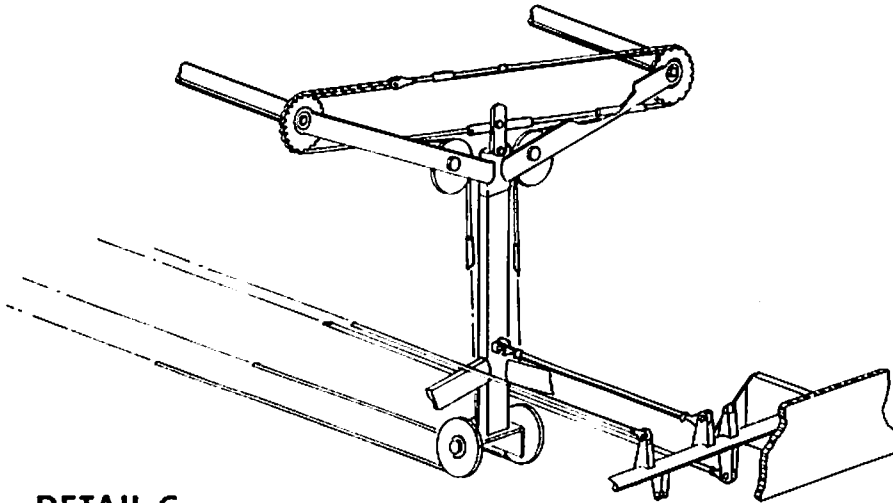
ROTATED 180°



DETAIL A



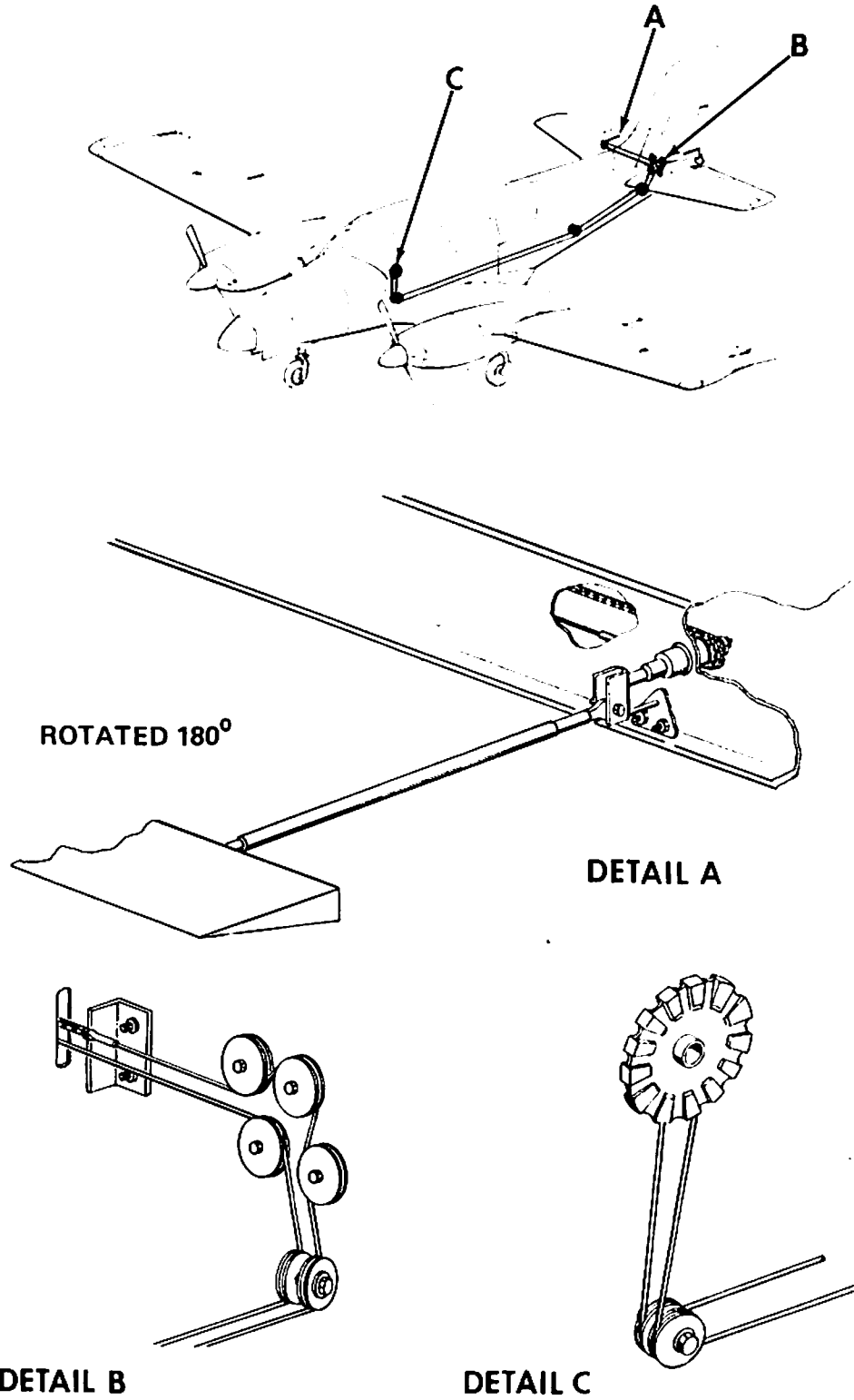
DETAIL B



DETAIL C

3669

Elevator Control System
Figure 1



3672

Elevator Trim System
Figure 2

6. Control Column (See Figure 3.)

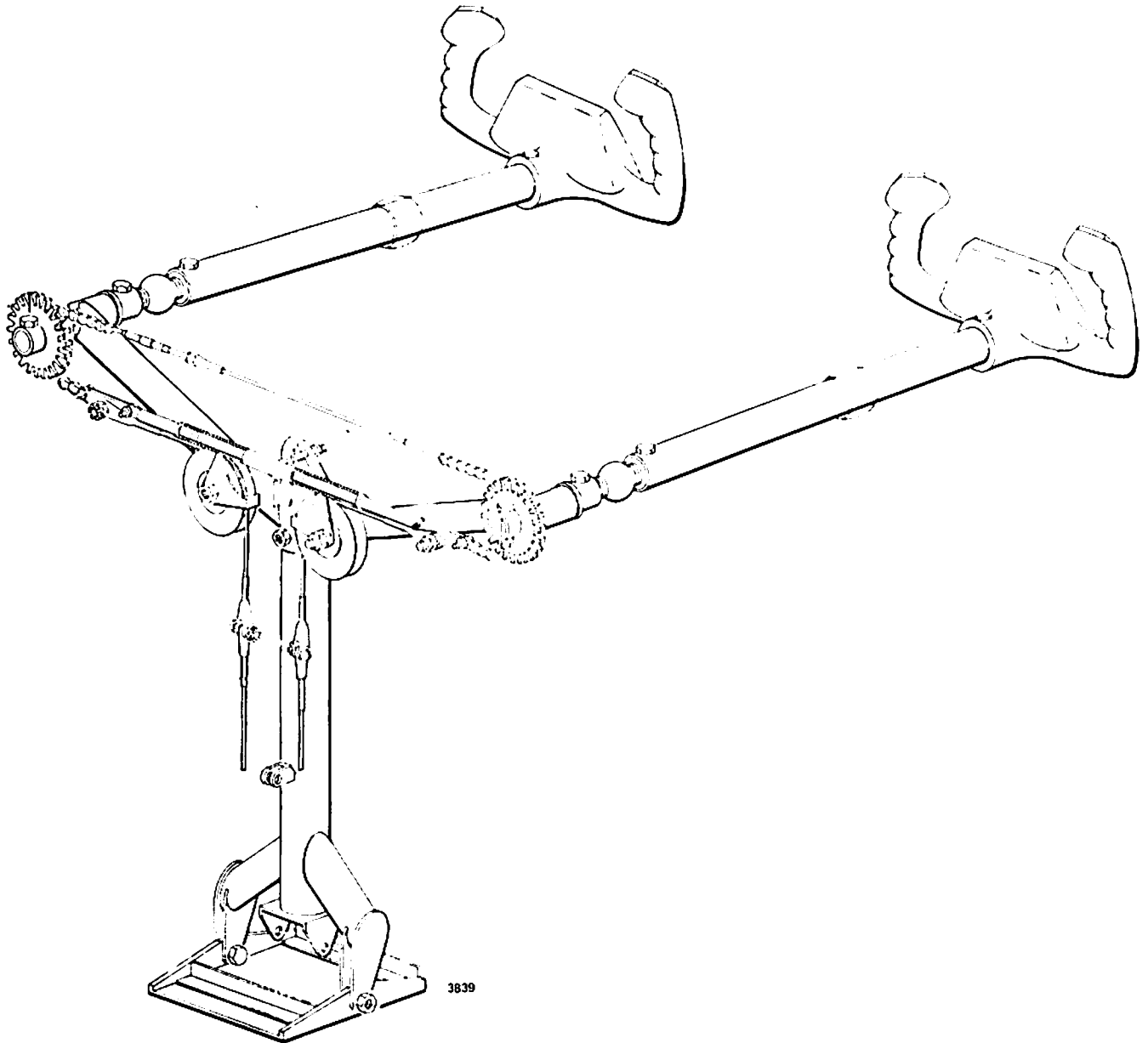
The control column is a Y-type column connected to the cabin floor by brackets containing TFE-lined, self-aligning bearings. The control wheel shaft is connected to the aileron cables by a system of chain and sprockets connected through a spring-loaded bungee to provide control return to neutral and aileron trim. The control wheel shaft is provided with a universal coupling to maintain the control wheel shaft horizontal in any point of fore-and-aft control column position, yet allowing control wheel rotation to be transmitted to the sprocket.

7. Stall Warning System (See Figure 4.)

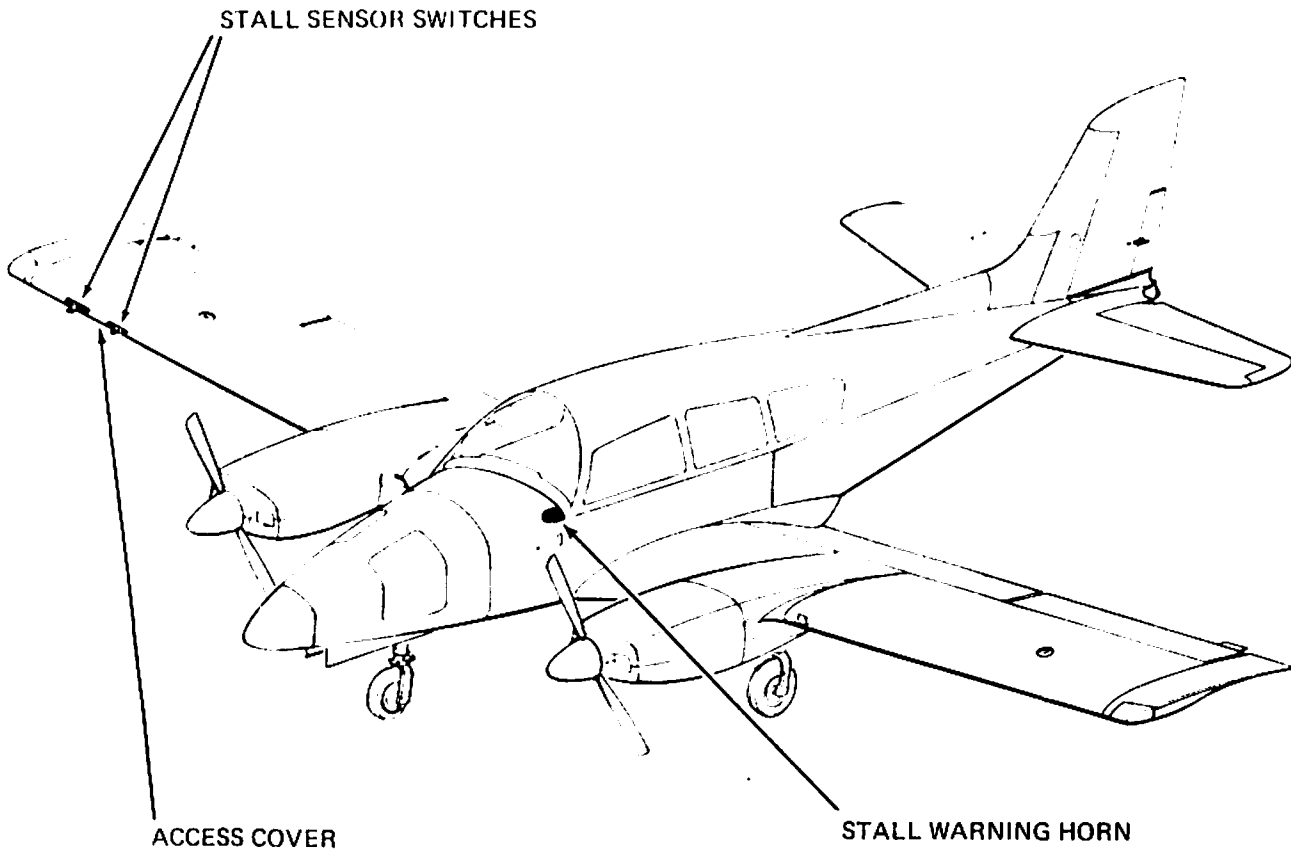
The electrically-operated stall warning system provides an aural warning of an impending stall approximately 4 to 9 knots (4 to 10 miles per hour) above stall speed. The system is composed of two stall sensor switches in the right wing outboard of the engine, a stall warning horn mounted on the cabin wall forward of the instrument panel, and a cam-actuated flap position detector microswitch adjacent to the flap torque tube. Power for the system is provided by the STALL WARNING circuit breaker on the instrument panel.

As stall conditions are approached, the changing angle of attack reaches a point where the stall sensor switch vane is raised, closing the switch, providing a ground return for the horn. Positive voltage from the main bus is supplied through the flap position detector switch to the positive terminal of the horn, causing it to sound as long as the stall sensor switch remains closed.

Two stall detector switches are provided for differences in aircraft flight characteristics with the flaps up or down. With the flaps retracted (0 degree to 4 degrees), the outboard stall detector switch in the right wing is monitored. With the flaps extended (5 degrees to 30 degrees), the inboard stall detector switch in the right wing is monitored.



**Control Column
Figure 3**



Stall Warning System
Figure 4

ELEVATOR AND TAB – MAINTENANCE PRACTICES

1. Elevator (See Figure 201.)

A. Removal

NOTE: To facilitate the removal of elevators and to reduce the possibility of aircraft structural damage, apply a liberal amount of penetrating oil to hinge points and attaching parts 4 hours prior to removal and again immediately before removal if signs of corrosion are noted.

- (1) Remove tail cone assembly per Chapter 53. Remove aft fuselage access covers per Chapter 53.

NOTE: Elevator removal and installation can be accomplished without disturbing the rigging as long as push rod lengths, cable turnbuckles, and stop adjustments are not disturbed.

- (2) Install the control wheel lock in the control column. Forward of the rudder pedals, install a rig pin through the rig pin holes in the mounting brackets and bellcranks.

- (3) At the aft fuselage access opening, install a rig pin in the aft elevator bellcrank rig pin hole.

CAUTION: PROVIDE A MEANS OF SUPPORT FOR ELEVATORS DURING REMOVAL AND INSTALLATION TO AVOID STRESS AND POSSIBLE MISALIGNMENT OR DAMAGE TO HINGES, STOPS, AND OTHER ELEVATOR COMPONENTS.

- (4) Remove nut (1, Figure 201), washer (2), and bolt (3). Separate push rod assembly (5) from horn (6) and remove washers (4).

- (5) Remove nut (7), washers (8), and bolt (9). Remove horn (6) from torque tube (10).

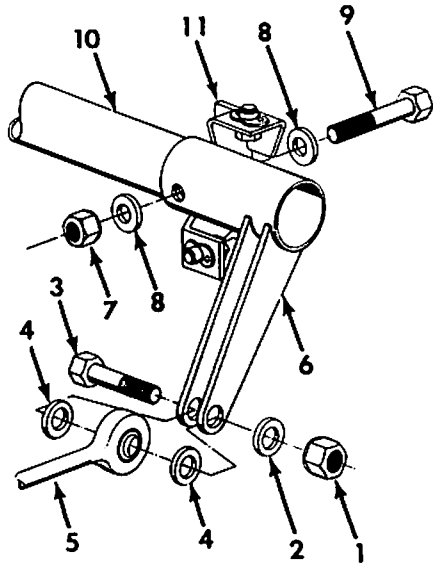
NOTE: Step (6) applies to the right-hand elevator only. Push elevator up to expose access openings beneath elevator at leading edge.

- (6) Remove cotter pin (12), nut (13), washer (14), and bolt (15). Separate trim tab push rod (18) from actuator clevis (17) by raising trim tab. Remove washers (16).

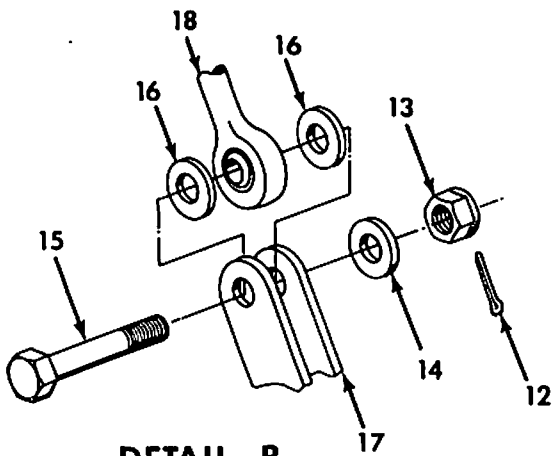
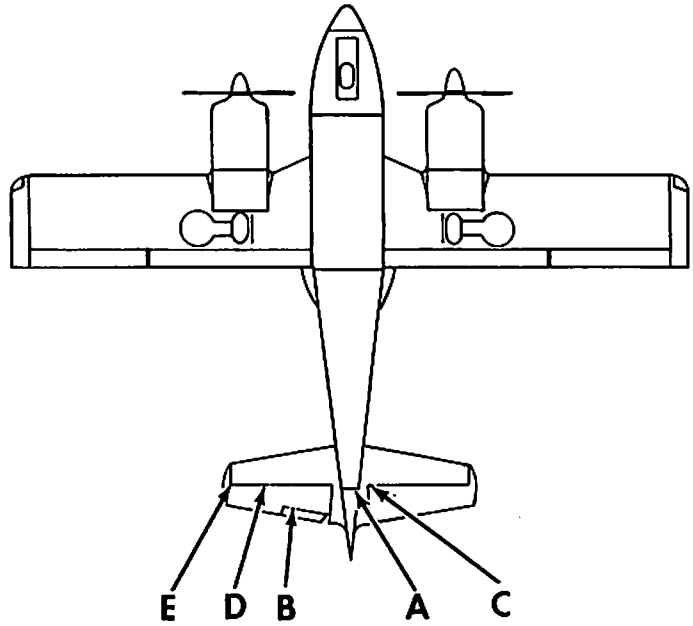
- (7) At inboard hinge point, remove cotter pin (19), nut (20), washers (21), and bolt (26). Remove washers (23 and 25).

- (8) At center hinge point, remove cotter pin (27), nut (28), washers (29), and bolt (34). Remove washers (31 and 33).

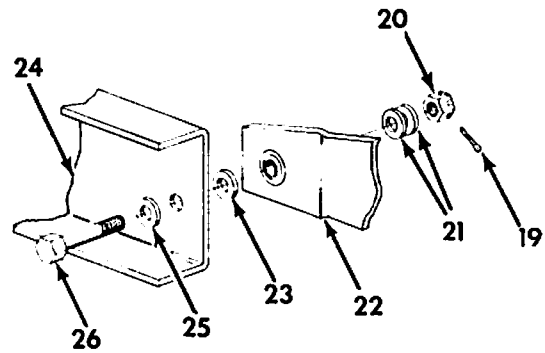
- (9) At outboard hinge point, remove lock wire (35). Remove bolt (36) and washers (37 and 39). Remove elevator from aircraft.



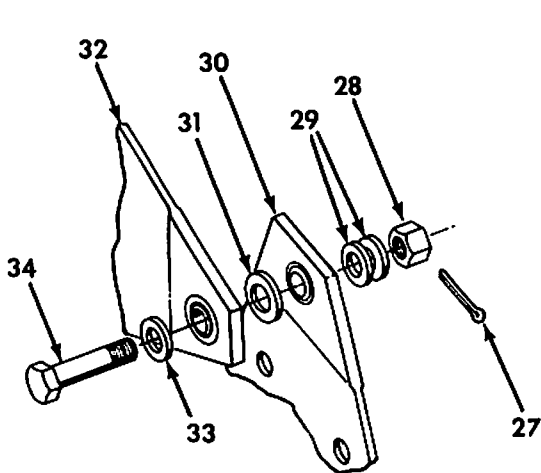
DETAIL A



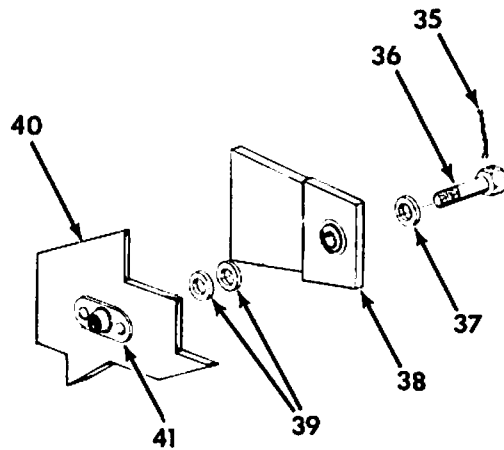
DETAIL B



DETAIL C



DETAIL D



DETAIL E

Elevator Removal and Installation
Figure 201 (Sheet 1 of 2)

- | | | |
|----------------------------|------------------------------|------------------------------|
| 1. Nut | 15. Bolt | 29. Washer |
| 2. Washer | 16. Washer | 30. Bearing Bracket Assembly |
| 3. Bolt | 17. Actuator Clevis | 31. Washer |
| 4. Washer | 18. Trim Tab Push Rod | 32. Elevator Hinge |
| 5. Push Rod Assembly | 19. Cotter Pin | 33. Washer |
| 6. Horn | 20. Nut | 34. Bolt |
| 7. Nut | 21. Washer | 35. Lock Wire |
| 8. Washer | 22. Bearing Bracket Assembly | 36. Bolt |
| 9. Bolt | 23. Washer | 37. Washer |
| 10. Torque Tube | 24. Elevator Hinge | 38. Bearing Bracket Assembly |
| 11. Elevator Stop Assembly | 25. Washer | 39. Washer |
| 12. Cotter Pin | 26. Bolt | 40. Elevator |
| 13. Nut | 27. Cotter Pin | 41. Nut Plate |
| 14. Washer | 28. Nut | |

Elevator Removal and Installation Figure 201 (Sheet 2 of 2)

B. Installation

CAUTION: PROVIDE A MEANS OF SUPPORT FOR ELEVATORS DURING REMOVAL AND INSTALLATION TO AVOID STRESS AND POSSIBLE MISALIGNMENT OR DAMAGE TO HINGES, STOPS, AND OTHER ELEVATOR COMPONENTS.

- (1) Move elevator assembly into position and provide support. Install washer (37, Figure 201) on bolt (36). Insert bolt (36) through bearing bracket assembly (38) and washers (39), and into nut plate (41) in elevator. Tighten securely and install lock wire (35).
- (2) Install washer (33) on bolt (34). Insert bolt (34) through elevator hinge (32), washer (31), bearing bracket assembly (30), and washers (29).
- (3) Install nut (28) and cotter pin (27).
- (4) Install washer (25) on bolt (26). Insert bolt (26) through elevator hinge (24), washer (23), bearing bracket assembly (22), and washers (21).
- (5) Install nut (20) and cotter pin (19).
- (6) Install washers (16) and trim tab push rod (18) into actuator clevis (17). Install bolt (15), washer (14), and nut (13). Install cotter pin (12).
- (7) Install horn (6) on torque tube (10). Install washer (8) on bolt (9). Insert bolt (9) through horn (6) and torque tube (10). Install washer (8) and nut (7).
- (8) Install washers (4) and push rod assembly (5) into horn (6). Install bolt (3), washer (2), and nut (1).
- (9) Remove rig pins and control lock. Perform a rigging check per Paragraph 11.

2. Control Column Push Rod (See Figure 202.)

A. Removal

- (1) Install control wheel lock. Install rig pin through front bellcranks and support brackets.
- (2) Remove left-hand nose cowling per Chapter 53. Provide a wooden block or other suitable means to support bob weight in position.
- (3) At control column (11, Figure 202), remove cotter pin (1), nut (2), washer (3), and bolt (4).
- (4) At elevator control bellcrank (9), remove cotter pin (5), nut (6), washer (7), and bolt (8). Remove control column push rod (1) and bob weight push rod (11).

B. Installation

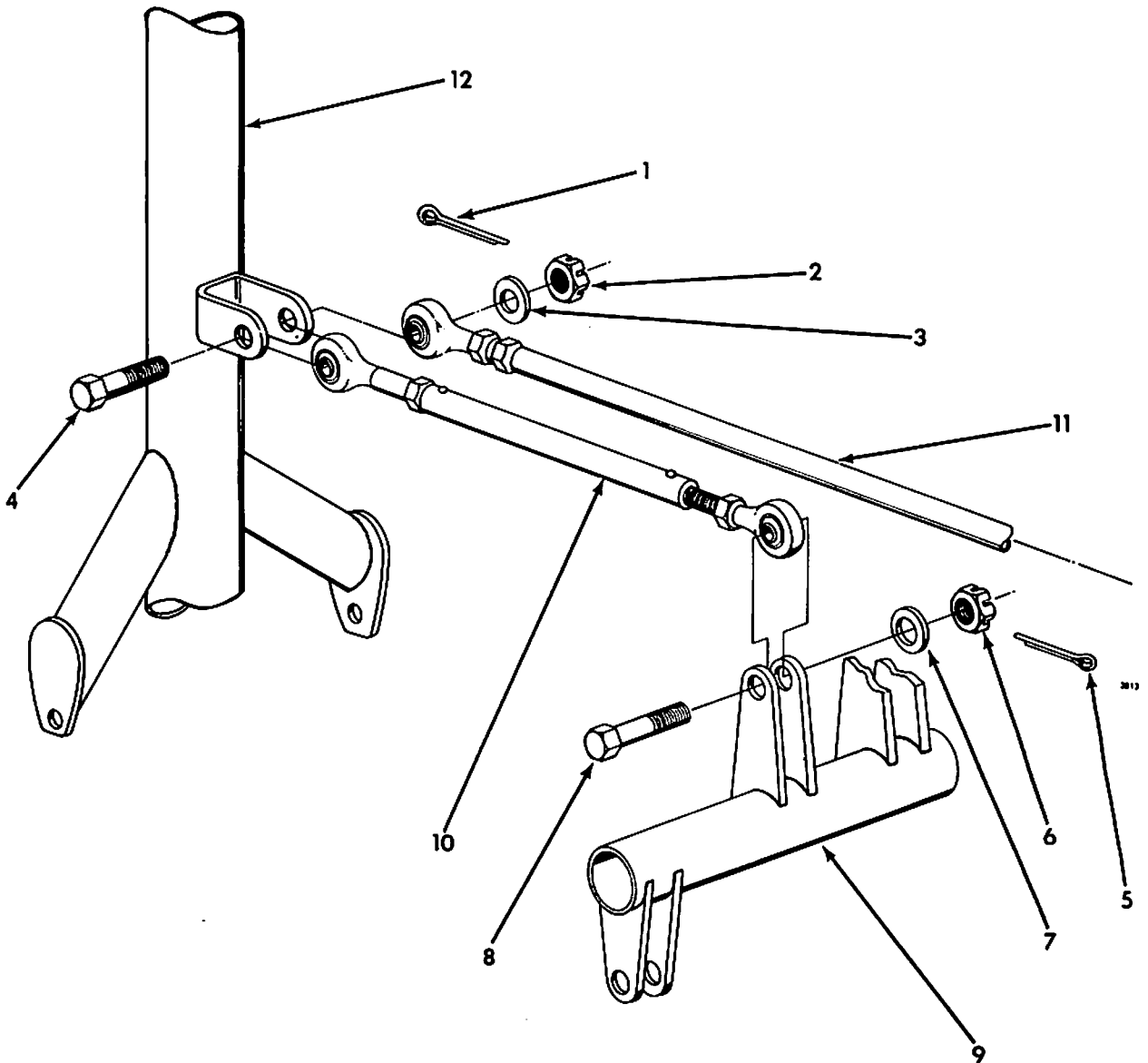
NOTE: With control wheel lock and front bellcrank rig pin installed, adjust length of control column push rod (10, Figure 202) as required to install bolts (4 and 8).

- (1) Place control column push rod (10) and bob weight push rod (11) into position between elevator control bellcrank (9) and control column (12). Install bolts (4 and 8).
- (2) Install washer (7), nut (6), and cotter pin (5).
- (3) Install washer (3), nut (2), and cotter pin (1).
- (4) Remove rig pin and control wheel lock.
- (5) Install left-hand nose cowling per Chapter 53.

3. Elevator Control Bellcrank (See Figure 203.)

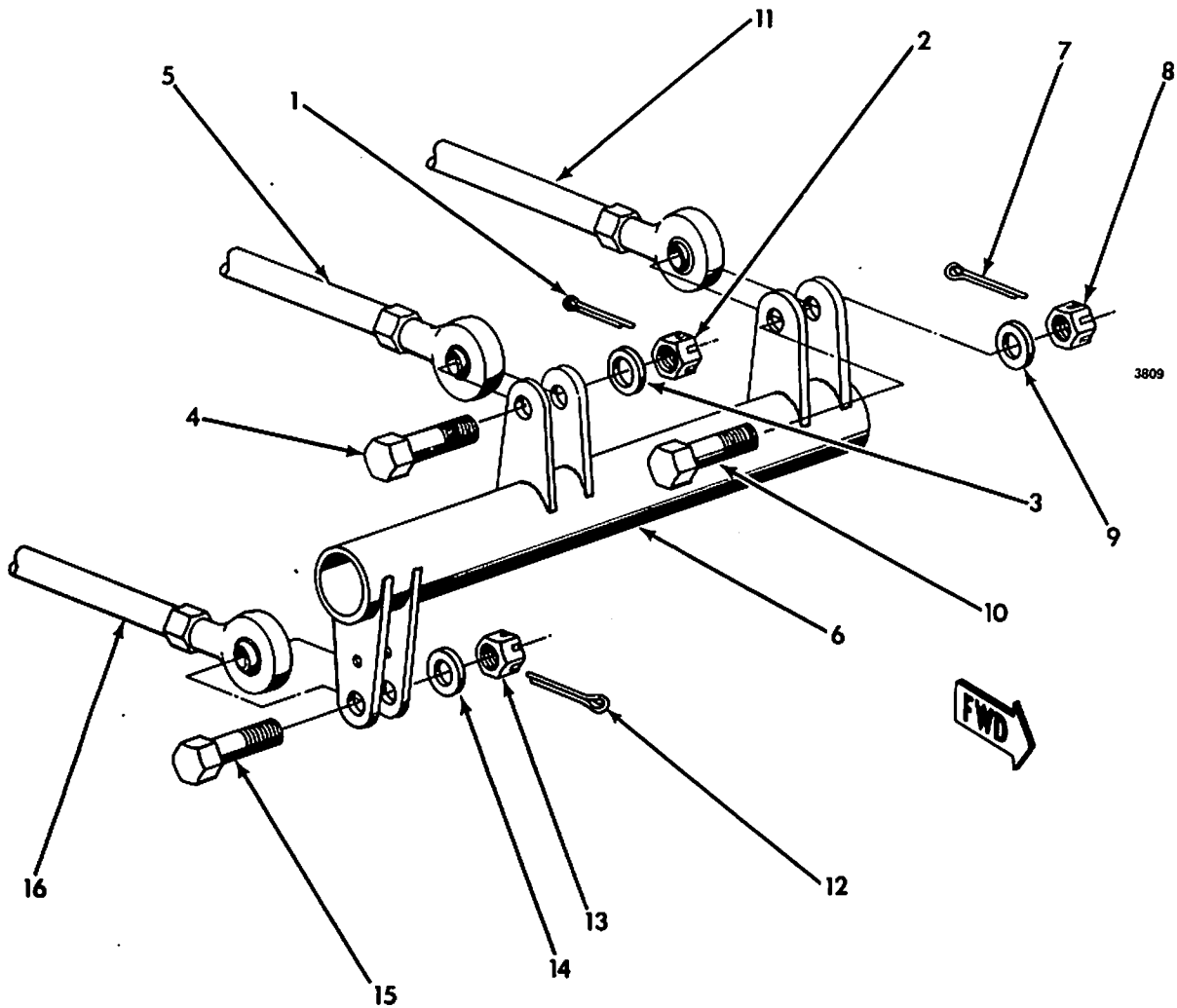
A. Removal

- (1) Install control wheel lock. Remove aft fuselage access covers and relieve tension on elevator cables at turnbuckles.
- (2) Remove cotter pin (1), nut (2), washer (3), and bolt (4). Remove elevator control push rod (5) from elevator control bellcranks (6).
- (3) Remove cotter pin (7), nut (8), washer (9), and bolt (10). Remove elevator down cable (11) from elevator control bellcrank (6).
- (4) Remove cotter pin (12), nut (13), washer (14), and bolt (15). Remove elevator up cable (16) from elevator control bellcrank (6).
- (5) Remove bellcrank assembly per Section 27-2-1.



- | | |
|---------------|-------------------------------|
| 1. Cotter Pin | 7. Washer |
| 2. Nut | 8. Bolt |
| 3. Washer | 9. Elevator Control Bellcrank |
| 4. Bolt | 10. Control Column Push Rod |
| 5. Cotter Pin | 11. Bob Weight Push Rod |
| 6. Nut | 12. Control Column |

Control Column Push Rod
Figure 202



- | | |
|-------------------------------|-------------------------|
| 1. Cotter Pin | 9. Washer |
| 2. Nut | 10. Bolt |
| 3. Washer | 11. Elevator Down Cable |
| 4. Bolt | 12. Cotter Pin |
| 5. Elevator Control Push Rod | 13. Nut |
| 6. Elevator Control Bellcrank | 14. Washer |
| 7. Cotter Pin | 15. Bolt |
| 8. Nut | 16. Elevator Up Cable |

Elevator Control Bellcrank
Figure 203

B. Installation

- (1) Install bellcrank assembly per Section 27-2-1.
- (2) Place elevator up cable (16, Figure 203) in horn of elevator control bellcrank (6). Install bolt (15), washer (14), nut (13), and cotter pin (12).
- (3) Place elevator down cable (11) in horn of elevator control bellcrank (6). Install bolt (10), washer (9), nut (8), and cotter pin (7).
- (4) Place elevator control push rod (5) in horn of elevator control bellcrank (6). Install bolt (4), washer (3), nut (2), and cotter pin (1).
- (5) Install rig pin through front bellcranks and support brackets. In aft fuselage, install rig pin in elevator bellcrank.
- (6) Tighten turnbuckles as required to obtain a tensiometer reading of 35 ± 5 pounds. Remove rig pins and control lock. Install aft fuselage access covers.

4. Aft Elevator Bellcrank (See Figure 204.)

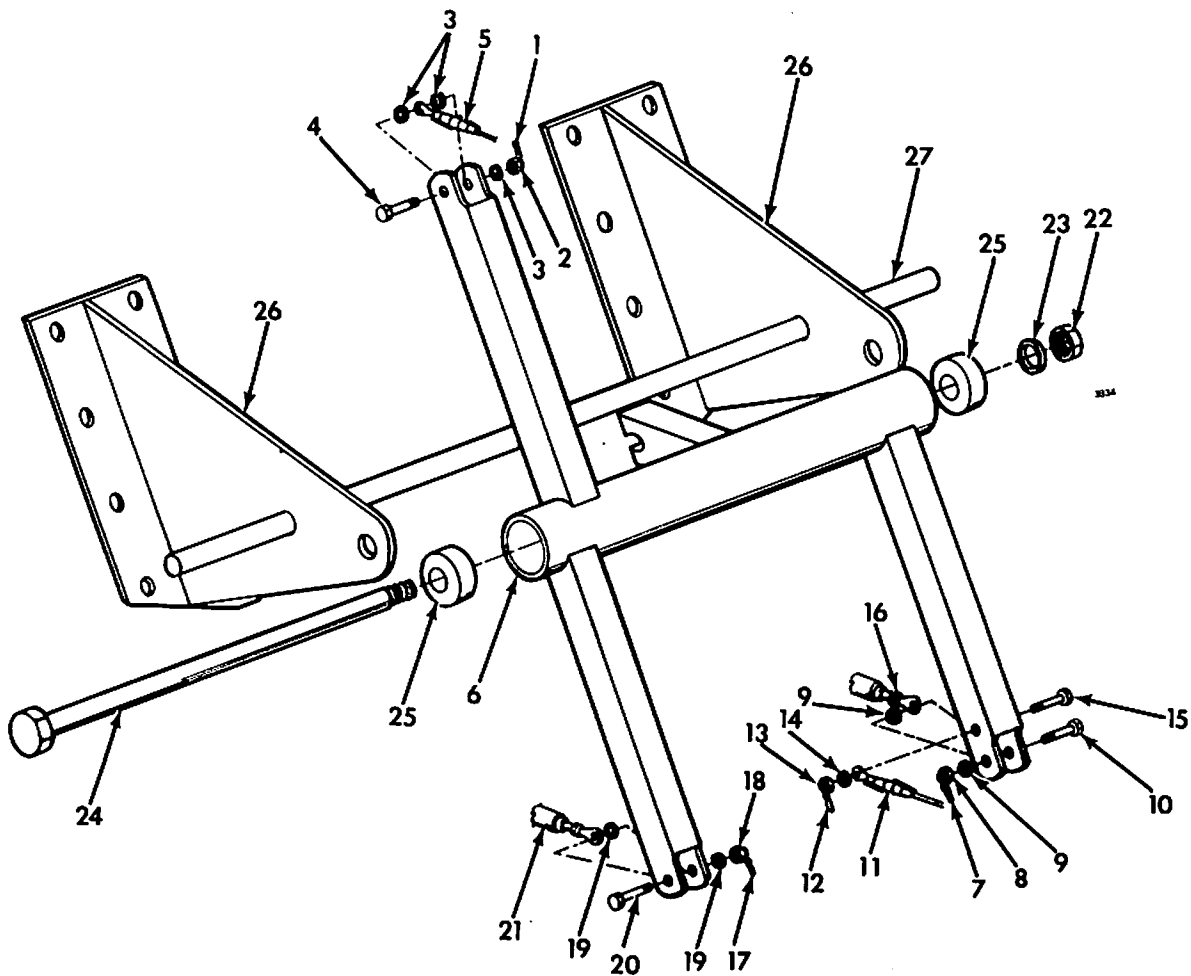
A. Removal

- (1) Install control wheel lock. Install rig pin through front bellcranks and support brackets.
- (2) Remove aft fuselage access covers and relieve cable tension at elevator turnbuckles. Install rig pin at aft elevator bellcrank (6, Figure 204).
- (3) Remove cotter pin (1), nut (2), washers (3), and bolt (4). Remove up elevator cable (5) from aft elevator bellcrank (6).
- (4) Remove cotter pin (7), nut (8), washers (9), and bolt (10). Remove down elevator cable (11) from aft elevator bellcrank (6).
- (5) Remove cotter pin (12), nut (13), washers (14), and bolt (15). Remove left elevator push rod (16) from aft elevator bellcrank (6).
- (6) Remove cotter pin (17), nut (18), washers (19), and bolt (20). Remove right elevator push rod (21) from aft elevator bellcrank (6).
- (7) Remove nut (22), washer (23), and bolt (24). Remove aft elevator bellcrank (6). If required, remove bearings (25) with a bearing puller.

B. Installation

NOTE: Do not install cotter pins (1, 7, 12, and 17, Figure 204) until rigging check is completed.

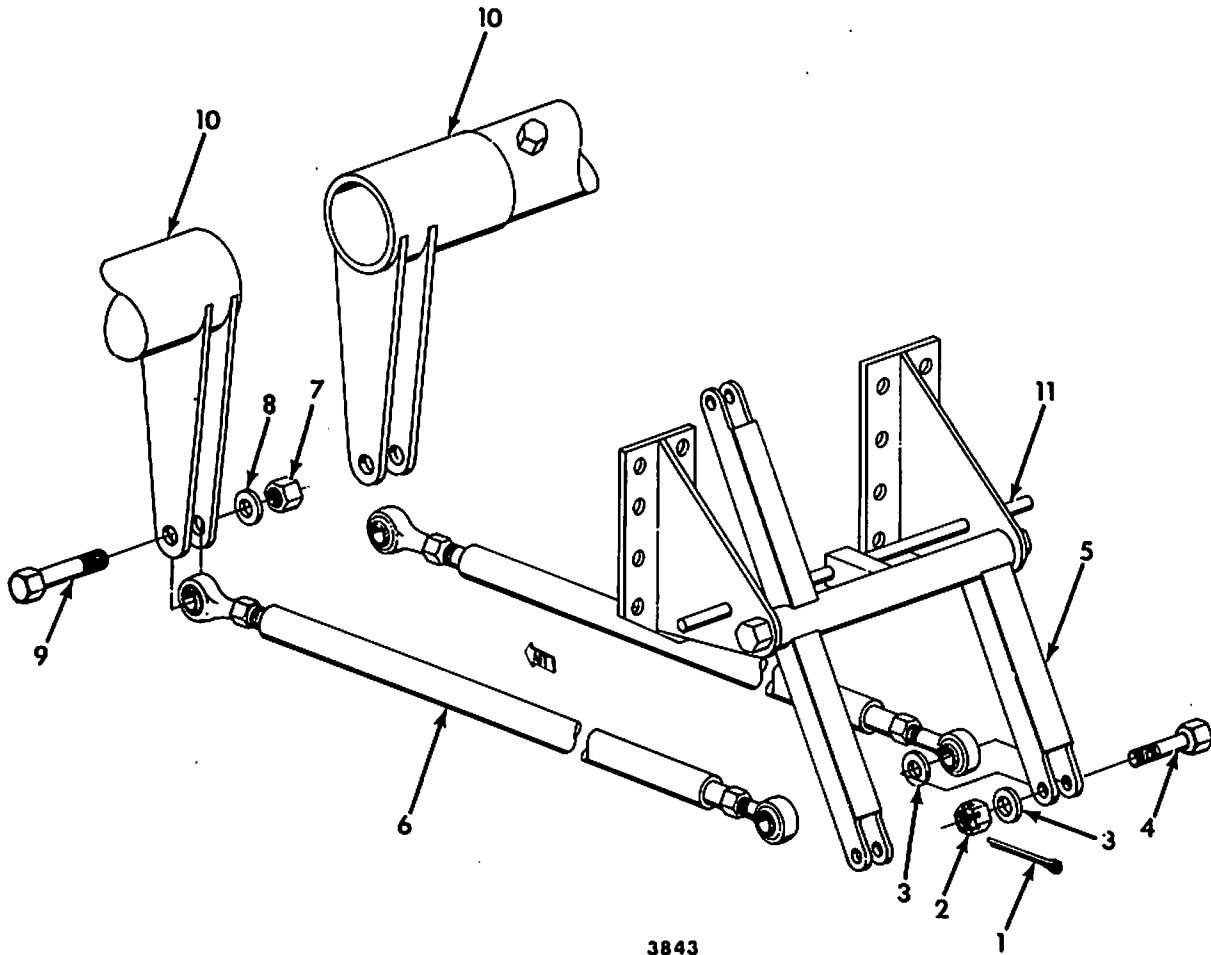
- (1) Install bearings (25) in aft elevator bellcrank (6). Install aft elevator bellcrank (6) in mounting brackets (26) fitting groove in rig pin arm over rig pin (27). Secure with bolt (24), washer (23), and nut (22).



- | | |
|---------------------------|-----------------------------|
| 1. Cotter Pin | 15. Bolt |
| 2. Nut | 16. Left Elevator Push Rod |
| 3. Washer | 17. Cotter Pin |
| 4. Bolt | 18. Nut |
| 5. Up Elevator Cable | 19. Washer |
| 6. Aft Elevator Bellcrank | 20. Bolt |
| 7. Cotter Pin | 21. Right Elevator Push Rod |
| 8. Nut | 22. Nut |
| 9. Washer | 23. Washer |
| 10. Bolt | 24. Bolt |
| 11. Down Elevator Cable | 25. Bearing |
| 12. Cotter Pin | 26. Mounting Bracket |
| 13. Nut | 27. Rig Pin |
| 14. Washer | |

Aft Elevator Bellcrank
Figure 204

- (2) Install right elevator push rod (21) into aft elevator bellcrank (6). Secure with bolt (20), washers (19), and nut (18).
 - (3) Install left elevator push rod (16) into aft elevator bellcrank (6). Secure with bolt (15), washers (14), and nut (13).
 - (4) Install down elevator cable (11) into aft elevator bellcrank (6). Secure with bolt (10), washers (9), and nut (8).
 - (5) Install up elevator cable (5) into aft elevator bellcrank (6). Secure with bolt (4), washers (3), and nut (2).
 - (6) With control wheel lock and both rig pins in place, support bob weight and tighten elevator cables to 35 ± 5 pounds as measured with a tensiometer. Cable tensions should be nearly equal.
 - (7) Perform a rigging check in accordance with Paragraph 11. Rig as required.
 - (8) Install cotter pins (1, 7, 12, and 17, Figure 204).
 - (9) Remove control lock and rig pins. Install aft fuselage covers per Chapter 53.
5. Elevator Push Rods (See Figure 205.)
- A. Removal
 - (1) Install control wheel lock. Install rig pin through front bellcranks and support brackets.
 - (2) Remove aft fuselage access covers and install rig pin at aft elevator bellcrank (11, Figure 205).
 - (3) Remove tail cone assembly per Chapter 53.
 - (4) At aft elevator bellcrank (5, Figure 205), remove cotter pin (1), nut (2), washer (3), and bolt (4). Separate elevator push rod (6) from aft elevator bellcrank (5).
 - (5) Remove nut (7), washer (8), and bolt (9). Separate elevator push rod (6) from elevator horn (10). Pull elevator push rod aft and out of fuselage.
 - B. Installation
 - (1) Install elevator push rod (6, Figure 205) through aft fuselage.
 - (2) Install aft end of elevator push rod (6) into elevator horn (10). Secure with bolt (9), washers (8), and nut (7).
 - (3) Install forward end of elevator push rod (6) into aft elevator bellcrank. Secure with bolt (4), washers (3), and nut (2). Do not install cotter pin (1) at this time.
 - (4) Perform an elevator rigging check per Paragraph 11. Rig as required.
 - (5) Install cotter pin (1, Figure 205). Install tail cone assembly per Chapter 53. Install aft fuselage access covers per Chapter 53.



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- | | |
|---------------------------|-------------------|
| 1. Cotter Pin | 7. Nut |
| 2. Nut | 8. Washer |
| 3. Washer | 9. Bolt |
| 4. Bolt | 10. Elevator Horn |
| 5. Aft Elevator Bellcrank | 11. Rig Pin |
| 6. Elevator Push Rod | |

**Elevator Push Rods
Figure 205**

6. Elevator Cables (See Figure 206.)**A. Removal**

NOTE: Elevator cable removal and installation can be accomplished without disturbing the rigging if the following procedure is followed closely.

- (1) Install the control wheel lock.
- (2) Remove access covers and panels from center console as required to gain access to elevator cables and pulley groups.
- (3) Remove aft fuselage access covers. Install a rig pin in the aft elevator bellcrank and brackets.
- (4) Remove locking clips and turnbuckles from elevator control cables.

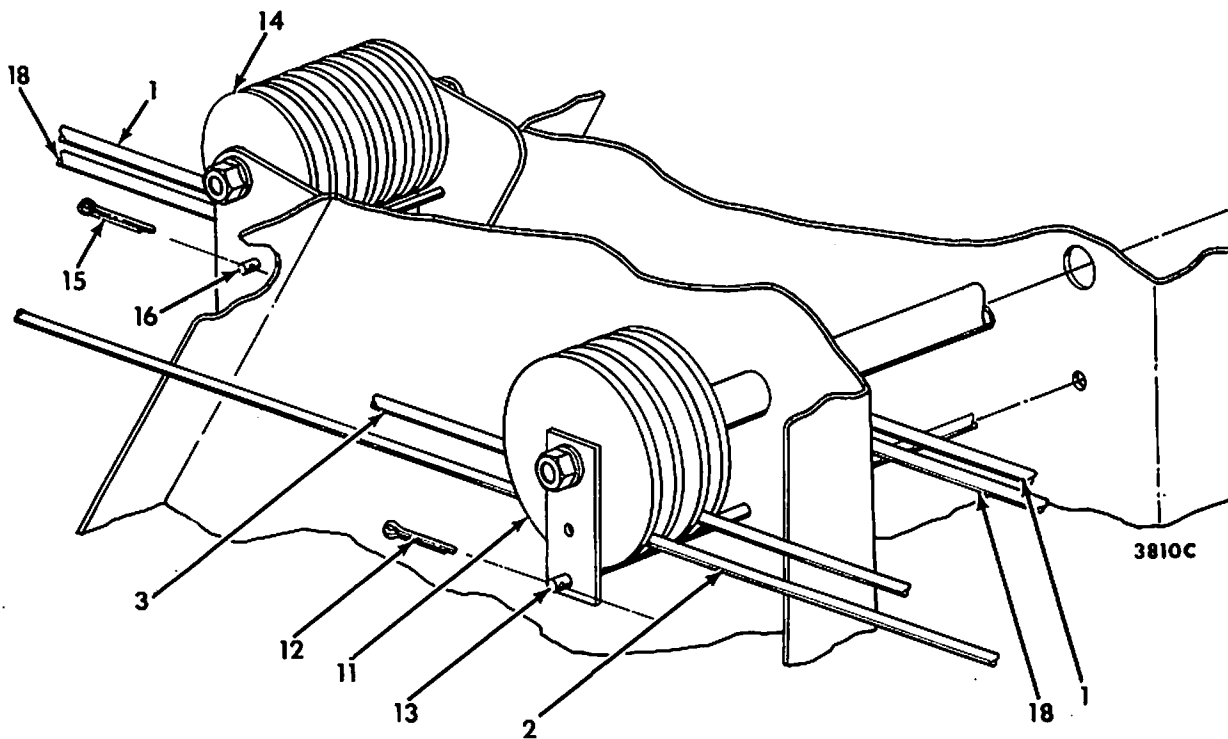
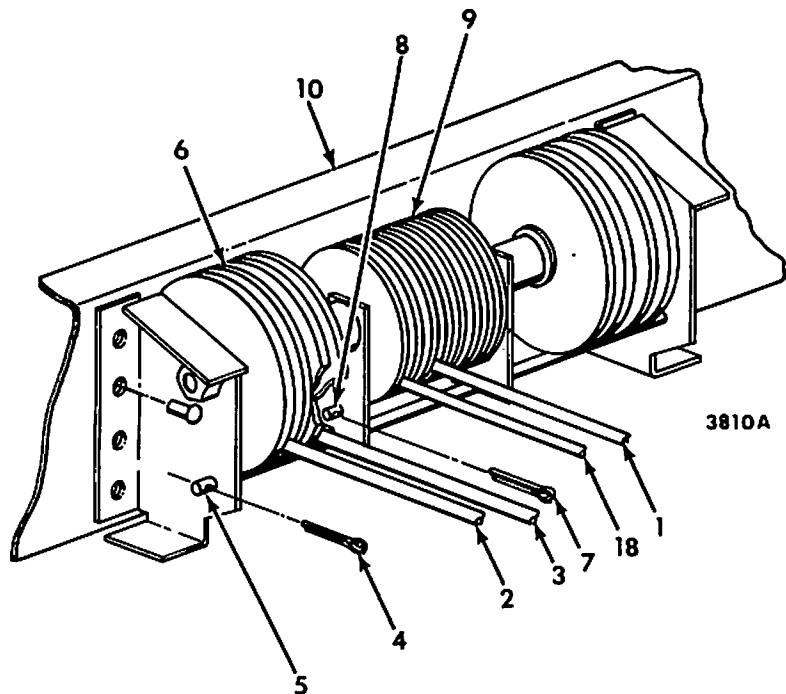
NOTE: Due to limited access to the aft fuselage and other areas through which the elevator cables pass, a wire or cord should be attached to the aft cable end and pulled into position as the existing cable is removed.

- (5) Attach a wire or cord to each elevator cable.
- (6) Remove lower panel of aft cabin bulkhead (10, Figure 206) by pulling forward. Remove cotter pin (4) and cable retainer (5). Pull elevator control cables (3) free of pulleys (6).
- (7) Pull aft end of passenger seat bottom up and forward to gain access to pulley group at Fuselage Station 143.25. Remove cotter pin (12) and cable retainer (13). Pull elevator control cables (3) free of pulleys (11).
- (8) Beneath elevator trim control at Fuselage Station 88.00, remove cotter pin (20) and cable retainer (21). Pull elevator cables free of pulleys.
- (9) At elevator bellcrank, remove cotter pin (7, Figure 203), nut (8), washer (9), and bolt (10). Remove elevator down cable (11) from elevator control bellcrank (6).
- (10) Remove cotter pin (12), nut (13), washer (14), and bolt (15). Remove elevator up cable (16) from elevator control bellcrank (6).
- (11) Pull elevator cables forward into passenger compartment. Disconnect pull wires or cords and leave in place.

B. Installation

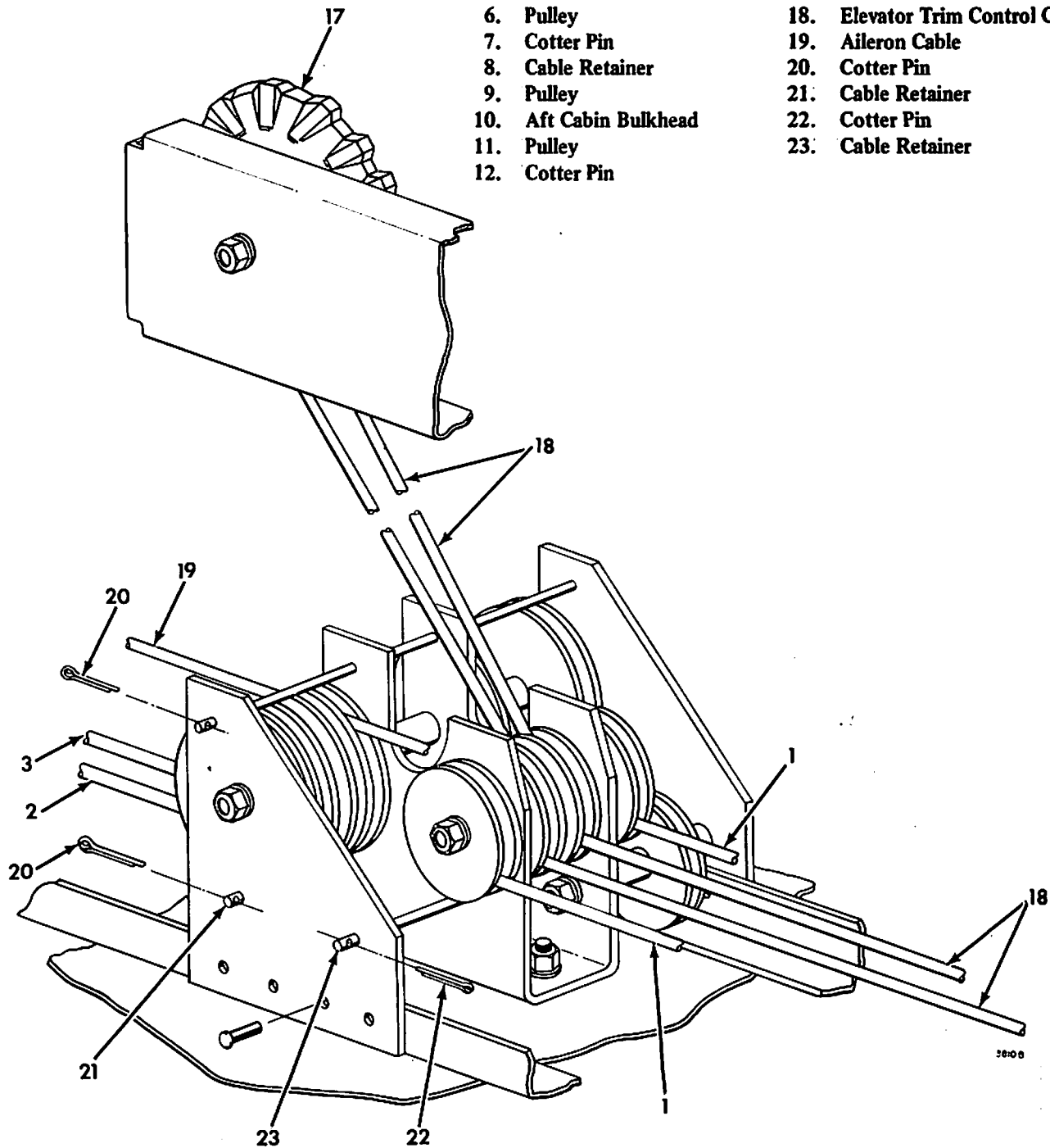
NOTE: Lubricate cables in pulley contact areas with commercial grade paraffin before installation.

- (1) Attach elevator cables to the pull wires or cords. Pull cables into position.
- (2) Install elevator up cable (16, Figure 203) on elevator control bellcrank (6). Secure with bolt (15), washer (14), nut (13), and cotter pin (12).



**Elevator Cable System
Figure 206 (Sheet 1 of 2)**

- | | |
|------------------------------|---------------------------------|
| 1. Rudder Trim Control Cable | 13. Cable Retainer |
| 2. Forward Rudder Cable | 14. Pulley |
| 3. Elevator Control Cable | 15. Cotter Pin |
| 4. Cotter Pin | 16. Cable Retainer |
| 5. Cable Retainer | 17. Elevator Trim Wheel |
| 6. Pulley | 18. Elevator Trim Control Cable |
| 7. Cotter Pin | 19. Aileron Cable |
| 8. Cable Retainer | 20. Cotter Pin |
| 9. Pulley | 21. Cable Retainer |
| 10. Aft Cabin Bulkhead | 22. Cotter Pin |
| 11. Pulley | 23. Cable Retainer |



**Elevator Cable System
Figure 206 (Sheet 2 of 2)**

- (3) Install elevator down cable (11) on elevator control bellcrank (6). Secure with bolt (10), washer (9), nut (8), and cotter pin (7).
- (4) Beneath elevator trim control at Fuselage Station 88.00, install elevator cables into pulleys as shown in Figure 207. Install cable retainer (21, Figure 206) and cotter pin (20).
- (5) Beneath rear passenger seat well at Fuselage Station 143.25, install elevator control cables into pulleys as shown in Figure 207. Install cable retainer (13, Figure 206) and cotter pin (12).
- (6) At Fuselage Station 181.632, install elevator cables into pulleys as shown in Figure 207. Install cable retainer (5, Figure 206) and cotter pin (4).
- (7) Install turnbuckles on elevator control cables. Tighten as required to obtain a reading of 35 ± 5 pounds on a tensiometer. Install locking clips.
- (8) Remove control wheel lock and rig pins. Perform a rigging check per Paragraph 11 and rig as necessary.
- (9) Install aft fuselage access covers. Install lower panel of aft cabin bulkhead.
- (10) Install access cover on center console.

7. Trim Tab

A. Removal

- (1) Remove elevator per Paragraph 1.
- (2) At lower side of elevator, remove cotter pin (1, Figure 208), nut (2), washers (3 and 4), and bolt (5). Remove elevator trim push rod (6).
- (3) At upper side of elevator, remove hinge pin (8). Remove trim tab (9) from elevator (10).

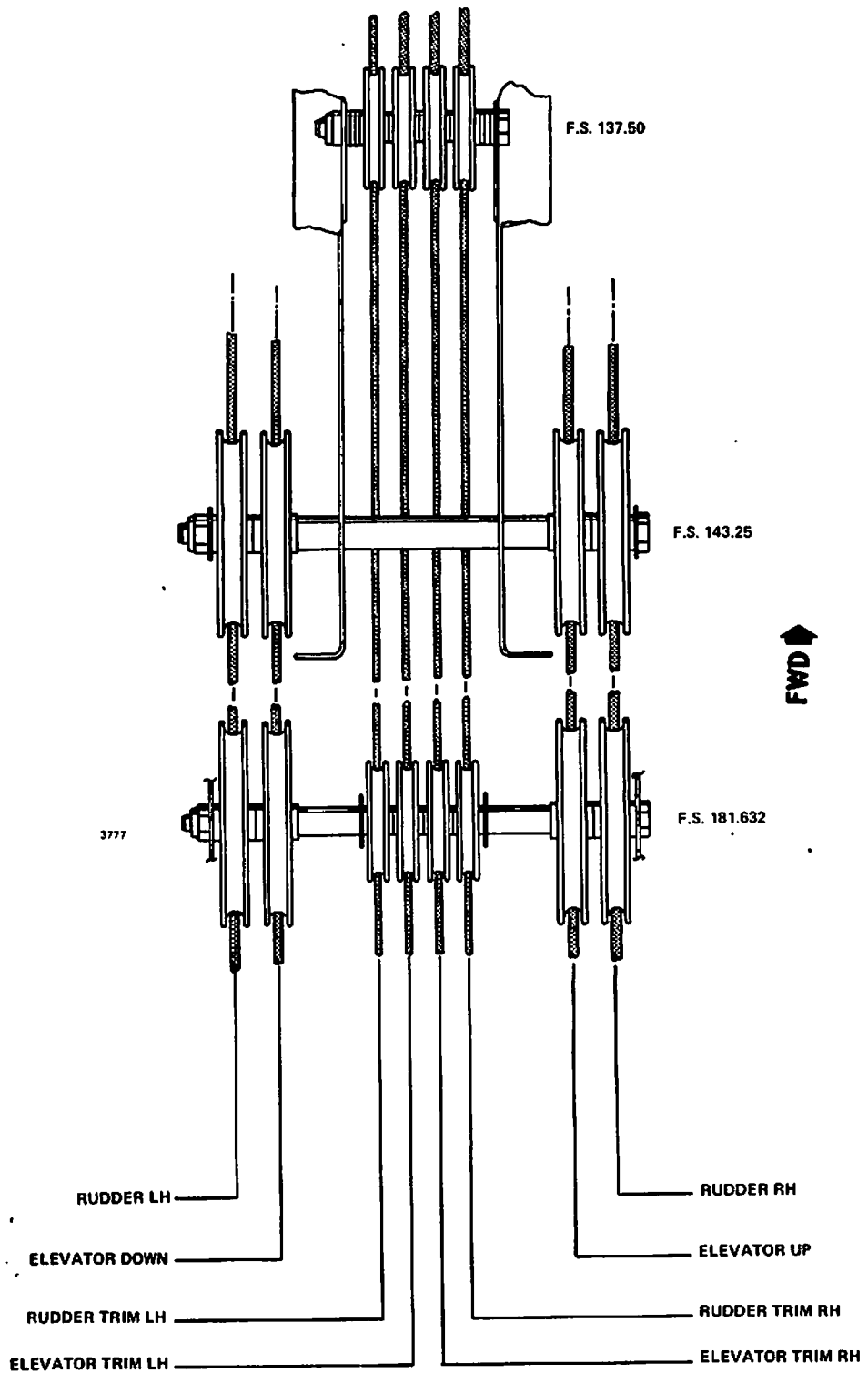
B. Installation

- (1) Align hinges on elevator (10, Figure 208) and elevator trim tab (9). Install hinge pin (8) and stake.

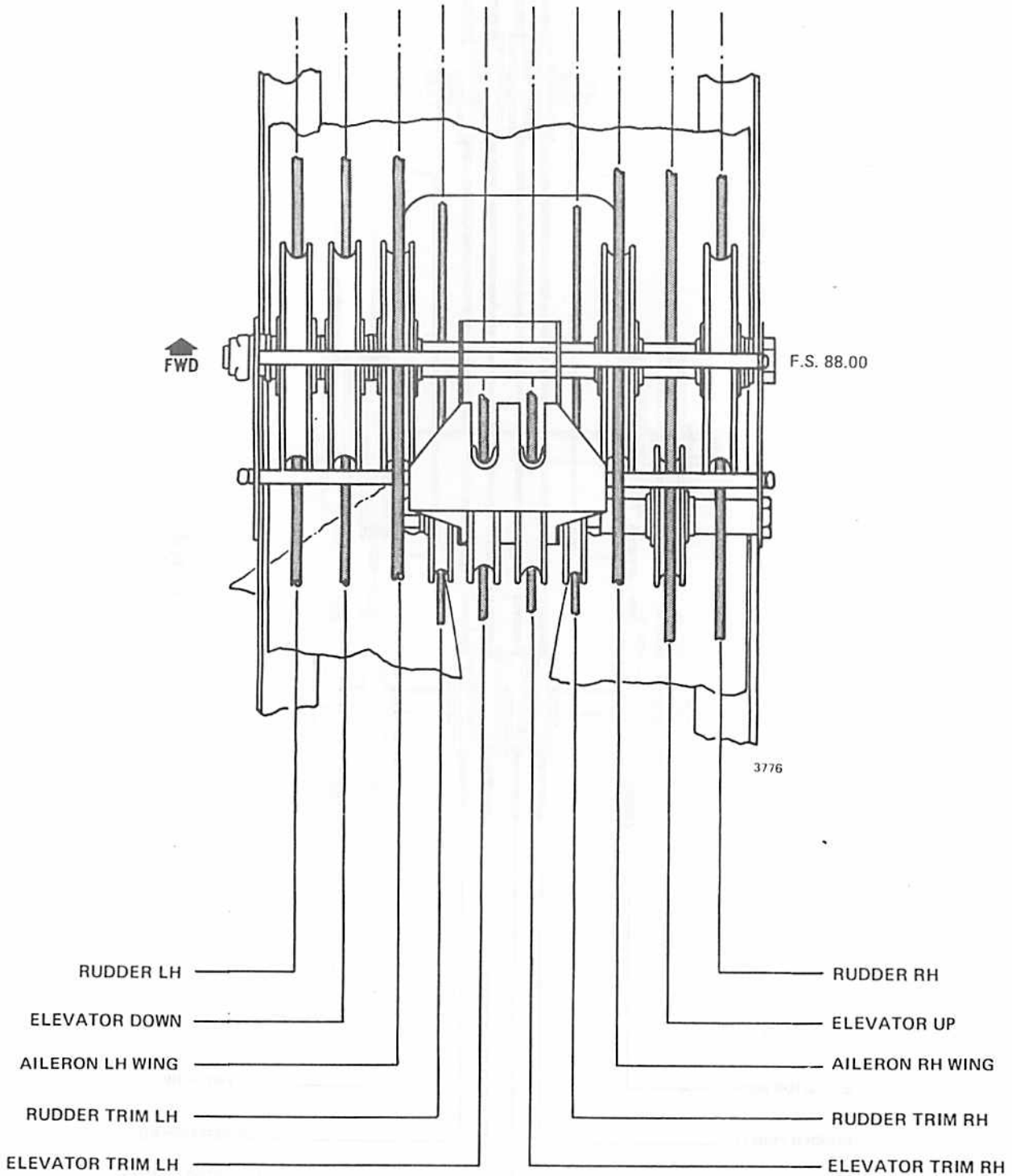
NOTE: Install elevator trim push rod with adjustable end aft.

- (2) Install elevator trim push rod (6) in elevator (10). Secure with bolt (5), washer (4), washer (3), and nut (2). Do not install cotter pin (1) at this time.
- (3) Install elevator per Paragraph 1.
- (4) Perform an elevator rigging check per Paragraph 11 and rig as required.
- (5) Install cotter pin (1, Figure 208).

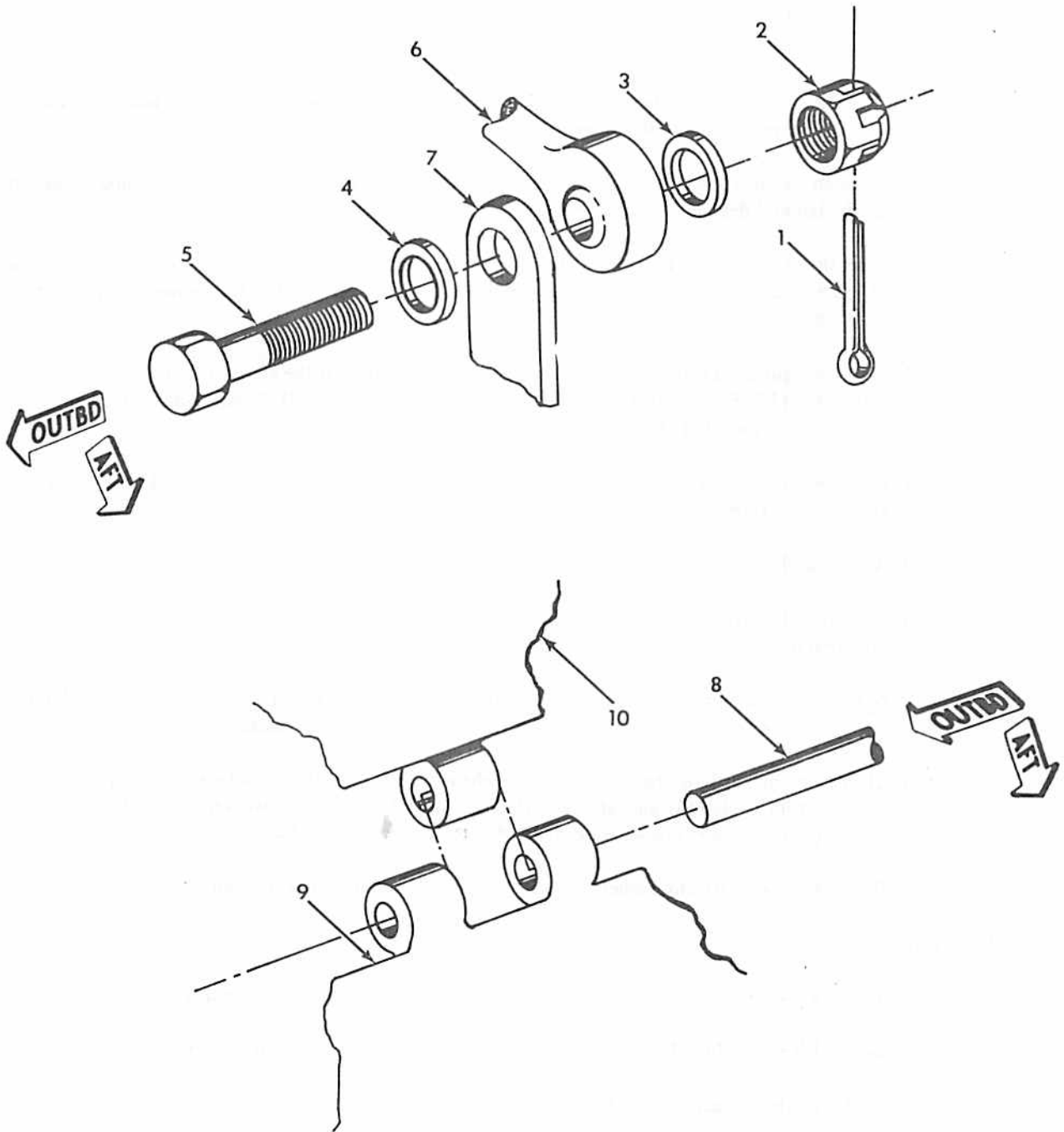
GRUMMAN AMERICAN AVIATION
GA-7/COUGAR
MAINTENANCE MANUAL



Control Cable Routing
Figure 207 (Sheet 1 of 2)



Control Cable Routing
Figure 207 (Sheet 2 of 2)



- | | |
|---------------|---------------------------|
| 1. Cotter Pin | 6. Elevator Trim Push Rod |
| 2. Nut | 7. Elevator Trim Horn |
| 3. Washer | 8. Hinge Pin |
| 4. Washer | 9. Trim Tab |
| 5. Bolt | 10. Elevator |

Elevator Trim Tab Installation
Figure 208

8. Trim Tab Actuator and Drive Assembly

A. Removal

NOTE: The amount of rigging required can be minimized if the procedure below is followed closely. Refer to Section 27-0 for rigging fixture part numbers.

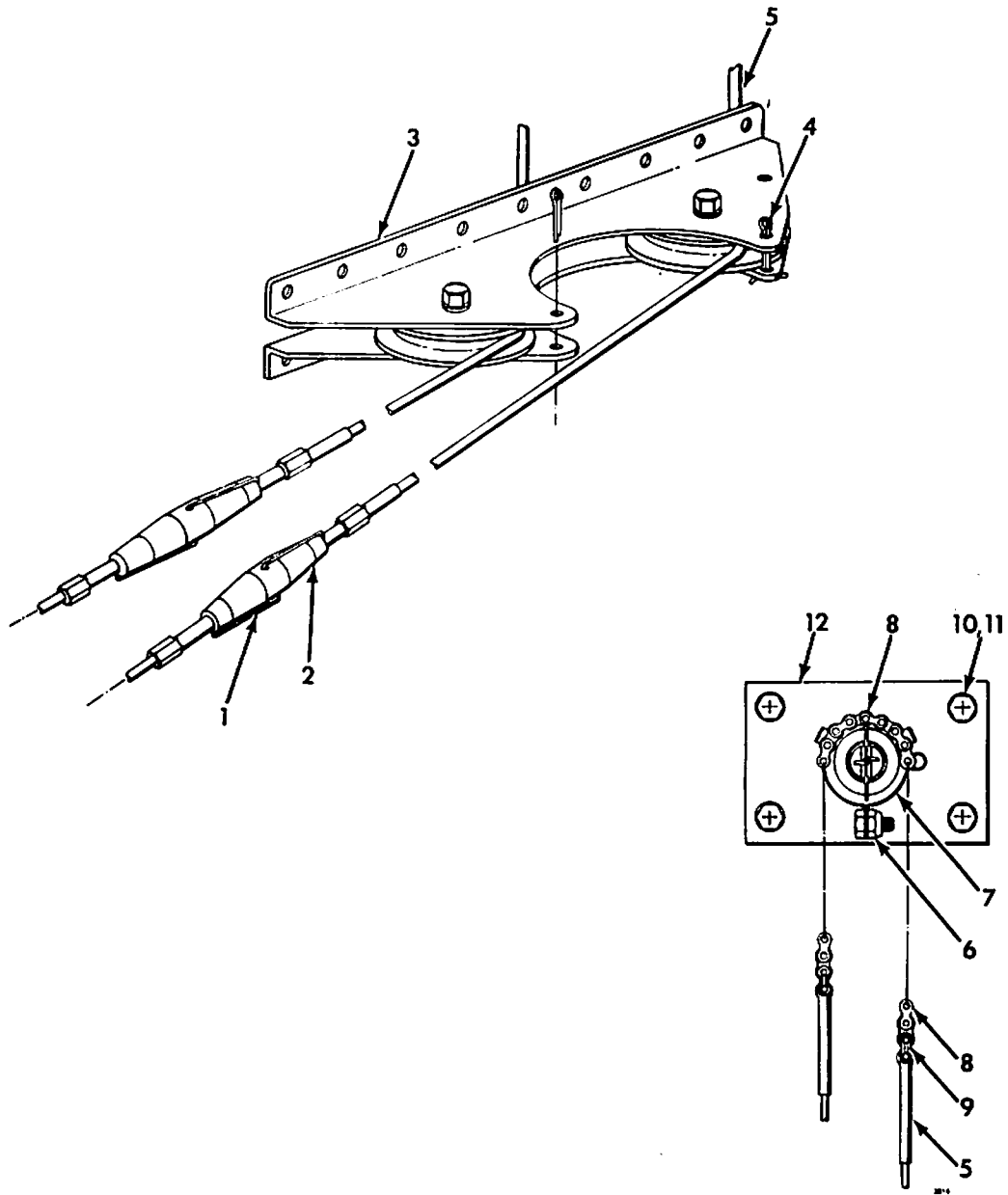
- (1) Using an elevator rigging fixture, set the elevator at 0 degree. Use an elevator tab rigging fixture to set the tab at 0 degree.
- (2) Beneath the right-hand horizontal stabilizer, remove the access cover and mark a link on the chain (4, Figure 209) and a corresponding point on the sprocket (12) for proper orientation at installation.
- (3) Push the right-hand elevator up to expose the access openings at the elevator leading edge. Remove cotter pin (12, Figure 201), nut (13), washer (14), and bolt (15). Separate actuator clevis (17) from trim tab push rod (18) and remove washers (16).
- (4) Remove aft fuselage access covers per Chapter 53. Remove locking clips (1, Figure 209) and elevator trim turnbuckles (2).
- (5) At trim pulley bracket (3), remove cotter pins (4) securing aft elevator trim cables (5).
- (6) At horizontal stabilizer access opening, loosen nut (6), slide chain guard (7) aft to free chain, and retighten nut.

NOTE: If removal of chain (8) is not required, a short piece of wire or cord may be looped around chain and secured to structure to hold chain in place.

- (7) Tie a wire or cord to chain (8). Remove chain from sprocket at fuselage access opening. Pull elevator trim cables (5) and attached chain (8) into fuselage. Remove wire or cord and leave in place. Remove clips (9) to separate chain (8) from elevator trim cables.
- (8) Remove screws (10) and washers (11). Remove drive assembly (12) from aircraft.

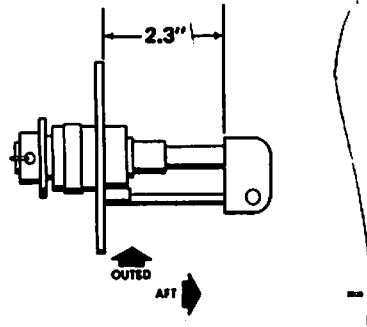
B. Installation

- (1) Turn sprocket (13, Figure 209) as required to obtain the dimension shown in Figure 210.
- (2) Install drive assembly (12, Figure 209) and secure with screws (10) and washers (11).
- (3) In aft fuselage, attach ends of elevator trim cables (5) to chain (8) using clips (9).
- (4) Attach chain (8) to wire or cord and pull through horizontal stabilizer until accessible through the horizontal stabilizer access opening. Remove wire or cord.
- (5) Install chain (8) on sprocket (13), using marks made in Step A (2). Loosen nut (6) and slide chain guard forward until chain is contacted, then aft approximately 0.06 inch. Tighten nut (6).
- (6) At aft fuselage opening, route cables through pulleys on aft fuselage bulkhead as shown in Figure 211.

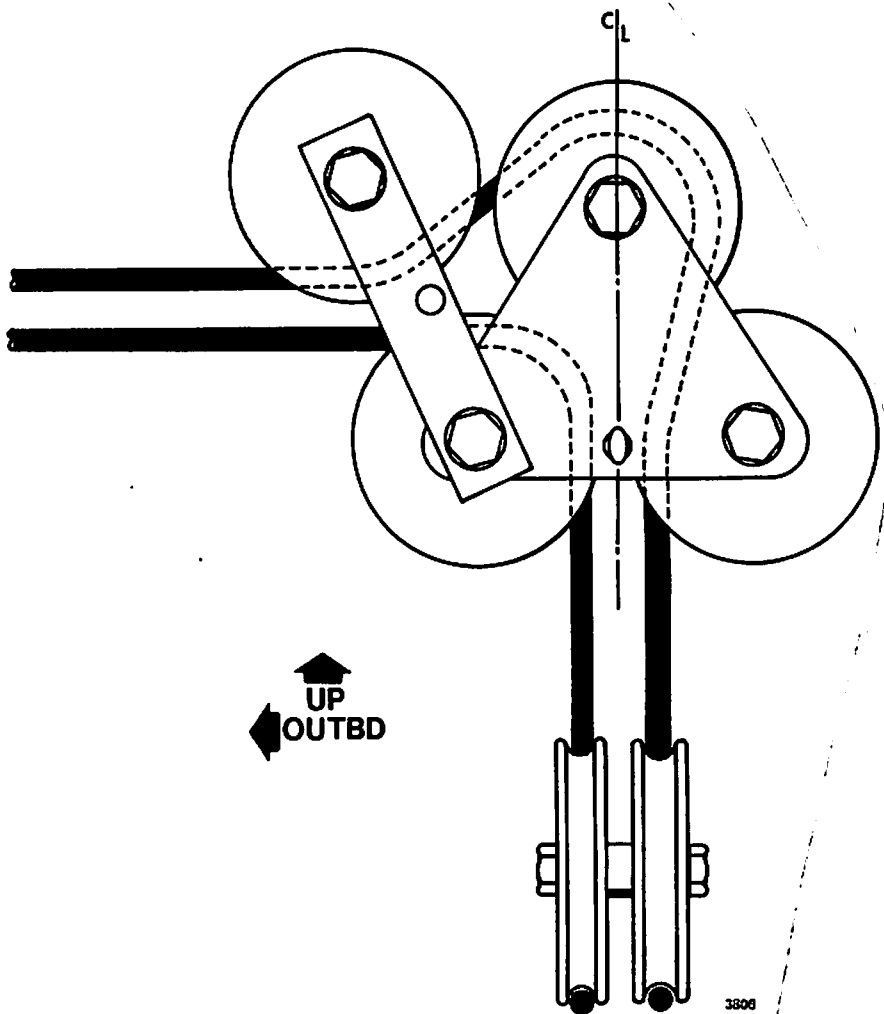


- | | |
|-----------------------------|--------------------|
| 1. Locking Clip | 8. Chain |
| 2. Elevator Trim Turnbuckle | 9. Clip |
| 3. Trim Pulley Bracket | 10. Screw |
| 4. Cotter Pin | 11. Washer |
| 5. Elevator Trim Cable | 12. Drive Assembly |
| 6. Nut | 13. Sprocket |
| 7. Chain Guard | |

**Trim Tab Actuator and Drive Assembly
Figure 209**



**Drive Assembly Prerigging
Figure 210**



**Elevator Trim Cable Routing
Figure 211**

- (7) Install cotter pins (4, Figure 209). Install turnbuckles (2) and tighten as required to obtain a reading of 15 ± 3 pounds on a tensiometer. Do not install locking clips (1) at this time.
- (8) Push the right-hand elevator up to expose the access openings at the elevator leading edge. Install trim tab push rod (18, Figure 201) into actuator clevis (17). Install washers (16), bolt (15), washer (14), and nut (13). Do not install cotter pin (12) at this time.
- (9) Perform an elevator rigging check per Paragraph 11 and rig as required.
- (10) Install cotter pin (12, Figure 201) and locking clips (1, Figure 209). Install access covers beneath the right-hand horizontal stabilizer and aft fuselage.

9. Trim Control and Cables

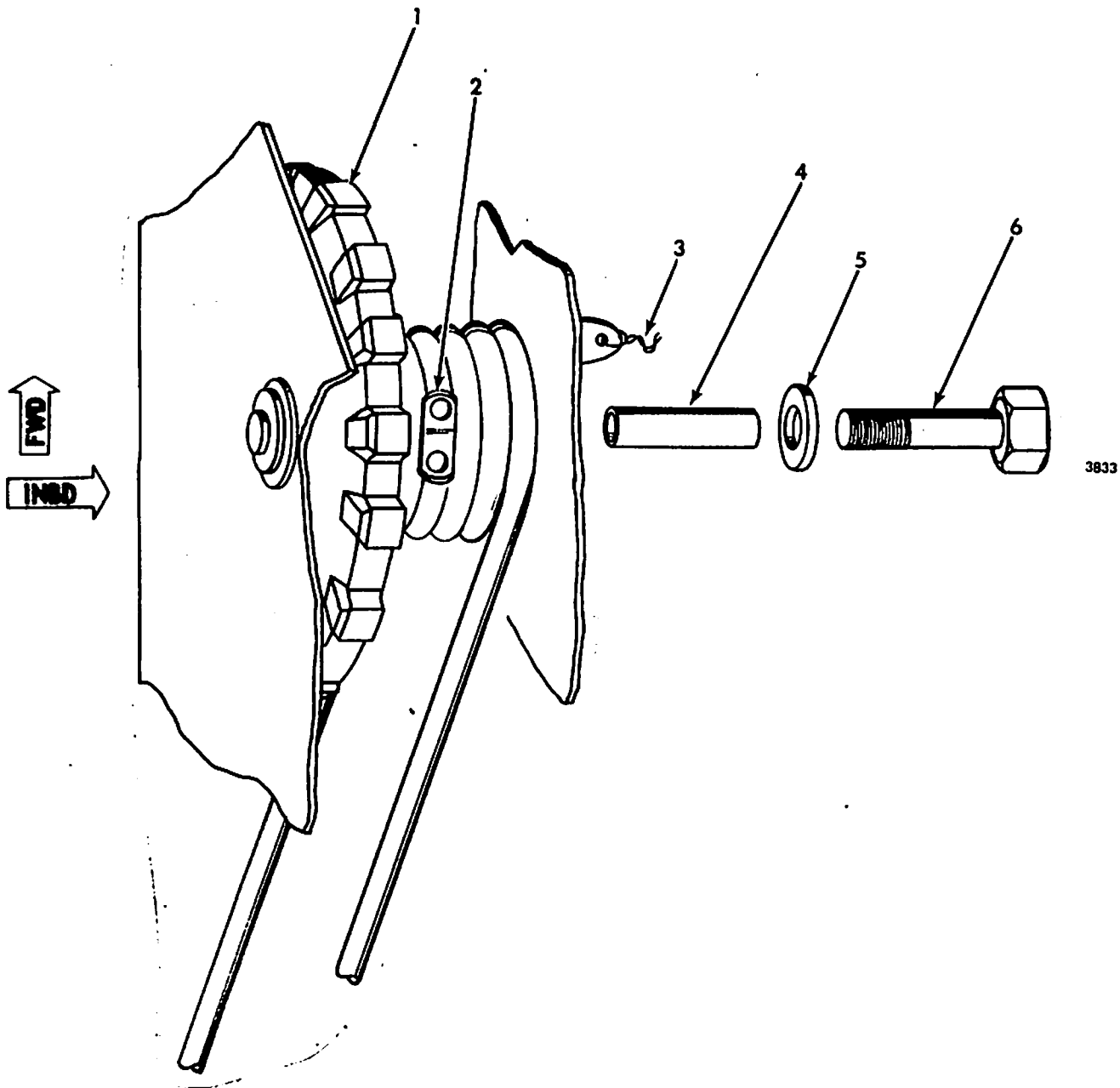
A. Removal

- (1) Remove aft fuselage access covers per Chapter 53.
- (2) Remove locking clips (1, Figure 209) and elevator trim turnbuckles (2). At trim pulley bracket (3), remove cotter pins (4).

CAUTION: PULL TRIM CABLE SLOWLY TO AVOID DAMAGE TO STOP.

- (3) Pull either elevator trim cable (5) slowly until stop is contacted. Remove clip (9) and attach a wire or cord to end of chain (8).
- (4) Pull remaining elevator trim cable (5) slowly until stop is contacted. Remove clip (9). Remove elevator trim cables (5).
- (5) In cabin, remove access panels and covers from aft console as required to gain access to elevator trim control and cables. Refer to Chapter 25.
- (6) Remove lower panel of aft cabin bulkhead (10, Figure 206). Remove cotter pin (7) and cable retainer (8). Pull elevator trim cables (18) free of pulleys.
- (7) Pull aft end of rear passenger seat bottom up and forward to gain access to pulley group at Fuselage Station 137.50. Remove cotter pin (15) and cable retainer (16). Pull elevator trim control cables (18) free of pulleys.
- (8) Beneath elevator trim control at Fuselage Station 88.00, remove cotter pin (22) and cable retainer (23). Pull elevator trim control cables (18) free of pulleys.
- (9) At elevator trim wheel (1, Figure 212) remove lock wire (3), bolt (6), and washer (5). Pull elevator trim wheel (1) up and out of center console.
- (10) Remove sleeve (4). Remove lock wire (3) from retainer (2) and release cables.

NOTE: Due to limited access to the aft fuselage and other areas through which the trim cables pass, a wire or cord should be attached to each cable end and pulled into position as the existing cables are removed.



- | | |
|------------------------|-----------|
| 1. Elevator Trim Wheel | 4. Sleeve |
| 2. Cable Retainer | 5. Washer |
| 3. Lock Wire | 6. Bolt |

**Elevator Trim Wheel Installation – View Looking Down
Figure 212**

- (11) Tie a wire or cord to each elevator trim control cable at aft console.
- (12) At aft fuselage access opening, pull cables aft and out of aircraft. Disconnect pull wires or cords and leave in place.

B. Installation

NOTE: Lubricate cables in pulley contact areas with commercial grade paraffin before installation.

- (1) At aft fuselage access opening, attach pull wires or cords to elevator trim control cables and pull cables into position. Allow sufficient free cable at forward ends for winding on drum of elevator trim wheel.
- (2) Beginning at left-hand side of trim wheel, wind free end of left-hand elevator trim control cable around drum 3-1/4 coils in a clockwise direction when viewed from left-hand side of trim wheel. (See Figure 212.)
- (3) Beginning at right-hand side of trim wheel, wind free end of right-hand elevator trim control cable around drum 3-1/4 coils in a counterclockwise direction when viewed from right-hand side of trim wheel. (See Figure 212.)
- (4) Install cable ends into cable retainer (2, Figure 212) and secure with lock wire.
- (5) Install sleeve (4) in elevator trim wheel (1). Install elevator trim wheel, placing trim indicator follower into center groove of spiral on trim wheel. Install washer (5) and bolt (6). Lock-wire bolt.
- (6) Beneath elevator trim control wheel, route cables as shown in Figure 207. Install cable retainer (23, Figure 206) and cotter pin (22).
- (7) At pulley group beneath passenger seat bottom at Fuselage Station 137.50, route elevator trim cables as shown in Figure 207. Install cable retainer (16, Figure 206) and cotter pin (15).
- (8) At pulley group beneath aft cabin bulkhead at Fuselage Station 181.632, route elevator trim cables as shown in Figure 207. Install cable retainer (8, Figure 206) and cotter pin (7). Install lower panel of aft cabin bulkhead (10).
- (9) Secure elevator trim cable (5, Figure 209) to chain (8) with clip (9).

CAUTION: PULL WIRE OR CORD SLOWLY TO AVOID DAMAGE TO STOP.

- (10) Pull wire or cord, Step A (3), down until stop is contacted. Remove wire or cord and secure other elevator trim cable (5) with clip (9).
- (11) Route cables around pulleys at trim pulley bracket (3), and at aft pulley group. (See Figure 211.) Install cotter pin (4, Figure 209).
- (12) Install elevator trim turnbuckles (2). Do not install locking clips (1) at this time. Perform a rigging check per Paragraph 11 and rig as necessary.
- (13) Install aft fuselage access covers. Install access covers on center console.

10. Bob Weight and Down Spring (See Figure 213.)

A. Removal

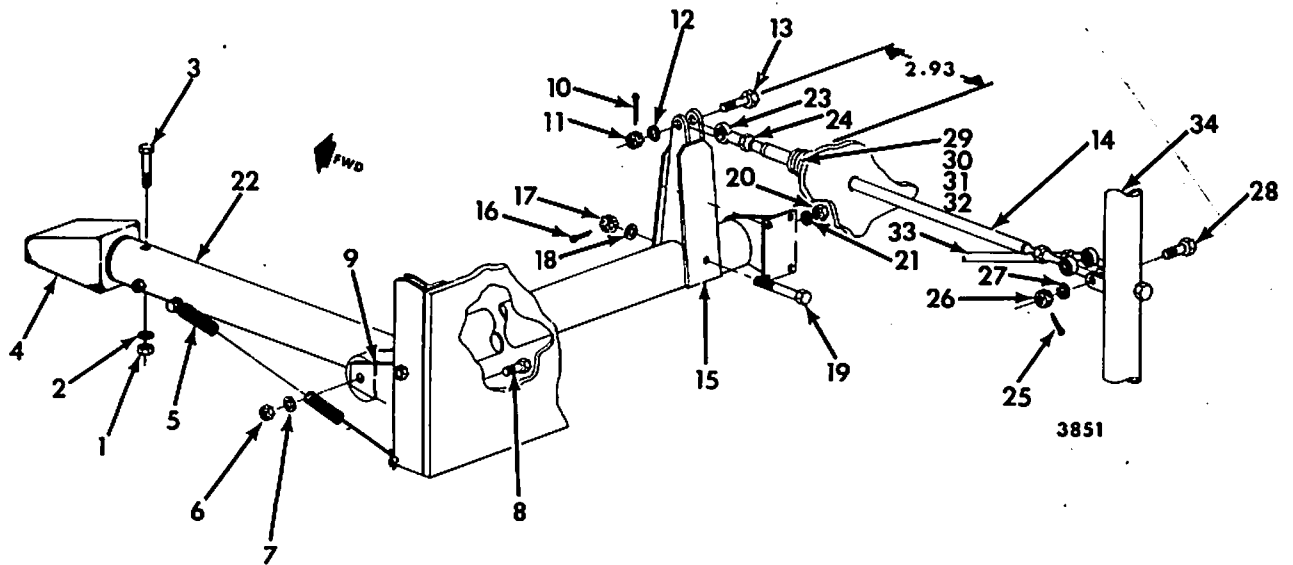
- (1) Remove left-hand nose baggage compartment access panel per Chapter 53.
- (2) Remove left-hand access cover from nose baggage compartment floor.
- (3) Install control lock in control column.

NOTE: The bob weight weighs approximately 16 pounds and is mounted at an inconvenient height and location for handling. Use both hands when removing or installing bob weight.

- (4) Remove nuts (1), washers (2), and bolts (3). Slide bob weight (4) forward to clear support assembly (22) and remove from aircraft.
- (5) In nose baggage compartment, unhook spring (5) at lower end. Remove nuts (6), washers (7), and bolts (8) holding bracket (9).
- (6) In nose wheel well, remove cotter pin (10), nut (11), washer (12), and bolt (13). Separate bob weight push rod (14) from crank (15).
- (7) Remove cotter pin (16), nut (17), washer (18), and bolt (19). Remove crank (15).
- (8) Remove nut (20) and washer (21). In nose baggage compartment, slide support assembly (22) outboard and remove from aircraft.
- (9) Loosen lock nut (24) and remove rod end (23). Remove locknut (24).
- (10) Beneath instrument panel, move clamp (29) aft to clear neck of bellows (32). At control column (34), remove cotter pin (25), nut (26), washer (27), and bolt (28). Separate bob weight push rod (14) and elevator push rod (33) from control column (34).
- (11) Compress bellows (32) and pull bob weight push rod (14) aft to clear bellows and remove from aircraft. Remove clamp (29).
- (12) Drill out rivets (30). Remove clamp plate (31) and bellows (32).

B. Installation

- (1) Install bellows (32, Figure 213) and clamp plate (31). Secure with rivets (30).
- (2) Install clamp (29) on bob weight push rod (14). Insert bob weight push rod through neck of bellows (32).
- (3) Install bob weight push rod (14) and elevator push rod (33) onto fitting on control column (34). Secure with bolt (28), washer (27), nut (26), and cotter pin (25).



- | | |
|-------------------------|-----------------------|
| 1. Nut | 18. Washer |
| 2. Washer | 19. Bolt |
| 3. Bolt | 20. Nut |
| 4. Bob Weight | 21. Washer |
| 5. Spring | 22. Support Assembly |
| 6. Nut | 23. Rod End |
| 7. Washer | 24. Locknut |
| 8. Bolt | 25. Cotter Pin |
| 9. Bracket | 26. Nut |
| 10. Cotter Pin | 27. Washer |
| 11. Nut | 28. Bolt |
| 12. Washer | 29. Clamp |
| 13. Bolt | 30. Rivet |
| 14. Bob Weight Push Rod | 31. Clamp Plate |
| 15. Crank | 32. Bellows |
| 16. Cotter Pin | 33. Elevator Push Rod |
| 17. Nut | 34. Control Column |

**Bob Weight and Down Spring Installation
Figure 213**

- (4) With control lock still installed in control column, install locknut (24) and rod end (23) on bob weight push rod (14). Adjust rod end as required to obtain 2.93 inches from center of bolt hole to bulkhead as shown in Figure 213. Tighten lock nut.
- (5) In nose baggage compartment, slide support assembly (22) into position.
- (6) In nose wheel well, install crank (15), bolt (19), washer (18), and nut (17). Do not install cotter pin (16) at this time.
- (7) Install threaded end of support assembly (22) into mounting. Install washer (21) and nut (20) but do not tighten.
- (8) In nose baggage compartment, install bracket (9) in proper position and secure with bolt (8), washer (7), and nut (6).
- (9) In nose wheel well, tighten nut (20).
- (10) Tighten nut (17) to a torque of 30 to 40 inch-pounds and install cotter pin (16).
- (11) Install rod end (23) into crank (15). Secure with bolt (13), washer (12), nut (11), and cotter pin (10).
- (12) Hook up lower end of spring (5).

NOTE: The bob weight weighs approximately 16 pounds and is mounted at an inconvenient height and location for handling. Use both hands when removing or installing bob weight.
- (13) Slide bob weight (4) into arm of support assembly (22). Secure with bolts (3), washers (2), and nuts (1).
- (14) Beneath instrument panel, adjust length of bellows (32) so that 4.70 inches of push rod shank is exposed and secure with clamp (29).
- (15) Remove control lock. Perform an elevator rigging check per Paragraph 11 and rig as required.
- (16) Install access panels per Chapter 53.

11. Elevator and Trim System Rigging Check

NOTE: Refer to Section 27-0 for rigging fixture part numbers.

A. Elevator Control System

- (1) Install control lock or 0.250-inch diameter rig pin through gust lock sleeve and control column.
- (2) Using an elevator rigging fixture, determine position of elevator trailing edges. Elevator trailing edges should be at 0 degree.

- (3) Remove control lock or rig pin and pull control wheel aft until stops are contacted. Elevator trailing edges should be 17 ± 1 degrees up.
- (4) Push control wheel forward until stops are contacted. Elevator trailing edges should be 16 ± 1 degrees down.

NOTE: Rig elevator per Paragraph 12 if requirements of Steps (2), (3), and (4) cannot be met.

B. Elevator Trim System

NOTE: Elevator must be clamped at 0 degree before trim tab readings are taken.

- (1) Using an elevator rigging fixture, set the right elevator trailing edge at 0 degree.
- (2) Rotate the trim wheel aft (nose up) until stop is contacted. Trim tab trailing edge should be $30 + 2 -3$ degrees down.
- (3) Rotate the trim wheel forward (nose down) until stop is contacted. Trim tab trailing edge should be 4 ± 1 degree up.

NOTE: Rig elevator per Paragraph 12 if requirements of Steps (2) and (3) cannot be met.

12. Elevator and Trim System Rigging Procedures

Elevator and trim rigging should be performed at an ambient temperature that is average for the area in which the aircraft is usually operated. If rigging must be done with the temperature above or below normal, it is recommended that cable tension be measured and adjusted as necessary when temperature returns to normal. Refer to Section 27-0 for rigging fixture part numbers.

A. Elevator Control System

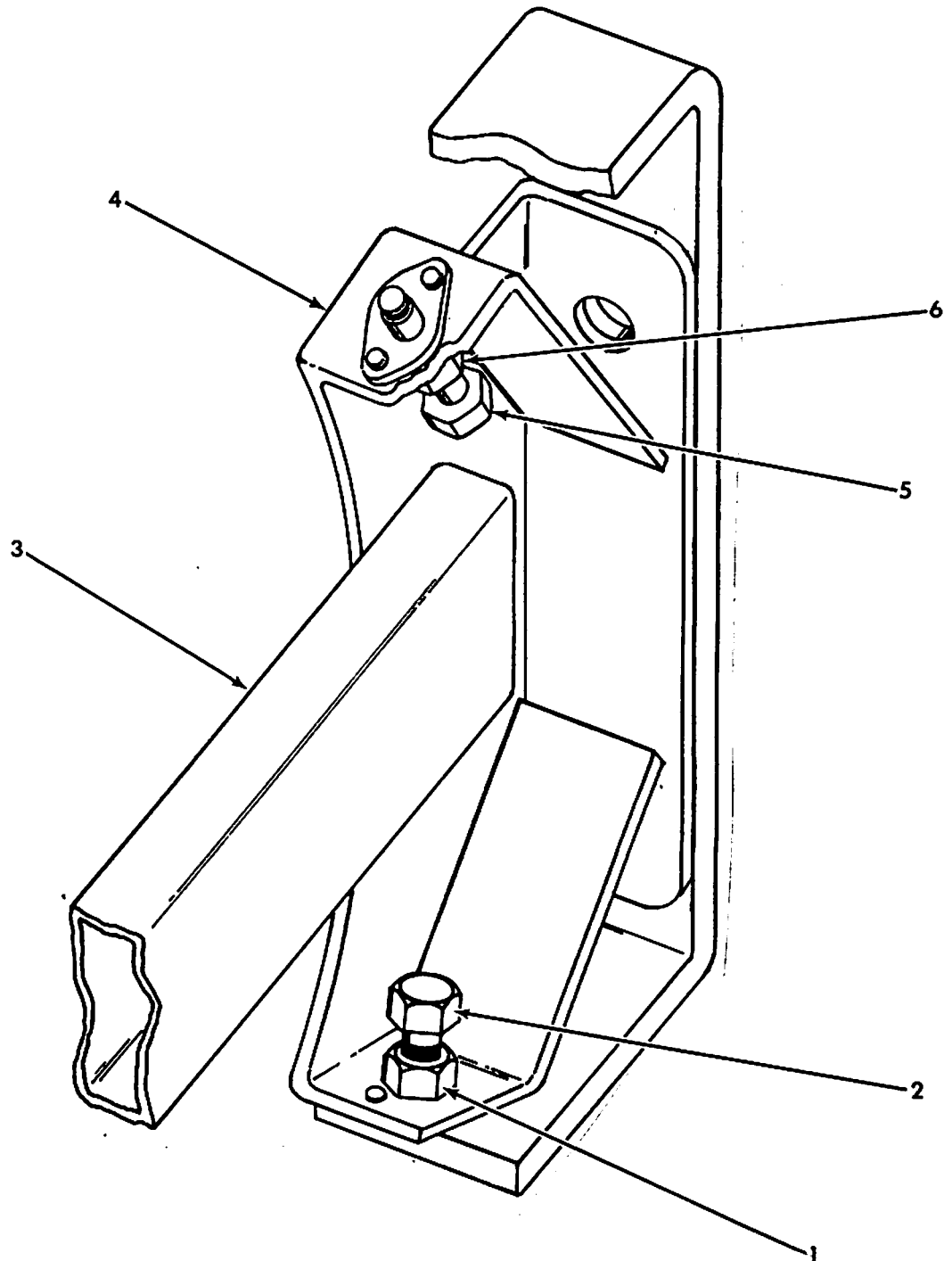
- (1) Install control lock or 0.250-inch diameter rig pin through gust lock sleeve and control column.
- (2) Beneath the instrument panel forward of the rudder pedals, install a rig pin through rig pin holes in front bellcranks and support brackets. If rig pin hole in elevator bellcrank is out of line, adjust length of control column push rod (10, Figure 202) as required to install rig pin. Refer to Paragraph 2.
- (3) Remove aft fuselage access covers and tail cone per Chapter 53. Install a rig pin at aft elevator bellcrank (11, Figure 205). If rig pin hole through aft elevator bellcrank is out of line, remove locking clips from elevator cables and adjust turnbuckles as required to install rig pin.
- (4) Using a cable tensiometer, measure tension on each elevator cable. Adjust turnbuckles as required to obtain 35 ± 5 pounds tension with bob weight supported. Difference in cable tension readings should be small enough to allow rig pin to be removed and installed without using force. Install locking clips.
- (5) With rig pins and control lock installed, determine position of elevator trailing edges with an elevator rigging fixture. Adjust lengths of elevator push rods (6, Figure 205) as required to position elevator trailing edges at 0 degree.

- (6) Remove control column lock and both rig pins. Pull control wheel aft until stops are contacted. Elevator trailing edges should be 17 ± 1 degrees up.
- (7) If required, loosen lock nut (1, Figure 214) and adjust elevator up travel by turning bolt (2) as required. Turn bolt clockwise to increase elevator travel, or counterclockwise to decrease elevator travel. Tighten lock nut (1) when proper travel is obtained.
- (8) Push control wheel forward until stops are contacted. Elevator trailing edges should be 16 ± 1 degrees down.
- (9) If required, loosen lock nut (6, Figure 214) and adjust elevator down travel by turning bolt (5) as required. Tighten lock nut (6) when proper travel is obtained.

B. Trim Control System

- (1) Rig elevator control system per Steps A (1) through (9).
- (2) Remove cover from elevator trim wheel housing.
- (3) Rotate trim wheel to the position shown in Figure 212. Make sure the cable coils lie evenly as shown and do not cross each other. There must be 3-1/4 turns of cable on either side of the cable retainer, and the cable retainer must be at the top of the drum.
- (4) At aft fuselage access opening, remove locking clips (1, Figure 209) and elevator trim turnbuckles (2). Tie a cord or wire to free end of each aft elevator trim cable.

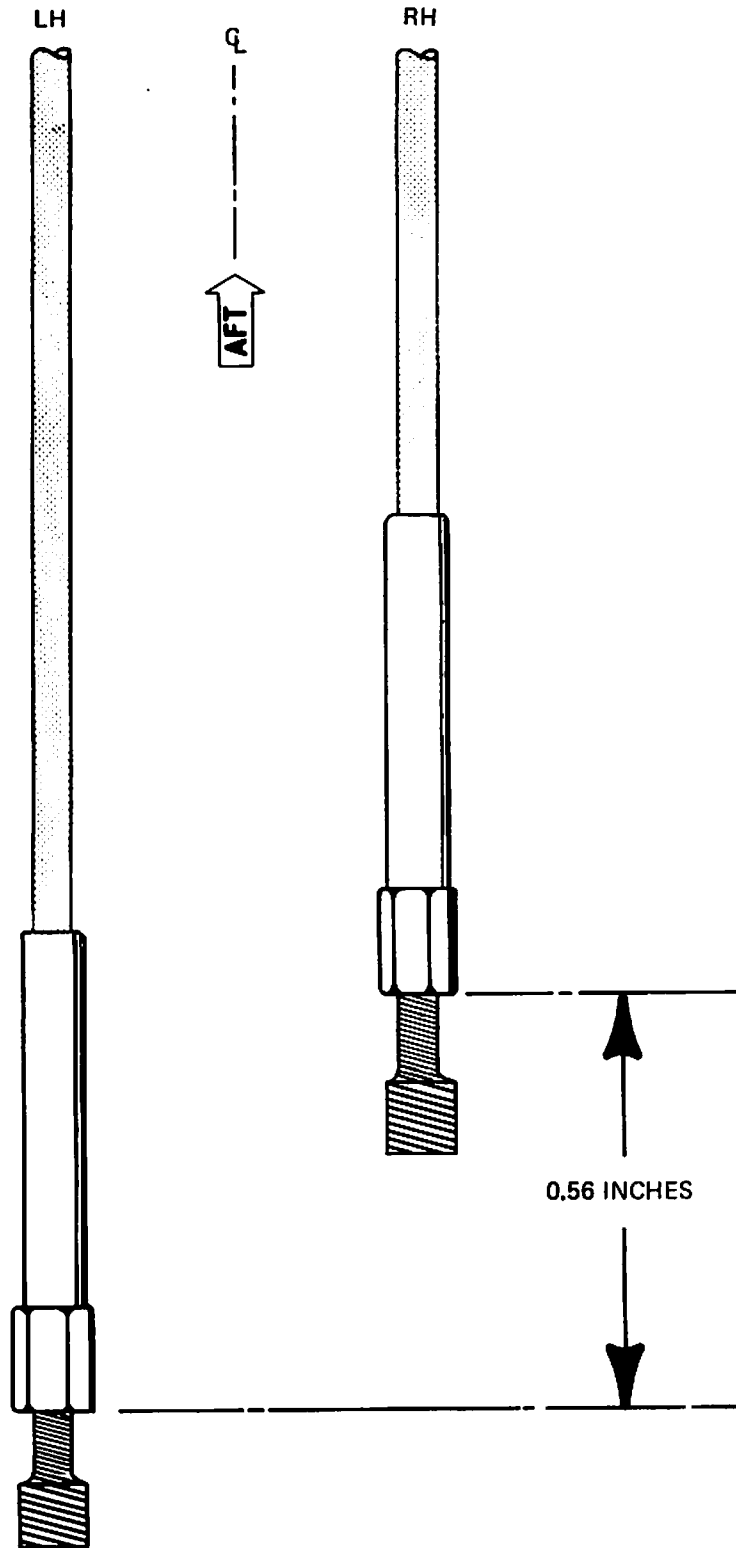
NOTE: Cut a piece of aluminum, phenolic, welding rod, or other suitable material to a length of 2.3 inches to measure actuator arm.
- (5) With the elevator in the full up position to gain access to the actuator, determine the length of the actuator arm. See Figure 210.
- (6) If required, remove access cover from right-hand horizontal stabilizer and rotate chain and sprocket to obtain an actuator arm measurement of 2.3 inches.
- (7) At aft fuselage access opening, measure offset at cable ends as shown in Figure 215.
- (8) If the offset is not as shown in Figure 215, loosen nut (6, Figure 209) and slide chain guard (7) aft to free chain.
- (9) Without turning sprocket, reposition chain on sprocket to obtain an offset of 0.56 inch as shown in Figure 215. Slide chain guard (7, Figure 209) forward until chain is contacted, then aft approximately 0.06 inch. Tighten nut (6).
- (10) Install elevator trim turnbuckles (2, Figure 209). Tighten turnbuckles equally to obtain a reading of 15 ± 3 pounds on a tensiometer. Install locking clips (1).



- 1. Locknut
- 2. Bolt
- 3. Arm

- 4. Bracket
- 5. Bolt
- 6. Locknut

**Elevator Stop Assembly
Figure 214**



**Aft Elevator Trim Cables – View Looking Up
Figure 215**

- (11) Set elevators at 0 degree and install a rig pin in aft elevator bellcrank.

NOTE: Refer to Section 27-0 for rigging fixture part numbers.

- (12) Rotate the elevator trim wheel until the nose up stop is contacted. Use an elevator trim rigging fixture to determine the elevator trim tab position. Adjust length of elevator trim push rod (6, Figure 208) as required to obtain a reading of 4 ± 1 degree up.
- (13) Rotate elevator trim wheel to both extremes of travel, noting reading at both stops. Trim readings at stops should be 4 ± 1 degree up and $30 + 2 - 3$ degrees down.
- (14) Remove rig pin from aft elevator bellcrank. Install access covers on horizontal stabilizer and aft fuselage. Install cover on elevator trim wheel housing.

13. Cleaning and Painting

CAUTION: PAINTING, REPAIRS, OR OTHER ALTERATIONS TO ANY CONTROL SURFACE MAY CAUSE AN UNDERBALANCED CONDITION. CHECK ELEVATOR BALANCE BEFORE INSTALLATION.

Refer to Chapter 20 for cleaning and painting instructions.

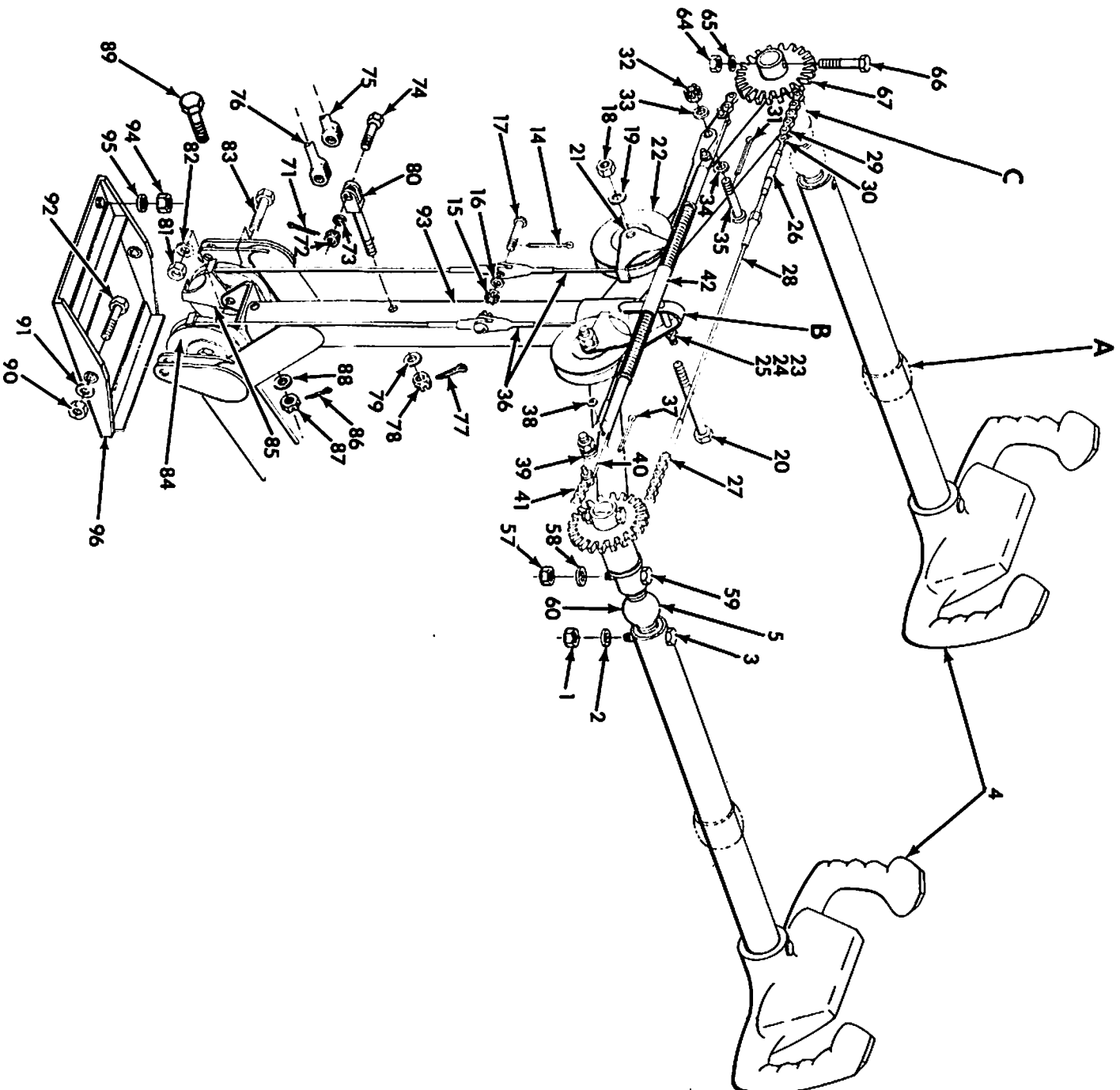
14. Control Column (See Figure 216.)

A. Removal

- (1) Install control wheel lock. Install a rig pin in bellcranks forward of rudder pedals.
- (2) Remove left-hand nose baggage compartment access panel per Chapter 53.
- (3) Remove left-hand access cover from nose baggage compartment floor.
- (4) Provide support for bob weight to maintain it in a fixed position. Remove access panels from aft wall of nose baggage compartment per Chapter 53. Remove control wheel lock.

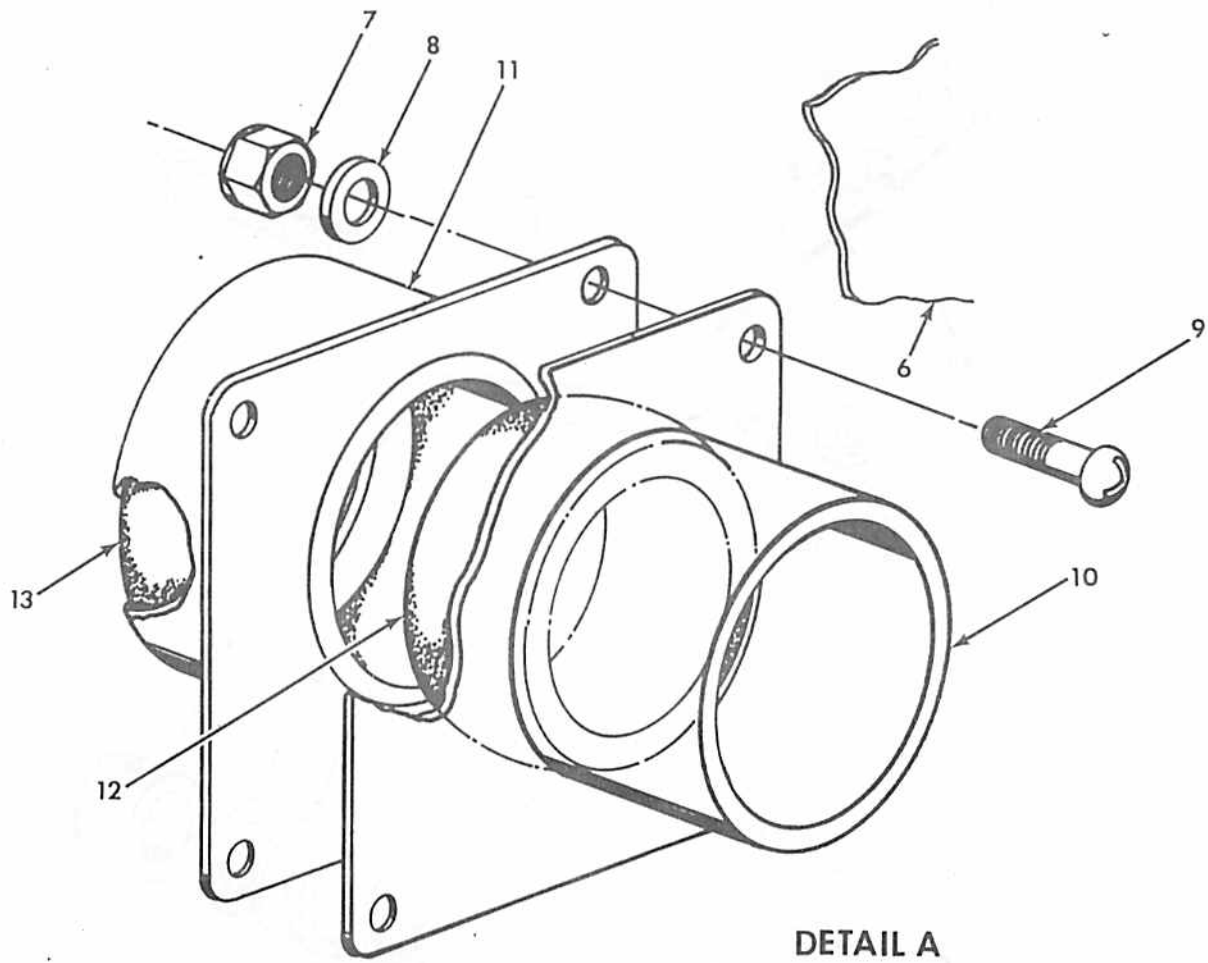
NOTE: If aircraft is equipped with autopilot option, disconnect control cable leads beneath instrument panel per Chapter 22. Push control cable into control wheel shaft and remove grommet.

- (5) Remove nut (1, Figure 216), washer (2), and bolt (3). Pull control wheel assembly (4) aft and out of instrument panel (6). Remove spacer (5).
- (6) Remove nuts (7), washers (8), and screws (9) securing control lock sleeve (10) and bushing cup (11) to instrument panel (6).
- (7) Remove bushing (12) and outer ring (13) from bushing cup (11).
- (8) Remove cotter pins (14), nuts (15), washers (16), and clevis bolts (17) at each side of control column.
- (9) At control column fork, remove nuts (18), washers (19), bolts (20), cable guards (21), and pulleys (22).



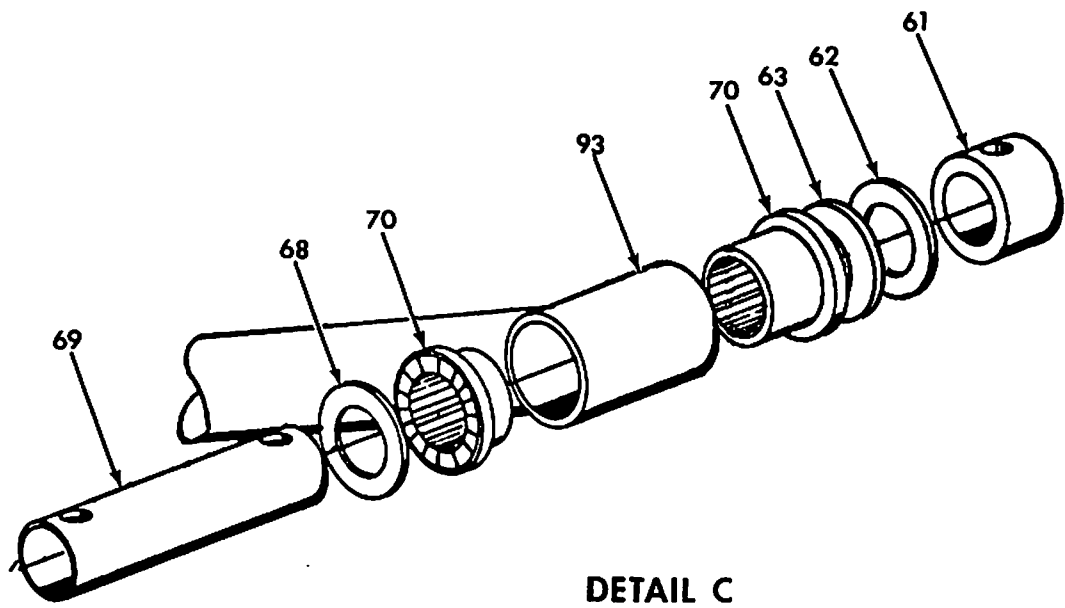
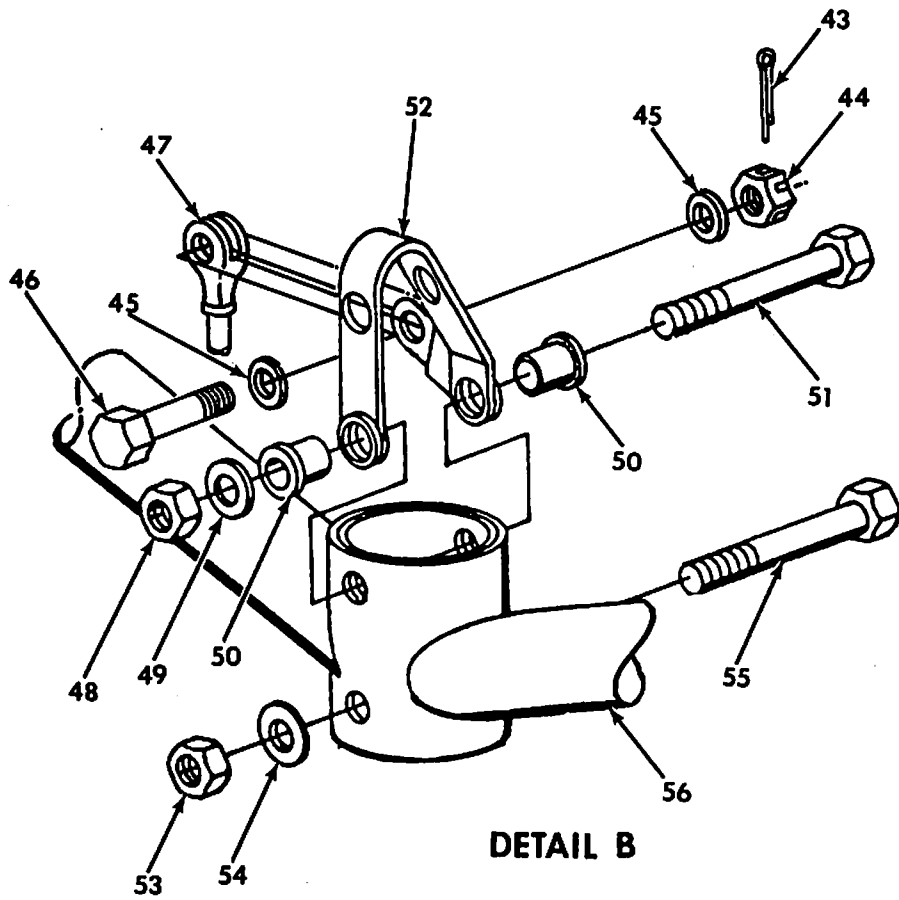
Control Column Installation
Figure 216 (Sheet 1 of 4)

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Control Column Installation
Figure 216 (Sheet 2 of 4)



**Control Column Installation
Figure 216 (Sheet 3 of 4)**

- | | | |
|---------------------------|---------------------|-------------------------|
| 1. Nut | 33. Washer | 65. Washer |
| 2. Washer | 34. Washer | 66. Bolt |
| 3. Bolt | 35. Bolt | 67. Sprocket |
| 4. Control Wheel Assembly | 36. Cable Assembly | 68. Thrust Plate |
| 5. Spacer | 37. Cotter Pin | 69. Shaft |
| 6. Instrument Panel | 38. Washer | 70. Thrust Bearings |
| 7. Nut | 39. Link Assembly | 71. Cotter Pin |
| 8. Washer | 40. Link | 72. Nut |
| 9. Screw | 41. Chain | 73. Washer |
| 10. Control Lock Sleeve | 42. Bungee | 74. Bolt |
| 11. Bushing Cup | 43. Cotter Pin | 75. Bob Weight Push Rod |
| 12. Bushing | 44. Nut | 76. Elevator Push Rod |
| 13. Outer Ring | 45. Washer | 77. Cotter Pin |
| 14. Cotter Pin | 46. Bolt | 78. Nut |
| 15. Nut | 47. Push Rod | 79. Washer |
| 16. Washer | 48. Nut | 80. Fork |
| 17. Clevis Bolt | 49. Washer | 81. Nut |
| 18. Nut | 50. Flanged Bushing | 82. Washer |
| 19. Washer | 51. Bolt | 83. Bolt |
| 20. Bolt | 52. Bellcrank | 84. Pulley |
| 21. Cable Guard | 53. Nut | 85. Cable Guard |
| 22. Pulley | 54. Washer | 86. Cotter Pin |
| 23. Nut | 55. Bolt | 87. Nut |
| 24. Bushing | 56. Y-Bar Assembly | 88. Washer |
| 25. Washer | 57. Nut | 89. Bolt |
| 26. Turnbuckle | 58. Washer | 90. Nut |
| 27. Connecting Link | 59. Bolt | 91. Washer |
| 28. Cable Assembly | 60. Universal Joint | 92. Bolt |
| 29. Connecting Link | 61. Spacer | 93. Control Column |
| 30. Turnbuckle Eye | 62. Shim | 94. Nut |
| 31. Cotter Pin | 63. Thrust Plate | 95. Washer |
| 32. Nut | 64. Nut | 96. Support Assembly |

Control Column Installation

Figure 216 (Sheet 4 of 4)

- (10) Remove nut (23), bushings (24), and washer (25). Cut lock wire and remove turnbuckle (26).
- (11) Remove chain and bungee assembly from aircraft. If required, disassemble as follows:
- (a) Remove connecting link (27) and cable assembly (28).
 - (b) Remove connecting link (29) and turnbuckle eye (30).
 - (c) Remove cotter pins (31), nuts (32), washers (33 and 34), and bolts (35). Remove cable assemblies (36).
 - (d) Remove cotter pins (37) and washers (38). Remove link assemblies (39), links (40), chains (41), and bungee (42).

- (12) Remove cotter pin (43), nut (44), washers (45), and bolt (46). Remove end of push rod (47) from bellcrank (52).
- (13) Remove nut (48), washer (49), flanged bushings (50), and bolt (51). Remove bellcrank (52).
- (14) Remove nut (53), washers (54), and bolt (55). Remove Y-bar assembly (56) from aircraft.
- (15) Remove nut (57), washer (58), and bolt (59). Remove universal joint (60), spacer (61), shims (62), and thrust plate (63).
- (16) Remove nut (64), washer (65), and bolt (66). Remove sprocket (67) and thrust plate (68). Remove shaft (69) and thrust bearings (70).
- (17) Remove cotter pin (71), nut (72), washer (73), and bolt (74). Separate bob weight push rod (75) and elevator push rod (76) from fork (80).
- (18) Remove cotter pin (77), nut (78), washer (79), and fork (80).
- (19) At base of control column (93), remove nuts (81), washers (82), and bolts (83). Remove pulleys (84) and cable guards (85).
- (20) Remove aileron trim linkage from base of control column (93) by removing cotter pin (86), nut (87), washer (88), and bolt (89).
- (21) Remove nuts (90), washers (91), and bolts (92). Remove control column (93) from aircraft.
- (22) Remove nuts (94) and washers (95). Remove support assemblies (96).

B. Installation

- (1) Install support assemblies (96) on studs and secure with washers (95) and nuts (94).

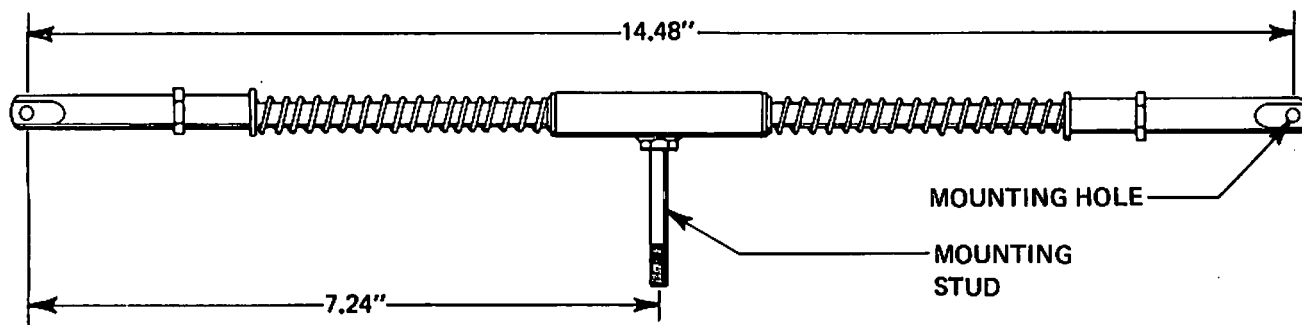
NOTE: Install control column so that slope in base slants forward.

- (2) Install control column (93) over support assemblies (96) and secure with bolts (92), washers (91), and nuts (90).
- (3) Assemble cable guards (85), aileron cables, and pulleys (84) on bolts (83). Install washers (82) and nuts (81).
- (4) Insert fork (80) through control column (93). Install washer (79) and nut (78). Tighten nut securely and back off as required to install cotter pin (77).
- (5) Position bob weight push rod (75) and elevator push rod (76) at fork (80). Install bolt (74), washer (73), nut (72), and cotter pin (71).

NOTE: Install sprocket (67) so that tooth on centerline of mounting holes and head of bolt (66) are at same end.

- (6) Install thrust bearings (70) into Y-bar assembly (56). Install shaft (69), thrust plate (68), and sprocket (67). Install bolt (66), washer (65), and nut (64).

- (7) Install thrust plate (63), shims (62), spacer (61), and universal joint (60). Install bolt (59), washer (58), and nut (57).
- (8) Check assembled parts for freedom of rotation and end play not to exceed 0.010 inch. Add or remove shims (62) as required.
- (9) Install Y-bar assembly (56) onto control column (93). Install bolt (55), washers (54), and nut (53).
- (10) Install bellcrank (52), bolt (51), flanged bushings (50), washer (49), and nut (48).
- (11) Install aileron trim linkage to base of control column with bolt (89), washer (88), nut (87), and cotter pin (86).
- (12) Install top end of push rod (47) to arm of bellcrank (52) with bolt (46), washers (45), nut (44), and cotter pin (43).
- (13) Assemble chain and bungee components as follows:
 - (a) Measure distance from mounting hole to mounting hole on bungee (42). Adjust as required to obtain dimension shown in Figure 217.
 - (b) Measure distance from mounting hole to mounting stud on bungee. Adjust bungee as required to obtain dimension shown in Figure 217.



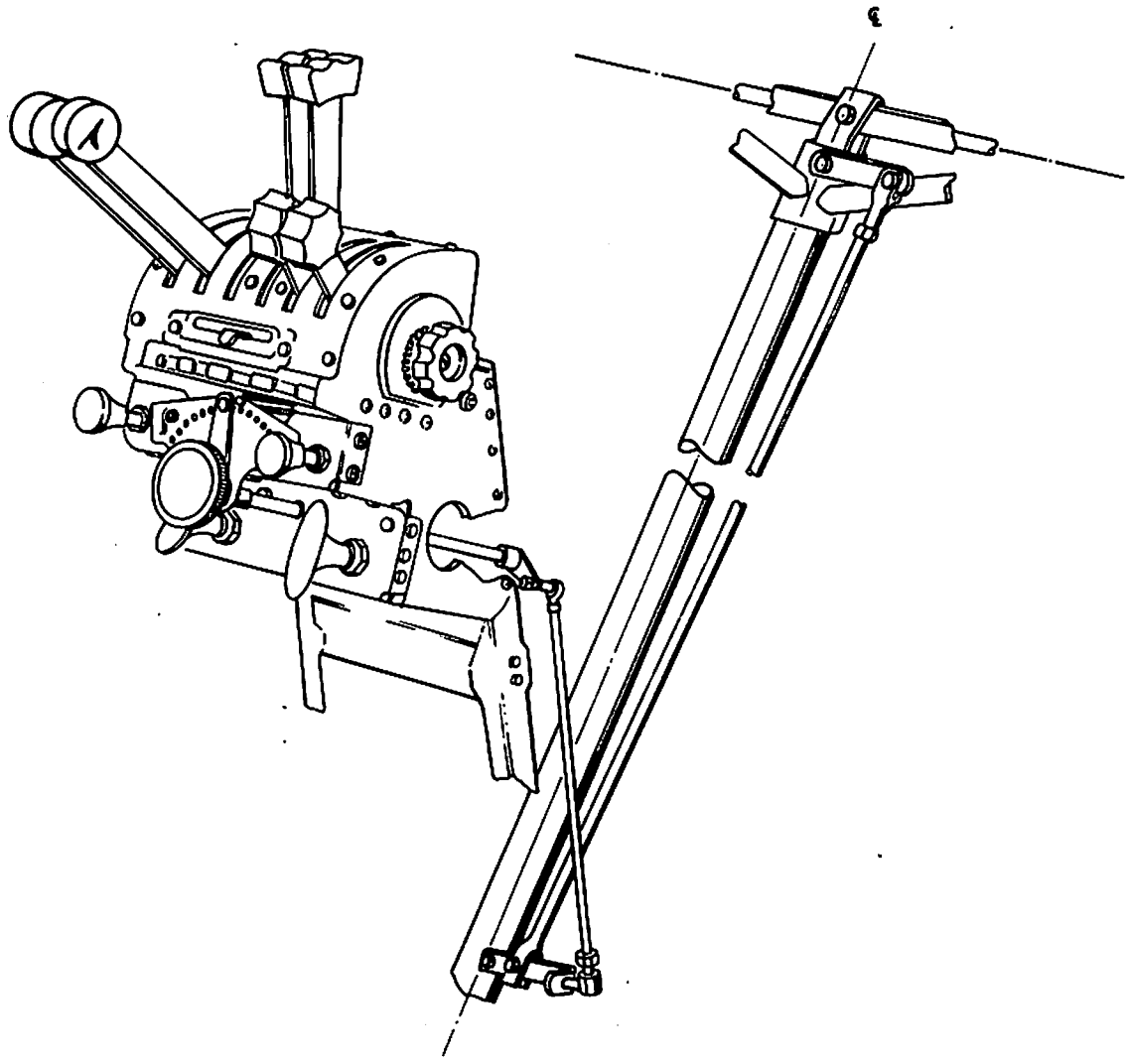
Bungee Assembly
Figure 217

- (c) Assemble arm of bungee (42) and end link of chain (41) with link assembly (39). Install link (40) and secure with washers (38) and cotter pins (37). Assemble remaining chain (41) to other bungee arm in a like manner.
 - (d) Install cable (36) and washers (34) between link assembly (39) and link (40). Secure with bolt (35), washer (33), nut (32), and cotter pin (31). Repeat procedure to install remaining cable assembly (36).
 - (e) Secure turnbuckle eye (30) to chain (41) with link (29).
 - (f) Secure cable assembly (28) to remaining chain (41) with connecting link (27).
- (14) Turn sprockets so that shafts of bolts (66) are parallel to centerline of control column (93) and install rig pins through rig pin holes in Y-bar assembly and between teeth of sprocket.
 - (15) Place aileron trim control knob in neutral position. Arm of bellcrank (52) should be parallel to centerline of control column (93). Adjust length of push rod (47) as required to obtain this condition.
 - (16) Install bushings (24) and stud of bungee assembly (42) into bellcrank (52). Install washer (25) and nut (23).
 - (17) Wrap chains (41) around sprockets (67), keeping bungee (42) centered, and an equal amount of free links at bungee ends.
 - (18) Joint turnbuckle eye (30) and end of cable assembly (28) with turnbuckle (26). Tighten turnbuckle (26) as required to remove slack from cable assembly (28). Do not install lock wire on turnbuckle at this time.
 - (19) Assemble cables (36), pulleys (22), cable guards (21), and bolts (20). Install bolts into Y-bar assembly (56) and secure with washers (19) and nuts (18).
 - (20) Join aileron cables with clevis bolts (17), washers (16), nuts (15), and cotter pins (14).
 - (21) Install outer ring (13) and bushing (12) into cup (11).
 - (22) Place cup (11) and control lock sleeve (10) on instrument panel (6) and secure with screws (9), washers (8), and nuts (7).
 - (23) Install spacer (5) over end of universal joint (60).
- NOTE:** If aircraft is equipped with autopilot option, pull autopilot cable out of control wheel shaft and install grommet after shaft has passed through bushing (12) and before installing over spacer (60). Reconnect wiring per Chapter 22.
- (24) Install control wheel assembly (4) through control lock sleeve (10), bushing (12), and over spacer (61). Install bolt (3), washer (2), and nut (1).
 - (25) In nose baggage compartment, remove support from bob weight assembly.
 - (26) Check control column rigging per Paragraph 15 below. Remove rig pins from control column.

- (27) Install access panels in aft wall of nose baggage compartment per Chapter 53.
- (28) Install left-hand access cover in nose baggage compartment floor and left-hand nose baggage compartment access panel.
- (29) Remove rig pins from bellcranks forward of rudder pedals.

15. Control Column Rigging Procedure

- A. Open nose baggage compartment and remove access panels from aft wall.
- B. Place aileron trim control knob in neutral position and observe bungee arm of bellcrank at top of control column. Bungee arm should lie along centerline of control column as shown in Figure 218. Adjust push rod lengths as required to obtain this condition.



Aileron Trim Linkage
Figure 218

- C. Cut lock wire and remove turnbuckle (Figure 219). Adjust length of bungee to dimensions shown in Figure 217.
- D. Make sure each sprocket is oriented so that a sprocket tooth and bolt head are at the top. If bolt head is not centered at the top, the sprocket must be rotated 180 degrees.
- E. With the bolts parallel to the control column, install the rig pins through the control column arms and between the sprocket teeth.
- F. Wrap the chains around the sprockets, leaving as little slack as possible between the bungee arms and the sprockets.
- G. Install the turnbuckle and tighten as required to remove slack. Remove rig pins.
- H. Install rig pins in aileron sectors per Section 27-1-1. Control wheel should be in neutral position.
- I. Rotate the aileron trim knob to each stop in turn, observing the shift in control wheel position. The control wheel neutral point should shift 18 degrees in each direction.

16. Stall Sensor Switch (See Figure 220.)

NOTE: The following procedures apply to either stall sensor switch. Refer to Section 27-4-1 for stall sensor selector switch maintenance.

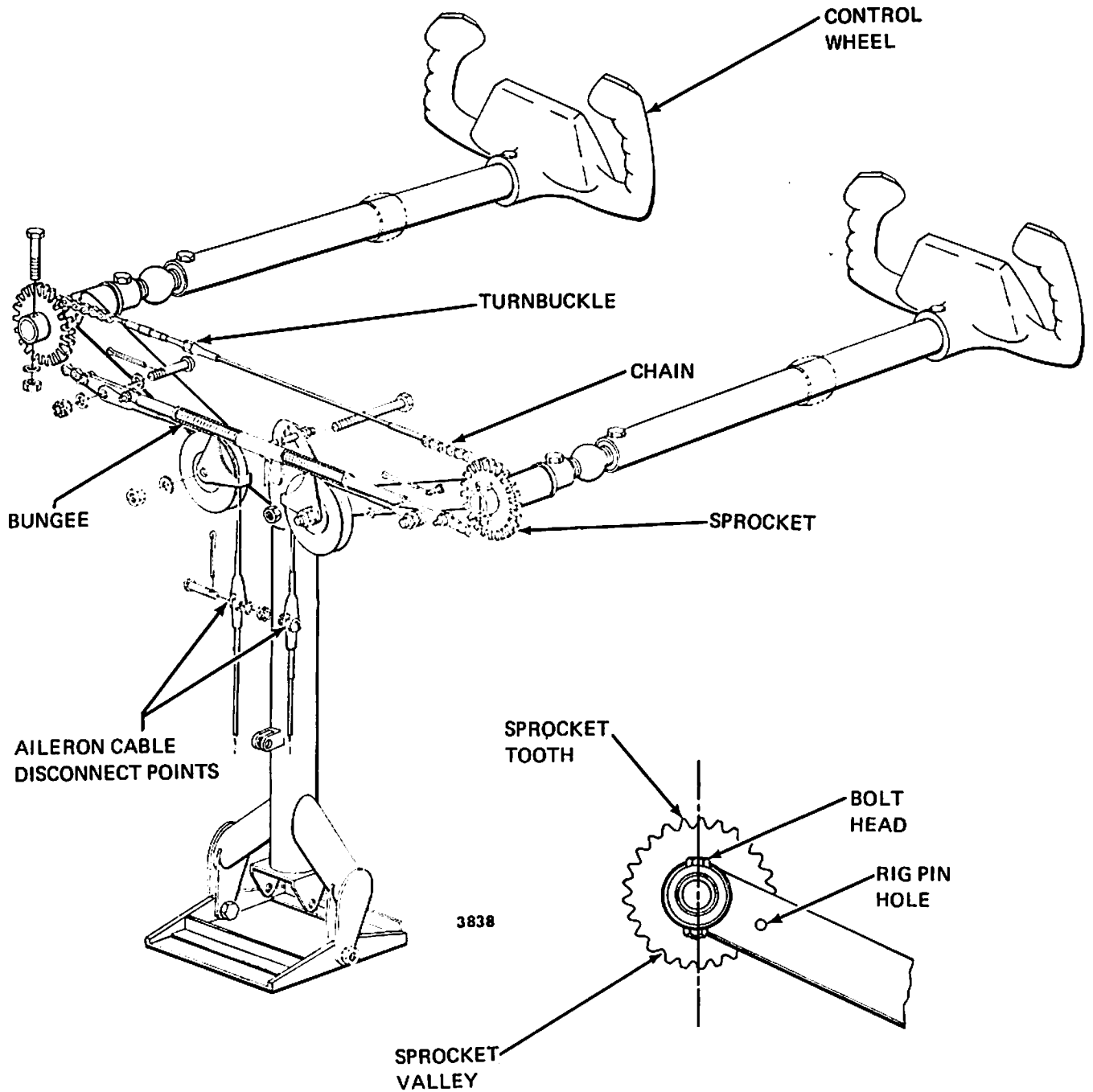
A. Removal

NOTE: The use of a template to locate switch is recommended to minimize flight test time after switch removal and installation.

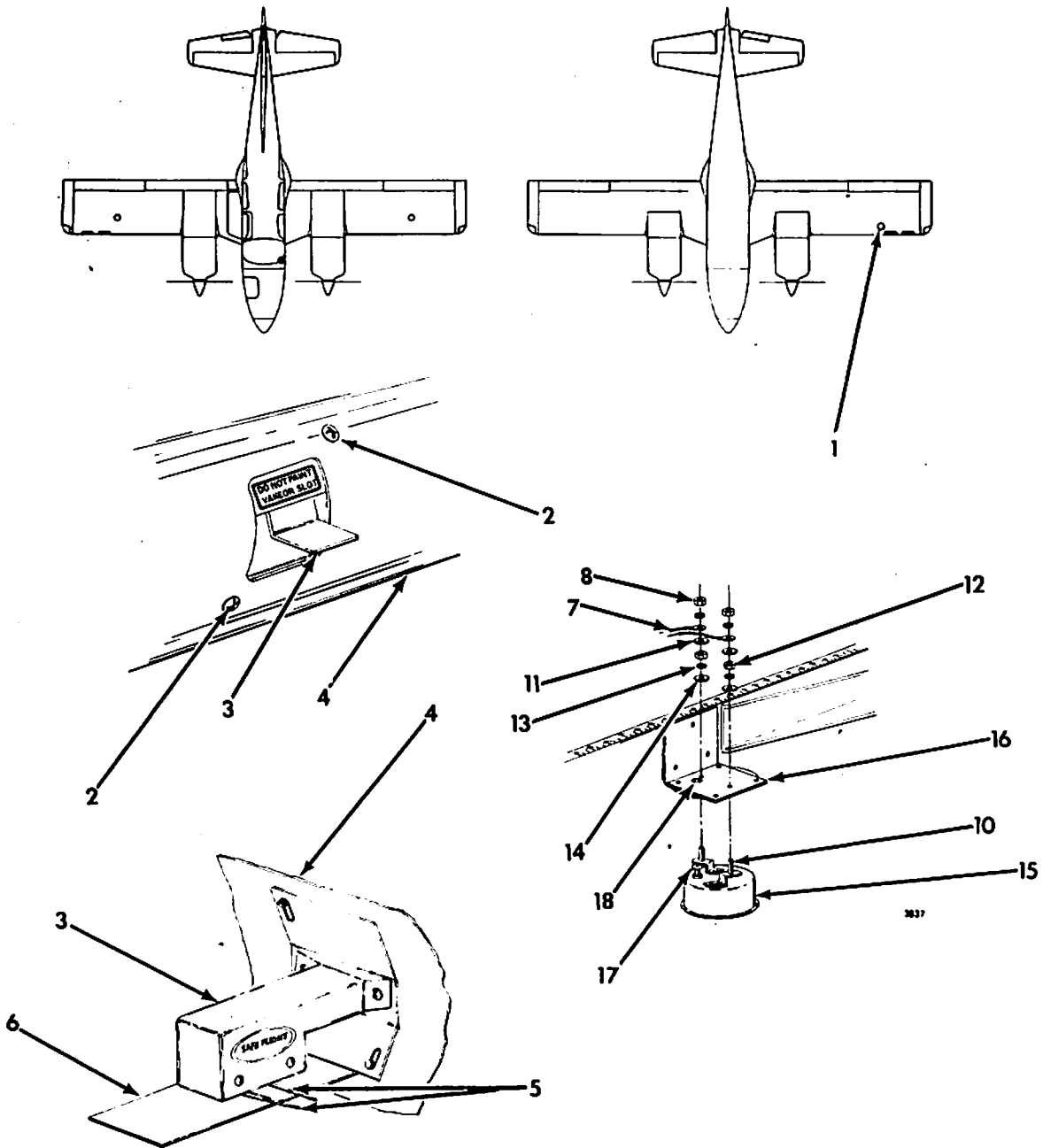
- (1) Cut a template from cardboard or other suitable material to fit wing leading edge. Fit the template over the wing adjacent to the stall warning switch vane. Draw a line on the cardboard to indicate the normal position and angle of the stall warning switch vane. Remove access cover (1) from wing.
- (2) Remove screws (2) securing sensor switch (3) to wing (4).
- (3) Tag and disconnect wires (5) and remove sensor switch (3) from inside of wing (4).
- (4) Ensure that insulating strip (6) is not damaged.

B. Installation

- (1) Make sure insulation strip (6, Figure 220) is in position beneath switch terminal screws.
- (2) Connect wires (5) to sensor switch (3).
- (3) Position sensor switch (3) inside wing (4) and install screws (2). Fit template over wing leading edge and use as a guide to position stall warning switch vane. Tighten screws (2).
- (4) Install access cover (1).
- (5) Flight test and adjust stall warning system per Paragraph 18.



Control Column Rigging
Figure 219



- | | |
|---------------------|------------------------|
| 1. Access Cover | 10. Terminals |
| 2. Screw | 11. Washer |
| 3. Sensor Switch | 12. Nut |
| 4. Wing | 13. Washer |
| 5. Wires | 14. Washer |
| 6. Insulating Strip | 15. Stall Warning Horn |
| 7. Wires | 16. Mounting Bracket |
| 8. Nut | 17. Adjustment Screw |
| 9. Washer | 18. Access Hole |

**Stall Warning System Removal/Installation
Figure 220**

17. Stall Warning Horn (See Figure 220.)

A. Removal

- (1) Tag wires (7).
- (2) Remove nuts (8), washers (9), and wires (7) from stall warning horn terminals (10).
- (3) Remove washers (11), nuts (12), and washers (13 and 14) from terminals (10).
- (4) Remove stall warning horn (15) from mounting bracket (16).

B. Installation

- (1) Position stall warning horn (15) so that its terminals (10) align with holes in mounting bracket (16) and so that adjustment screw (17) aligns with access hole (18) in mounting bracket.
- (2) Place washers (14), washers (13), and nuts (12) on terminals (10).
- (3) Tighten nuts (12) per Chapter 91.
- (4) Place washers (11), wires (7), washers (9), and nuts (8) on terminals (10). Torque to standard value. (See Chapter 91.)

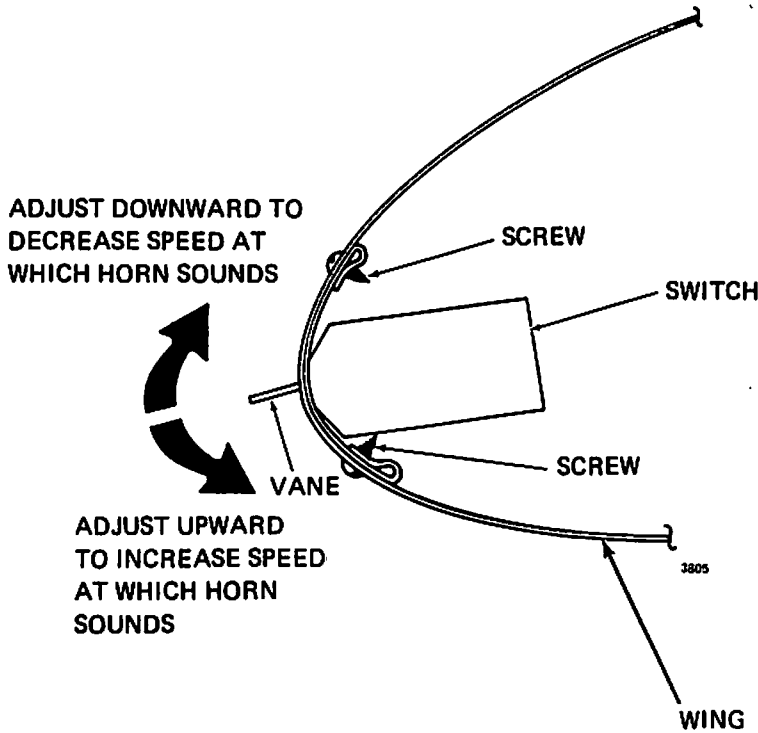
18. Stall Warning System Adjustment (See Figure 221.) (See Figure 222 for Schematic Diagram.)

- A. With flaps up, flight test aircraft, noting speed at which stall warning system sounds, and speed at which stall occurs. Stall warning horn shall sound at 4 to 9 knots (5 to 10 mph) prior to stall.
- B. If stall warning occurs at incorrect speed, adjust inboard switch in right wing as follows:
 - (1) Remove stall sensor switch access panel (1, Figure 220).
 - (2) Loosen screws (2) securing sensor switch.
 - (3) Position switch upward to increase speed at which horn sounds, or downward to decrease speed.
 - (4) Tighten screws (2) and replace access panel (1).
 - (5) Repeat Steps A and B as necessary to obtain proper stall warning.
- C. Repeat Steps A and B with flaps down. Adjust outboard switch in right wing if required.

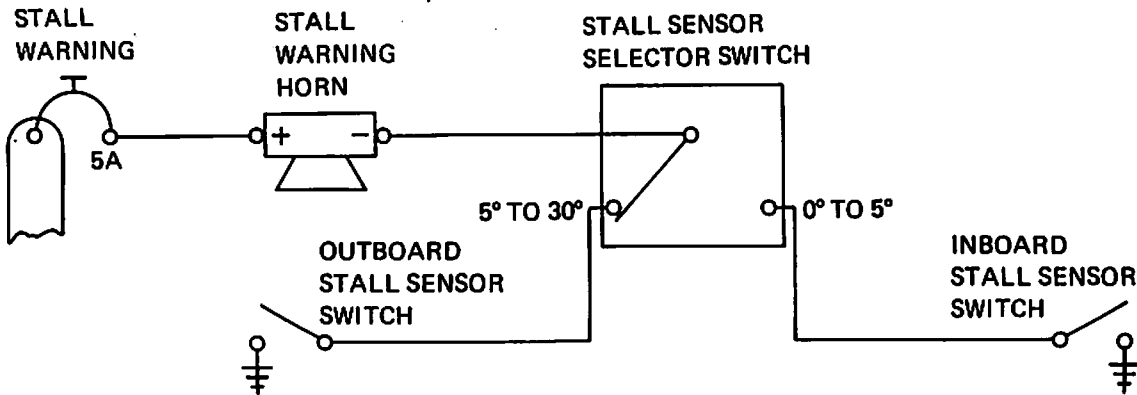
19. Stall Warning System Operational Check

NOTE: The following check gives only a system go, no-go check. It does not test for operation at proper airspeed.

- A. Set master switch to ON.



**Stall Sensor Switch Adjustment
Figure 221**



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**Stall Warning System – Schematic Diagram
Figure 222**

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- B. Raise flaps to full up position.
- C. Lift and hold inboard vane on right wing stall sensor switch. Stall warning horn should sound.
- D. Release vane.
- E. Lower flaps below 6 degrees.
- F. Lift and hold outboard stall sensor switch. Stall warning horn should sound.
- G. Release vane and set master switch to OFF.

20. Bearing Inspection and Replacement

- A. Remove elevators in accordance with Paragraph 1.
- B. Inspect bearings per Section 27-1-1.
- C. Install elevators in accordance with Paragraph 1.

21. Elevator Balancing Procedure

Refer to Section 27-1-1 for control surface balancing procedures.

FLAPS – DESCRIPTION/OPERATION

1. General (See Figure 1.)

The flap system consists of a flap mounted on each wing, a worm gear actuator, driven by an electric motor, a torque tube, and mechanical linkages to actuate the flaps. The electric motor is controlled by a three-position switch mounted in the instrument panel to the right of the center console. A flap position indicator is mounted adjacent to the switch.

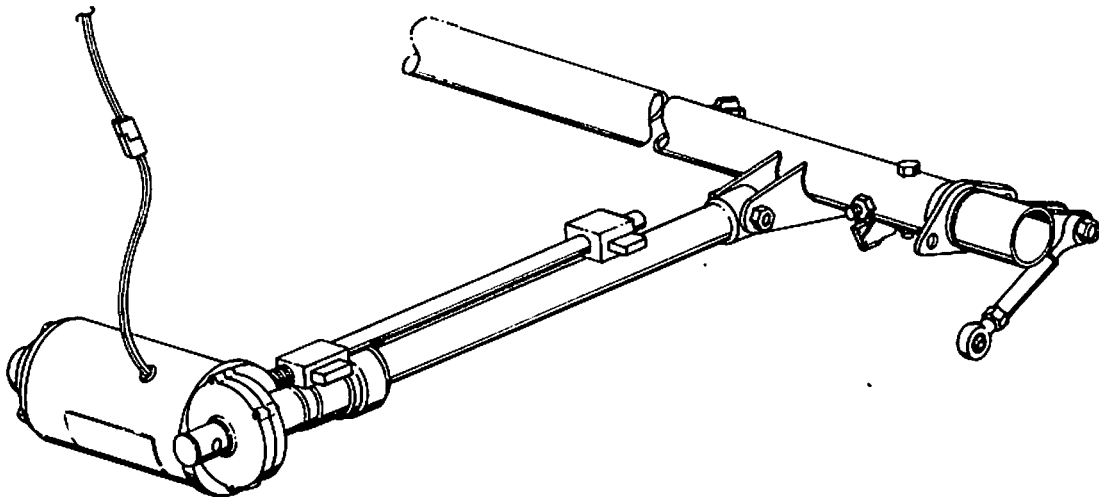
2. Flap Structure

Each flap consists of a spar, ribs, and an aluminum skin bonded to the ribs. Hinge halves beneath each flap provide a means of attachment to the wing structure. The flaps are connected to the flap torque tube by push rods.

3. Flap Drive and Torque Tube

Mechanical power to position the flaps is provided by a reversible DC motor which turns a worm drive in the gearbox. The driven gear actuates a screw mechanism which in turn moves the push-pull linkage. The linkage is attached by a rod end to a horn on the flap torque tube.

A bellcrank at each end of the torque tube transmits the movement through push rods connected to the flaps. The gears and other linkage provide a large mechanical advantage for the DC motor so that the flaps can be moved against aerodynamic loads imposed during flight. The worm drive mechanism prevents flap movement by forces extraneous to the motor and effectively locks the flaps in position each time the DC motor is stopped.



Flap Actuator Installation
Figure 1

Flap travel is limited beyond 0 degree and 30 degrees by a pair of cam-operated microswitches on a boom parallel to the worm drive travel. The switches are integral to the drive mechanism.

In addition to transmitting flap actuator motion to the flap push rods, the flap torque tube contains cams which actuate microswitches and a position indicator transmitter, providing needed information as to the flap position for use in the stall warning, landing gear warning, and flap position indicating systems. The flap torque tube is located beneath the rear seat.

4. Flap Position Indicating System

The flap position indicating system provides a visual indication of flap angle relative to the retracted (faired) position. The system consists of an indicator located on the instrument panel to the right of the control quadrant, and a position transmitter located beneath the rear passenger seat bottom adjacent to the flap drive torque tube. The roller arm of the transmitter tracks a cam on the flap drive torque tube, changing position each time the flaps are repositioned, and causing a corresponding change in pointer position on the indicator.

5. Flap Electrical System (See Figure 2.)

A. Flap Position Indicator

The flap electrical system receives power from the DC bus through the 15-amp FLAP MOTOR circuit breaker. DC bus voltage is applied from the circuit breaker to the flap position indicator and to the flap control switch.

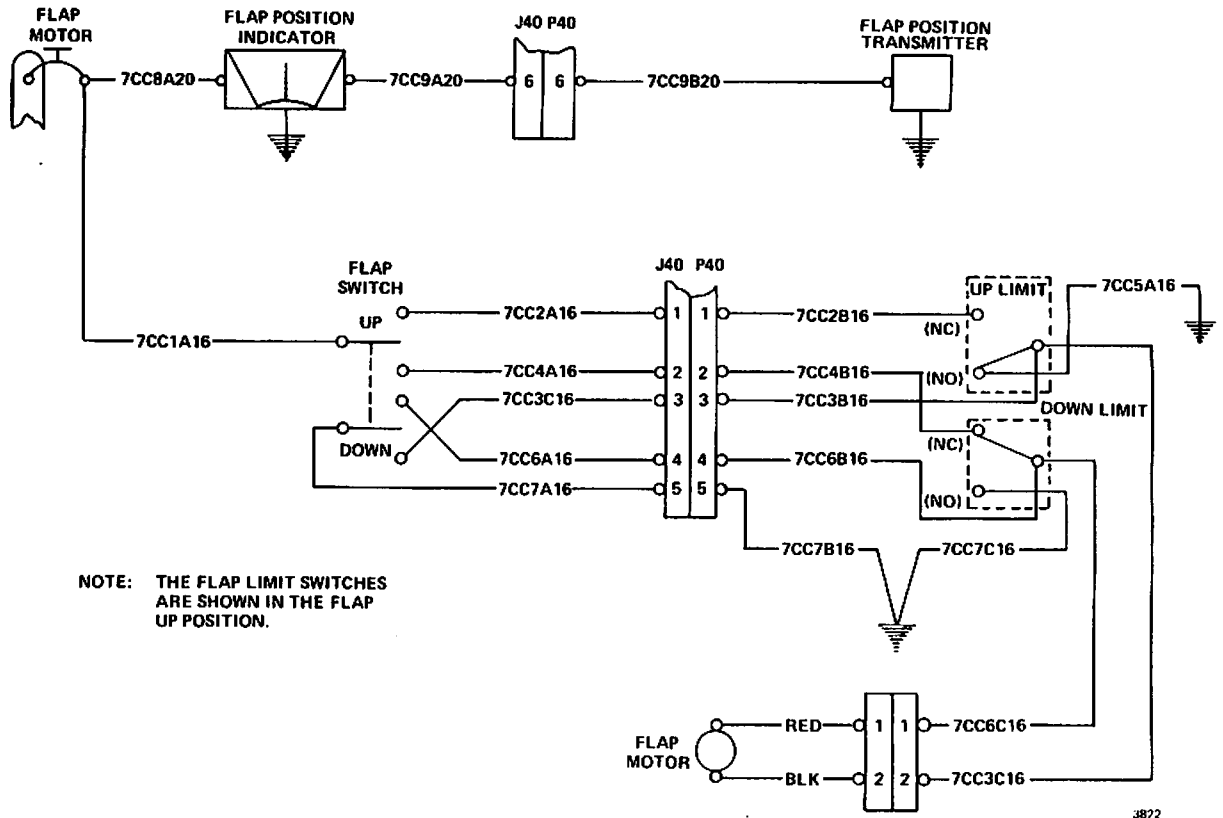
The flap position indicator contains a D'Arsonval current-sensitive meter. The scale is calibrated to read flap position in degrees from the UP (0 degree) to 30 degrees (down) position in increments of 10 degrees. The meter is provided with an off-scale dot at the top. The pointer will go to this dot when power is off or in the event of a malfunction.

The flap position transmitter is essentially a resistive element with a sliding contact. The position of the roller arm on the torque tube cam determines the effective electrical resistance of the position transmitter, and the amount of current flow in the circuit. Current flow then determines the position of the indicator pointer.

B. Flap Drive System

DC bus voltage is applied through the 15-amp FLAP MOTOR circuit breaker to the flap control switch on the instrument panel. Holding the flap control switch in the DOWN position causes current flow through the down limit switch and through the red lead of the motor. From the motor, current proceeds through the black motor lead, through a second set of contacts on the flap control switch, and to ground. Current flow through the motor is in a direction to cause the flaps to be lowered. If the flap control switch is held in the DOWN position until the down limit switch actuator is contacted, power to the motor is interrupted by the opening contacts of the down limit switch, stopping flap movement.

Holding the flap control switch in the UP position causes current flow through the up limit switch and through the black lead of the motor. From the motor, current proceeds through the red motor lead through a second set of contacts on the flap control switch, and to ground. Current flow through the motor is in the opposite direction, causing the flaps to be raised. If the flap control switch is held in the UP position until the up limit switch actuator is contacted, power to the motor is interrupted by the opening contacts of the down limit switch, stopping flap movement.



Flap Electrical System
 Figure 2

FLAPS - TROUBLESHOOTING

1. Troubleshooting Flap Drive System

TROUBLE	PROBABLE CAUSE	REMEDY
<p>Flaps do not move in either direction when switch is actuated.</p>	<p>No power.</p>	<p>Turn master switch to ON, set FLAP MOTOR circuit breaker.</p>
	<p>Defective flap motor or flap switch.</p>	<p>Check for 12 VDC across pins 1 and 2 of motor connector with flap switch in UP and DOWN positions. Replace motor if voltage is present. Check wiring and flap switch if no voltage is present.</p>
<p>Flaps drive beyond up or down limit switch.</p>	<p>Switch improperly rigged or defective.</p>	<p>Manually actuate limit switch and attempt to start flap drive with flap switch. If drive will operate, limit switch is defective. If drive will not operate, check switch rigging.</p>
<p>Flaps at one extreme of travel and will not move in opposite direction.</p>	<p>Defective limit switch.</p>	<p>Check switch at opposite end of travel for proper operation. Replace if defective.</p>
	<p>Defective flap switch.</p>	<p>Check switch for proper operation. Replace if defective.</p>

FLAPS – MAINTENANCE PRACTICES

1. Flaps

A. Removal

NOTE: To facilitate the removal of flaps and to reduce the possibility of structural damage, apply a liberal amount of penetrating oil to hinge points and attaching parts 4 hours prior to removal and again immediately before removal if signs of corrosion are noted.

- (1) Place the master switch in the ON position. Hold the flap switch in the DOWN position until the flaps are fully lowered and the flap drive motor is shut off by the flap down limit switch. Place the master switch in the OFF position.

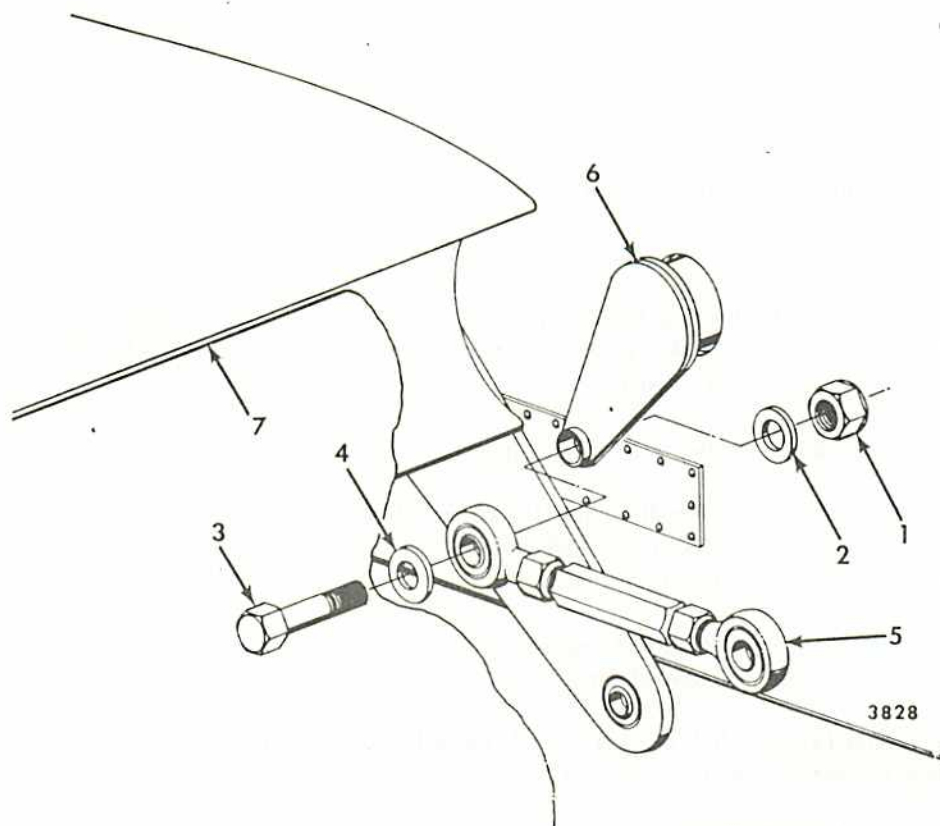
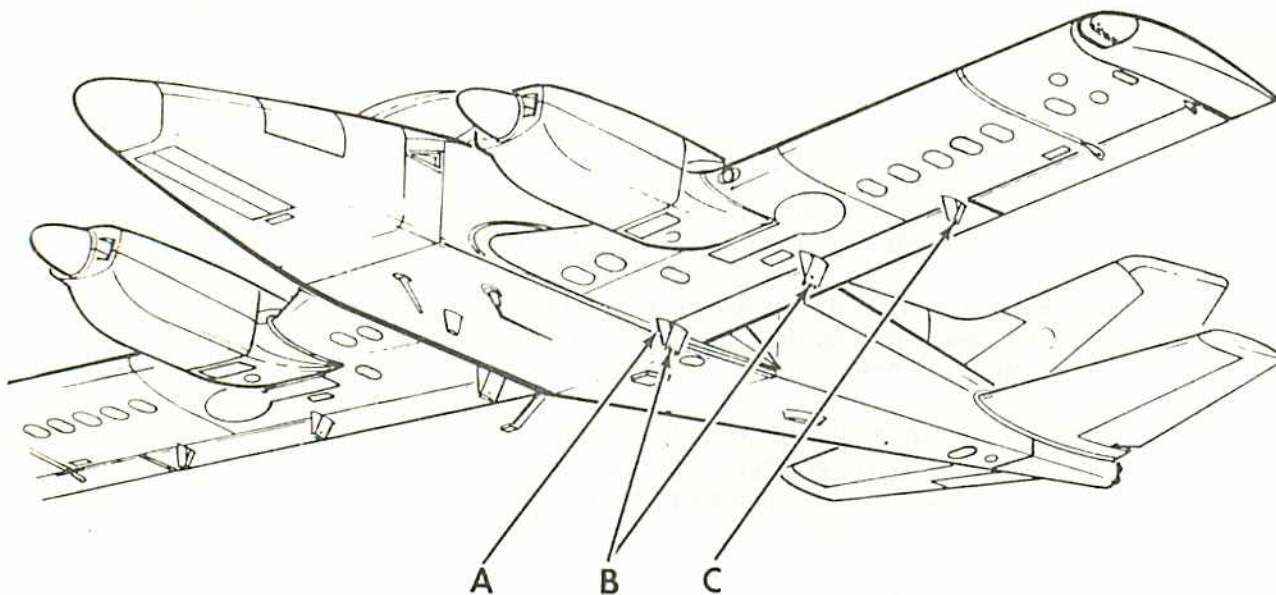
CAUTION: PROVIDE A MEANS OF SUPPORT FOR FLAPS DURING REMOVAL TO AVOID STRESS AND POSSIBLE MISALIGNMENT OR DAMAGE TO HINGES AND OTHER FLAP COMPONENTS. DO NOT REST FLAPS ON LEADING OR TRAILING EDGES.

- (2) Beneath the aft wing fairing and forward of the flaps, remove nut (1, Figure 201) and washer (2). Raise flap (7) slightly and remove bolt (3) and washer (4). Move push rod (5) clear of torque tube bellcrank (6).
- (3) At inboard flap hinge, remove cotter pin (8), nut (9), washer (10), and bolt (11). Repeat procedure at center flap hinge.
- (4) At outboard flap hinge, remove cotter pin (14), nut (15), and washer (16). Remove bolt (17) and washer (18). Remove flap from aircraft.

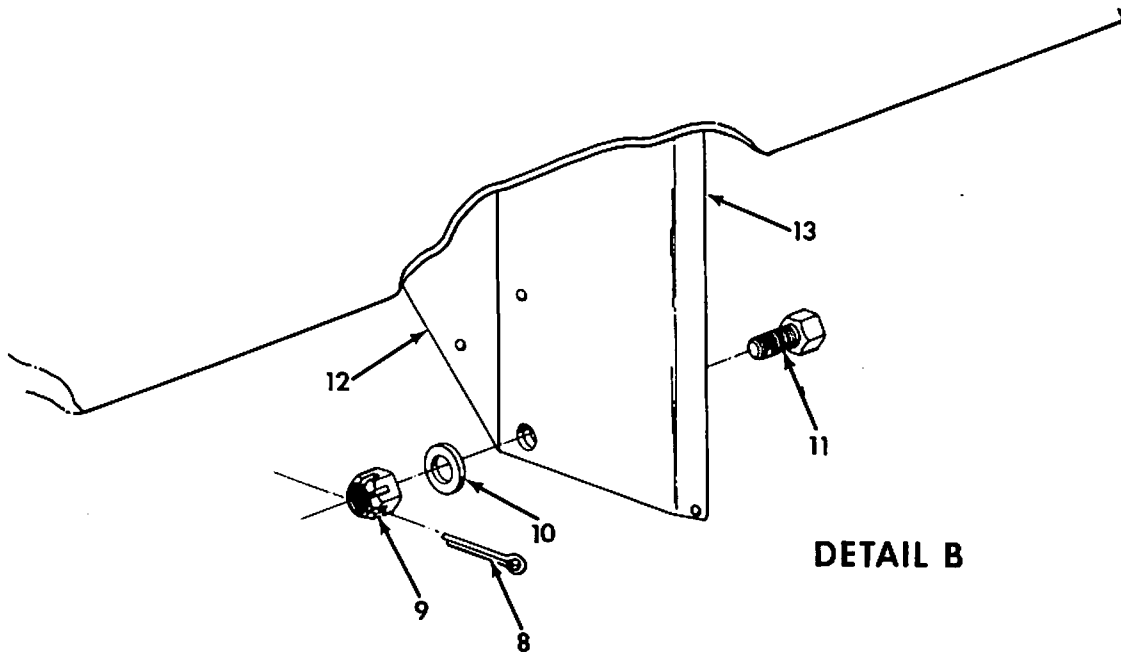
B. Installation

CAUTION: PROVIDE A MEANS OF SUPPORT FOR FLAPS DURING INSTALLATION AND MAINTAIN ALIGNMENT OF FLAP TO WING TRAILING EDGE TO AVOID DAMAGE OR MISALIGNMENT OF HINGES.

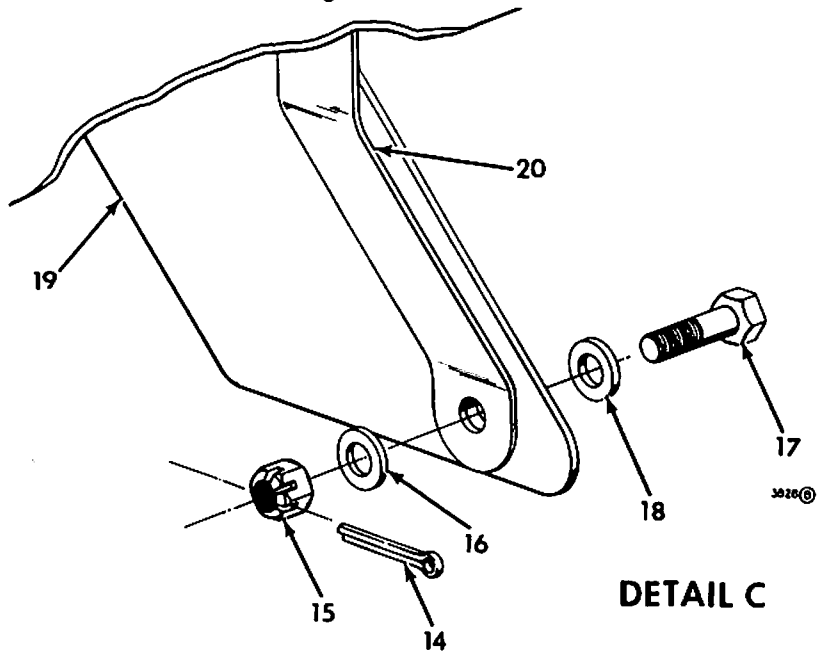
- (1) Raise flap into proper position and provide support during installation.
- (2) At outboard hinge point, install washer (18, Figure 201) on bolt (17). Install bolt (17) through hinge halves (19 and 20), making sure washer (18) seats in fairing. Install washer (16) and nut (15). Do not install cotter pin (14) at this time.
- (3) At flap center hinge, install bolt (11), washer (10), and nut (9). Do not install cotter pin (8) at this time. Repeat procedure at inboard flap hinge.
- (4) Install washer (4) on bolt (3). Insert bolt (3) through end of flap push rod (5) and torque tube bellcrank (6). Install washer (2) and nut (1).
- (5) Tighten hinge bolts (11 and 17) to recommended torque value (Chapter 91). Install cotter pins (8 and 14).
- (6) Check flap rigging per Paragraph 8.



Flap Removal and Installation
Figure 201 (Sheet 1 of 2)



DETAIL B



DETAIL C

- | | |
|--------------------------|----------------------------|
| 1. Nut | 11. Bolt |
| 2. Washer | 12. Wing Hinge Half |
| 3. Bolt | 13. Flap Hinge Half |
| 4. Washer | 14. Cotter Pin |
| 5. Flap Push Rod | 15. Nut |
| 6. Torque Tube Bellcrank | 16. Washer |
| 7. Flap | 17. Bolt |
| 8. Cotter Pin | 18. Washer |
| 9. Nut | 19. Wing Hinge Half |
| 10. Washer | 20. Torque Tube Hinge Half |

**Flap Removal and Installation
Figure 201 (Sheet 2 of 2)**

2. Flap Actuator Drive Assembly (See Figure 202.)

A. Removal

NOTE: If flaps have not been previously removed, support or restraint must be provided to prevent the flaps from swinging down before drive assembly is removed.

(1) Provide suitable support to hold flaps securely in position. Disconnect electrical connector (1) and ground lead. Remove nut (2), washer (3), and bolt (4). Remove drive assembly (5) from horn of torque tube (6).

(2) Remove nut (7), washer (8), and bolt (9). Remove drive assembly (5) from bracket (10).

B. Installation

(1) Install drive assembly (5) into bracket (10) and secure with bolt (9), washer (8), and nut (7).

(2) Install drive assembly (5) into horn of torque tube (6). Secure with bolt (4), washer (3), and nut (2). Connect electrical connector (1) and ground lead.

3. Flap Position Indicating System

A. Removal

CAUTION: MAKE SURE GROUND (NEGATIVE) BATTERY CABLE IS DISCONNECTED AND CLEAR OF BATTERY TERMINAL BEFORE REMOVING SYSTEM COMPONENTS.

(1) Place master switch in OFF position. Open battery compartment and disconnect ground (negative) cable from battery. (See Chapter 25.)

(2) Pull rear seat up and forward to gain access to flap position transmitter (5, Figure 203). Remove screws (1) and washers (2).

(3) Pull flap position transmitter (5) out of mounting bracket (6) to expose wire (9). Remove nut (7) and washer (8). Remove wire (9) from flap position transmitter (5).

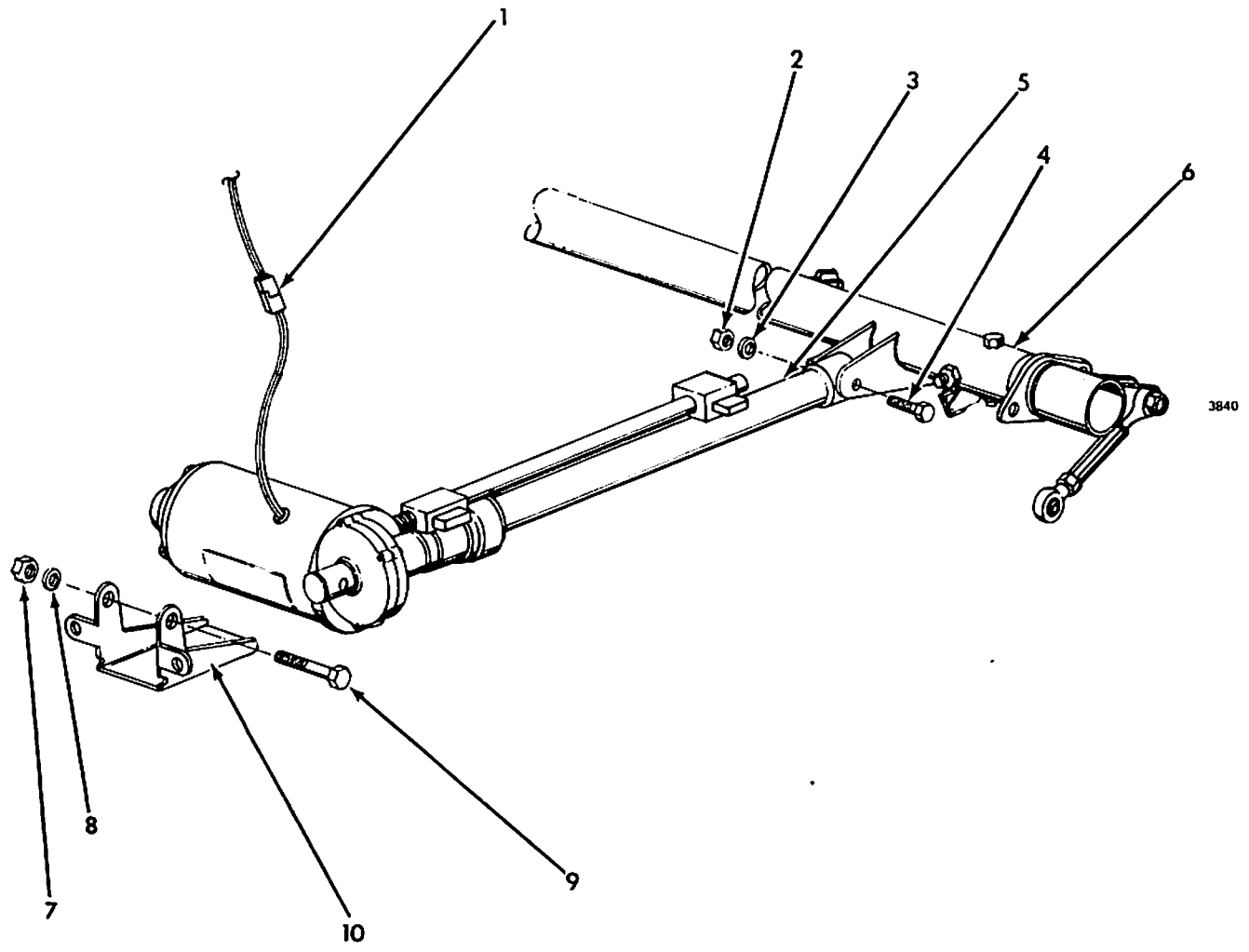
(4) Beneath instrument panel (16), tag wires (12) at rear of flap position indicator (15). Remove nuts (10), washers (11), and wires (12).

(5) Remove nuts (13), screws (14), and flap position indicator (15).

B. Installation

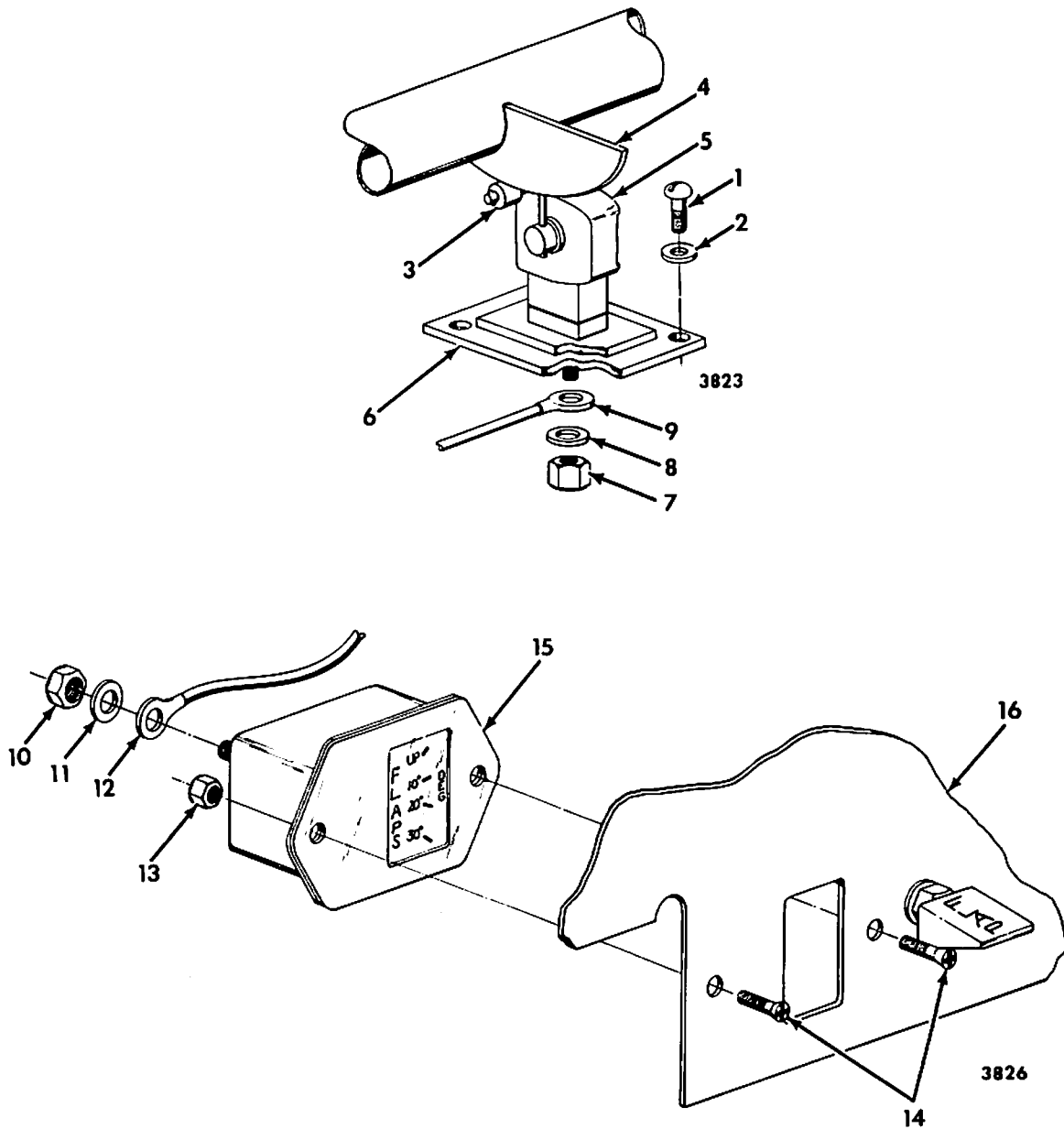
(1) Position flap position indicator (15, Figure 203) behind instrument panel (16) and secure with screws (14) and nuts (13).

(2) Install wires (12) to proper terminals at rear of flap position indicator (15). Secure with washers (11) and nuts (10).



- | | |
|-------------------|----------------|
| 1. Connector | 6. Torque Tube |
| 2. Nut | 7. Nut |
| 3. Washer | 8. Washer |
| 4. Bolt | 9. Bolt |
| 5. Drive Assembly | 10. Bracket |

Flap Actuator Drive Assembly – Removal and Installation
Figure 202



- | | |
|------------------------------|-----------------------------|
| 1. Screw | 9. Wire |
| 2. Washer | 10. Nut |
| 3. Roller Arm | 11. Washer |
| 4. Torque Tube Cam | 12. Wire |
| 5. Flap Position Transmitter | 13. Nut |
| 6. Mounting Bracket | 14. Screw |
| 7. Nut | 15. Flap Position Indicator |
| 8. Washer | 16. Instrument Panel |

**Flap Position Indicating System
Figure 203**

- (3) Install wire (9) to terminal on flap position transmitter (5). Secure with washer (8) and nut (7).
- (4) Install flap position transmitter (5) into mounting bracket (6). Make sure roller arm (3) is positioned properly to track torque tube cam (4). Secure flap position transmitter (5) with washers (2) and screws (1).
- (5) Make sure master switch is in OFF position. Install ground (negative) cable to battery terminal. (See Chapter 25.)
- (6) Check flap rigging per Paragraph 8 and rig as required.

4. Landing Gear and Stall Sensor Selector Switches (See Figure 204.)

A. Removal

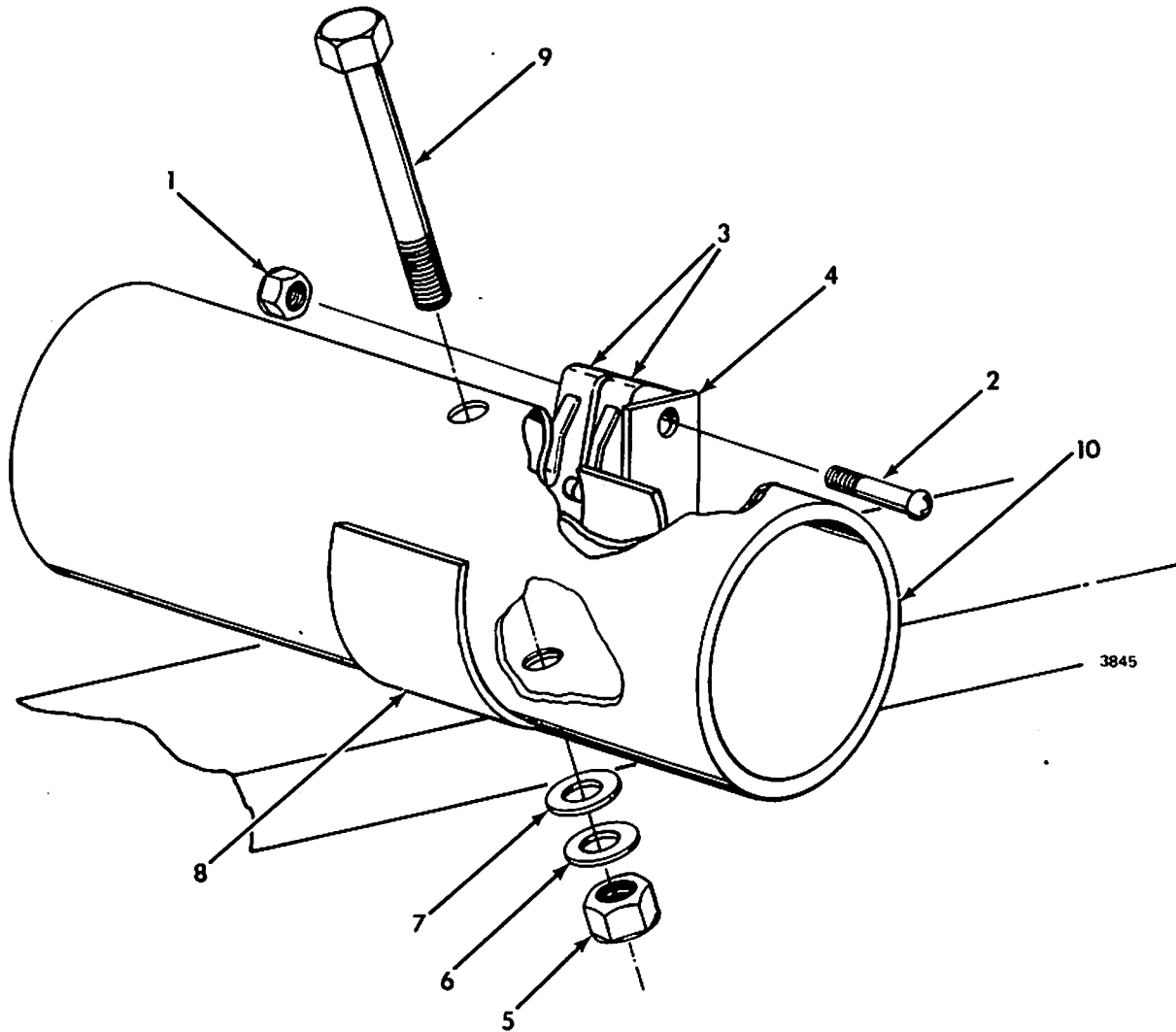
CAUTION: MAKE SURE GROUND (NEGATIVE) BATTERY CABLE IS DISCONNECTED AND CLEAR OF BATTERY TERMINAL BEFORE DISCONNECTING WIRING.

- (1) Pull aft passenger seat bottom up and forward to gain access to flap torque tube. Locate landing gear and stall detector microswitch installation at flap torque tube adjacent to left cabin wall. Tag and disconnect wiring at terminals.
- (2) Remove nuts (1), screws (2), and switches (3) from mounting brackets (4).
- (3) Remove nut (5), washers (6 and 7), and cam (8). Remove bolt (9).

B. Installation

- (1) Install bolt (9, Figure 204), cam (8), washers (7 and 6), and nut (5). Leave nut (5) loose.
- (2) Install switches (3) on bracket (4) and secure with screws (2) and nuts (1).
- (3) With an ohmmeter or other continuity tester, adjust position of cam so that stall detector (outside) switch is actuated when flap is at $5 \text{ degrees} \pm 1 \text{ degree}$.
- (4) Connect wiring to terminals.

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- | | |
|---------------------|-----------------|
| 1. Nut | 6. Washer |
| 2. Screw | 7. Washer |
| 3. Switch | 8. Cam |
| 4. Mounting Bracket | 9. Bolt |
| 5. Nut | 10. Torque Tube |

Sensor Switch Installation – Typical
Figure 204

5. Flap Torque Tube**A. Removal**

NOTE: To facilitate the removal of the flap torque tube and to reduce the possibility of structural damage, apply a liberal amount of penetrating oil to attaching parts and around juncture of horn 4 hours prior to removal and again immediately before removal if signs of corrosion are noted.

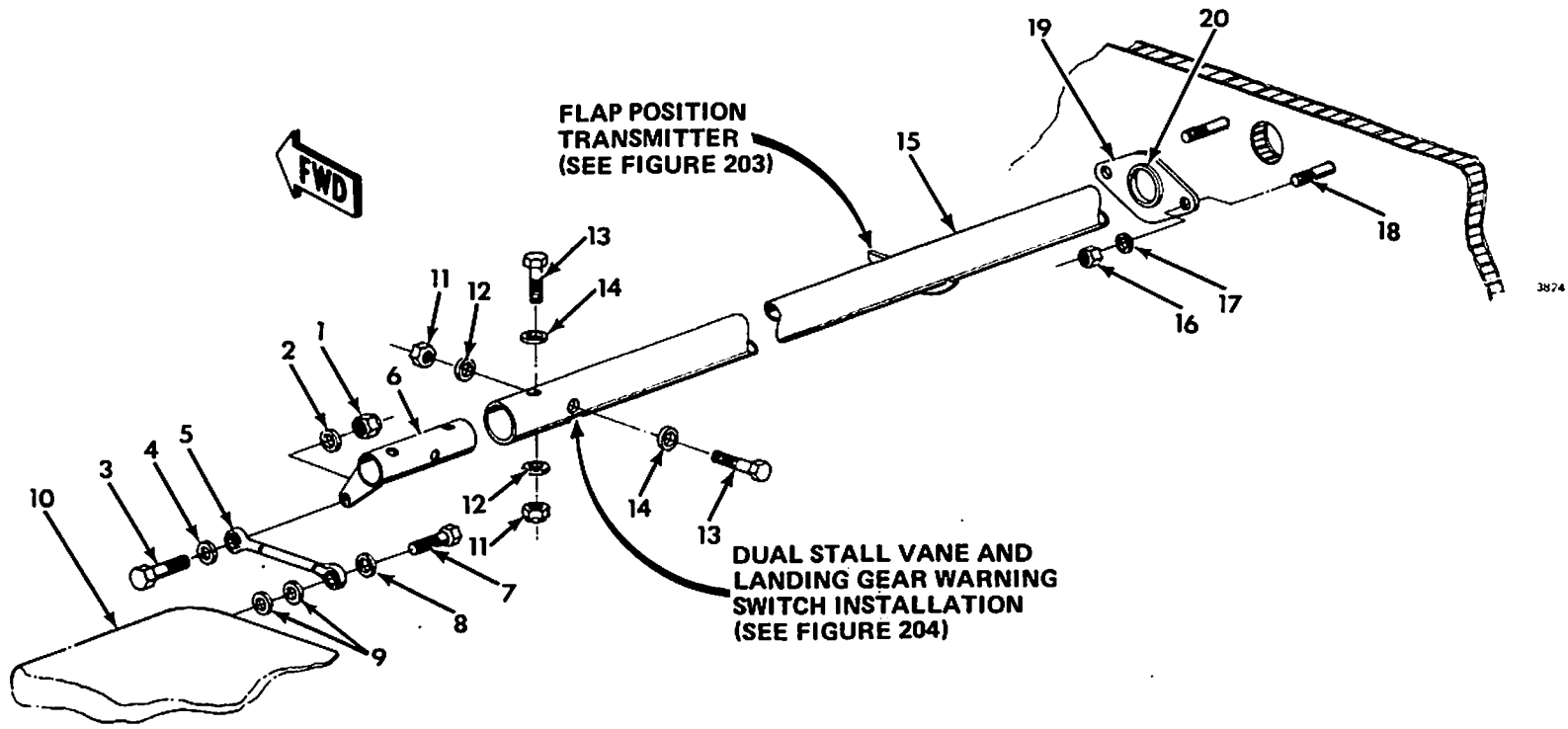
- (1) Place the master switch in the ON position. Hold the flap switch in the DOWN position until the flaps are fully lowered and the flap drive motor is shut off by the flap down limit switch. Place the master switch in the OFF position.
- (2) Remove flap actuator drive assembly (Paragraph 2).
- (3) Remove flap position transmitter (Paragraph 3).
- (4) Remove landing gear and stall detector switches (Paragraph 4).

CAUTION: PROVIDE A MEANS OF SUPPORT FOR FLAPS DURING REMAINING PROCEDURES TO AVOID POSSIBLE DAMAGE TO SKIN, STRUCTURE, OR OTHER COMPONENTS.

- (5) Beneath the aft wing fairing and forward of the left flap, remove nut (1, Figure 205) and washer (2). Raise flap (10) slightly, and remove bolt (3) and washer (4). Move push rod (5) clear of bellcrank (6).
- (6) Swing flap down to clear fuselage and remove bolt (7), washer (8), push rod (5), and washers (9).
- (7) Repeat Steps (5) and (6) at right flap.
- (8) Remove left and right bellcranks (6) by removing nuts (11), washers (12), bolts (13), and washers (14). Remove torque tube (15) from aircraft.
- (9) Remove nuts (16) and washers (17). Remove bearing support assemblies (19) from studs (18).
- (10) Inspect bearings (20) and bellcranks (6) for wear per Paragraph 6. Replace as necessary.

B. Installation

- (1) Install bearing support assemblies (19) on studs (18) and secure with washers (17) and nuts (16).
- (2) Place torque tube (15) in aircraft. Install bellcranks (6) through bearings (20) and into ends of torque tube (15).
- (3) Install washers (14) on bolts (13). Install bolts (13) through torque tube (15) and bellcranks (6). Install washers (12) and nuts (11).
- (4) Assemble bolt (7), washer (8), push rod (5), and washers (9). Install assembled parts to left flap (10).



Flap Torque Tube Installation
Figure 205

- | | |
|--------------|------------------------------|
| 1. Nut | 11. Nut |
| 2. Washer | 12. Washer |
| 3. Bolt | 13. Bolt |
| 4. Washer | 14. Washer |
| 5. Push Rod | 15. Torque Tube |
| 6. Bellcrank | 16. Nut |
| 7. Bolt | 17. Washer |
| 8. Washer | 18. Stud |
| 9. Washer | 19. Bearing Support Assembly |
| 10. Flap | 20. Bearing |

- (5) Install washer (4) on bolt (3). Raise flap (10) as required to align holes in push rod (5) and bellcrank (6). Install bolt (3), washer (2), and nut (1).
- (6) Repeat Steps (4) and (5) at right flap.
- (7) Install landing gear and stall detector switches (Paragraph 4).
- (8) Install flap position transmitter (Paragraph 3).
- (9) Install flap actuator drive assembly (Paragraph 2).
- (10) Rig flaps in accordance with Paragraph 8.

6. Flap Bearing and Bellcrank Wear Limits

A. Flap Bearings

The maximum wear limit for the bearings is as follows:

Minimum radial wall thickness – 0.030 inch.

Any bearings that have been worn to the above limit must be replaced. Bearings with cracked or separated flanges must be replaced.

B. Bellcrank

Maximum bellcrank wear is 0.030 inch wall thickness reduction. Wear greater than this will require replacement of the bellcrank.

7. Bearing Replacement

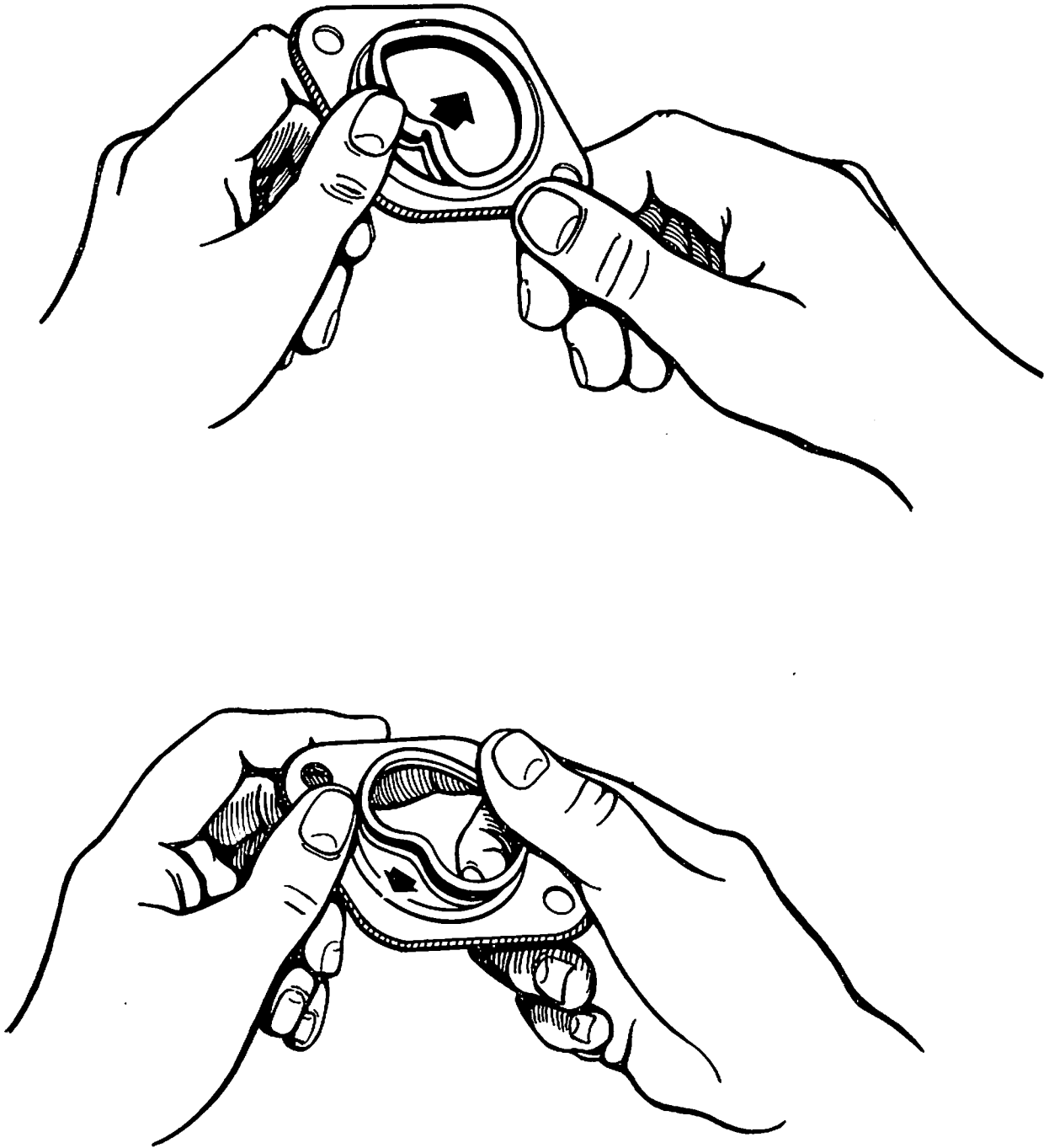
- A. Remove flap torque tube as described in Paragraph 5.
- B. Collapse bearing as shown in Figure 206 and remove from support.

CAUTION: DO NOT ATTEMPT TO COLLAPSE A NEW BEARING IF AMBIENT TEMPERATURE IS BELOW 70°F. THE BEARING MATERIAL BECOMES STIFF AND MAY BREAK IF IT IS COLLAPSED WHILE COLD. BEARING INSTALLATION CAN BE FURTHER FACILITATED BY WARMING THE BEARING TO BODY TEMPERATURE.

- C. Collapse new bearing and install it in bearing support as shown in Figure 206.

NOTE: New bearings should be sized to prevent binding and increased load on flap motor.

- D. Use a bearing sizing tool to seat bearing. Once inserted in the bearing support assembly, the bearing should be rounded out or “sized” to the correct inside diameter by inserting the bearing sizing tool and rolling the new bearing into proper position.
- E. Install flap torque tube as described in Paragraph 5.



Flap Bearing Removal/Installation
Figure 206

8. Flap Control System Rigging (See Figure 207.)

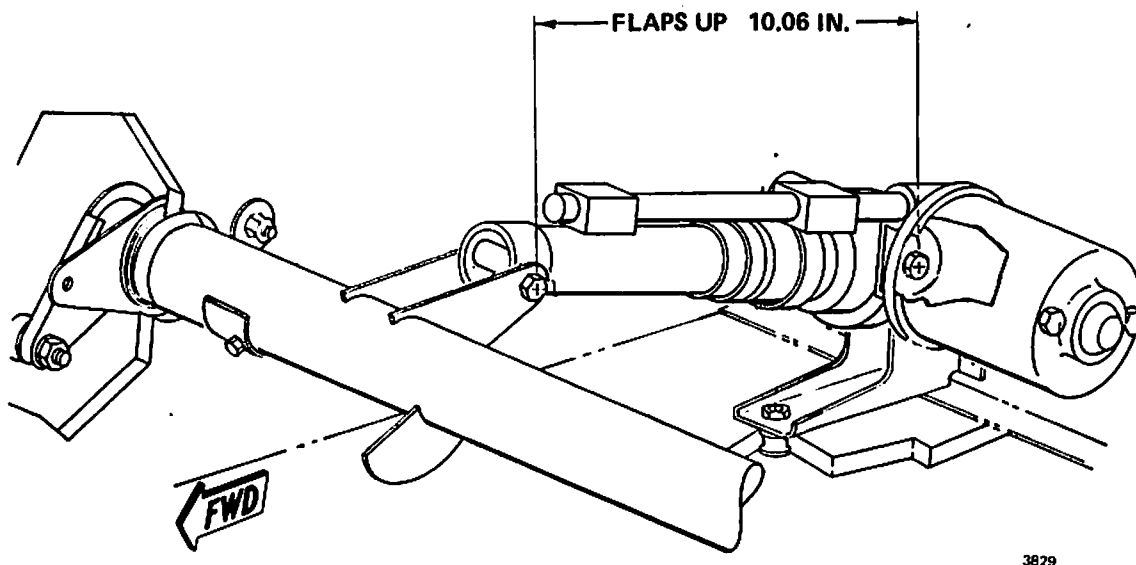
NOTE: Aerodynamic lift encountered during flight, and normal tolerances in the linkage from drive motor to flap trailing edge result in a smaller flap angle in flight than that encountered with the aircraft on the ground. Manually raise and hold both flaps before taking flap position readings to ensure an approximation of flight conditions. Failure to comply will result in shortened flap travel when airborne.

A. Pull the rear seat bottom up and forward to gain access to the flap drive assembly.

NOTE: The following procedures require use of the aircraft battery. Turn off all lights, radios, and other electrical system loads to prevent unnecessary drain on the battery.

B. On the instrument panel, hold the flap switch in the UP position until the drive motor on the flap actuator is stopped by the up limit switch.

C. Measure the distance between the flap actuator mounting centers as shown in Figure 207.



Flap Actuator Assembly Prerigging
Figure 207

- D. If the up dimension obtained is not that shown in Figure 207, subtract the smaller dimension from the larger and move the up limit switch this distance along the rail. Move the up limit switch aft to decrease the distance or forward to increase the distance.
- E. Hold the flap switch in the DOWN position until the cam moves away from the up limit switch.
- F. Repeat Steps B through E as required to obtain the up dimension given in Figure 207.

NOTE: Use a flap rigging fixture to determine flap position in the following procedures. The flaps must be rigged before the flap position indicator can be rigged. Part numbers for rigging fixtures are found in Section 27-0.

- G. With the flaps fully retracted, install a flap rigging fixture on the wing. Flap position should be 0 degree. Adjust length of push rod (5, Figure 205) as required to position flap at 0 degree. Repeat the procedure on other wing.
- H. Hold the flap switch in the down position until the drive motor on the flap actuator is stopped by the down limit switch. With a man at each wing, manually lift both flaps to take up slack in the linkage. The flap rigging device should read 30 ± 2 degrees.
- I. Adjust the position if required. Move the down limit switch forward to decrease flap travel or aft to increase flap travel.
- J. Hold the flap switch in the UP position until the cam moves away from the down limit switch.
- K. Repeat Steps H through J as required to obtain a flap reading of 30 ± 2 degrees on the flap rigging fixture.
- L. With the flaps still at 30 ± 2 degrees and manually lifted, note the reading of the flap position indicator. The indicator should read 30 degrees. Bend the roller arm (3, Figure 203) slightly as required to obtain the desired reading.
- M. Raise the flaps so that a reading of 3 degrees is obtained on the flap rigging fixture. Raise the inboard stall warning vane on the right wing. The stall warning horn should sound. Raise the outboard stall warning vane on the right wing. The stall warning horn should not sound.
- N. Lower the flaps so that a reading of 5 degrees is obtained on the flap rigging fixture. Raise the inboard stall warning vane on the right wing. The stall warning horn should not sound. Raise the inboard stall warning vane on the right wing. The stall warning horn should sound.

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FUEL SYSTEM – DESCRIPTION/OPERATION**1. General (See Figure 1.)**

The GA-7/Cougar aircraft has an independent fuel system incorporated into each wing, permitting each engine to operate from its own fuel supply. The two systems are interconnected by means of a crossfeed that will permit fuel from one tank to be drawn by the opposite engine in the event of an emergency. Each system consists of a wing fuel tank, a vent system, a sump tank, two quick-drain valves, an electrical fuel pump, a selector valve, a primer solenoid valve, an engine-driven fuel pump, a fuel pressure gauge, a fuel quantity gauge, and associated plumbing and wiring.

Fuel is drawn through the mesh finger strainers at the inboard end of the fuel tank, through the sump tank, through the electrically-operated fuel pump mounted on the first rib, through the fuel selector valve mounted on the fourth rib, through the primer solenoid valve, through the engine-driven fuel pump to the carburetor. A quick-drain valve is supplied at each sump tank and on each main tank slightly rear of center at Wing Station 109.

A. Wing Tanks

The wing fuel tanks are integral parts of the I-beam wing spar and are located between the main and rear wing spars. Solid end ribs are used to close off inboard and outboard ends of the tanks. Five ribs inside each fuel tank retard fuel slosh during uncoordinated maneuvers. Each wing tank is equipped with a quick-drain valve. Capacity of the tanks is 120 gallons with 118 gallons usable.

B. Vent System

The fuel tanks are vented overboard through vent lines extending outboard from each tank. Vent lines from the sump tanks extend to each respective main tank to prevent the sump tanks from air-locking.

C. Sump Tanks

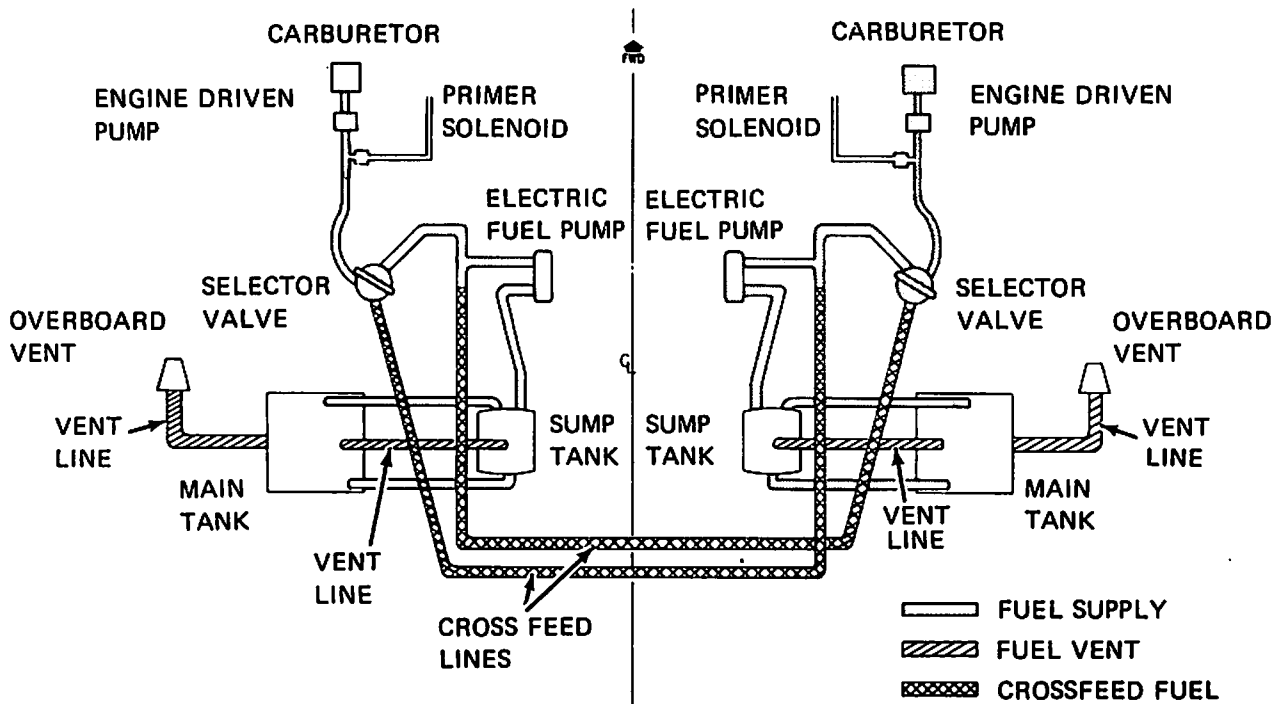
The sump tanks are located inboard of each engine. Each sump tank is equipped with a quick drain.

D. Fuel Tank Quick Drains

The fuel tank quick-drains are located on the bottom of each sump tank and on each main tank slightly rear of center at Wing Station 109. The quick-drain valves are spring loaded in the closed position and are included in the system to provide easy preflight draining for fuel examination. A sampler cup must be used for preflight fuel check of both wing tanks. (See Figure 2.) The sampler cup is placed under the quick-drain valve and the plunger is pushed upward against the valve, allowing fuel to fill the cup for examination.

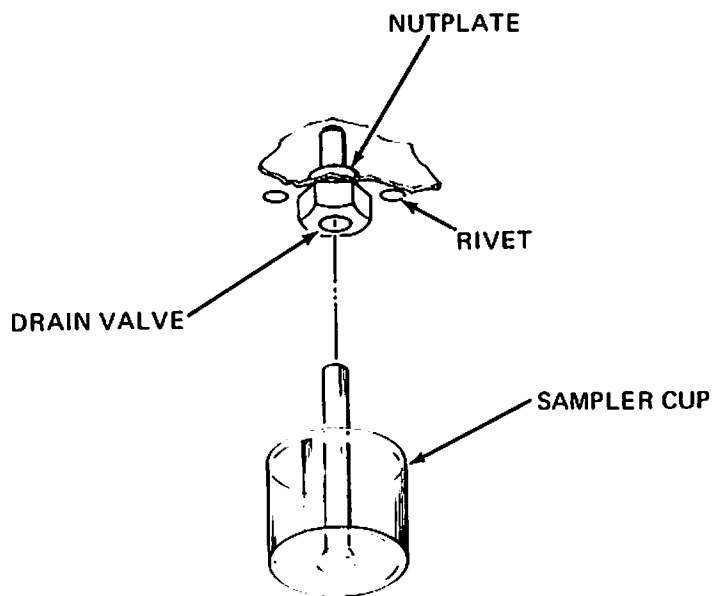
E. Electric Fuel Pumps

An electric fuel pump is located immediately forward of each sump tank. An integral bypass and check valve permits fuel flow through the pump while it is inoperative, but prevents reverse flow. The pump is used as a source of fuel pressure in the event of an engine-driven pump failure. Both types of pumps are intended to be operative during takeoff and landing to provide redundancy.



**GA-7/Cougar Fuel System Schematic
Figure 1**

28G72-1



28G72-2

Fuel Tank Quick-Drain Valve and Sampler Cup
Figure 2

F. Fuel Selector Valves

A three-position fuel selector valve is located inboard of each engine. The control for each valve is positioned on the aft center console. The control positions are labelled **LEFT ENGINE**, **RIGHT ENGINE**, **CROSS FEED**, and **OFF**. The valves are connected to the controls by mechanical linkage.

G. Primer Solenoid Valves

Engine priming is accomplished by use of primer solenoid valves which are located between the fuel selector valves and the engine-driven fuel pumps. The valves are operated by a toggle switch located on the lower left side of the instrument panel.

H. Engine-Driven Fuel Pumps

During normal operation, fuel is supplied to each engine by means of an engine-driven fuel pump. The pump is an integral part of the engine. Refer to Avco Lycoming Engine Overhaul Manual for information concerning the engine-driven fuel pump.

I. Fuel Pressure Gauges

Fuel pressure is measured by two electrically-operated fuel pressure gauges mounted on the lower right portion of the instrument panel. These gauges are actuated by current from transducers mounted on an instrumentation transmitter bracket bolted to the engine mount.

J. Fuel Quantity Gauges

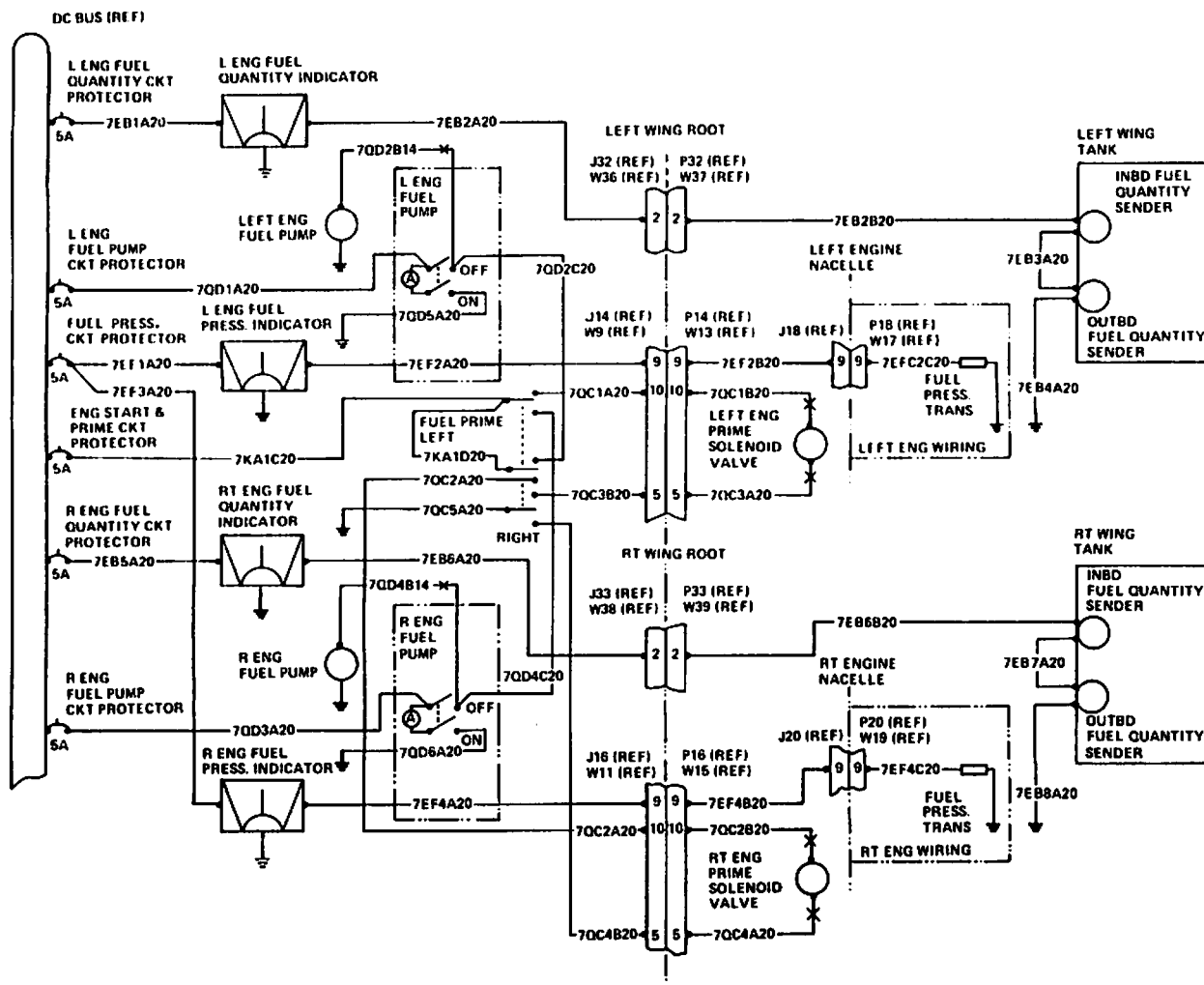
Fuel quantity is measured by two electrically-operated fuel quantity indicators on the lower right portion of the instrument panel. The indicators are actuated individually by two fuel quantity transmitters, installed in the inboard and outboard ends of each fuel tank.

The transmitters consist of a float attached to a pivoted rod, one end of which is a rheostat wiper. The vertical motion of the fuel causes angular travel of the float which increases or decreases the amount of resistance in the circuit. This resistance is reflected in the amount of needle deflection at the indicator, thus providing visual indication of fuel quantity.

K. Fuel System Electrical Circuitry (See Figure 3.)

The electrical wiring, controls, and circuit protective devices that supply electrical power to the auxiliary fuel pump, fuel quantity gauges, and fuel pressure gauges are shown in Figure 3.

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GA-7/Cougar Fuel System Electrical Circuits
Figure 3

28G72-3

FUEL SYSTEM – TROUBLESHOOTING

1. Fuel System Troubleshooting

Troubleshoot the fuel system as follows:

TROUBLE	PROBABLE CAUSE	REMEDY
No fuel pressure (electric fuel pump turned off).	Fuel selector valve in OFF position.	Switch to correct setting.
	Fuel tanks empty.	Service with proper grade of fuel.
	Defective engine pump.	Remove outlet line, crank engine several times, check for fuel flow from pump. Replace if faulty.
No fuel pressure.	Dirty tank strainer.	Remove and clean strainer. Flush tank clean prior to reassembly.
	Defective gauge.	Temporarily substitute a 72.0-ohm resistance for the fuel pressure trans- ducer. If fuel pressure gauge does not indicate 10 psi, replace gauge.
No or low fuel pressure (electric fuel pump turned on).	Partial or no fuel flow from the preceding causes.	Use the preceding remedies.
	Defective fuel pressure transducer.	Temporarily substitute a 72.0-ohm resistance for the fuel pressure trans- ducer. If fuel pressure gauge indicates 10 psi, replace transducer.
	Tripped circuit protector.	Reset circuit protector.
	Faulty switch.	Replace switch.
	Defective pump.	Remove outlet line from pump. Little or no fuel flow indicates bad pump. Repair or replace.

TROUBLE	PROBABLE CAUSE	REMEDY
<p>Low pressure or surging pressure.</p>	<p>Obstruction in fuel lines.</p>	<p>Starting at carburetor, remove, inspect, and clean all fuel lines.</p>
	<p>Fuel valve improperly positioned.</p>	<p>Check position.</p>
	<p>Clogged filter in electric pump.</p>	<p>Clean filter.</p>
	<p>Defective engine pump.</p>	<p>Repair or replace.</p>
	<p>Obstructed or leaking fuel line or connection.</p>	<p>Inspect all lines and tighten connection. Use thread sealant as required.</p>
<p>No fuel quantity indication.</p>	<p>Empty fuel tank.</p>	<p>Service with proper grade of fuel.</p>
	<p>Defective fuel quantity transmitter.</p>	<p>Temporarily substitute a 90.0-ohm resistance for the fuel quantity transmitter. If fuel quantity gauge indicates 58 gallons/348 pounds, replace fuel quantity transmitter.</p>
	<p>Defective gauge.</p>	<p>Temporarily substitute a 90.0-ohm resistance for the fuel quantity transmitter. If fuel quantity gauge does not indicate 58 gallons/348 pounds, replace fuel quantity transmitter.</p>
	<p>Tripped circuit protector.</p>	<p>Reset circuit protector.</p>
<p>Fuel leakage at primer solenoid valve or primer valve inoperative.</p>		<p>For repair or replacement of primer solenoid valve, refer to Chapter 73.</p>

FUEL SYSTEM – MAINTENANCE PRACTICES**1. Defueling/Refueling****A. Perform defueling procedures as follows:**

- (1) Place suitable containers (totaling approximately 60 gallons capacity) under left fuel tank drain.
- (2) Open dry nitrogen supply valve and ensure that pressure regulator indicates 3.5 psi.

CAUTION: WHEN FUEL TANK QUICK-DRAIN VALVE IS REMOVED, FUEL WILL DRAIN RAPIDLY INTO CONTAINER. BE SURE THAT CONTAINER IS PROPERLY POSITIONED TO CATCH FUEL. KEEP ARM ABOVE LOCKNUT TO PREVENT FUEL FLOWING ON BODY.

A CONTINUOUS SUPPLY OF NITROGEN AT 0.6 PSI MUST BE MAINTAINED TO PERMIT SIPHONING AND INERTING OF THE AIR SPACE CREATED BY DEFUELING.

- (3) Remove left wing fuel tank quick-drain valve by rotating locknut counterclockwise.
- (4) Drain left wing fuel tank completely and continue to purge tank with dry nitrogen for 15 minutes before shutting off nitrogen supply.
- (5) Set fuel selector to OFF.
- (6) Repeat steps (1) through (5) for the right-hand fuel tank.

B. Perform refueling procedures in accordance with Chapter 12.

**FUEL STORAGE SYSTEM – DESCRIPTION/OPERATION****1. General**

Fuel is stored inside two independent fuel tanks incorporated into each wing. The two tanks are interconnected by a crossfeed system that will permit either engine to operate with fuel from either tank. Total volume (including both tanks) is 120 gallons with 118 usable in all flight attitudes. Three position fillers provide a convenient method to limit fuel quantity when aircraft loading restricts the use of the total fuel capacity. Each fuel tank is equipped with a quick-drain valve located on the sump tanks.

2. Fuel Tank Caps

The fuel tank caps must provide an air-tight seal with the fuel filler neck. Absence of an air-tight seal may produce erroneous readings in the fuel measurement system. Scupper drains are provided to funnel spilled fuel from around the fuel filler neck and overboard, through the wing drain.

FUEL STORAGE SYSTEM – MAINTENANCE PRACTICES1. Fuel Storage System Components Removal/Installation

A. Removal of Fuel Tank Strainer (See Figure 201.)

- (1) Ensure that all power is off.

WARNING: FUEL TANK MUST BE EMPTY AND VAPOR FREE BEFORE ATTEMPTING REMOVAL OF FUEL TANK STRAINER.

- (2) Remove access panel immediately outboard of wheel well at Wing Station 109.
- (3) Place wrench on union to keep it from loosening.
- (4) From inside tank, loosen coupling nut holding strainer assembly to union.
- (5) Remove fuel strainer from inside threaded portion of union.

B. Installation of Fuel Tank Strainer (See Figure 201.)

WARNING: FUEL TANK MUST BE EMPTY AND VAPOR FREE BEFORE ATTEMPTING INSTALLATION OF FUEL TANK STRAINER.

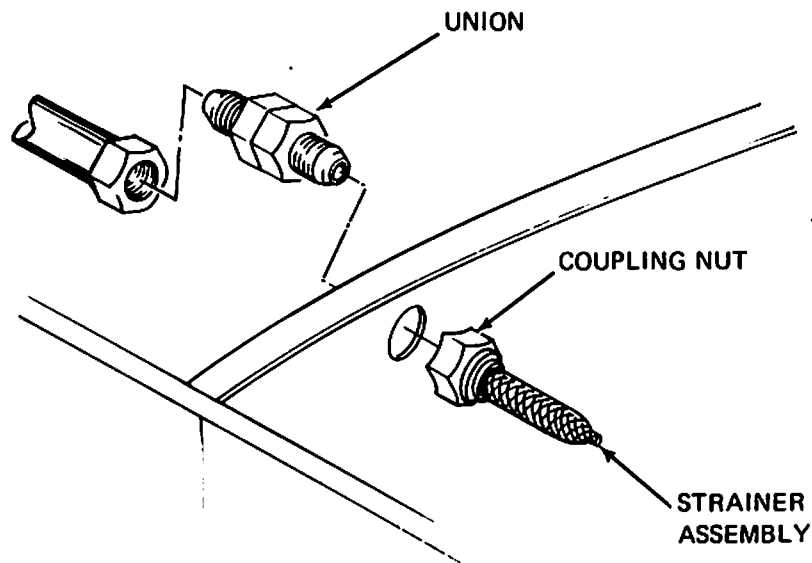
- (1) Insert strainer onto inside threaded portion of union.
- (2) Insert coupling nut over strainer.
- (3) Tighten coupling nut onto inside threaded portion of union, holding wrench on outside portion of union to keep it from rotating.
- (4) Check connections for leaks.
- (5) Replace access panel. Seal per GAPS 1163 Type II.

C. Removal of Quick-Drain Valve Assembly (See 28-0, Figure 2.)

The quick-drain valve assembly is comprised of a housing and a quick-drain valve which is screwed into the housing. The housing, which is a casting, normally will not require replacement. To remove quick-drain valve, simply unscrew valve and allow it to drop from housing. Removal of the housing will require removal of rivets securing the housing. The following procedures are for complete removal of the quick-drain valve assembly (including housing):

WARNING: FUEL TANK MUST BE EMPTY AND VAPOR FREE BEFORE ATTEMPTING REMOVAL OF QUICK-DRAIN VALVE, QUICK-DRAIN HOUSING, OR QUICK-DRAIN VALVE ASSEMBLY.

- (1) Remove access plate.



28G72-4

Removal/Installation of Fuel Tank Strainer
Figure 201

- (2) Remove quick-drain valve from housing.
- (3) Remove two rivets securing quick-drain housing to wing.

D. Installation of Quick-Drain Valve Assembly (See 28-0, Figure 2.)

NOTE: Replacement of quick-drain valve can be accomplished simply by inserting threaded end of valve in housing and securing valve to housing. Torque to 100 ± 25 inch-pounds.

The following procedures are for installation of the complete quick-drain valve assembly (including housing):

- (1) At appropriate location on trailing edge of wing, secure quick-drain housing to wing with two rivets.
- (2) Insert quick-drain valve in housing and secure to housing.
- (3) Check for leaks (using dry air nitrogen) as described in this chapter.
- (4) Replace access panel. Seal per GAPS 1163 Type II.

WARNING: ENSURE AIRCRAFT IS PROPERLY GROUNDED. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES OR SPARKS.

(5) Fill tank with 3 gallons of fuel (minimum) and depress valve plunger. Check operation.

2. **Fuel Storage System Components Inspection/Check**

A. **Checking Fuel Tank Leaks (See Figure 202.)**

Fuel leaks which are not considered a flight hazard are stains, seeps, and heavy seeps NOT in an enclosed area. However, all fuel leaks should be repaired as soon as possible.

NOTE: Stains from previously repaired leaks are not considered a flight hazard but must be inspected before each flight to ensure that seepage has not reoccurred to cause a flight hazard.

(1) **Hazardous Fuel Tank Leaks**

Fuel leaks which are a flight hazard are running leaks in any area, seeps, and heavy seeps or stains in enclosed areas such as those surrounding the fuel tanks. These leaks must be repaired before that tank is used for any flight. The wet or stained spot on the wing in the area of the tank is an indication of leak intensity. Fuel leak classifications are shown in Figure 202.

It is recommended that leaks classified as flight hazardous leaks be repaired prior to further use of the aircraft.

B. **Checking Fuel Tank Caps**

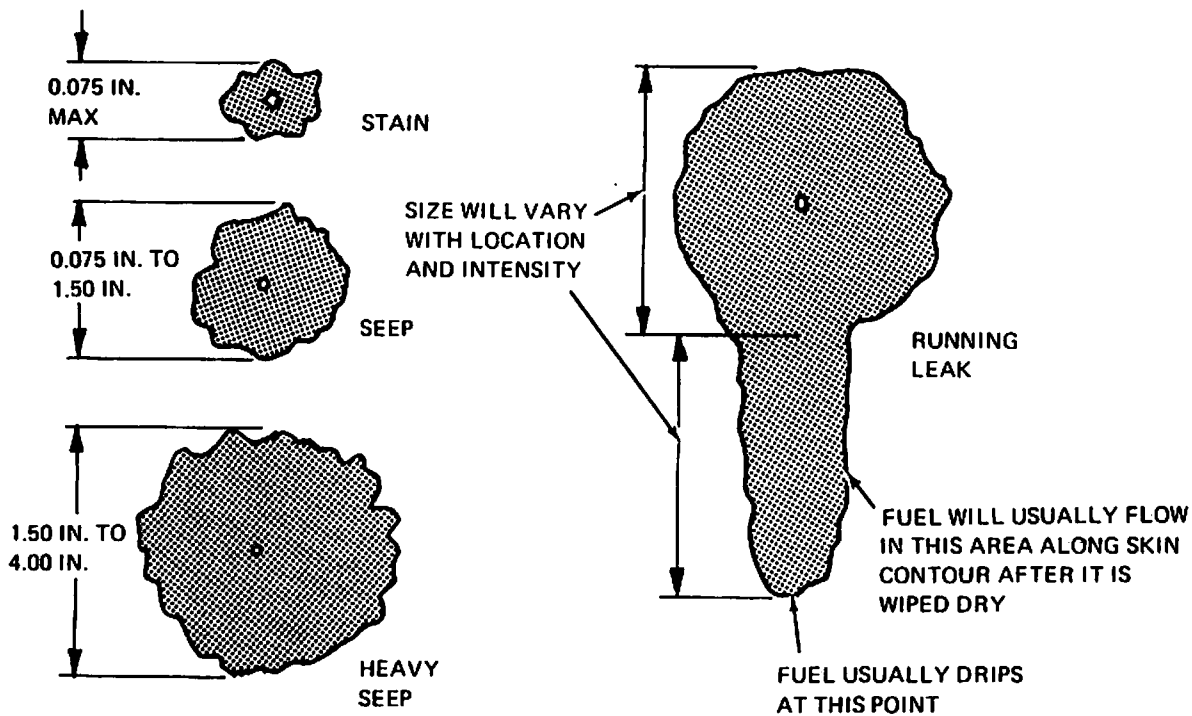
The fuel tank caps are not vented and should be inspected at every scheduled inspection to ensure that the cap gasket is not deformed or deteriorated.

C. **Checking Fuel Tank Quick Drains (See 28-0, Figure 2.)**

The fuel tank quick drains should be checked at every scheduled inspection to ensure that leakage through the quick-drain valve is not occurring. In addition, the quick drains should be checked for proper operation.

D. **Checking Fuel Tank Vents (See 28-0, Figure 1.)**

The fuel tank vents (one located at the bottom outer portion of each wing) should be checked before each flight to ensure that vents are not obstructed. Damaged or clogged fuel tank vents could cause improper operation of the fuel system or cause incorrect fuel measurement indications.



**Classification of Fuel Leaks
Figure 202**

28G72-5

FUEL DISTRIBUTION SYSTEM – DESCRIPTION/OPERATION

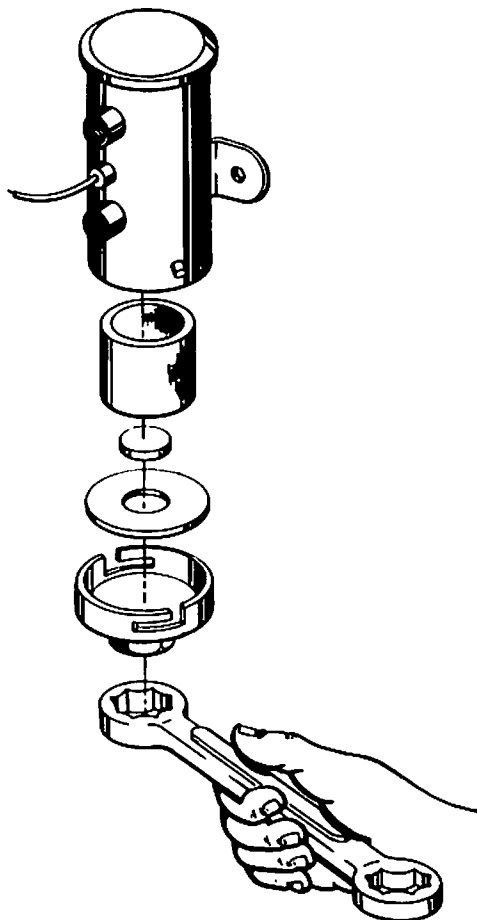
1. **General** (See 28-0, Figure 1.)

The fuel distribution system consists of two wing tanks (one mounted in each wing), two sump tanks, two electric fuel pumps, two selector valves, two primer solenoid valves, two engine-driven fuel pumps, and associated plumbing. In addition, the electrical circuitry necessary to supply operating power to the electric fuel pumps, to the primer solenoid valves, and to the fuel pressure indicators, is included in this system.

FUEL DISTRIBUTION SYSTEM – MAINTENANCE PRACTICES**I. Servicing****A. Electric Fuel Pump Filter (See Figure 201.)**

A 40-micron filter, through which all engine fuel must pass, is incorporated in each of the electric fuel pumps (also called booster or auxiliary pumps). These filters must be serviced periodically (every 100 operating hours). The following procedures are recommended for fuel pump filter servicing.

- (1) Gain access to fuel pump through access plate.
- (2) Remove the bottom cover from the fuel pump by cutting the safety wire and turning the bottom cover clockwise with a 5/8-inch wrench.



Fuel Pump Servicing
Figure 201

28G72-6

- (3) Remove the cover, gasket, magnet, and filter.

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (4) Clean the filter by rinsing in Stoddard solvent or equivalent and blowing out cleansing agent with compressed air. If filter is distorted or damaged, it should be replaced. Refer to the Illustrated Parts Catalog for replacement part number.
- (5) Clean the bottom cover, gasket, and magnet in the same manner as the filter.
- (6) Reinstall filter, magnet, gasket, and bottom cover.
- (7) Turn bottom cover counterclockwise until lugs engage, and safety wire with 0.032 inch wire.

2. Removal/Installation

A. Fuel Selector Panel and Fuel Selector Valve Description (See Figure 202.)

The fuel selector panel, located forward in the console, provides means for fuel tank selection and fuel supply shutoff. Two switches are provided, marked LEFT ENGINE and RIGHT ENGINE, and are connected by mechanical linkage to the pivot arm of the respective fuel selector valve. The selections provided for these switches are LEFT ENGINE, RIGHT ENGINE, CROSS FEED, and OFF.

B. Fuel Selector Valve Removal (See Figure 202.)

WARNING: WHEN FUEL LINES ARE DISCONNECTED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO SPILLAGE.

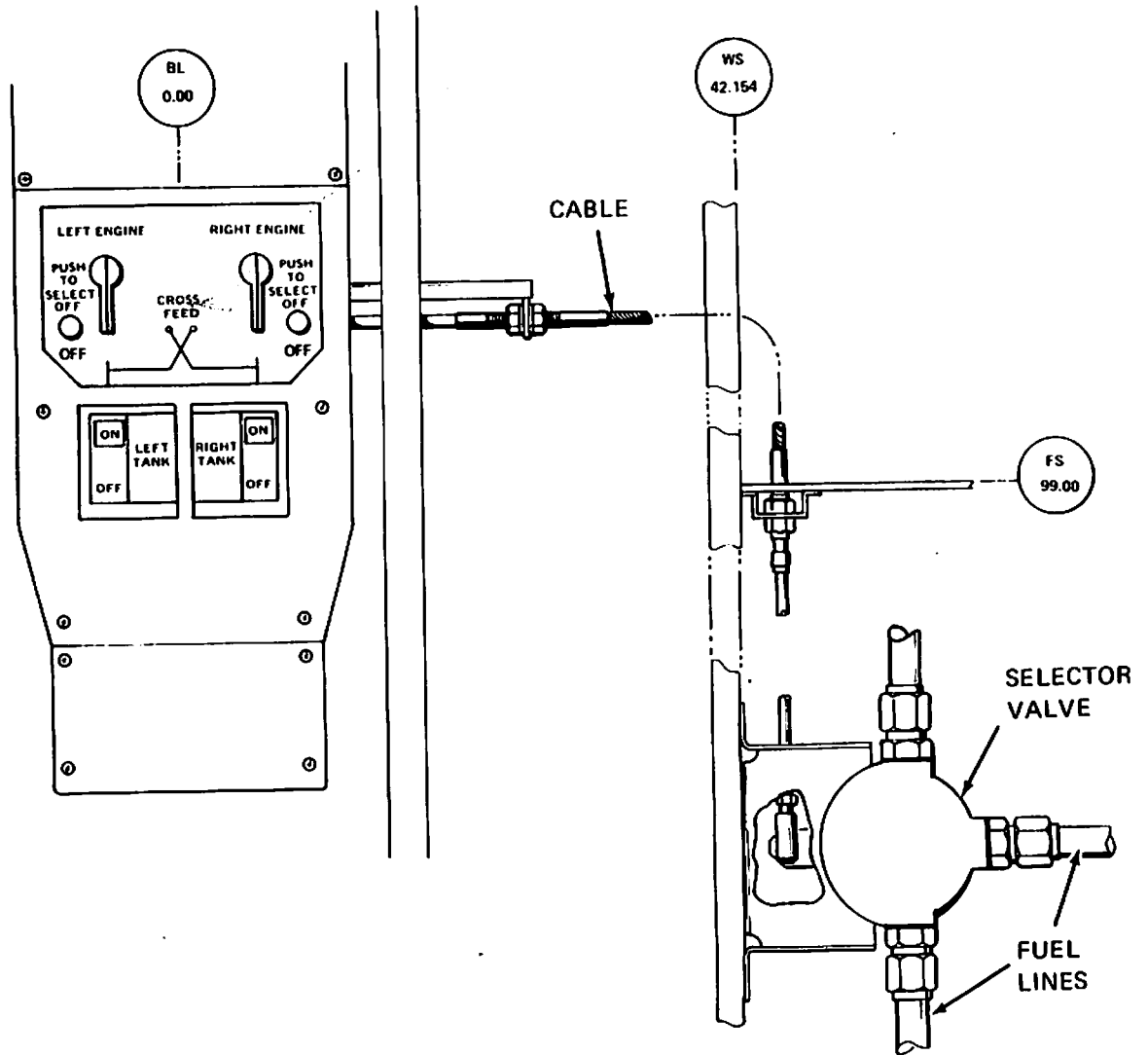
- (1) Disconnect three fuel lines connected to fuel selector valve. Cap open fuel lines.
- (2) Disconnect cable from pivot arm of fuel selector valve.
- (3) Remove screws and washers attaching valve to support bracket. Remove valve from bracket.

C. Fuel Selector Valve Installation (See Figure 202.)

- (1) Position fuel selector valve in bracket.
- (2) Install screws and washers through bracket and into fuel selector valve.
- (3) Clean exposed threads on the fuel selector valve.

CAUTION: TO PREVENT CROSS THREADING, USE CARE TO ENSURE FUEL LINES ARE PROPERLY SEATED IN FUEL SELECTOR VALVE BEFORE TIGHTENING NUTS.

- (4) Uncap and reconnect (hand tighten) the three fuel lines to fuel selector valve.



Fuel Selector Panel and Fuel Selector Valve Removal/Installation
Figure 202

28G72-7

- (5) Torque fuel line fitting nuts to 100 ± 25 inch-pounds.
- (6) Connect cable to pivot arm of fuel selector valve and rig cable so that selector valve position corresponds with fuel panel switch position.
- (7) Fill both fuel tanks.
- (8) Set fuel selectors alternately to LEFT ENGINE, RIGHT ENGINE, CROSS FEED, and OFF while observing to ensure that no fuel leakage occurs and that both fuel selector valves operate correctly.

D. Primer Solenoid Valves Removal/Installation

For removal and installation procedures for primer solenoid valves refer to Chapter 73.

E. Fuel System Plumbing Removal

Since the fuel system plumbing is composed of standard aircraft tubing and fittings, its removal is merely the use of standard maintenance practices.

The following precautions should be observed when removing plumbing:

- (1) Cap all open lines and fittings to prevent contamination from entering system.
- (2) When disconnecting lines, first ensure that all residual fuel is drained from the line.
- (3) Exercise the precautions previously mentioned to minimize fire hazards.

F. Fuel System Plumbing Installation

Like removal, the installation of fuel system plumbing follows standard maintenance practices. In addition, the following procedures and precautions should be followed during installation:

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

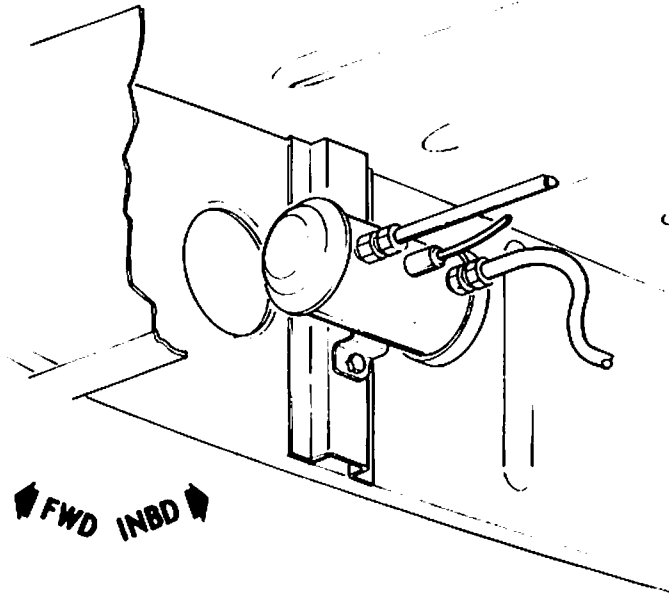
- (1) Prior to installation, all fuel lines and fittings should be cleaned internally (by passing Stoddard solvent through them, then air drying) to prevent contamination from being introduced into the system.

G. Electric Fuel Pump Removal (See Figure 203.)

- (1) Disconnect electrical connector.

WARNING: WHEN FUEL LINES ARE DISCONNECTED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO SPILLAGE.

- (2) Disconnect two fuel lines from the pump and cap fittings.



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**Electric Fuel Pump Removal/Installation
Figure 203**

(3) Remove screws and washers securing the pump to the rib and remove the pump.

H. Electric Fuel Pump Installation (See Figure 203.)

- (1) Position fuel pump on rib.
- (2) Install washers and screws.
- (3) Clean exposed threads on fuel pump fittings with a stiff-bristle brush.
- (4) Connect fuel lines to fuel pump.
- (5) Torque fittings to 100 ± 25 inch-pounds.
- (6) Connect electrical pigtail.
- (7) Operate pump and check for leaks.

I. Engine-Driven Fuel Pump – Removal/Installation

Refer to Avco Lycoming Engine Overhaul Manual for engine-driven fuel pump removal and installation procedures.

3. Adjustment/Test

A. Fuel System Plumbing Pressure Test

- (1) Pressurize fuel system plumbing by performing procedures in Fuel Storage System Components – Inspection/Check.
- (2) Visually check plumbing connections for evidence of leakage.
- (3) If plumbing holds pressure for 15 minutes, with pressure loss not exceeding 0.05 psi, plumbing is acceptable.
- (4) If leaks are found, replace defective components and retest system.

B. Electric Fuel Pump Operational Check

- (1) Ensure that the fuel tank contains at least 3 gallons of fuel.
- (2) For left engine fuel pump check, set fuel selector valve to left engine.
- (3) Set master switch to ON.
- (4) Set auxiliary fuel pump switch to ON.
- (5) Observe fuel pressure gauge. Gauge should indicate 0.5 to 8.0 psi.
- (6) Set auxiliary fuel pump and master switch to OFF.
- (7) Repeat test for right engine, with fuel selector valve set to RIGHT ENGINE.

C. Engine-Driven Fuel Pump Operational Check

It is necessary to operate the aircraft engine in order to check the engine-driven fuel pump.

- (1) Ensure that the fuel tank contains at least 3 gallons of fuel.
- (2) Set mixture to FULL RICH.
- (3) For left engine-driven fuel pump check, set fuel selector valve to LEFT ENGINE.
- (4) Set master switch to ON.
- (5) Set auxiliary fuel pump switch to ON.
- (6) Observe fuel pressure gauge. Gauge should indicate 0.5 to 8.0 psi.

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(7) If required, prime engine.

WARNING: ENSURE THAT PROPELLER AREA IS CLEAR PRIOR TO STARTING ENGINE.

(8) Set magneto switch to LEFT.

(9) Press starter button until engine starts.

(10) Set magneto switch to BOTH.

(11) Check oil pressure gauge. Oil pressure should be indicated within 30 seconds.

(12) Set auxiliary fuel pump switch to OFF while observing fuel pressure gauge. Gauge should indicate 0.5 to 8.0 psi, with auxiliary fuel pump off.

(13) Run engine at several different power settings and ensure that fuel pressure remains between 0.5 and 8.0 psi.

(14) Idle engine and set mixture to IDLE CUTOFF.

(15) Set magneto switch to OFF.

(16) Set master switch to OFF.

(17) Repeat test for right engine-driven fuel pump, with fuel selector valve set to RIGHT ENGINE.

FUEL INDICATING SYSTEM – DESCRIPTION/OPERATION

1. General

The fuel indicating system consists of two fuel pressure gauges and two fuel quantity gauges. The pressure gauges and the quantity gauges are mounted on the left instrument cluster in the instrument panel.

A. Fuel Pressure Gauges

The fuel pressure gauges are actuated individually by electrical transducers mounted on a bracket on the right side of the engine mounts.

B. Fuel Quantity Gauges

The two fuel quantity gauges are actuated individually by fuel quantity transmitters, installed in the inboard and outboard ends of each fuel bay.

The transmitters consist of a float attached to a pivoted rod, one end of which is a rheostat wiper. The vertical motion of the fuel causes angular travel of the float which increases or decreases the amount of resistance in the circuit. This resistance is reflected in the amount of needle deflection at the indicator, thus providing visual indication of fuel quantity.

FUEL INDICATING SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation

A. Fuel Pressure Gauge Removal (See Figure 201.)

- (1) Ensure that master switch is set to OFF.
- (2) At right side of the instrument panel, behind the left instrument cluster, disconnect electrical leads from back of fuel pressure gauge.
- (3) At front of the instrument cluster, remove four screws holding the instrument cluster to the instrument panel. Retain screws for reuse.
- (4) From front of the instrument panel, push instrument cluster slightly forward and downward to clear instrument panel.
- (5) While holding front of fuel pressure gauge, remove locknuts and insulating washers that secure fuel pressure gauge to instrument cluster. Retain nuts for reuse.
- (6) Disengage and remove fuel pressure gauge from instrument cluster.

B. Fuel Pressure Gauge Installation (See Figure 201.)

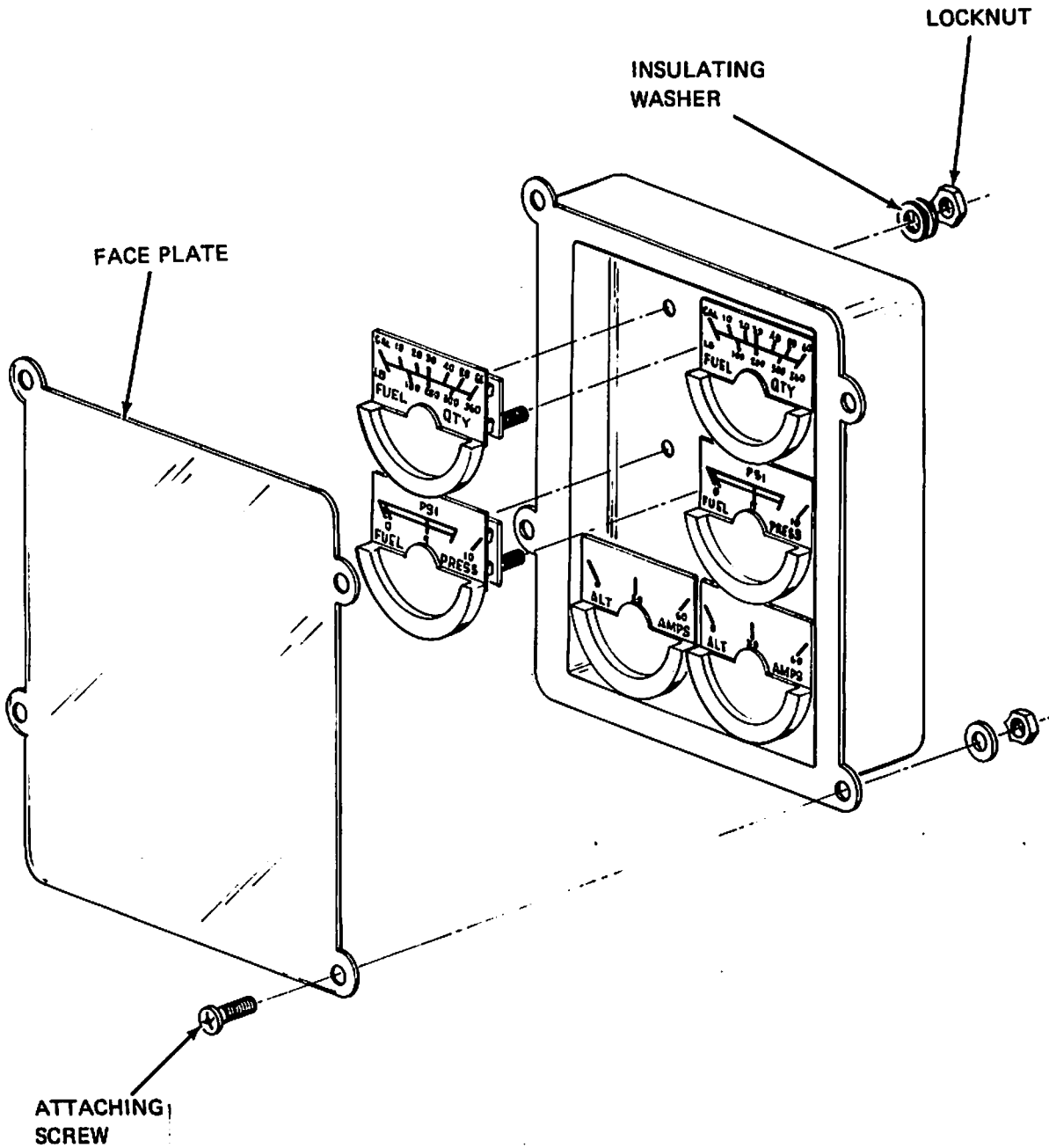
- (1) Insert fuel pressure gauge into center section of left instrument cluster so studs protrude through holes in metal support plate.
- (2) Properly align face of fuel pressure gauge in instrument cluster and secure fuel pressure gauge to instrument cluster with nuts previously removed.
- (3) Secure instrument cluster to instrument panel with four screws previously removed.
- (4) Connect electrical leads to studs on back of fuel pressure gauge, using locknuts provided with gauge.

C. Fuel Pressure Transmitter Removal/Installation

For fuel pressure transmitter removal/installation procedures, refer to Chapter 73.

D. Fuel Quantity Gauge Removal (See Figure 201.)

- (1) Ensure that master switch is set to OFF.
- (2) At right side of the instrument panel, behind the left instrument cluster, disconnect electrical leads from back of fuel quantity gauge.
- (3) At front of the instrument cluster, remove four screws holding the instrument cluster to instrument panel. Retain screws for reuse.



**Fuel Pressure Gauge/Fuel Quantity Gauge Removal/Installation
Figure 201**

28G72-9

- (4) From front of the instrument panel, push instrument cluster slightly forward and downward to clear instrument panel.
- (5) While holding front of fuel quantity gauge, remove locknuts and insulating washers from studs protruding through instrument cluster.
- (6) Disengage and remove fuel quantity gauge from instrument cluster.

E. Fuel Quantity Gauge Installation (See Figure 201.)

- (1) Insert fuel quantity gauge into top section of left instrument cluster so that studs protrude through holes in metal support plate.
- (2) Properly align face of fuel quantity gauge in instrument cluster and secure gauge to instrument cluster with insulating washers and locknuts.
- (3) Secure instrument cluster to instrument panel with four screws previously removed.
- (4) Connect electrical leads to studs on back of fuel quantity gauge, using locknuts provided with gauge.

F. Fuel Level Sender Unit Removal (See Figure 202.)

- (1) Ensure that all power is off.

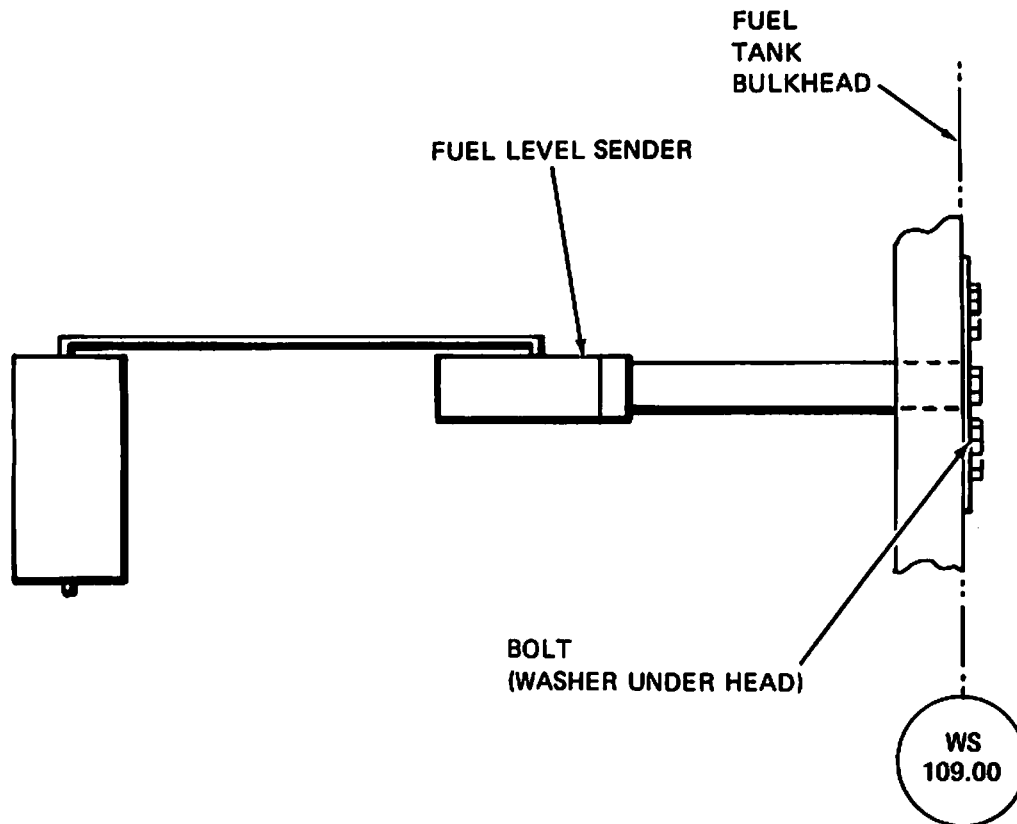
WARNING: FUEL TANK MUST BE EMPTY AND VAPOR FREE BEFORE ATTEMPTING REMOVAL OF FUEL LEVEL SENDER UNIT.

- (2) Disconnect electrical leads to fuel level sender at inboard and outboard bulkhead of fuel tank.
- (3) Remove five bolts and five washers attaching sender unit to fuel tank bulkhead.
- (4) Withdraw sender unit through hole in fuel tank bulkhead.

G. Fuel Level Sender Unit Installation (See Figure 202.)

WARNING: FUEL TANK MUST BE EMPTY AND VAPOR FREE BEFORE ATTEMPTING INSTALLATION OF FUEL LEVEL SENDER.

- (1) Insert fuel level sender unit through hole in fuel tank bulkhead at Wing Station 109.
- (2) Seal per GAPS 1163.
- (3) Insert five washers and five bolts to attach sender unit to bulkhead.
- (4) Torque bolts to standard value. Refer to Chapter 91.
- (5) Connect electrical leads to terminals on sender unit.



28G72-10

Fuel Level Sender Unit Removal/Installation
Figure 202

2. Adjustment/Test

Normally no attempt should be made to calibrate or repair a defective fuel pressure gauge or a fuel quantity gauge. These gauges should be replaced with serviceable gauges.

ICE AND RAIN PROTECTION – DESCRIPTION/OPERATION

1. General

This chapter includes those units and components which are installed on the GA-7/Cougar aircraft, as a means of preventing and disposing of ice formation in the carburetor and pitot system, and the elimination of frost and fog on the windows and windshield.

This chapter contains the following systems and their related components.

Carburetor Heat System

Pitot Heater System

Windshield Defrosting and Window Defogging System

NOTE: Wing leading edge deicing and propeller anti-icing systems will be offered as optional equipment at a future date. These systems will be added to the maintenance manual as a revision when system data becomes available.

CARBURETOR HEAT SYSTEM – DESCRIPTION/OPERATION

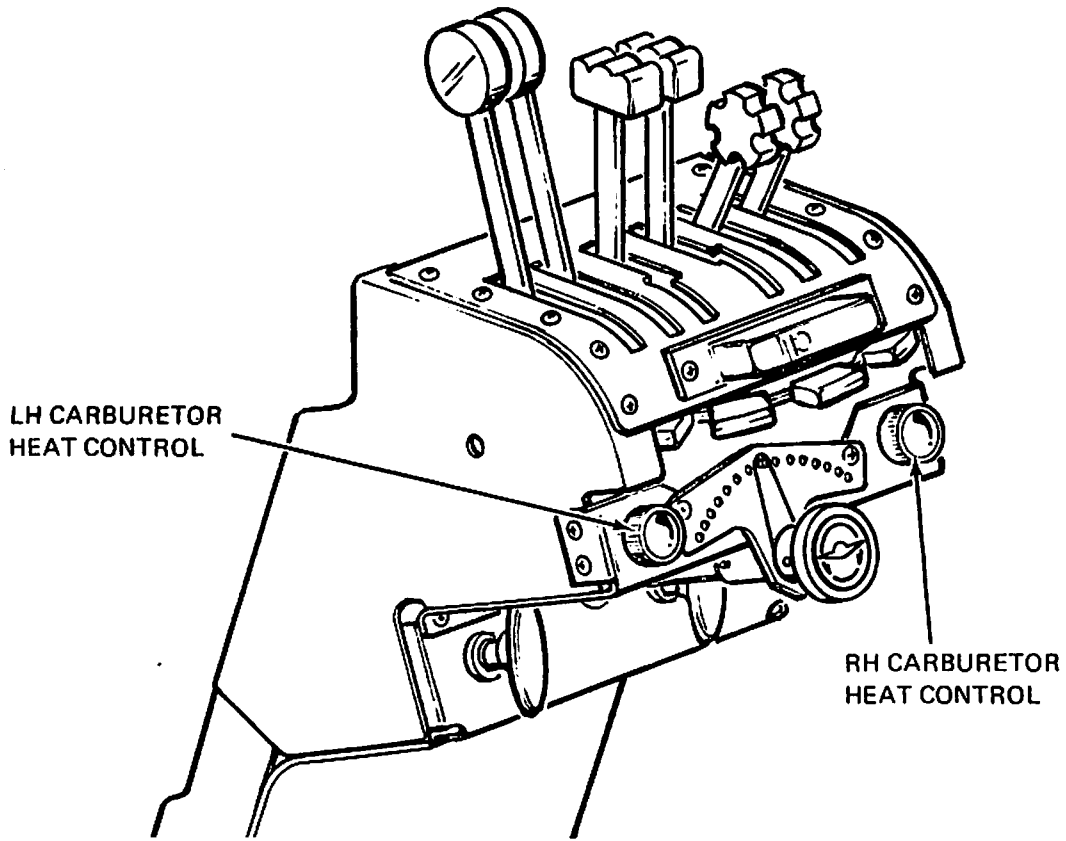
1. General (See Figures 1 and 2.)

The aircraft engines are equipped with a carburetor heat system which is used when carburetor icing conditions exist. The system provides a source of heated air ducted from the exhaust muffler to the carburetor air box assembly. The system is controlled from the center console by the carburetor heat controls which are connected to a shutoff valve on the carburetor air boxes by a cable linkage. When the carburetor heat control is in the OFF (pushed in) position, filtered air is drawn through ducting into the carburetor. When the carburetor heat control is in the ON (pulled out) position outside air is shut off and heated unfiltered air is routed to the carburetor through ducting from the exhaust muffler to the carburetor air box.

2. Major Components and Their Locations

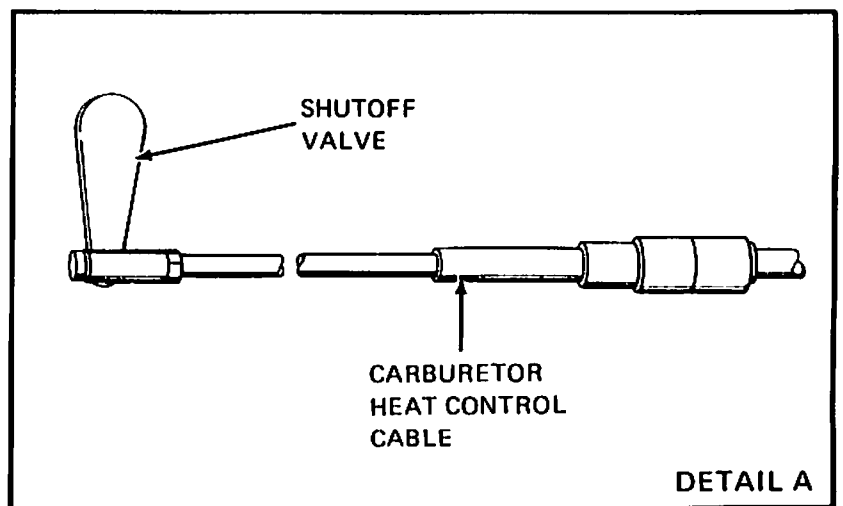
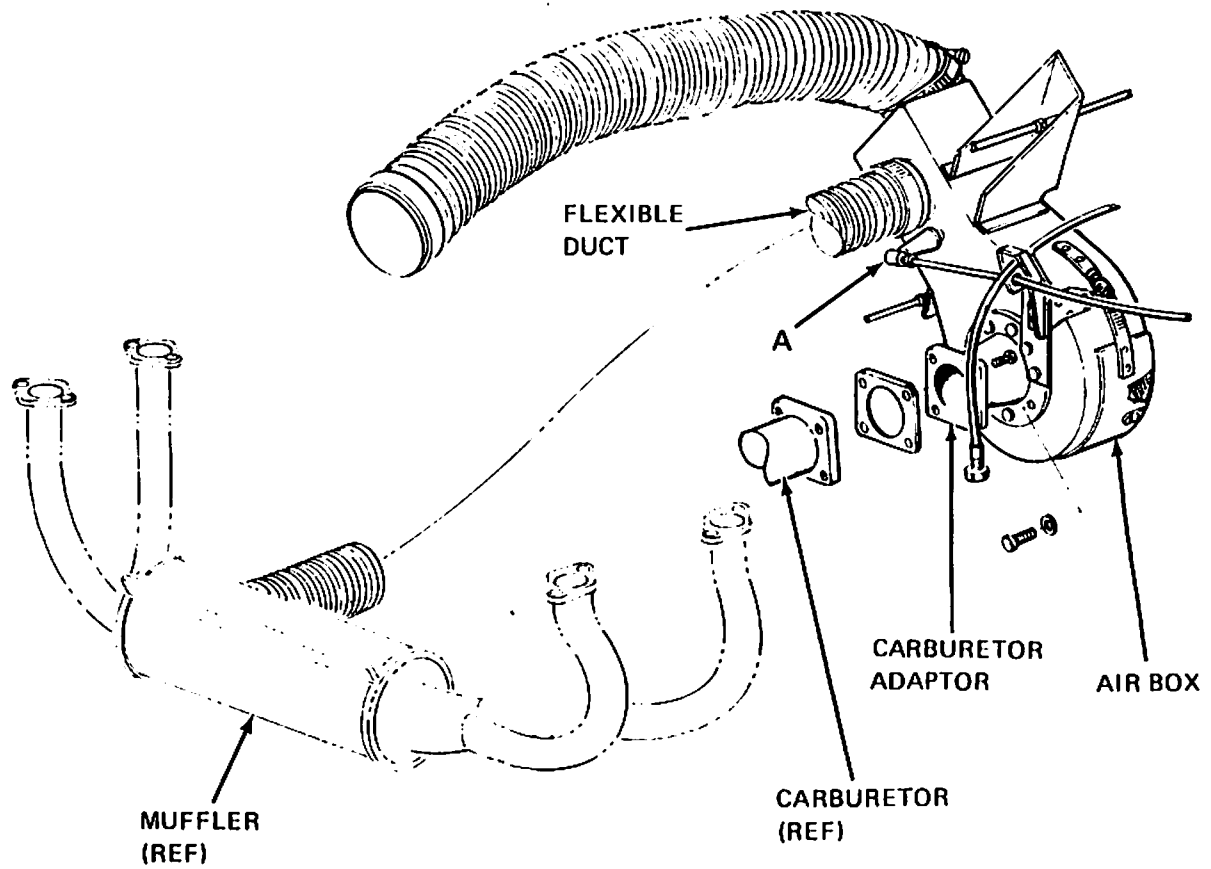
A. Carburetor Heat System

Unit	No. Per Aircraft	Location
Carburetor Heat Control	2	On Center Console.
Carburetor Heat Shutoff Valve	2	In carburetor air box housing.
Carburetor Heat Control Cable	2	Runs from control handle on console to shutoff valve on Carburetor air box



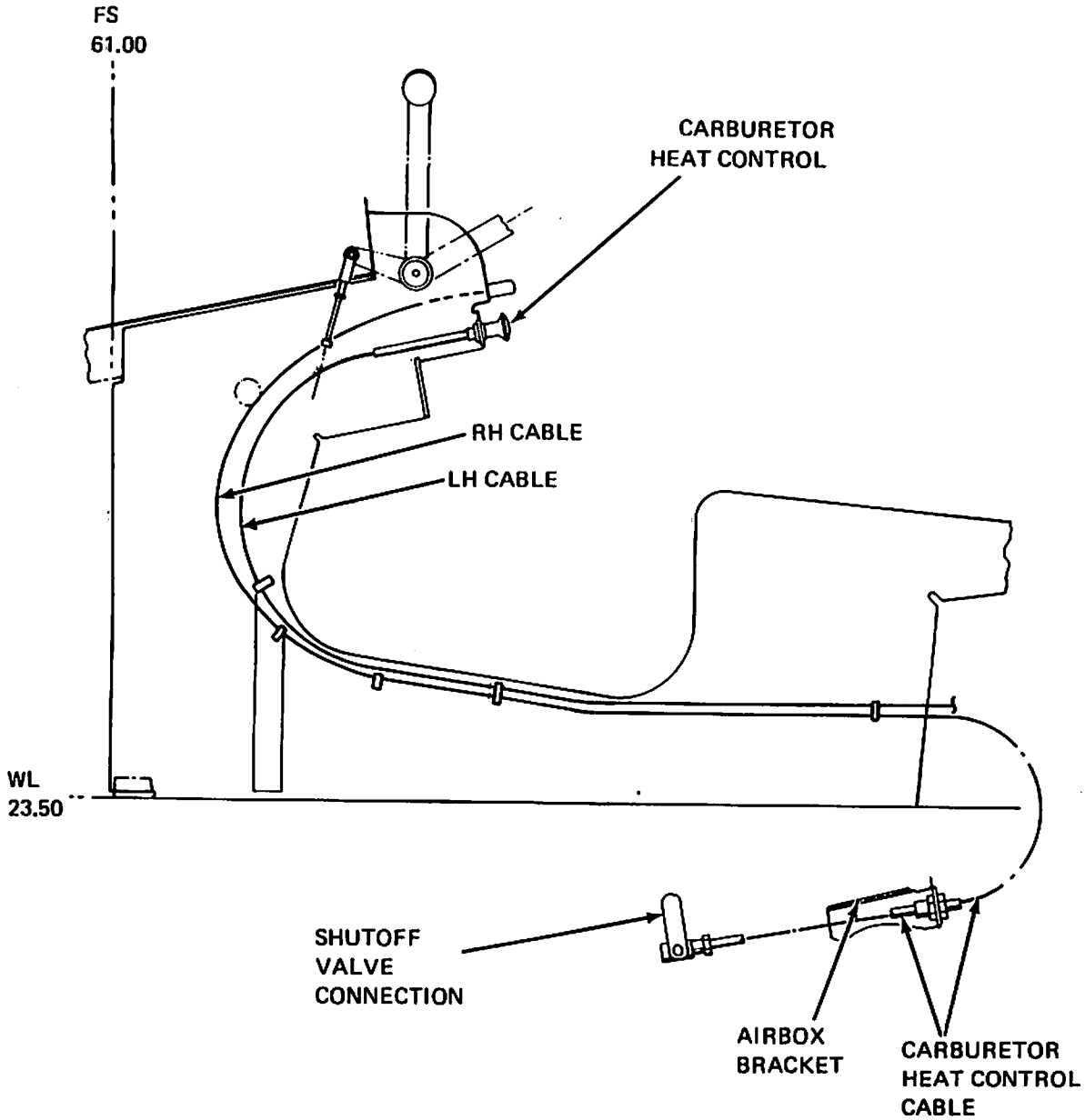
**Carburetor Heat Controls
Figure 1**

30G72-1



Carburetor Heat System Components
Figure 2 (Sheet 1 of 2)

30G72-2-1



Carburetor Heat System Components
Figure 2 (Sheet 2 of 2)

30G72-2-2

CARBURETOR HEAT SYSTEM – MAINTENANCE PRACTICES

1. Carburetor Heat System – Operational Test

- A. Disconnect the hot air duct at the air box assembly.
- B. Pull the carburetor heat control knob out (ON position) and visually check that the shutoff valve on the carburetor air box is in the fully open position, push heat control knob in (CLOSED position) and visually check that shutoff valve is full closed. Ensure no binding exists throughout travel of heat control.

NOTE: It is necessary to operate the aircraft engines to test the carburetor heat system operationally.

WARNING: ENSURE THAT PROPELLER AREAS ARE CLEAR PRIOR TO STARTING ENGINES.

- C. Start and run engine or engines as required. Refer to the Pilot's Operating Handbook.
 - (1) Run engine at 1800 rpm.
 - (2) Pull carburetor heat control out (ON position) and check for a positive indication of rpm drop which indicates heat to carburetor on engine being checked.
 - (3) Push carburetor heat control in (CLOSED position) and note increase in rpm.
- D. Shut down engine or engines. Refer to the Pilot's Operating Handbook.

CARBURETOR HEAT CONTROL -- DESCRIPTION/OPERATION

1. **General** (Refer to Figures 1 and 2, Section 30-1-0.)

The carburetor heat control is used to control the flow of heated air to the carburetor during icing conditions. It consists of a control knob for each engine. The control knobs are mounted on the control quadrant below the throttles, prop control, and mixture control levers. The heat controls are connected by control cables to a shutoff valve mounted on each carburetor air box. The controls are push/pull type. When the controls are pulled out the carburetor heat is ON; pushing the controls in turns the system to OFF.

CARBURETOR HEAT CONTROL - TROUBLESHOOTING1. Troubleshooting the Carburetor Heat Control

TROUBLE	PROBABLE CAUSE	REMEDY
Control will not operate through full travel range.	Linkage binding, broken, or crimped.	Adjust linkage or replace as required.
	Control binding in control quadrant.	Clean, adjust, and lubricate as required.
	Air shutoff valve binding or stuck on carburetor air box.	Clean, adjust, lubricate, or replace valve as required.
Control moves through full range of travel but does not fully shut off, or restricts flow of heated air to carburetor.	Control and linkage improperly adjusted.	Adjust control and linkage.
	Control cable loose or disconnected.	Tighten or connect cable.
Flow of heated air to carburetor inadequate to prevent icing.	Heat duct from muffler to carburetor air box disconnected or damaged.	Replace duct.

CARBURETOR HEAT CONTROL – MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove carburetor heat control cable as follows:

- (1) Remove the carburetor heat control cable from the shutoff valve on the carburetor air box by disconnecting it at the ball joint connecting cable to shutoff valve arm.
- (2) Remove cable from mount brackets on carburetor air box and slide cable from brackets.
- (3) Remove console side trim to gain access to cable mount clamps and control knob locknuts.
- (4) Remove control knob locknuts and remove push-pull knob.
- (5) Remove cable retaining clamps below console assembly.
- (6) Open wing access panels and remove cable clamp halves at Wing Stations 24.40, 42.154, and 59.907.
- (7) Ensure all attaching hardware and clamps are disconnected. Attach a wire or string long enough to reach from the console to the engine firewall to the ball joint end of the cable to facilitate installation of new cable. Slide cable out through console assembly. Remove wire or string from old cable.

B. Install carburetor heat control cable as follows:

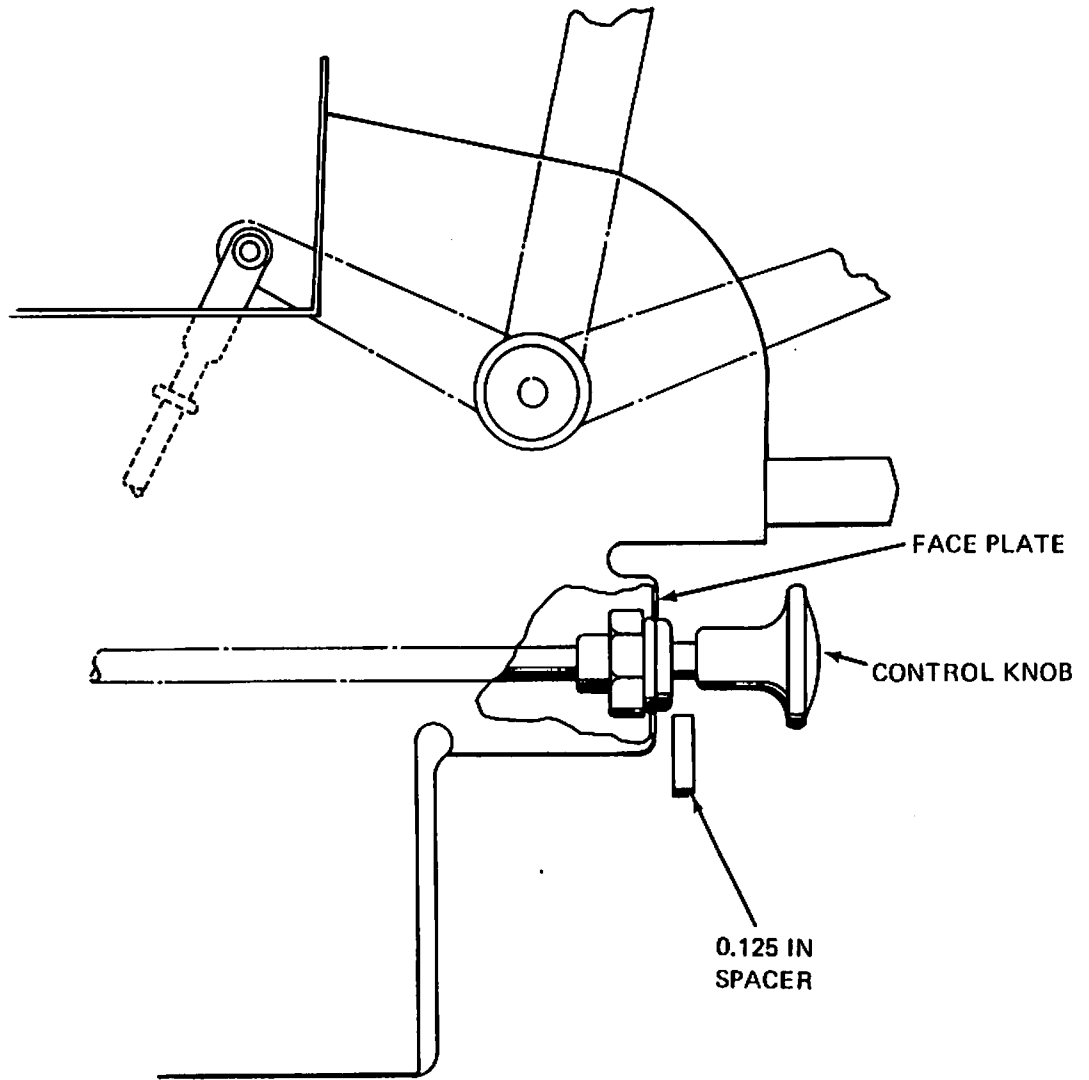
- (1) Attach wire or string to ball joint end of new cable to be installed.
- (2) Thread cable from console assembly through wing to carburetor air box by pulling gently on wire or string.
- (3) Secure cable to push-pull control knob and tighten locknuts at console.
- (4) Secure cable retaining clamps below console and at Wing Stations 24.40, 42.154, and 59.907. Ensure cable is adjusted to provide a 4-1/2 inch bend radius.
- (5) Remove wire or string from ball joint end of cable at carburetor air box.
- (6) Attach ball joint end of cable to carburetor air shutoff valve arm.
- (7) Install console trim and access panels.
- (8) Move heat control through full range of travel and ensure that no binding exists.
- (9) Seal opening in firewall around carburetor heat control cable with Coast Pro-Seal 700 Firewall Sealant (MIL-S-38249, Type 1) manufactured by Essex Chemical Corp., 19451 Susana Road, Compton, California 90221.

2. Adjustments (See Figure 201.)

- A. Position the carburetor heat control knob in the completely closed position. The knob should be within 1/8 inch of the faceplate or stop. A 1/8 inch spacer can be used for measurement.
- B. Minor adjustments can be made at the ball joint connection on carburetor air box shutoff valve. If further adjustments are required, loosen cable mount clamps and re-position cable assembly to obtain the dimensions in Paragraph 2.A.
- C. Remove spacer and tighten ball joint nut or clamps as required.

3. Operational Test

- A. Move carburetor heat control knob fully forward and aft and check control for full travel with a minimum of 1/8 inch "pinch" at both ends of travel.



Typical Control Knob Rigging
Figure 201

30G72-3

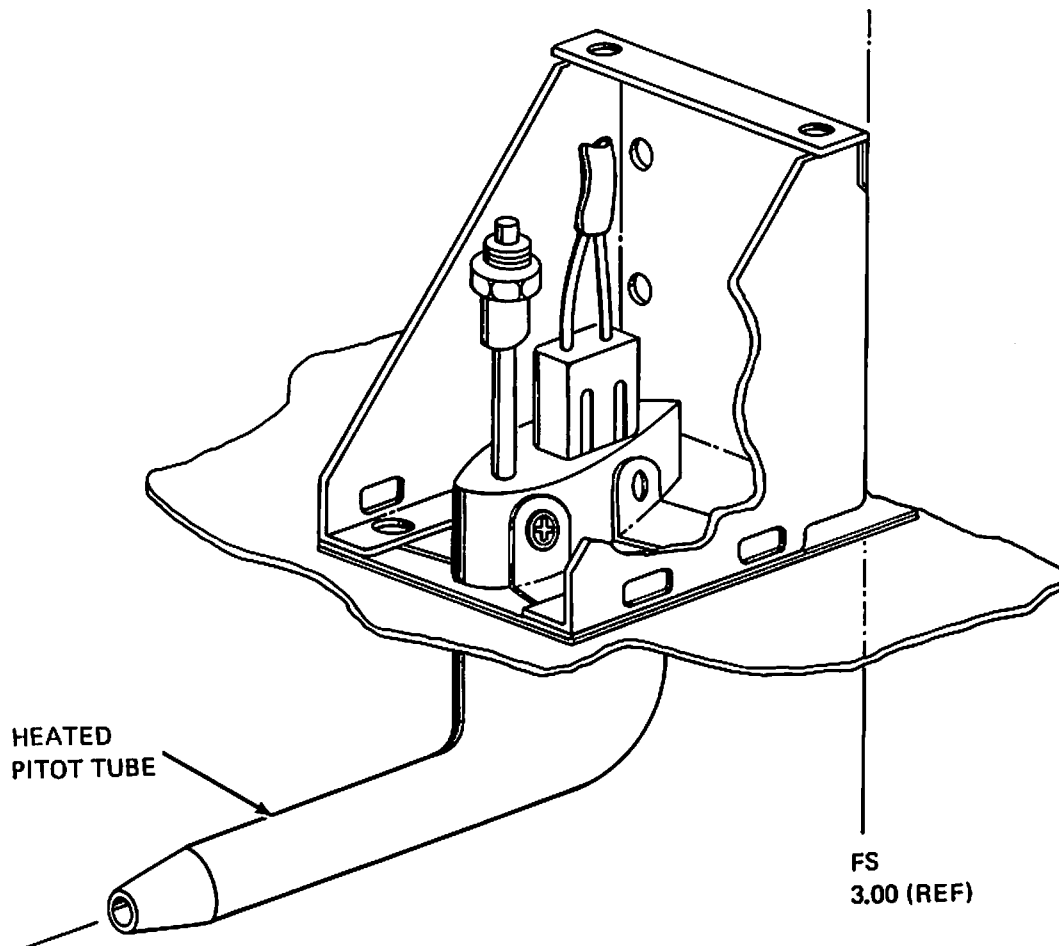
CARBURETOR HEAT SHUTOFF VALVE – DESCRIPTION/OPERATION**1. General (See Section 30-1-0, Figure 2.)**

The carburetor heat shutoff valve is an integral part of the carburetor air box. The valve control arm is located on the exterior section of the carburetor air box and is connected to the carburetor heat control lever by a cable assembly. When the shutoff valve is open, heated air is diverted to the carburetor air intake. Carburetor heat is shut off when the valve is closed. Since the carburetor heat shutoff valve is an integral part of the carburetor air box, removal or replacement of the valve requires removal of the carburetor air box. (Refer to Chapter 73 of this manual.) To perform an operational test on the carburetor heat shutoff valve, refer to Section 30-1-0, this chapter.

PITOT HEATER SYSTEM – DESCRIPTION/OPERATION

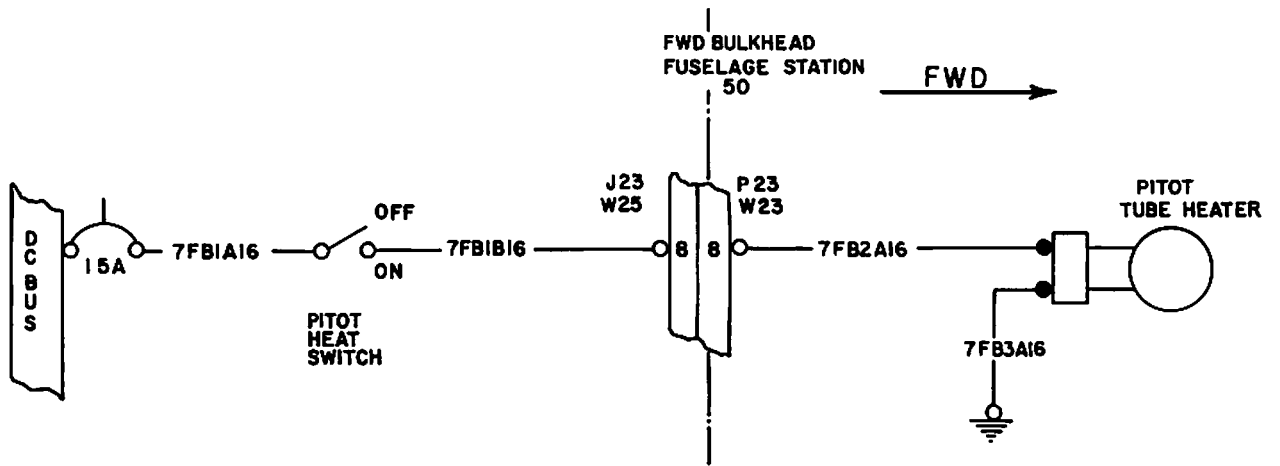
1. **General** (See Figure 1.)

The pitot heater system consists of an electrical heating element which is an integral part of the pitot tube, a receptacle for connection to the element, an ON-OFF switch, and associated wiring. The switch is of plastic construction and is mounted on the lower left section of the instrument panel. The heater has a 15 amp circuit breaker incorporated (See Figure 2.) which is located on the lower right side of the instrument panel circuit breaker section. The purpose of the pitot heater is to prevent or eliminate the formation of ice inside the pitot tube during aircraft flight. The heated pitot tube is an optional item of equipment on the GA-7/Cougar aircraft.



**Pitot Heater System
Figure 1**

30G72-4



**Pitot Heater Circuit
Figure 2**

30G72-5

PITOT HEATER SYSTEM – TROUBLESHOOTING

1. Troubleshooting Pitot Heater System

TROUBLE	PROBABLE CAUSE	REMEDY
Pitot tube fails to heat.	Circuit breaker popped.	Reset circuit breaker. If it pops again, do not reset. Determine cause and correct.
	Defective wiring.	Check with ohmmeter and repair as required.
	Heater element burned out.	Replace pitot tube.

PITOT HEATER SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of Pitot Heater

When the pitot heater becomes inoperative, the pitot tube assembly must be replaced. For removal/installation procedures, refer to Chapter 34.

2. Removal/Installation of Pitot Heater Switch

A. Remove Pitot Heater Switch

- (1) Ensure that battery master switch is in OFF position.
- (2) Remove switch from instrument panel by pushing switch out through face of panel.
- (3) Disconnect wiring from switch terminals.

B. Install Pitot Heater Switch

- (1) Ensure that battery master switch is in OFF position.
- (2) Connect wiring to switch terminals.
- (3) Position switch in place on instrument panel and push switch into mounting hole until switch snaps into panel.

3. Operational Test of Pitot Heater

A. Test Pitot Heater

WARNING: WHEN THE PITOT HEATER IS OPERATING, THE PITOT TUBE BECOMES EXTREMELY HOT. PHYSICAL CONTACT COULD RESULT IN A SEVERE BURN.

- (1) Place battery master switch to ON position.
- (2) Place pitot heater switch to ON position. Within 2 or 3 seconds, pitot tube should begin to get warm.
- (3) Lightly feel the pitot tube immediately after the pitot heater switch has been placed in ON position.

NOTE: Ground operation of the pitot heater should be held to a minimum during operational checks.

- (4) Place pitot heater switch and battery master switch to OFF position.

**WINDSHIELD DEFROSTER SYSTEM – DESCRIPTION/OPERATION****1. General**

To provide for windshield defrosting, air ducts are routed from the left and right forward cabin air outlet valves to the left and right windshield defroster vent outlets. Operation of the defroster is accomplished by operating the cabin heating system (Refer to Chapter 21.) and adjusting the volume of airflow by moving the air valves in the defroster vents and regulating the outlet temperature by positioning the L CABIN AIR – OFF/WARM control as desired.

CHAPTER 32

LANDING GEAR

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LANDING GEAR – DESCRIPTION/OPERATION

1. General

The GA-7/Cougar aircraft is equipped with a retractable tricycle air-oil strut type landing gear, retracted or extended by an electrically powered hydraulic power pack. The landing gear system consists of the main gears, nose gear, and a hydraulic power pack. Landing gear positions are indicated by lights located on the instrument panel. When the gears are all down and locked, three green lights illuminate on the instrument panel. When all of the gears are not down and locked (NOT SAFE), an amber light illuminates on the instrument panel.

An aural sound (warning horn) will be activated under certain in-flight conditions to alert the pilot that the landing gear is not extended.

In the event the aircraft is on the ground and the landing gear control handle is placed in the UP position, a safety switch (squat switch) will prevent the hydraulic pump from actuating. The squat switch is located on the left main gear. Detailed information on the gear position and warning system is provided in Section 32-6-1.

MAIN LANDING GEAR – DESCRIPTION/OPERATION**1. General**

The main landing gears consist mainly of a wheel and brake assembly, a forged trunnion, oleo cylinder, yoke, axle, scissors, brace assembly, actuator assembly, and collar. The gear is retracted or extended hydraulically with a single hydraulic actuator. Hydraulic pressure is supplied to the actuator by a power pack operated by a DC electric motor. Actuation is initiated by a locking type, two-position handle mounted on the instrument panel.

MAIN LANDING GEAR – MAINTENANCE PRACTICES1. Removal/Installation of Main Landing Gear Assembly

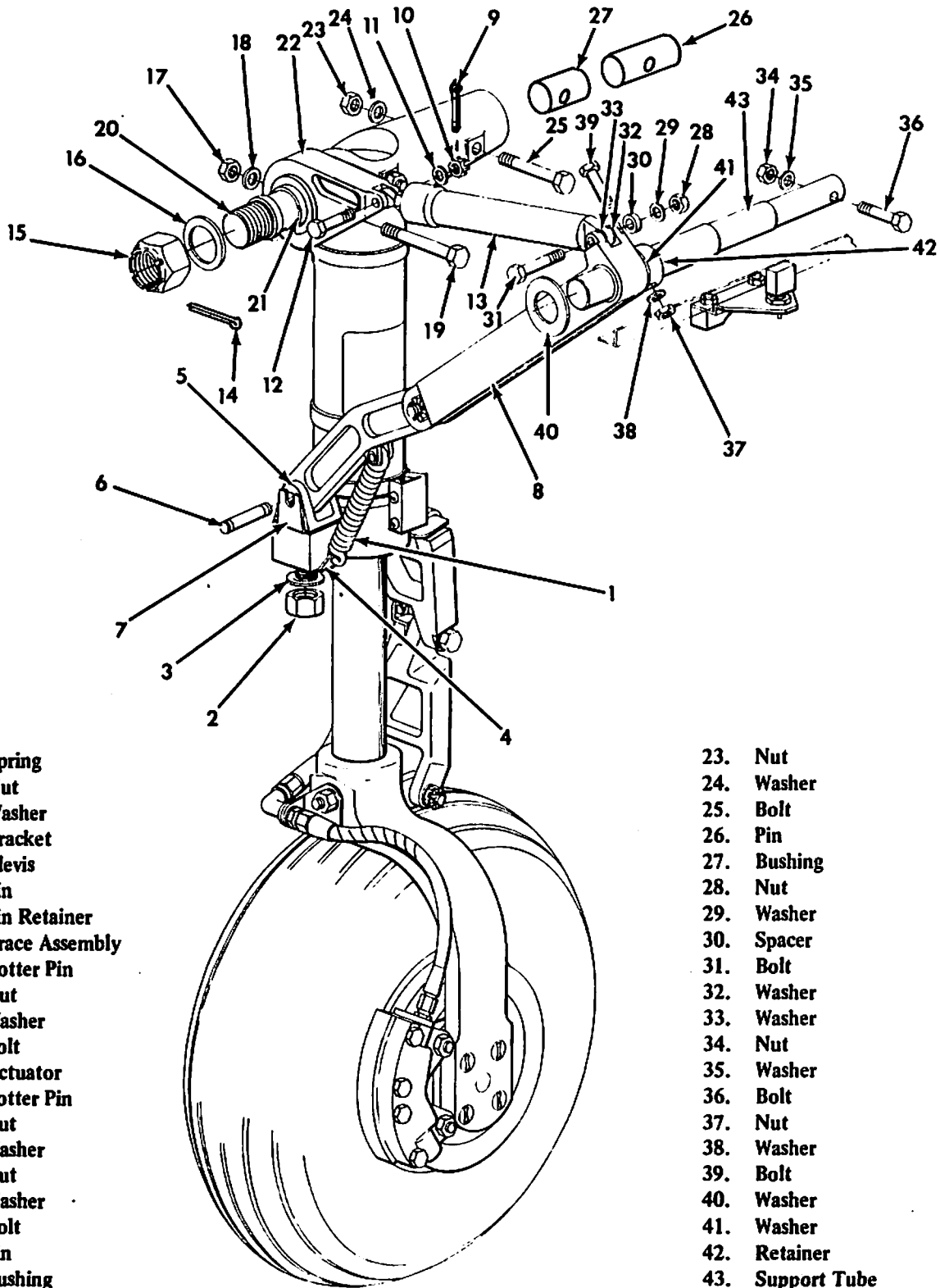
NOTE: Prior to proceeding with instructions provided in this chapter, the aircraft must be placed on jacks. (Refer to Lifting and Jacking, Chapter 7.) When any component of the landing gear is removed or any hydraulic line disconnected for any reason, the gears should be cycled and checked for proper operation and servicing. Refer to Chapter 12 for servicing.

A. Remove Main Landing Gear Trunnion and Oleo Assembly (See Figure 201.)

- (1) Place a container beneath wheel to catch any hydraulic fluid spillage and disconnect hydraulic brake line near top of main landing gear.
- (2) With aircraft on jacks, disconnect door linkage from main gear trunnion by removing nut, washer, and bolt.
- (3) Disconnect brace assembly from main gear trunnion by disconnecting spring (1), nut (2), washer (3), bracket (4), clevis (5), pin (6), pin retainer (7), and remove brace assembly (8) from trunnion.
- (4) Disconnect actuator assembly (13) from actuator arm (22) by removing cotter pin (9), nut (10), washer (11), bolt (12), and remove actuator (13) from actuator arm (22).
- (5) Remove access panels beneath wing to gain access to main gear mounting hardware.
- (6) Remove cotter pin (14), nut (15), and washer (16). From inside wheel well, remove nut (17), washer (18), and bolt (19). Slide pin (20) and bushing (21) through bearing in wheel well wall.
- (7) On other side of trunnion, remove nut (23), washer (24), and bolt (25) holding pin (26) and bushing (27). Slide pin (26) out of rear bearing and remove main landing gear from aircraft.

B. Disassemble Main Landing Gear Trunnion and Oleo Assembly (See Figure 202.)

- (1) Remove main landing gear trunnion and oleo assembly. Refer to Paragraph A.
- (2) Release air pressure and remove air valve (1) with O-ring (2), and drain hydraulic fluid.
- (3) Remove nut (5), washer (6), bolt (7), and remove yoke assembly (8) from trunnion.
- (4) Remove nut (9), washer (10), bolt (11), torque plate (12), and axle (13) from yoke (8).
- (5) Remove nut (14), washer (15), and bolt (16) from top of trunnion and pull plug and orifice tube out of trunnion and separate plug (22) from orifice tube (21).
- (6) Remove retaining ring (17), orifice (18), and with extension wrench remove bolt (19) and washer (20) from orifice tube (21).
- (7) Remove barrel nut (23), backup ring (24), O-ring (25), and plate (26) from plug (22).
- (8) Remove plug (27), backup ring (28), and O-ring (29).

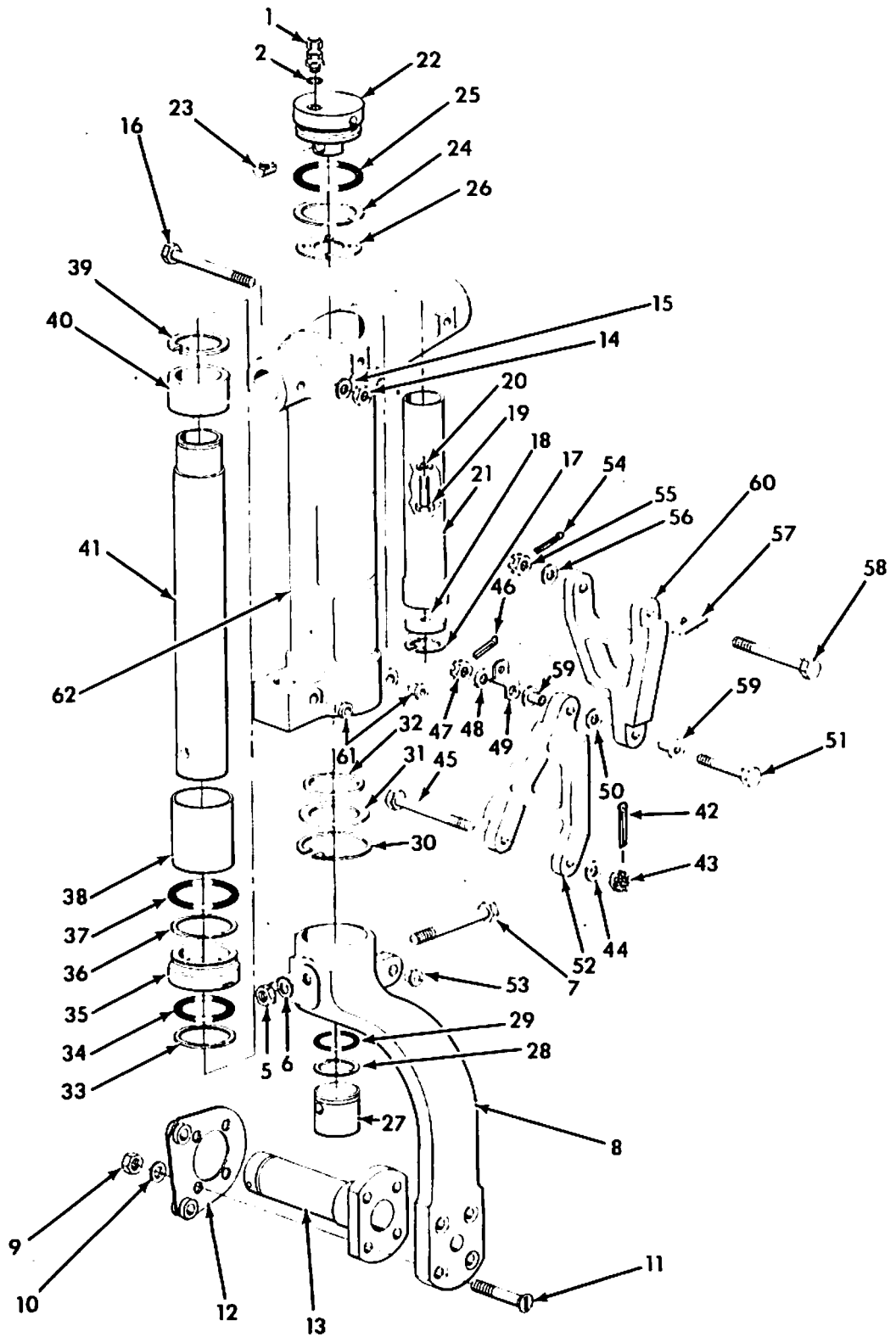


- 1. Spring
- 2. Nut
- 3. Washer
- 4. Bracket
- 5. Clevis
- 6. Pin
- 7. Pin Retainer
- 8. Brace Assembly
- 9. Cotter Pin
- 10. Nut
- 11. Washer
- 12. Bolt
- 13. Actuator
- 14. Cotter Pin
- 15. Nut
- 16. Washer
- 17. Nut
- 18. Washer
- 19. Bolt
- 20. Pin
- 21. Bushing
- 22. Actuator Arm

- 23. Nut
- 24. Washer
- 25. Bolt
- 26. Pin
- 27. Bushing
- 28. Nut
- 29. Washer
- 30. Spacer
- 31. Bolt
- 32. Washer
- 33. Washer
- 34. Nut
- 35. Washer
- 36. Bolt
- 37. Nut
- 38. Washer
- 39. Bolt
- 40. Washer
- 41. Washer
- 42. Retainer
- 43. Support Tube

**Main Landing Gear Installation
Figure 201**

32G72-1



Trunnion and Oleo Assembly
Figure 202 (Sheet 1 of 2)

32G72-2

- | | |
|--------------------|--------------------|
| 1. Air Valve | 32. Scraper |
| 2. O-ring | 33. Backup Ring |
| 3. Not Used | 34. O-ring |
| 4. Not Used | 35. Lower Bearing |
| 5. Nut | 36. Backup Ring |
| 6. Washer | 37. O-ring |
| 7. Bolt | 38. Sleeve |
| 8. Yoke | 39. Retaining Ring |
| 9. Nut | 40. Bearing |
| 10. Washer | 41. Oleo Piston |
| 11. Bolt | 42. Cotter Pin |
| 12. Torque Plate | 43. Nut |
| 13. Axle | 44. Washer |
| 14. Nut | 45. Bolt |
| 15. Washer | 46. Cotter Pin |
| 16. Bolt | 47. Nut |
| 17. Retaining Ring | 48. Washer |
| 18. Orifice | 49. Hose Bracket |
| 19. Bolt | 50. Washer |
| 20. Washer | 51. Bolt |
| 21. Orifice Tube | 52. Scissor Half |
| 22. Plug | 53. Bushings |
| 23. Barrel Nut | 54. Cotter Pin |
| 24. Backup Ring | 55. Nut |
| 25. O-ring | 56. Washer |
| 26. Plate Stop | 57. Switch Bracket |
| 27. Plug | 58. Bolt |
| 28. Backup Ring | 59. Bushings |
| 29. O-ring | 60. Scissor Half |
| 30. Retaining Ring | 61. Bushings |
| 31. Spacer | 62. Trunnion |

**Trunnion and Oleo Assembly
Figure 202 (Sheet 2 of 2)**

- (9) Remove retaining ring (30), spacer (31), scraper (32), backup ring (33), O-ring (34), bearing (35), backup ring (36), O-ring (37), and sleeve (38).
- (10) Remove retaining ring (39) and bearing (40) from piston (41).
- (11) Remove scissors from trunnion by removing cotter pin (42), nut (43), washer (44), bolt (45), cotter pin (46), nut (47), washer (48), bracket (49), washer (50), bolt (51), and remove scissor half (52). Remove bushings (53) from yoke (8).
- (12) Remove cotter pin (54), nut (55), washer (56), switch bracket (57), bolt (58), and remove bushings (59) from scissor half (60) and remove bushings (61) from trunnion (62).
- C. Cleaning, Inspection, and Repair of Trunnion and Oleo Assembly**
- (1) Clean all parts with a suitable dry type cleaning solvent.

- (2) Inspect components for wear, cracks, nicks, corrosion, and overall condition.
- (3) Repair of the trunnion and oleo assembly consists of smoothing out minor scratches, nicks, and dents and replacement of defective parts.

D. Assemble Trunnion and Oleo Assembly (See Figure 202.)

NOTE: Replace all O-rings during assembly.

- (1) Install bushings (61) in trunnion (62) and install scissor half (60) on trunnion with bolt (58), switch bracket (57), washer (56), nut (55), and cotter pin (54).
- (2) Attach bottom scissor half (52) to upper scissor half (60) with bushings (59), bolt (51), washer (50), bracket (49), washer (48), nut (47), and cotter pin (46).
- (3) Attach bottom half of scissors (52) to yoke (8) with bushings (53), bolt (45), washer (44), nut (43), and cotter pin (42).
- (4) On piston (41), install bearing (40), retaining ring (39), and sleeve (38).
- (5) On lower bearing (35), install O-ring (37), backup ring (36), O-ring (34), and backup ring (33). Install bearing assembly (35) with scraper (32), spacer (31), and retaining ring (30) in bottom of trunnion.
- (6) Install O-ring (29) and backup ring (28) on plug (27). Install plug (27) on bottom of piston (41).
- (7) On plug (22), install O-ring (25), backup ring (24), and barrel nut (23).
- (8) Place stop plate (26) on top of orifice tube (21) and position plug assembly (22) in place on top of stop plate (26). Through the bottom of orifice tube (21), install washer (20), bolt (19), and screw bolt (19) into barrel nut (23).
- (9) Install orifice (18) and retaining ring (17).
- (10) Place the assembled oleo assembly in the trunnion and install bolt (16), washer (15), and nut (14).
- (11) Install axle (13), torque plate (12), bolt (11), washer (10), and nut (9). Align hole in yoke (8) with hole in piston and plug (27) and install bolt (7), washer (6), and nut (5).
- (12) Service the strut and install O-ring (2) and valve (1). Refer to Chapter 12 for servicing instructions.

E. Install Main Landing Gear Trunnion and Oleo Assembly (See Figure 201.)

- (1) With assistance, place landing gear in position in wheel well and, through bearing in wall of wheel well, install pin (20). Align holes in actuator arm (22) and pin (20) with holes in trunnion and install bolt (19), washer (18), and nut (17).
- (2) Through rear bearing, install pin (26) and align holes with trunnion and install bolt (25), washer (24), and nut (23).

- (3) Through access panel install washer (16), nut (15), and cotter pin (14).
- (4) Connect actuator (13) to actuator arm (22) by installing bolt (12), washer (11), nut (10), and cotter pin (9).
- (5) Connect brace assembly (8) to trunnion by installing bracket (7), clevis (6), pin (5), bracket (4), washer (3), and nut (2).
- (6) Connect spring (1) to bracket (4).

2. Removal/Installation of Main Gear Actuator

A. Remove Main Gear Actuator (See Figure 201.)

- (1) Using a rag to absorb hydraulic fluid leakage, disconnect hydraulic lines from actuator and plug all ports.
- (2) Remove cotter pin (9), nut (10), washer (11), and bolt (12) attaching actuator (13) to actuator arm (22).
- (3) Remove nut (28), washer (29), spacer (30), bolt (31), and washers (32 and 33). Remove actuator from aircraft.

B. Disassemble Main Gear Actuator

Main and nose gear actuators are the same. Refer to Section 32-2-1, Paragraph 8B, and Figure 206 for disassembly procedures.

C. Cleaning, Inspection, and Repair of Main Gear Actuator

- (1) Clean actuator components with a suitable dry cleaning solvent.
- (2) Inspect components for wear, cracks, nicks, corrosion, proper lubrication, and general condition.
- (3) Repair of the main gear actuator consists of smoothing out minor scratches, nicks and dents, and replacement of defective parts.

D. Assemble Main Gear Actuator

Refer to Section 32-2-1, Paragraph 8D and Figure 206 for assembly procedures.

E. Install Main Gear Actuator (See Figure 201.)

- (1) Place end of actuator (13) in brace assembly lug and place washers (33 and 32) in position on each side of actuator end, and install bolt (31), spacer (30), washer (29), and nut (28).
- (2) Place rod end of actuator in actuator arm and install bolt (12), washer (11), nut (10), and cotter pin (9).

(3) Connect hydraulic lines to actuator.

(4) Refer to Paragraph 5 for adjustments.

3. Removal/Installation of Main Landing Gear Support Tube Assembly

A. Remove Main Landing Gear Support Tube Assembly (See Figure 201.)

(1) Remove nut (34), washer (35), and bolt (36).

(2) Remove nut (37), washer (38), and bolt (39).

(3) Slide support tube (43) through hole in wheel well wall and remove washer (40), brace assembly (8), washers (41), and retainer (42) from support tube (43).

B. Cleaning, Inspection, and Repair of Main Landing Gear Support Tube Assembly

(1) Clean support tube with a suitable dry cleaning solvent.

(2) Inspect support tube for wear, cracks, nicks, corrosion, and general condition.

(3) Repair of the main landing gear support tube consists of smoothing out minor nicks, scratches, and dents; replacement of parts; and applying new finish.

C. Install Main Landing Gear Support Tube Assembly (See Figure 201.)

(1) Slide support tube (43) through support block on forward wheel well wall.

(2) Slide retainer (42), washers (41), brace assembly (8), and washer (40) on support tube (43) and place other end of support tube in bracket on aft wheel well wall.

(3) Align holes in retainer (42) with hole in support tube and install bolt (39), washer (38), and nut (37).

(4) Align hole in aft end of support tube with holes in aft support bracket and install bolt (36), washer (35), and nut (34).

4. Removal/Installation of Main Landing Gear Brace Assembly

A. Remove Main Landing Gear Brace Assembly (See Figure 201.)

(1) Remove main landing gear support tube. Refer to Paragraph 3A.

(2) Break brace at knee joint and swing it out to disconnect actuator (13) by removing nut (28), washer (29), spacer (30), bolt (31), and washers (32 and 33).

- (3) Remove nut (2), and washers (3), remove brace assembly (8), by sliding clevis (5), out of trunnion lug.
- (4) Remove brackets (4), from spring (1), and remove clevis (5), pin (6), and pin retainer (7), from brace assembly (8).

B. Disassemble Main Landing Gear Brace Assembly

The main landing gear brace assembly and nose landing gear brace assembly are the same. Refer to Section 32-2-1, Paragraph 9B, and Figure 207 for disassembly procedures.

C. Cleaning, Inspection, and Repair of Main Landing Gear Brace Assembly

Refer to Section 32-2-1, Paragraph 9C.

D. Assemble Main Landing Gear Brace Assembly

Refer to Section 32-2-1, Paragraph 9D, and Figure 207 for assembly procedures, and to Paragraph 5 for adjustments.

E. Install Main Landing Gear Brace Assembly (See Figure 201.)

- (1) Preassemble brace assembly (8), with bracket (4), clevis (5), Pin (6), and pin retainer (7). Install clevis through pin retainer, trunnion lug, and bracket (4).
- (2) Install bracket (4), washer (3), nut (2), and spring (1).
- (3) Install actuator (13), into brace lug, position washers (32 and 33) on each side of actuator end and install bolt (31), spacer (30), washer (29), and nut (28).
- (4) Install main landing gear support tube. Refer to Paragraph 3C of this section.

5. Main Landing Gear Side Brace Prerigging Procedures (See Figures 203 and 204.)

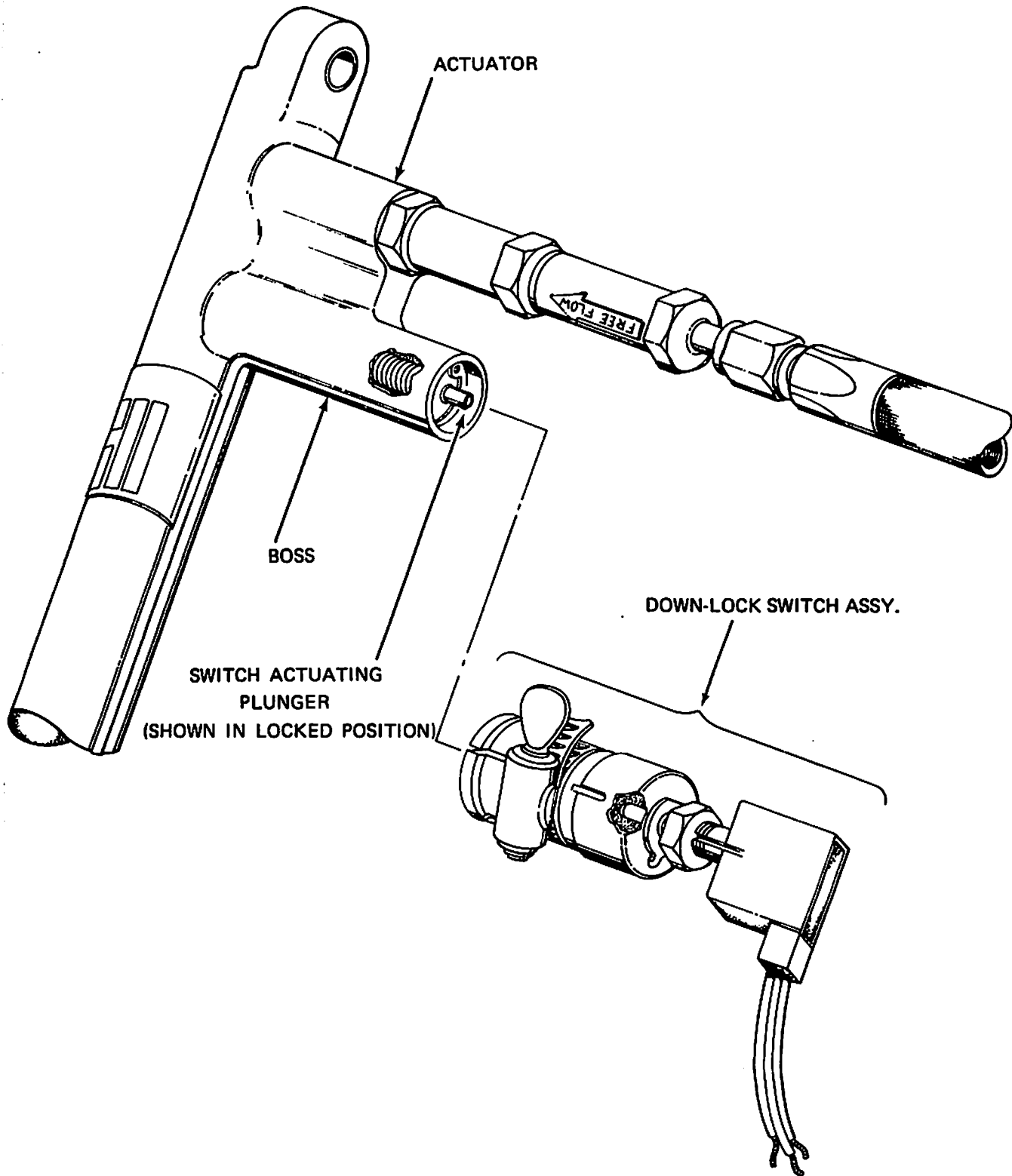
If either main landing gear has been removed from the aircraft, the side brace assembly over center adjustment should be made on the bench before the side brace assembly is installed. It is essential that the side brace over center adjustment be made properly to ensure a locked condition when the gear descends.

- A. Remove lockwire (14, Figure 204), loosen locknut (1), and make sure bolt (2) will turn freely. Position the brace over center locating template, Part Number 7YL10002LT, as shown (8, Figure 204). Place the side brace in an over center position so that the two pins on the template can be inserted into the locator holes (9 and 10) in the side brace.

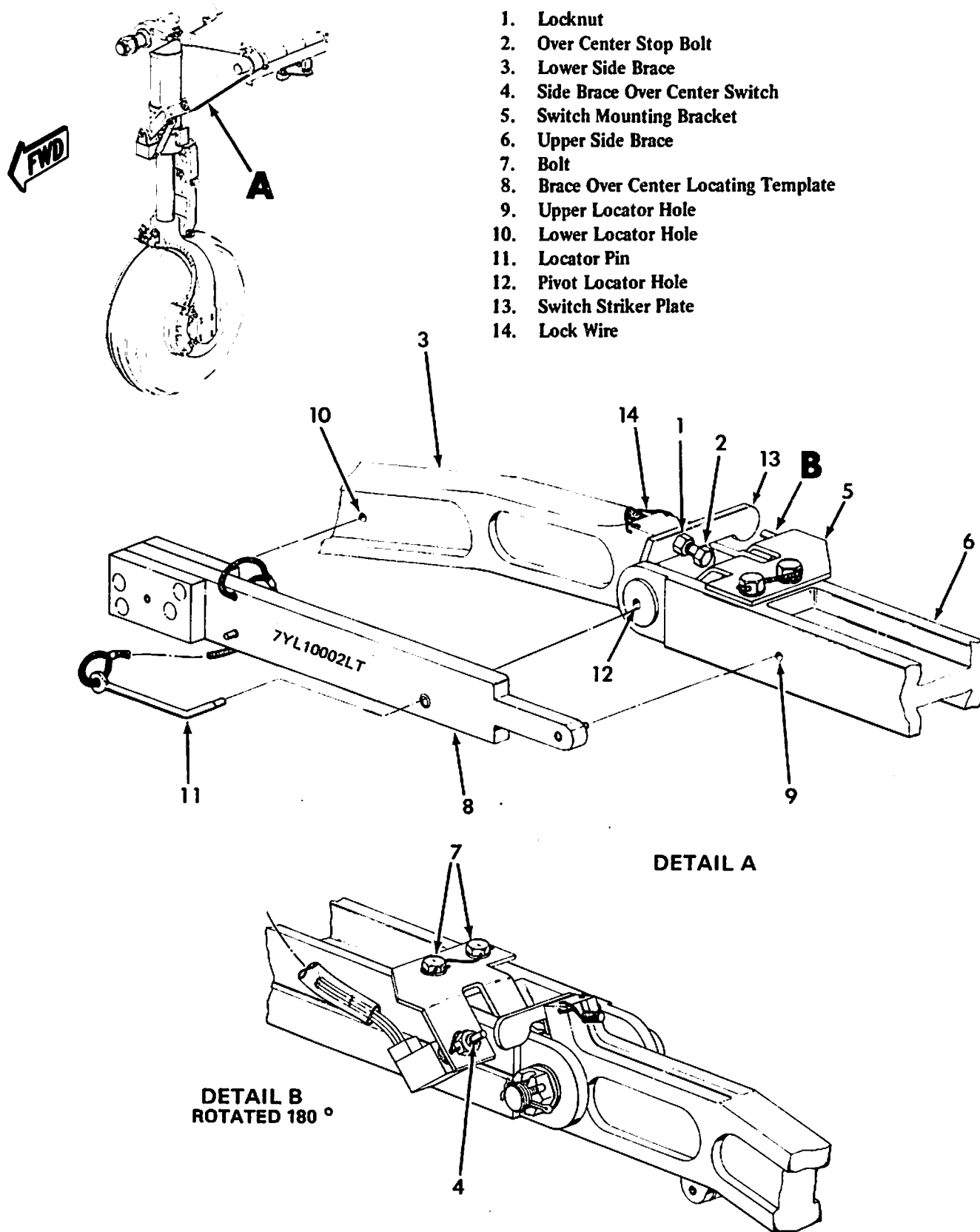
CAUTION: AVOID THE USE OF EXCESSIVE FORCE TO THE SIDE BRACE WITH THE LOCATING TEMPLATE INSTALLED.

NOTE: The side brace over center locating template is designed for use in all three landing gear side braces and must be oriented properly for each gear. Read the instructions on the template to determine which side of the template goes out (toward the observer), and remember that the thick end of the template always goes against the lower side brace (3, Figure 204).

- B. Adjust bolt (2) as required so that the bolt head contacts switch mounting bracket (5) firmly. Apply 10 pounds of force to the pivot in an over center direction, install template, and adjust bolt (2) as required so that the locator pin (11) can be installed through hole in template (8) and into hole (12) in pivot bolt.



**Main Landing Gear Down and Locked Switch Installation
Figure 203**



**Main Landing Gear Side Brace Installation
Figure 204**

- NOTE:** When the adjustment is made properly, the locator pin (11) will pass in and out of the hole (12) freely without shaking or force being necessary.
- C. Release the force and remove template. Without disturbing setting of bolt (2), make sure switch striker plate (13) is in position against lower side brace (3), and tighten locknut (2) securely.
 - D. Apply 10 pounds of force to the pivot in an over center direction, and install over center locating template. Locator pin (11) should pass freely through template and into hole (12) without shaking or force being necessary.
 - E. Repeat Steps A through D above as necessary to obtain proper side brace over center rigging. Install lockwire.

NOTE: If a brace over center locating template is not available, adjust setting of bolt (2, Figure 204) as required to obtain a 0.170 inch to 0.190 inch over center condition on side brace. This must be accomplished on the bench only.

6. Main Landing Gear Rigging Procedures

NOTE: The landing gear must be carefully rigged to ensure proper powered operation, and to ensure free fall to the down and locked position in the event of power failure. Perform all of the procedures below in the order indicated, then perform an operational check to make sure the landing gear is operating properly.

A. Side Brace Alignment

With the landing gear installed on the aircraft, it is necessary to make sure no misalignment or other cause for binding exists so that the landing gear will free fall to the down and locked position.

- (1) Jack the aircraft in accordance with Chapter 7. Remove cotter pin (9, Figure 201), nut (10), washer (11) and bolt (12). Store or tie actuator (13) out of the way.
- (2) Loosen locknuts on over center switch (4, Figure 204). Back switch out until switch plunger is not contacted by striker plate (13) with the side brace in the over center position. Using 16 pounds of force, swing side brace back and forth over center to be sure no binding exists. Any cause for binding must be located and corrected before proceeding.

NOTE: If the main landing gear side brace prerigging procedures (Paragraph 5 above) have been accomplished on the bench before installation, the procedures in B (1) through (3) below may be omitted.

B. Side Brace Over Center Adjustment

With the landing gear properly installed on the aircraft, accomplish the following:

- (1) Remove lock wire (14, Figure 204), loosen locknut (1) and make sure bolt (2) will turn freely. Position the brace over center locating template, Part Number 7YL10002LT, as shown (8, Figure 204). Place the side brace in an over center position so that the two pins on the template can be inserted into the locator holes (9 and 10) in the side brace.

CAUTION: AVOID THE USE OF EXCESSIVE FORCE TO THE SIDE BRACE WITH THE LOCATING TEMPLATE INSTALLED.

NOTE: The brace over center locating template is designed for use in all three landing gear side braces and must be oriented properly for each gear. Read the instructions on the template to determine which side of the template goes out (toward the observer), and remember that the thick end of the template always goes against the lower side brace (3, Figure 204).

- (2) Adjust bolt (2) as required so that the bolt head contacts switch mounting bracket (5) firmly. With template installed in holes (9 and 10), adjust bolt (2) as required so that the locator pin can be installed through hole in template and into hole (12) in pivot bolt.

NOTE: If the adjustment is made properly, the locator pin (11) will pass in and out of the hole (12) freely without shaking or force being necessary.

- (3) Remove template. Without disturbing setting of bolt (2), make sure switch striker plate (13) is in position against lower side brace (3), and tighten locknut (1) securely.
- (4) Check over center rigging by installing template. Locator pin must pass in and out of pivot locator (12) freely.
- (5) Repeat Steps (1) through (4) above as necessary to obtain proper side brace over center rigging. Install lock wire.

C. Side Brace Over Center Switch Adjustment

- (1) Locate side brace over center switch (4, Figure 204) and trace wiring to connector at upper end of strut. Connect an ohmmeter or other continuity tester to pins 4 and 7.
- (2) With side brace in over center position, and head of over center stop bolt (2) firmly against switch mounting bracket (5), adjust side brace over center switch (4) toward switch striker plate (13) until a continuity indication is obtained. Adjust switch an additional 0.030 to 0.040 inch toward striker plate and tighten locknuts. Remove continuity tester and install connector.

D. Landing Gear Actuator Down and Locked Adjustment

The following procedure will ensure that the landing gear actuator will lock each time the side brace is over center and the stop bolt is in contact with the switch bracket.

- (1) At landing gear actuator, loosen clamp and remove down-lock switch assembly from boss. (See Figure 203.)

NOTE: Once in the locked condition, the actuator can only be unlocked by applying hydraulic pressure to the gear up port or by disassembling the actuator.

- (2) Rock the piston rod end in and out of the cylinder to make sure the lock pin is seated. A properly seated lock pin will allow the piston rod to be rocked in and out slightly (approximately 0.030 inch), but will prevent the rod from being extended fully. If the piston rod is free, push the rod into the cylinder until a click is heard and the piston rod locks in place. The switch actuating plunger should be protruding slightly or approximately level with the end of the boss, and should not yield to thumb pressure.

- (3) Swing actuator into the normal installation position and check alignment of attach holes in rod end and actuator arm with piston rod held pushed in fully.
- (4) If adjustment is necessary to obtain proper alignment, hold the piston rod with a wrench to prevent turning, and loosen locknut. Adjust rod end (not piston rod) to line up attach holes. With the piston rod held in fully, it should be possible to install and remove bolt (12, Figure 201) freely without binding.
- (5) Install bolt (12), washer (11), and nut (10). Do not install cotter pin (9) at this time.
- (6) Clamp side brace free play measuring jig (Part Number 7YL10004CF for left main gear or Part Number 7YL10004CF-2 for right main gear) to lip of wheel well, adjacent to side brace as shown in Figure 205. Position jig so that adjustment screw can be run out to contact a flat surface on side brace.

NOTE: Do not displace the side brace with the adjustment screw. Run the adjustment screw out far enough to make contact with the side brace, but not far enough to move it. Secure adjustment screw in place by tightening wing nut.

- (7) Apply 20 pounds of pressure to side brace, parallel to center line of adjustment screw as indicated by arrow shown in Figure 205. While maintaining pressure, use the go, no-go gauge or feeler gauges to determine the gap between the end of the adjustment screw and the side brace. The "go" end should pass through gap, the "no-go" end should not.

NOTE: If feeler gauges are used, the gap tolerance is 0.100 inch to 0.120 inch.

- (8) If the "go" end of the gauge will not pass (gap less than 0.100 inch) or the brace will not deflect at all, investigate for misalignment, damage, or other causes for binding.
- (9) If the "no-go" end of the gauge will pass (gap more than 0.120 inch), hold the actuator piston rod and loosen the locknut. Rotate piston rod (not rod end) one eighth (1/8) turn or less in a counterclockwise direction to shorten the length of the cylinder. Tighten locknut.

NOTE: One eighth (1/8) turn on piston rod will reduce side brace free play approximately 0.050 inch.

- (10) Repeat Steps (7) through (9) above as required to bring gap within tolerance. Remove Jig.

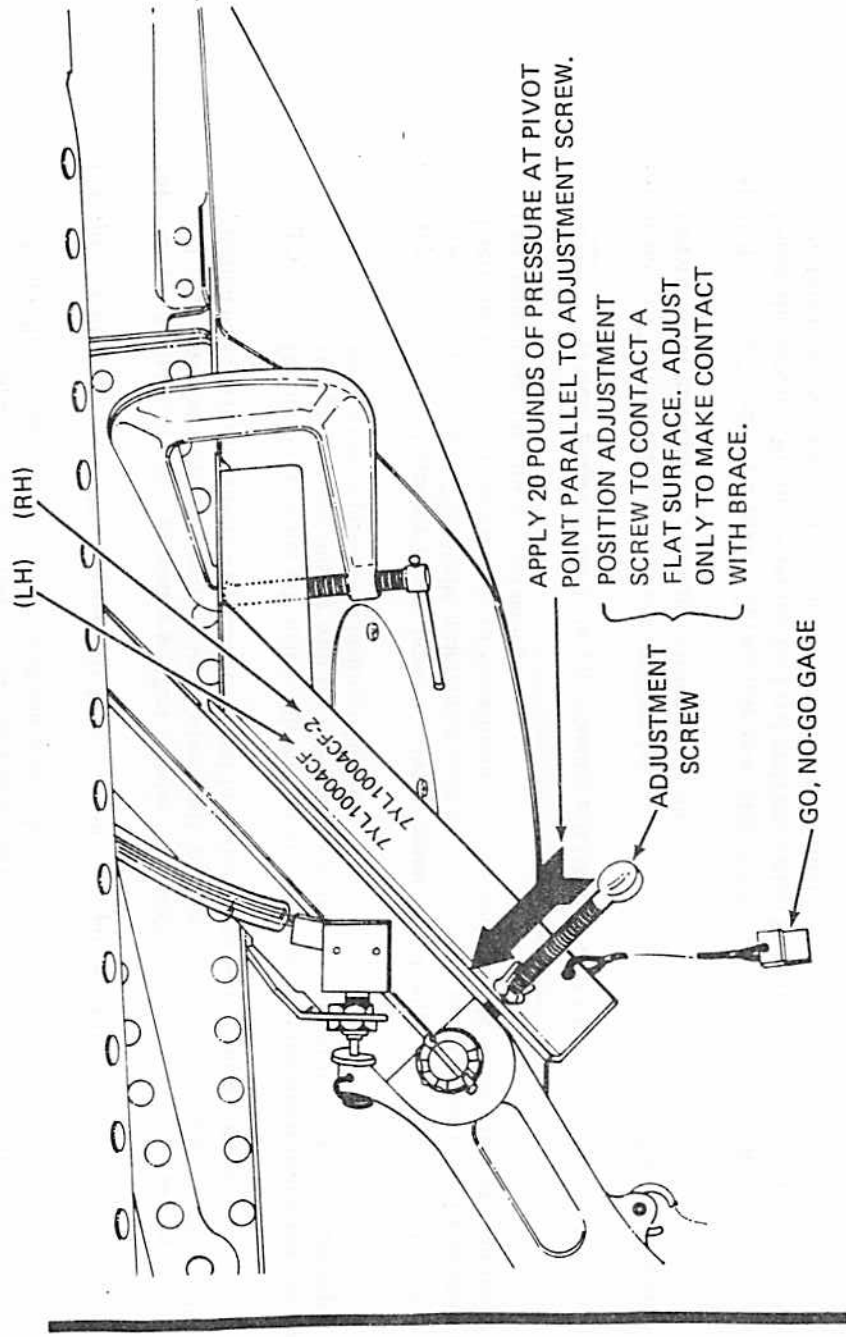
NOTE: Delay installation of the down-lock switch (Figure 203) until after the procedures below and a successful operational check (Paragraph 7 below) have been performed.

E. Squat Switch Adjustment (Left Main Gear)

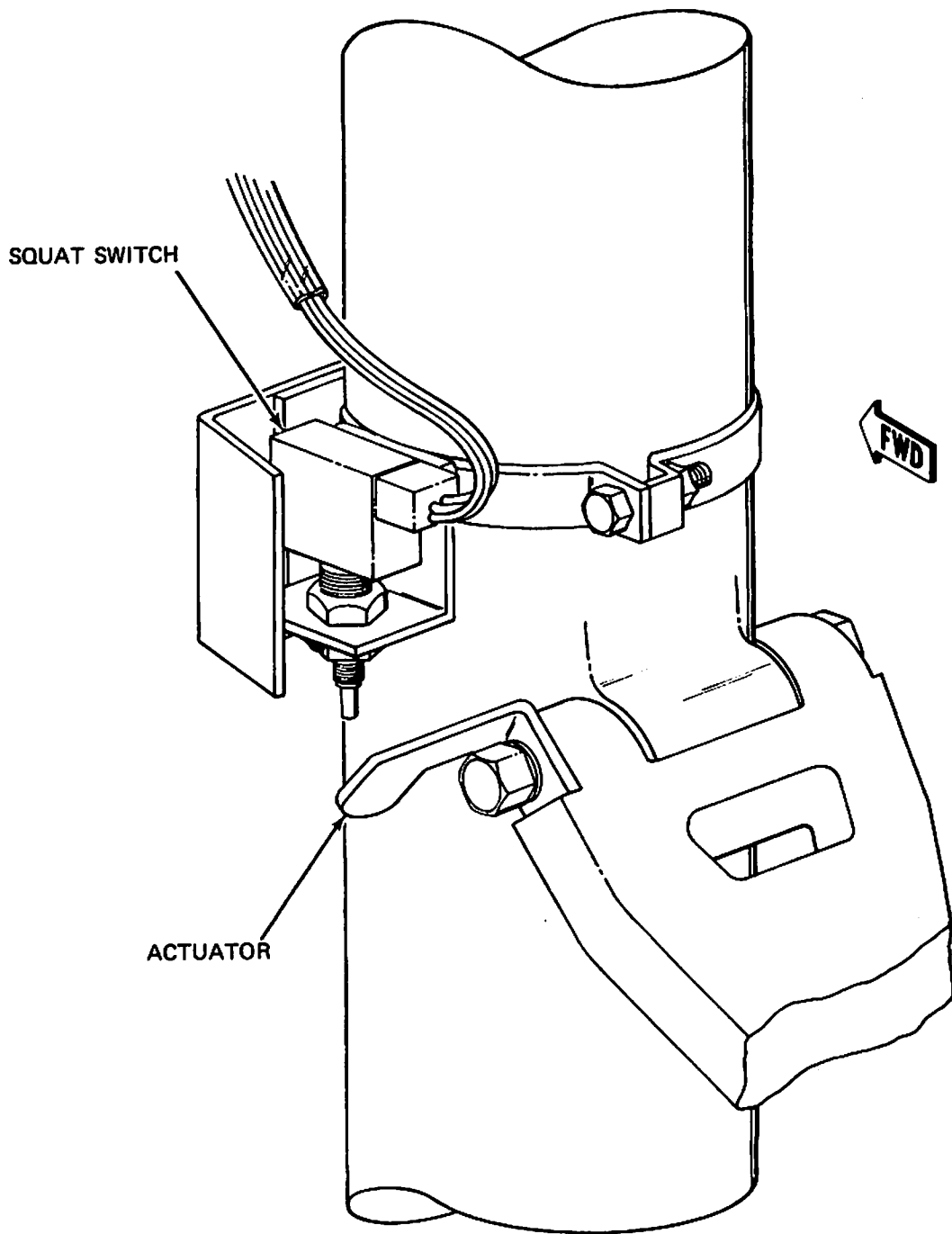
- (1) Locate squat switch (Figure 206) and trace wiring to connector at strut upper end. Connect an ohm-meter or other continuity tester to pins 11 and 14.

NOTE: The aircraft must be jacked clear of the ground (refer to Chapter 7) and the strut must be serviced to ensure it is fully extended before making any squat switch adjustments. Refer to Chapter 12 for servicing instructions.

- (2) Measure distance from bottom strut barrel to top of block holding fork. Distance should be 7.5 inches.



Side Brace Free Play Measuring Tool
Figure 205



Note: The Scissors and Actuator are shown with the Oleo Strut compressed (Aircraft on ground) for clarity.

Main Landing Gear Squat Switch Installation
Figure 206

- (3) Loosen switch locknuts and back switch off until plunger is free of striker plate.
- (4) Adjust switch toward striker plate until a continuity reading is obtained. Adjust switch toward stiker an additional 0.03 to 0.06 inch and tighten locknuts. Remove continuity tester leads and install connector.

F. Up Stop Adjustment

NOTE: Adjustment of the up stop requires adjustment of the up position switch and the wheel well door per Steps G and H below.

NOTE: Do not rotate piston or rod end in cylinder.

- (1) Remove nut (10, Figure 201), washer (11) and bolt (12). Tie or store actuator (13) out of the way while performing the following operations.
- (2) Loosen two bolts holding phenolic pad and shims sufficiently to allow fore and aft movement of the pad for adjustment check. Check to be sure a nominal thickness of 0.064 inch (two shims) is installed.
- (3) Loosen locknuts on up position switch and back off switch 2 or 3 turns on locknuts.
- (4) Disconnect main gear door closing link from bolt eye on outboard side of gear leg.
- (5) Swing gear by hand to "up" position. As gear reaches "full up," note position of pad. The curved portion of the pad should be centered on the chrome tube of the gear leg. If not, slide pad forward or aft as required to match gear. Mark position of pad. Lower gear. Tighten two bolts holding pad in place. Swing gear to up position again to check that pad is still positioned correctly.
- (6) While holding gear solid against up pad, check tire position relative to wing lower contour. Tire should be parallel to lower contour. If tire is too high, fork will hit top wing skin; if too low, excessive drag in flight will result. If either condition exists, add or subtract shims under pad as required to reposition wheel. Shim stack may be from zero (no shims) to 0.128 inch (four shims) as required. Nominal thickness is 0.064 inch (two shims).

NOTE: Rigging procedures for the wheel well door below require that the actuator be disconnected so that the gear can be raised manually. Leave the actuator disconnected until these procedures have been performed.

- (7) Lower gear and connect door closer link to bolt eye on outboard side of gear leg.
- (8) Adjust up position switch and wheel well door per G and H below.

G. Up Position Switch Adjustment

- (1) With gear down, disconnect connector located near upper end of strut. Connect ohmmeter leads to pins 1 and 2. Obtain a piece of rigid tubing 2 inches in diameter and 3 to 4 inches long.
- (2) While holding the 2-inch-diameter tubing hard against the up pad, adjust the switch downward until the meter shows switch actuation. Adjust switch down another 0.03 to 0.06 inch and tighten locknuts. Remove meter and install connector.

H. Wheel Well Door Adjustments

- (1) Place a piece of modeling clay or similar material, about the size of a marble, at the center of the up pad. Very carefully swing gear toward up position by pushing on tire. Use caution to avoid pinching hands or fingers. As gear reaches near up, go slow and check door to see if door seats before gear reaches up stop pad. If door seats first, stop, as further travel will damage door. Lower gear and check to see what thickness of clay is left between the gear and the pad. This thickness will give an idea of how much to lengthen door closer link.
- (2) Remove bolt holding door closer link to eye bolt on outboard side of gear leg. Loosen locknut holding lower rod end on link. If door seated before strut, lengthen link as required. If strut seated before door, shorten link as required. Temporarily attach link to eye bolt and swing gear to check fit. Door should be a tight fit on lands without showing any distortion.
- (3) Lower gear; tighten locknut on link; install bolt, washer, nut, and cotter pin holding link to eye bolt.
- (4) Swing actuator into position. Install bolt (12, Figure 201), washer (11), nut (10), and cotter pin (9). Perform an operational check per Paragraph 7 below.

I. Wheel Alignment

- (1) With landing gear down and locked, and tires inflated to recommended pressure (Chapter 12), position a straight edge against tires at axle height. Use a carpenter's square to check wheel alignment.
- (2) Using a force of 10 pounds, rock wheel assembly left and right around strut. Misalignment (toe in and toe out), measured at the wheel rim at hub level, must not exceed 0.06 inch in either direction.
- (3) Remove any excess play by installing shim washers between scissors half (52, Figure 202) and either side of yoke (8) and between scissors half (60) and either side of trunnion (62).

7. Operational Check

WARNING: DO NOT PERFORM ANY RIGGING PROCEDURES OR ATTEMPT TO FORCE THE DRAG BRACE OUT OF OVER CENTER POSITION WITH THE AIRCRAFT WEIGHT ON THE LANDING GEAR. JACK THE AIRCRAFT (REFER TO CHAPTER 7) BEFORE ANY TEST OR ADJUSTMENTS ARE MADE ON ANY LANDING GEAR.

NOTE: Landing gear and hydraulic reservoir should be properly serviced (Chapter 12) before operating. Apply grease conforming to MIL-G-7711 to all moving joints not otherwise lubricated. The aircraft must be on jacks (Chapter 7).

A. Preliminary Requirements

- (1) There must be no chafing, binding, or interference between moving parts and aircraft structure.
- (2) With the landing gear fully retracted, all gear doors must be fully seated and faired with the wing or fuselage lower skin. No signs of distortion should be evident.
- (3) With the landing gear in the up position, pull the circuit breaker. Crack the control slightly from the UP position as required to allow the landing gear to descend at a rate of 0.5 to 1 degree per second. All landing gear should descend to the full down and locked condition.

B. Check and Adjustment

- (1) If not previously accomplished, loosen clamp and remove down-lock switch from each actuator. With the actuator in the locked condition, the switch actuating plunger should be level with the end of the tube or protruding slightly as shown in Figure 203. Thumb pressure should not move plunger into tube.

NOTE: Removal of actuator lock switches will not disable normal function of landing gear indicator lights on instrument panel.

- (2) Cycle the landing gear 10 times normally and three times with slow free fall (Step A (3) above).
- (3) At the down and locked position of each cycle, verify that each actuator is in the locked condition by observing that the switch actuating plunger is approximately level with end of tube as shown in Figure 203. Attempt to push the plunger into the tube with thumb pressure to verify that it is locked in position. Also make sure that the over center stop bolt (2, Figure 204) is against the switch mounting bracket (5).
- (4) If any actuator fails to lock, hold the actuator piston rod with a wrench to prevent turning and loosen locknut. Rotate piston rod in a clockwise direction when viewed from rod end to lengthen cylinder as required to obtain a locked condition. Tighten locknut.

NOTE: One eighth turn on piston rod will increase free play approximately 0.050 inch.

- (5) Recheck the drag brace free play (Paragraph 6 D above, Steps (6) through (10) for main gear, and Section 32-2-1, Maintenance Practices, Paragraph 12 D, Steps (6) through (10) for nose gear).
- (6) If adjustments are necessary, cycle the landing gear 10 times normally and three times with slow free fall after the adjustments are made.
- (7) After all cycle tests are completed successfully, place the landing gear in the down and locked condition. Remove nut and washer securing rod end of all three landing gear actuators. With the actuator rod end compressed, it should be possible to remove and install the bolts without binding. This will prove locks are free and will not prevent cylinder from locking.
- (8) Install bolts, washers, nuts, and all cotter pins.

NOTE: Perform Steps (9) through (11) below on each landing gear in turn.

- (9) Trace down-lock switch wiring to connector. Connect an ohmmeter or other continuity tester to pins 3 and 6.
- (10) Install down-lock switch on actuator. Move slowly down tube until the continuity tester indicates that the switch has changed state. Mark the position of the mounting bracket.

NOTE: Repeat Step (10) above as necessary to make sure the position at which the switch changes state has been accurately determined.

- (11) Back the mounting bracket off 0.06 to 0.09 inch from the mark and tighten clamp. Disconnect continuity tester and install connector.
- (12) Cycle the gear (normal mode) one time to make sure the landing gear indicating lights are operating normally.

C. Clearance Check

- (1) Inspect for a minimum 0.100 inch clearance between components of each landing gear and its well, in the fully retracted position, and as the gear enters or leaves the wheel well. Pay particular attention to flexible brake lines, brackets, switches, electrical cable, and other items which protrude from the gear or are routed through the wheel well area.
- (2) Inspect each wheel well interior for deposition of foreign matter, chafing, or other signs of interference between the gear and wheel well. Reposition any interfering components as required to obtain at least 0.100 inch clearance.

NOTE: If the point of interference cannot be readily located, coat the chafed area with chalk, paste lubricant, or other material which rubs off easily. Cycle the gear and look for deposits of the material on adjacent portions of the landing gear.

- (4) Remove bushing (12) from upper link (13).
- (5) On lower link, remove adjusting screw (14), nut (15), and switch striker (16).
- (6) Remove pin (17) and bushings (18, 19, and 20) from lower link (21).

C. Cleaning, Inspection, and Repair of Nose Gear Brace Assembly

- (1) Clean brace assembly and components with a suitable dry cleaning solvent.
- (2) Inspect parts for wear, cracks, nicks, corrosion, proper lubrication, and general condition.
- (3) Repair of the nose gear brace assembly consists of smoothing out minor scratches, nicks, and dents and replacement of defective parts.

D. Assemble Nose Gear Brace Assembly (See Figure 207.)

- (1) On lower link (21), install bushings (20, 19, and 18) and install pin (17).
- (2) Install switch striker (16) with nut (15) and adjusting screw (14).
- (3) In upper link (13), install bushing (12).
- (4) Install switch (11) with jam nut (10), washer (9), and nut (8).
- (5) Install switch bracket (7) with washers (6) and bolts (5).
- (6) Assemble upper and lower links together with pin (4), washer (3), nut (2), and cotter pin (1).

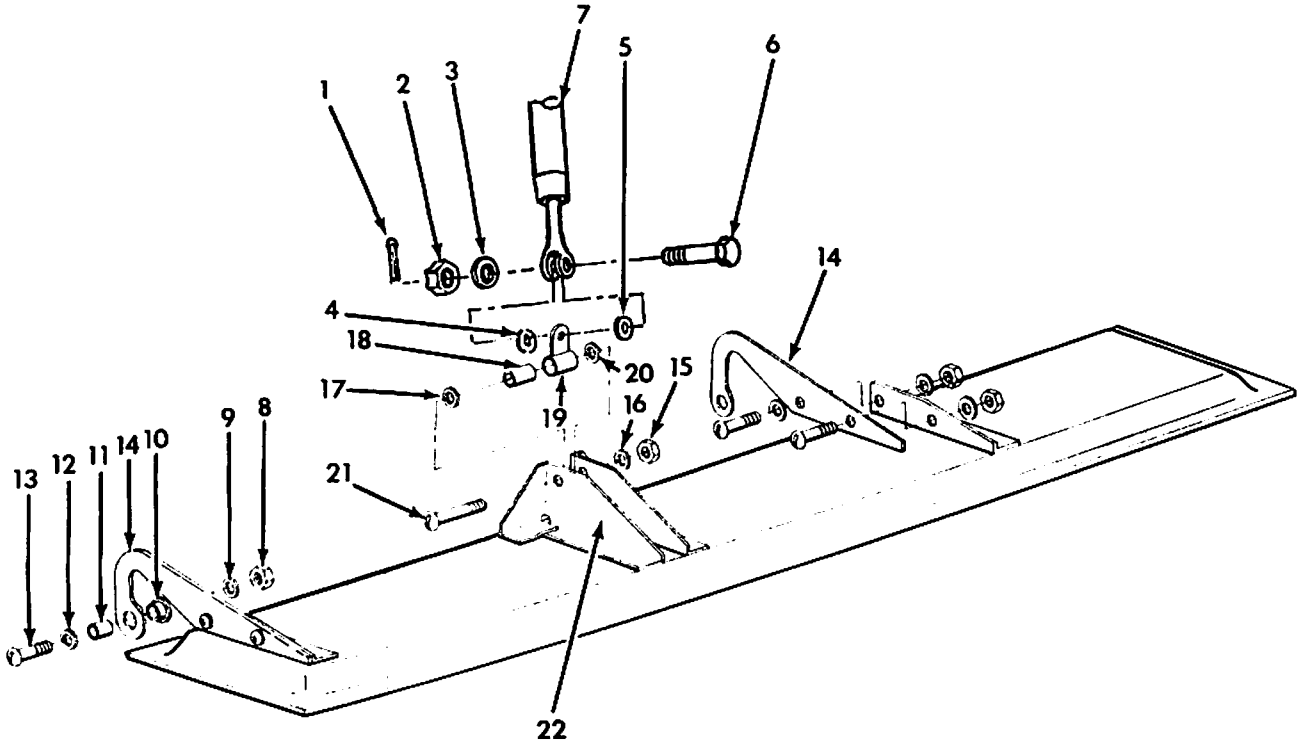
E. Install Nose Gear Brace Assembly (See Figure 201.)

- (1) Position brace assembly (8) on drag link pin and install washers (7), nut (6), and cotter pin (5).
- (2) Connect spring (4) to brace assembly and install nose gear door closer mechanism support tube as described in Paragraph 7.

10. Removal/Installation of Nose Gear Doors

A. Remove Nose Gear Doors (See Figure 208.)

- (1) Disconnect retracting linkage from doors by removing cotter pins (1), nuts (2), washers (3), spacers (4 and 5), and bolt (6) and removing linkage (7) from door.



- | | |
|-----------------------|-------------|
| 1. Cotter Pin | 12. Washer |
| 2. Nut | 13. Bolt |
| 3. Washer | 14. Hinge |
| 4. Spacer | 15. Nut |
| 5. Spacer | 16. Washer |
| 6. Bolt | 17. Washer |
| 7. Retracting Linkage | 18. Spacer |
| 8. Nut | 19. Lug |
| 9. Washer | 20. Washer |
| 10. Bushing | 21. Bolt |
| 11. Spacer | 22. Bracket |

**Nose Landing Gear Door Assembly
Figure 208**

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(2) Remove nuts (8), washers (9), bushings (10), spacers (11), washers (12), and bolts (13) from door hinges (14).

B. Disassemble Lug Assembly (See Figure 208.)

Remove nuts (15), washers (16 and 17), spacer (18), lugs (19), washers (20), and bolts (21) from bracket (22).

C. Assemble Lug Assembly (See Figure 208.)

(1) Place spacers (18) in lugs (19) and position lugs (19) in brackets (22).

(2) Install washers (17 and 20), bolts (21), washers (16), and nuts (15).

D. Install Nose Gear Doors (See Figure 208.)

(1) Place doors in position and install bushings (10) and spacers (11) in door hinges (14).

(2) Install bolts (13), washers (12 and 9), and nuts (8).

(3) Position retracting linkages (7) on lugs (19) and install bolts (6), spacers (5 and 4), washers (3), nuts (2), and cotter pin (1).

E. Nose Gear Doors Adjustments

Refer to Paragraph 7F for adjustments.

11. Nose Landing Gear Side Brace Prerigging Procedures (See Figures 209 and 210.)

If the nose landing gear has been removed from the aircraft, the side brace assembly over center adjustment should be made on the bench before the side brace assembly is installed. It is essential that the side brace over center adjustment be made properly to ensure a locked condition when the gear descends.

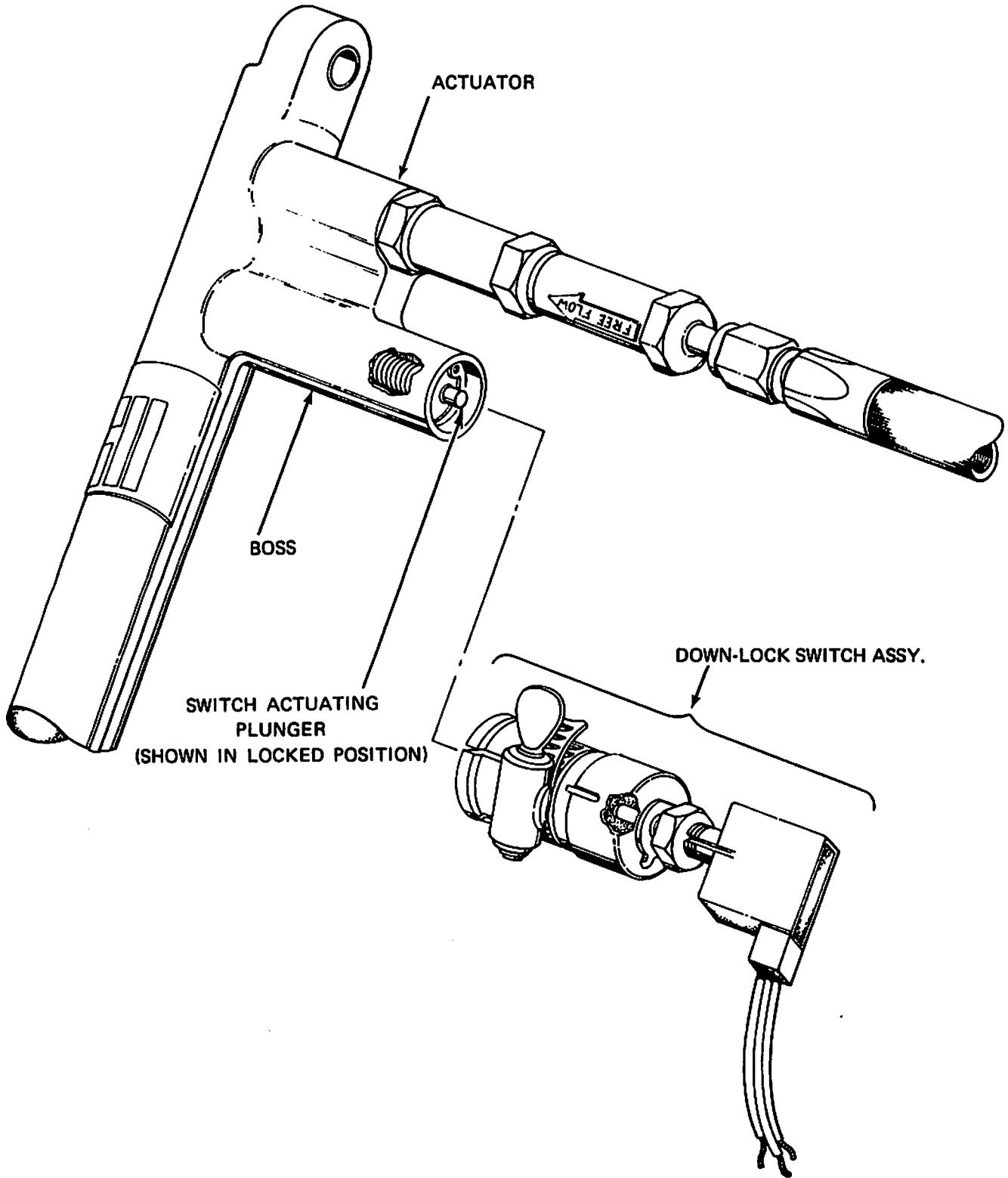
A. Remove lockwire (14, Figure 210) loosen locknut (1), and make sure over center stop bolt (2) will turn freely. Position the brace over center locating template 7YL10002LT as shown (8, Figure 210). Place the side brace in an over center position so that the two pins on the template can be inserted into the locator holes (9 and 10) in the side brace.

CAUTION: AVOID THE USE OF EXCESSIVE FORCE TO THE SIDE BRACE WITH THE LOCATING TEMPLATE INSTALLED. REMOVE TEMPLATE BEFORE MAKING ANY ADJUSTMENTS.

NOTE: The side brace over center locating template is designed for use in all three landing gear side braces and must be oriented properly for each gear. Read the instructions on the template to determine which side of the template goes out (toward the observer), and remember that the thick end of the template always goes against the lower side brace (3, Figure 210).

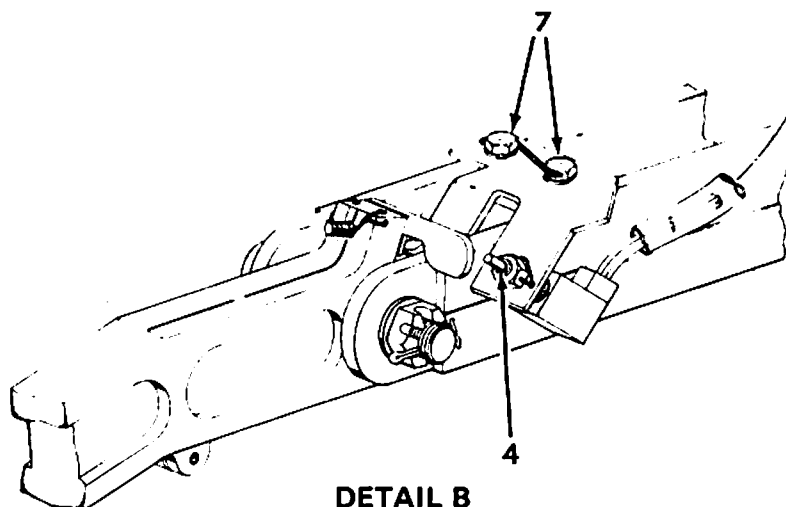
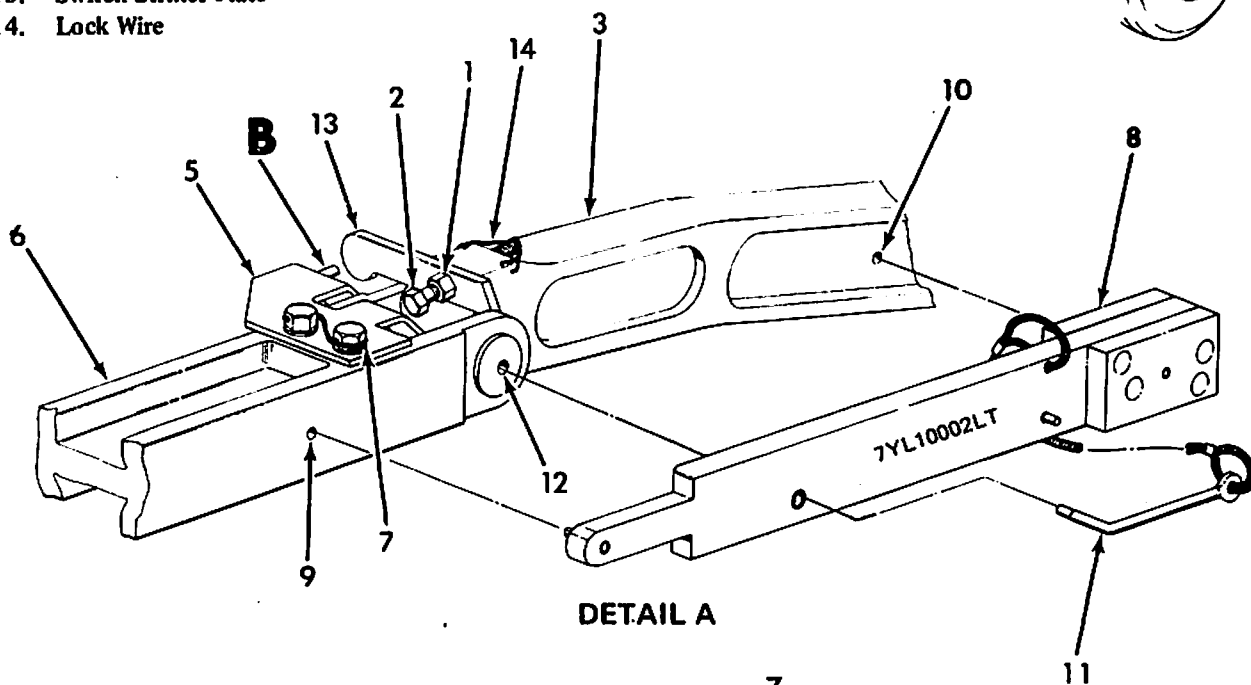
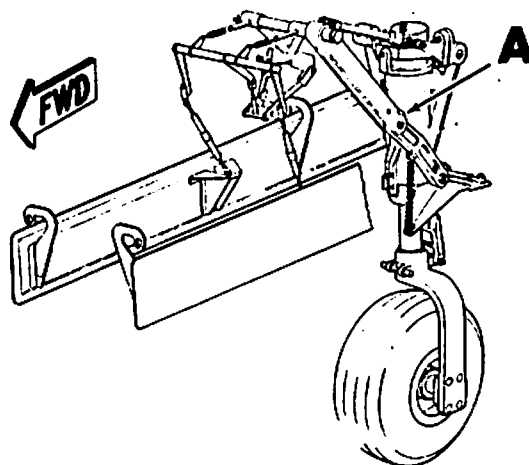
B. Adjust over center stop bolt (2) as required so that the bolt head contacts switch mounting bracket (4) firmly. Apply 10 pounds of force to the pivot in an over center direction, install template, and adjust over center stop bolt (2) as required so that the locator pin (11) can be installed through hole in template (8) and into hole (12) in pivot bolt.

NOTE: When the adjustment is made properly, the locator pin (11) will pass in and out of the pivot locator hole (12) freely without shaking or force being necessary.



**Nose Landing Gear Down and Locked Switch Installation
Figure 209**

1. Locknut
2. Over Center Stop Bolt
3. Lower Side Brace
4. Side Brace Over Center Switch
5. Switch Mounting Bracket
6. Upper Side Brace
7. Bolt
8. Brace Over Center Locating Template
9. Upper Locator Hole
10. Lower Locator Hole
11. Locator Pin
12. Pivot Locator Hole
13. Switch Striker Plate
14. Lock Wire



Nose Gear Brace Installation
Figure 210

- C. Release the force and remove template. Without disturbing setting of bolt (2), make sure switch striker plate (13) is in position against lower side brace (3), and tighten locknut (2) securely.
- D. Apply 10 pounds of force to the pivot in an over center direction, and install over center locating template. Locator pin (11) should pass freely through template and into hole (12) without shaking or force being necessary.
- E. Repeat Steps A through D above as necessary to obtain proper side brace over center rigging. Install lock wire.

NOTE: If a side brace over center locating template is not available, adjust setting of bolt (2, Figure 210) as required to obtain a 0.170 inch to 0.190 inch over center condition on side brace. This must be accomplished on the bench only.

12. Nose Landing Gear Rigging Procedures

NOTE: The landing gear must be carefully rigged to ensure proper powered operation, and to ensure free fall to the down and locked position in the event of power failure. Perform all of the procedures below in the order indicated, then perform an operational check to make the sure the landing gear is operating properly.

A. Side Brace Alignment

With the landing gear installed on the aircraft, it is necessary to make sure no misalignment or other cause for binding exists so that the landing gear will free fall to the down and locked position.

- (1) Jack the aircraft in accordance with Chapter 7. Remove cotter pin (45, Figure 201), nut (46), washer (47), and bolt (48). Store or tie actuator (55) out of the way.
- (2) Loosen locknuts on side brace over center switch (4, Figure 209). Back switch out until switch plunger is not contacted by switch striker plate (13) with the side brace in the over center position. Using 16 pounds of force, swing side brace back and forth over center to be sure no binding exists. Any cause for binding must be located and corrected before proceeding.

NOTE: If the nose landing gear side brace prerigging procedures (Paragraph 11 above) have been accomplished on the bench before installation, the procedures in B (1) through (3) below may be omitted.

B. Side Brace Over Center Adjustment

With the landing gear properly installed on the aircraft, accomplish the following:

- (1) Remove lock wire (14, Figure 210), loosen locknut (1), and make sure bolt (2) will turn freely. Position the brace over center locating template, Part Number 7YL10002LT, as shown (8, Figure 210). Place the side brace in an over center position so that the two pins on the template can be inserted into the locator holes (9 and 10) in the side brace.

CAUTION: AVOID THE USE OF EXCESSIVE FORCE TO THE SIDE BRACE WITH THE LOCATING TEMPLATE INSTALLED.

NOTE: The brace over center locating template is designed for use on all three landing gear side braces and must be oriented properly for each gear. Read the instructions on the template to determine which side of the template goes out (toward the observer), and remember that the thick end of the template always goes against the lower side brace (3, Figure 210).

- (2) Adjust over center stop bolt (2) as required so that the bolt contacts the switch mounting bracket (5) firmly. With template installed in locator holes (9 and 10), adjust bolt (2) as required so that the locator pin can be installed through hole in template and into pivot locator hole (12) in pivot bolt.

NOTE: If the adjustment is made properly, the locator pin (11) will pass in and out of the hole (12) freely without shaking or force being necessary.

- (3) Remove template. Without disturbing setting of bolt (2), make sure switch striker plate (13) is in position against lower side brace (3), and tighten locknut (1) securely.
- (4) Check over center rigging by installing template. Locator pin must pass in and out of pivot bolt hole (12) freely.
- (5) Repeat Steps (1) through (4) above as necessary to obtain proper side brace over center rigging. Install lockwire.

C. Side Brace Over Center Switch Adjustment

- (1) Locate the side brace over center switch (4, Figure 210) and trace wiring to connector at upper end of strut. Connect an ohmmeter or other continuity tester to pins 4 and 7.
- (2) With side brace in over center position, and head of over center stop bolt (2) firmly against switch mounting bracket (5), adjust side brace over center switch (4) toward switch striker plate (13) until a continuity indication is obtained. Adjust switch an additional 0.030 to 0.040 inch toward striker plate and tighten locknuts. Remove continuity tester and install connector.

D. Landing Gear Actuator Down and Locked Adjustment

The following procedure will ensure that the landing gear actuator will lock each time the side brace is over center and the stop bolt is in contact with the switch bracket.

- (1) At the landing gear actuator, loosen clamp and remove the down-lock switch assembly from the boss. See Figure 209.

NOTE: Once in the locked condition, the actuator can only be unlocked by applying hydraulic pressure to the gear up port or by disassembling the actuator.

- (2) Rock the piston rod end in and out of the cylinder to make sure the lock pin is seated. A properly seated lock pin will allow the piston rod to be rocked in and out slightly (approximately 0.030 inch), but will prevent the rod from being extended fully. If the piston rod is free, push the rod into the cylinder until a click is heard and the piston rod locks in place. The switch actuating plunger should be protruding slightly or approximately level with the end of the boss, and should not yield to thumb pressure.
- (3) Swing actuator into the normal installation position and check alignment of attach holes in rod end and actuator arm with piston rod held pushed in fully.

- (4) If adjustment is necessary to obtain proper alignment, hold the piston rod with a wrench to prevent turning, and loosen locknut. Adjust rod end (not piston rod) to line up attach holes. With the piston rod held in fully, it should be possible to install and remove bolt (48, Figure 201) freely without binding.
- (5) Install bolt (48), washer (47), and nut (46). Do not install cotter pin (45) at this time.
- (6) Clamp side brace free play measuring jig, Part Number 7YL10003CF, to aft nose gear door hinges as shown in Figure 211. Position jig so that adjustment screw can be run out to contact a flat surface on side brace.

NOTE: Do not displace the side brace with the adjustment screw. Run the adjustment screw out far enough to make contact with the side brace, but not far enough to move it. Secure adjustment screw in place by tightening wing nut.

- (7) Apply 20 pounds of pressure to side brace, parallel to center line of adjustment screw as indicated by arrow shown in Figure 211. While maintaining pressure, use the go, no-go gauge or feeler gauges to determine the gap between the end of the adjustment screw and the side brace. The "go" end should pass through the gap, the "no-go" end should not.

NOTE: If feeler gauges are used, the gap tolerance is 0.120 inch to 0.140 inch.

- (8) If the "go" end of the gauge will not pass (gap less than 0.120 inch) or the brace will not deflect at all, investigate for misalignment, damage, or other causes for binding.
- (9) If the "no-go" end of the gauge will pass (gap more than 0.140 inch), hold the actuator piston rod and loosen locknut. Rotate piston rod (not rod end) one eighth (1/8) turn or less in a counterclockwise direction to shorten the length of the cylinder. Tighten locknut.

NOTE: One eighth (1/8) turn on piston rod will reduce side brace free play approximately 0.050 inch.

- (10) Repeat Steps (7) through (9) above as required to bring gap within tolerance. Remove jig.

NOTE: Installation of the down-lock switch (Figure 209) should be delayed until after the procedures below and a successful operational check have been performed. Refer to Section 32-1-1, Paragraph 7 for operational check procedures.

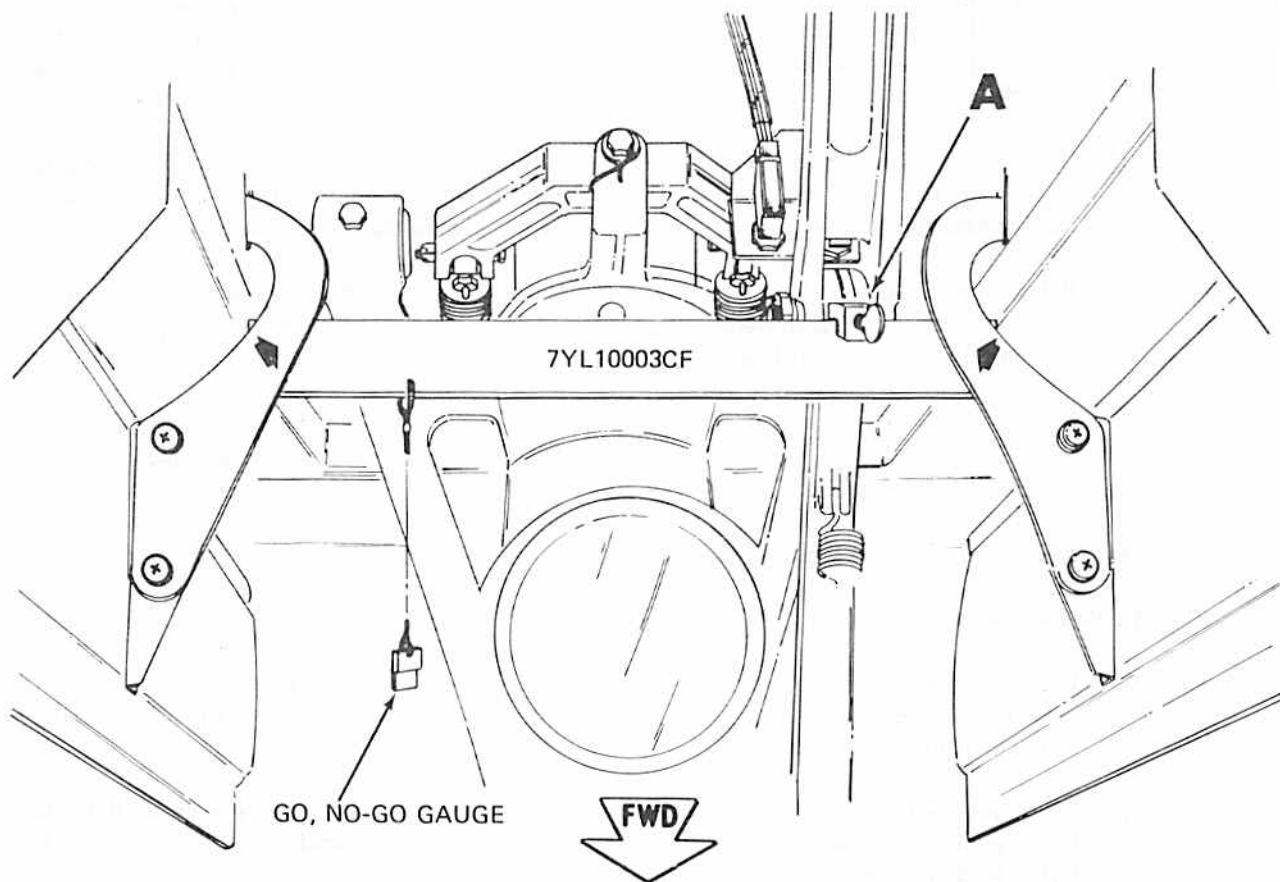
E. Up Stop Block Adjustment

NOTE: Adjustment of the up stop block requires adjustment of the up position switch and the wheel well door per Steps F and G below.

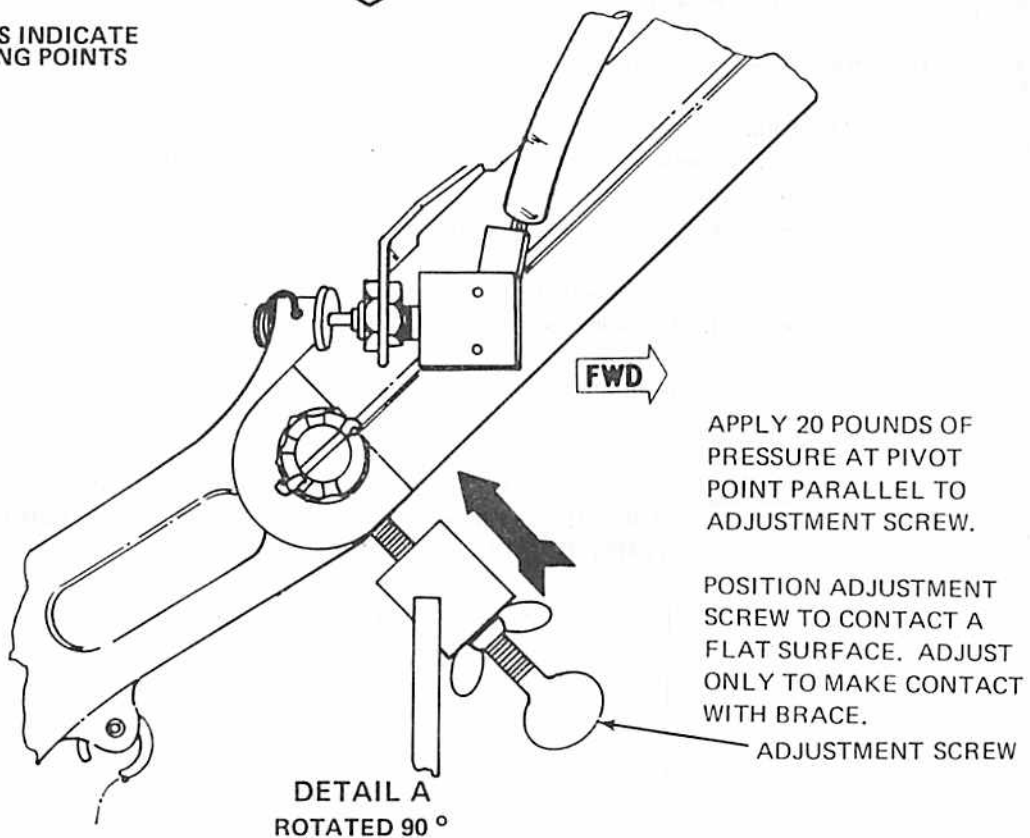
NOTE: Do not rotate piston or rod end in cylinder.

- (1) Remove nut (46, Figure 201), washer (47), and bolt (48). Tie or store actuator out of the way.
- (2) At each nose gear door, remove cotter pin (1, Figure 208), nut (2), washer (3), and bolt (4). Disconnect retracting linkage (7) from door.
- (3) Loosen locknuts and back up position switch out two or three turns.

NOTE: The nose landing gear strut and tire must be fully serviced (Chapter 12) before making any adjustments.



➔ NOTE: ARROWS INDICATE CLAMPING POINTS



APPLY 20 POUNDS OF PRESSURE AT PIVOT POINT PARALLEL TO ADJUSTMENT SCREW.

POSITION ADJUSTMENT SCREW TO CONTACT A FLAT SURFACE. ADJUST ONLY TO MAKE CONTACT WITH BRACE.

Nose Gear Brace Free Play Alignment Tool
Figure 211

- (4) Swing gear by hand to the fully retracted position, noting the position of the gear relative to the up stop block (51, Figure 205). The curved part of the up stop block should be aligned and centered with respect to the oleo assembly. Loosen bolts (49) and reposition up stop block if required. Swing gear into the fully retracted position again to make sure that up stop block is positioned correctly.
- (5) While holding the gear in the fully retracted position, check the gear and tire position relative to the wheel well. The oleo assembly should contact the up stop block, allowing the wheel to spin freely. Close each landing gear door in turn, checking for clearance between the tire and the door.
- (6) If interference exists at top of wheel well, add shims (52, Figure 205) as required to obtain clearance. If interference exists at either door, remove shims as required to obtain clearance. Shim stack may be from no shims to a maximum of four shims.

NOTE: Rigging procedures for the wheel well doors below require that nose gear be raised manually. Leave the actuator and the wheel well door linkage disconnected until the procedure can be performed.

- (7) Adjust up position switch and wheel well doors per Steps F and G below.

F. Up Position Switch Adjustment

- (1) Locate up position switch adjacent to up stop block. Trace wiring to connector adjacent to upper end of strut. Connect an ohmmeter or other continuity tester to Pins 1 and 2. Obtain a piece of rigid tubing 2 inches in diameter and 3 to 4 inches long.
- (2) While holding the tubing flush against the up stop block, adjust the switch downward until the meter indicates switch actuation. Adjust the switch downward an additional 0.03 to 0.06 inch and tighten locknuts. Remove meter and install connector.

G. Wheel Well Door Adjustment

- (1) While holding the nose landing gear against the up block, raise each nose gear door in turn to be sure it fits properly with the fuselage. Mark the position of one door edge in the closed position, then raise the other door to be sure no interference or overlapping exists. Any repairs or alignment must be performed before attempting to adjust the operation of the doors.
- (2) At the left nose gear door, swing retracting linkage (7, Figure 208) into position on door, and secure with bolt (4), washer (3), and nut (2). Do not install cotter pin (1) at this time.
- (3) Form a piece of modeling clay or similar material into a ball about the size of a marble and place it at the center of the depression in the up stop block.

CAUTION: SWING THE GEAR SLOWLY TO AVOID PINCHING THE FINGERS OR OTHER INJURY. IF ANY INTERFERENCE IS NOTED, STOP AND INVESTIGATE. DO NOT ATTEMPT TO FORCE GEAR OR DOORS.

- (4) From the right side of the aircraft, slowly swing the nose landing gear toward the up stop block until the door is seated or the gear is stopped by the up stop block.

- (5) If the door seats first, stop, as further attempts to raise the gear will damage the door. Make sure the door is faired properly with the fuselage. Lower the gear and note the thickness of the clay where it was compressed by the nose gear strut. This thickness will give an idea of how much the linkage (7, Figure 201) should be lengthened.
- (6) If the gear reaches the up stop block before the door is closed, note the width of the gap. This will give some idea of how much the linkage (7, Figure 208) should be shortened.
- (7) Repeat Steps (3) through (6) above until the door is closed properly and securely as the gear reaches the up stop block. The door should be a tight fit, but without any evidence of distortion.
- (8) At the left nose gear door, remove nut (2, Figure 208), washer (3), and bolt (4). Disconnect retracting linkage (7) from door.
- (9) Repeat Steps (2) through (7) above at the right gear door.
- (10) At the left nose gear door, swing retract linkage (7, Figure 208) into position on door, and secure with bolt (4), washer (3), and nut (2). Install cotter pins (1) at both doors.
- (11) Swing nose landing gear actuator into position. Install bolt (48, Figure 201), washer (47), and nut (46). Do not install cotter pin (45).
- (12) Locate the nose gear door down stops on the left and right nose wheel well walls. Adjust the stops as required so that the nose gear doors are parallel to Buttock Line zero and the linkage is 0.09 inch to 0.15 inch over center with the nose landing gear down and locked.
- (13) Perform an operational check. See Section 32-1-1, Maintenance Practices, Paragraph 7.

NOSE LANDING GEAR – DESCRIPTION/OPERATION**1. General**

The nose landing gear consists mainly of a forged trunnion, oleo cylinder, piston and fork assembly, torque links, brace, various seals and seal retainers, nose wheel, and tire assembly. The nose gear is steerable through steering bungees attached between arms connected to the rudder pedal bars and the nose gear strut. The nose gear steering bungees provide nose gear steering through an arc of approximately 20 degrees each side of centerline and allow swiveling the nose gear through approximately 35 degrees with differential braking. When the nose gear retracts, the steering linkage becomes free to pivot so that rudder pedal action is not impeded by the nose gear steering mechanism.

A shimmy dampener is employed to eliminate shimmy effects. Retraction of the nose gear is accomplished with a single hydraulic actuator. The down lock is a hydraulic-mechanical pin lock and overcenter linkage which gives positive locking characteristics and up lock is provided by pressure within the hydraulic actuator.

NOSE LANDING GEAR – MAINTENANCE PRACTICES

1. Removal/Installation of Nose Landing Gear Assembly

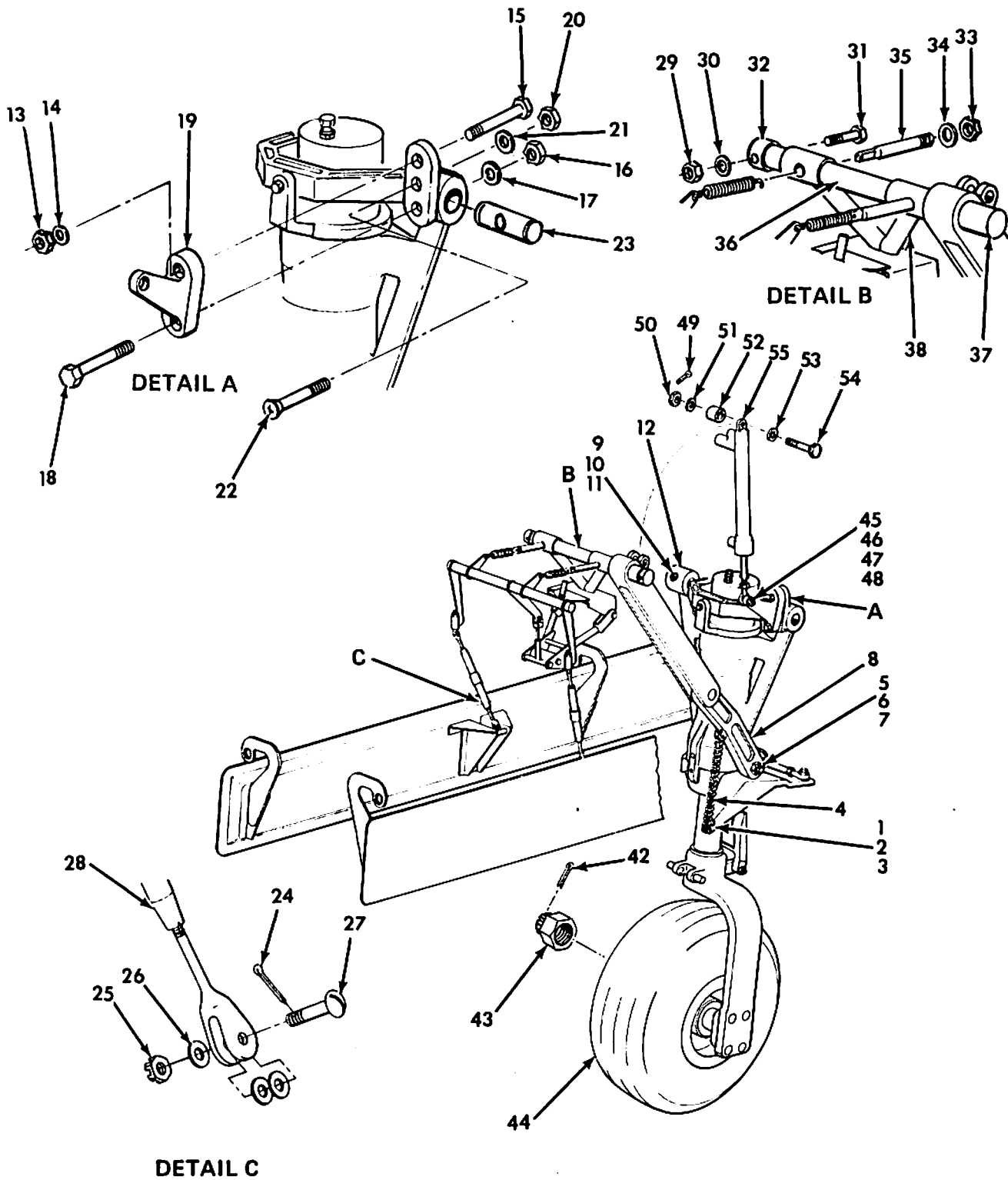
A. Remove Nose Gear Trunnion and Oleo Assembly (See Figure 201.)

NOTE: To gain access to the nose gear trunnion pins, remove access panels from nose baggage compartment floor.

- (1) Place aircraft on jacks and place drip pan beneath gear to catch any spillage of hydraulic fluid.
- (2) Disconnect leads to landing gear light (if installed).
- (3) Disconnect steering linkage from steering arm by removing nut (1, Figure 203), washer (2), and bolt (3).
- (4) Remove cotter pin (1, Figure 201), washer (2), and clevis pin (3) attaching spring (4) to bracket.
- (5) Remove cotter pin (5), nut (6), and washers (7) from brace assembly (8).
- (6) Remove nut (9), washer (10), and bolt (11) from trunnion (12).
- (7) Remove nut (13), washer (14), bolt (15), nut (16), washer (17), and bolt (18). Remove actuator arm (19).
- (8) Remove nut (20), washer (21), and bolt (22) from trunnion (12).
- (9) Working through openings in nose baggage compartment floor, pull pins (23) out of the nose gear support fittings and remove nose gear trunnion and oleo assembly.

B. Disassemble Oleo Assembly (See Figure 202.)

- (1) Release air pressure from oleo through air valve (1) on top of oleo. Remove air valve (1) and O-ring seal (2) from top of oleo and siphon hydraulic fluid into a container.
- (2) Remove nut (3), washer (4), bolt (5), and remove yoke (6).
- (3) Remove nut (7), washer (8), bolt (9), and remove plug (15), orifice tube (14), and piston (26) from inner tube (39).
- (4) Remove retaining ring (10) from bottom of orifice tube and remove orifice (11), bolt (12), and O-ring (13) from orifice tube (14).
- (5) From top of orifice tube (14), remove plug (15), barrel nut (16), backup ring (17), O-ring (18), and stop plate (19).
- (6) From top of piston (26), remove retaining ring (20), bearing (21), and sleeve (22).

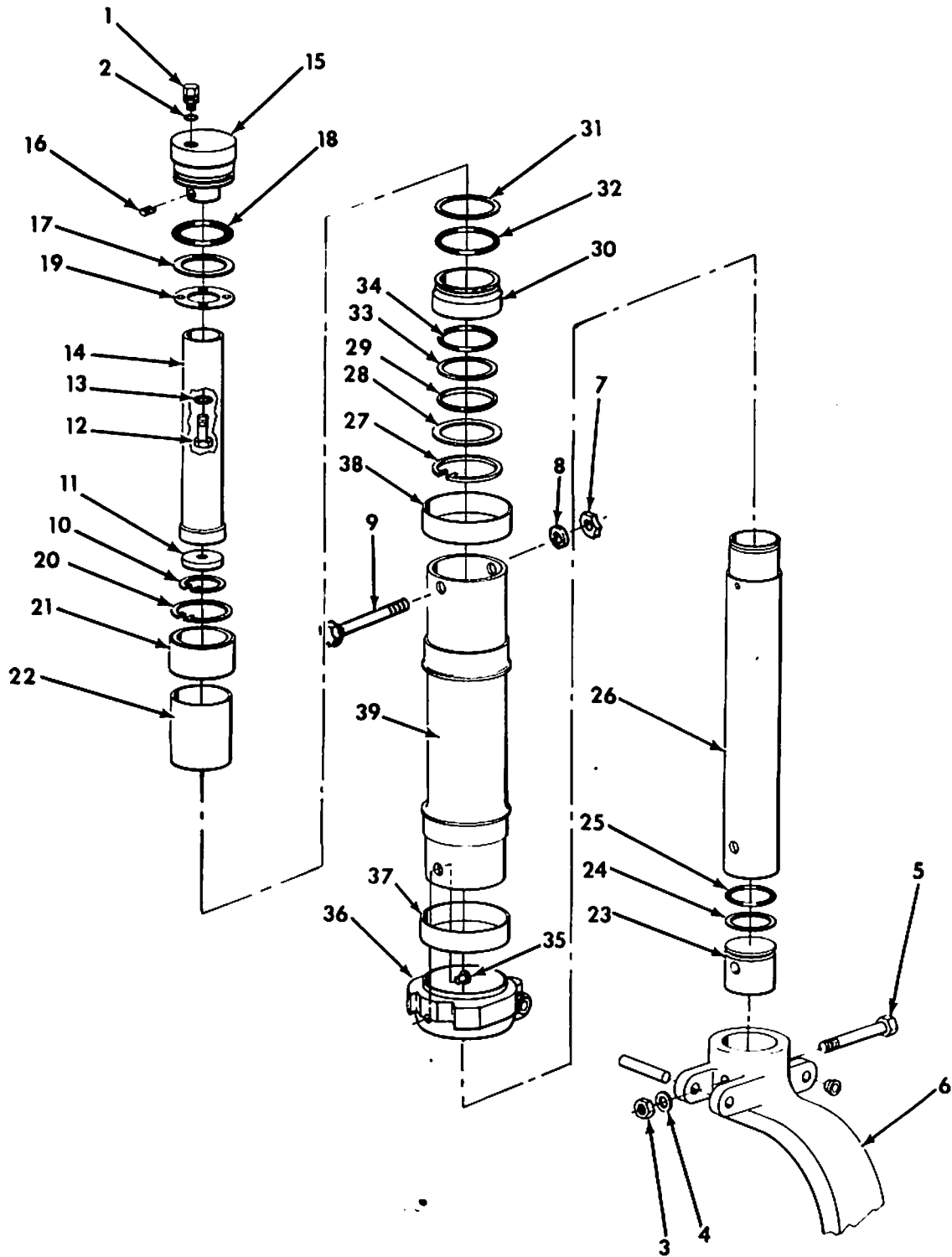


**Nose Landing Gear Assembly
Figure 201 (Sheet 1 of 2)**

32G72-3

- | | |
|-------------------------|---------------------------|
| 1. Cotter Pin | 29. Nut |
| 2. Washer | 30. Washer |
| 3. Clevis Pin | 31. Bolt |
| 4. Spring | 32. Collar |
| 5. Cotter Pin | 33. Nut |
| 6. Nut | 34. Washer |
| 7. Washers | 35. Eye Bolt |
| 8. Brace Assembly | 36. Support Tube |
| 9. Nut | 37. Spacer |
| 10. Washer | 38. Up Stop Link Assembly |
| 11. Bolt | 39. Not Used |
| 12. Trunnion Assembly | 40. Not Used |
| 13. Nut | 41. Not Used |
| 14. Washer | 42. Cotter Pin |
| 15. Bolt | 43. Nut |
| 16. Nut | 44. Wheel Assembly |
| 17. Washer | 45. Cotter Pin |
| 18. Bolt | 46. Nut |
| 19. Actuator Arm | 47. Washer |
| 20. Nut | 48. Bolt |
| 21. Washer | 49. Cotter Pin |
| 22. Bolt | 50. Nut |
| 23. Pin | 51. Washer |
| 24. Cotter Pin | 52. Spacer |
| 25. Nut | 53. Washer |
| 26. Washer | 54. Bolt |
| 27. Bolt | 55. Actuator |
| 28. Turnbuckle Assembly | |

Nose Landing Gear Assembly
Figure 201 (Sheet 2 of 2)



Nose Gear Oleo Assembly
Figure 202 (Sheet 1 of 2)

32G72-4

- | | |
|--------------------|--------------------|
| 1. Air Valve | 21. Bearing |
| 2. O-ring | 22. Sleeve |
| 3. Nut | 23. Plug |
| 4. Washer | 24. Backup Ring |
| 5. Bolt | 25. O-ring |
| 6. Yoke | 26. Piston |
| 7. Nut | 27. Retaining Ring |
| 8. Washer | 28. Spacer |
| 9. Bolt | 29. Scraper |
| 10. Retaining Ring | 30. Bearing |
| 11. Orifice | 31. Backup Ring |
| 12. Bolt | 32. O-ring |
| 13. O-ring | 33. Backup Ring |
| 14. Orifice Tube | 34. O-ring |
| 15. Plug | 35. Collar Pin |
| 16. Barrel Nut | 36. Collar |
| 17. Backup Ring | 37. Inner Race |
| 18. O-ring | 38. Inner Race |
| 19. Stop Plate | 39. Inner Tube |
| 20. Retaining Ring | |

**Nose Gear Oleo Assembly
Figure 202 (Sheet 2 of 2)**

- (7) From bottom of piston (26), remove plug (23), backup ring (24), and O-ring (25).
- (8) Remove retaining ring (27), spacer (28), and scraper (29) from inner tube and remove bearing (30).
- (9) Remove backup ring (31), O-ring (32), backup ring (33), and O-ring (34) from bearing (30).
- (10) From inside of inner tube, remove collar pin (35) and collar (36). Remove inner races (37 and 38) from inner tube (39).

C. Cleaning, Inspection, and Repair of Oleo Assembly

- (1) Clean all parts using a suitable dry type cleaning solvent.
- (2) Inspect components for wear, cracks, nicks, corrosion, and overall condition.
- (3) Repair of the oleo assembly consists of smoothing out minor scratches, nicks and dents, and replacement of defective parts.

D. Assemble Oleo Assembly (See Figure 202.)

NOTE: Replace all O-rings during assembly of oleo assembly.

- (1) On inner tube (39), install inner races (38 and 37), collar (36), and collar pin (35).

- (2) Install O-ring (34), backup ring (33), O-ring (32), and backup ring (31) on bearing (30).
- (3) Install bearing (30), scraper (29), spacer (28), and retaining ring (27).
- (4) In piston (26), install O-ring (25), backup ring (24), and plug (23).
- (5) From top of piston (26), install sleeve (22), bearing (21), and retainer ring (20).
- (6) Install O-ring (18), backup ring (17), and barrel nut (16) on plug (15). Place stop plate (19) and plug (15) on top of orifice tube (14).
- (7) From bottom of orifice tube (14), install O-ring (13), bolt (12), orifice (11), and retaining ring (10).
- (8) Place assembled piston and orifice tube in inner tube. Align holes in top of inner tube and plug (15) and install bolt (9), washer (8), and nut (7).
- (9) Place yoke (6) in position on bottom of piston (26) and install bolt (5), washer (4), and nut (3).
- (10) Fill strut with MIL-H-5606 hydraulic fluid. Refer to Chapter 12 for servicing. Install O-ring (2) and air valve (1). Inflate strut to 90 psi.

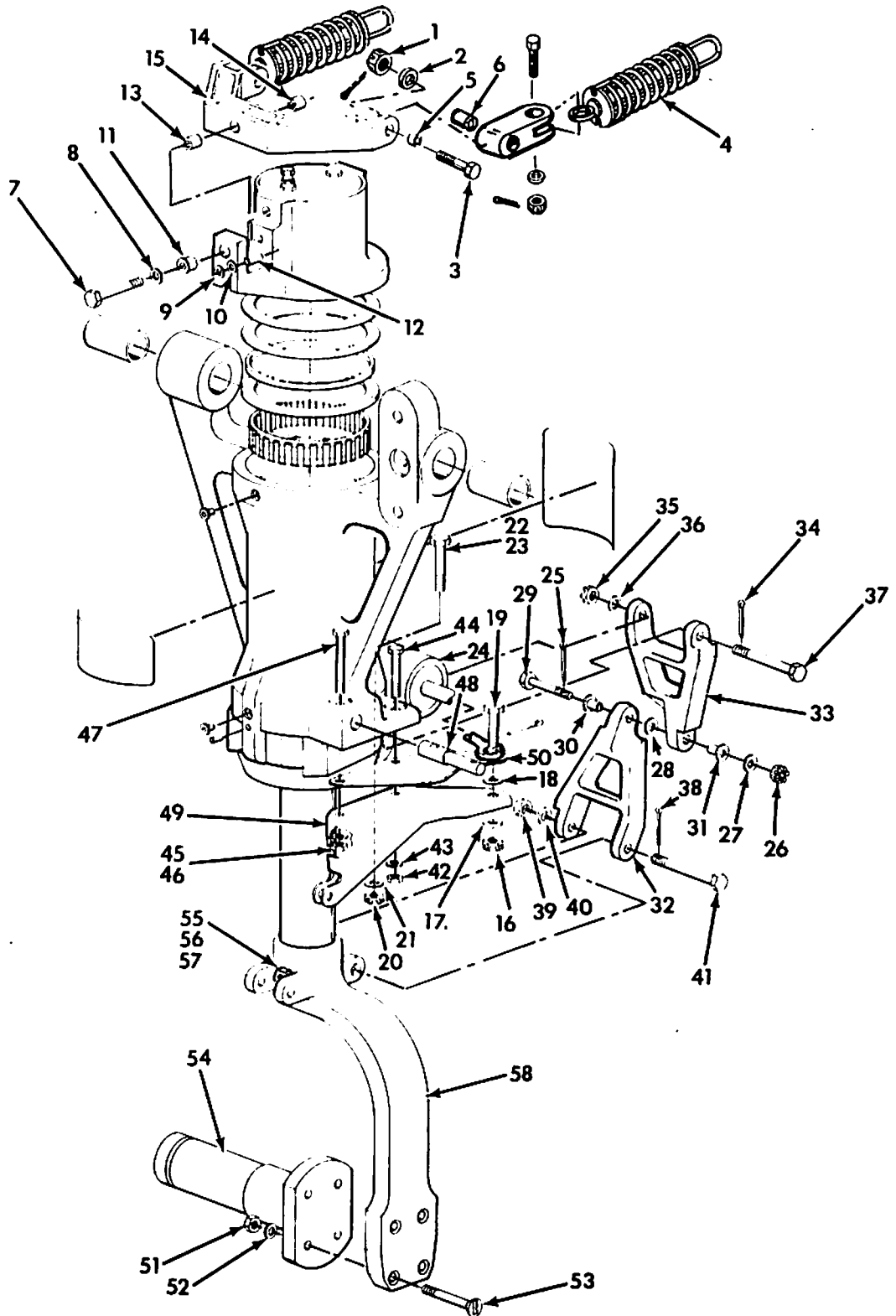
E. Install Trunnion and Oleo Assembly (See Figure 201.)

- (1) Place trunnion and oleo assembly in position in wheel well and align mounting holes in trunnion with mount fitting holes in wheel well.
- (2) Working through access openings in nose baggage compartment floor, install pins (23) through wheel well fittings into trunnion and align holes in pins with holes in trunnion.
- (3) Install bolt (22), washer (21), nut (20), actuator arm (19), bolt (18), washer (17), nut (16), bolt (15), washer (14), and nut (13).
- (4) On other side of trunnion (12), install bolt (11), washer (10), and nut (9).
- (5) Attach brace (8) to trunnion bracket by installing washers (7), nut (6), and cotter pin (5).
- (6) Attach spring (4) to trunnion bracket by installing clevis pin (3), washer (2), and cotter pin (1).

2. Removal/Installation of Nose Gear Steering Arm Assembly

A. Remove Nose Gear Steering Arm Assembly (See Figure 203.)

- (1) Remove nut (1), washer (2), bolt (3), bungee (4), bearing (5), and bearing (6) from each end of steering arm (15).
- (2) Remove safety wire and remove bolt (7), washers (8, 9, and 10), and bearings (11, 12, 13, and 14). Remove steering arm (15).



**Trunion and Oleo Assembly
Figure 203 (Sheet 1 of 2)**

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- | | |
|----------------------|----------------------|
| 1. Nut | 30. Bearing (Oilite) |
| 2. Washer | 31. Bearing (Oilite) |
| 3. Bolt | 32. Scissor Half |
| 4. Bungee | 33. Scissor Half |
| 5. Bearing (Oilite) | 34. Cotter Pin |
| 6. Bearing (Oilite) | 35. Nut |
| 7. Bolt | 36. Washer |
| 8. Washer | 37. Bolt |
| 9. Washer | 38. Cotter Pin |
| 10. Washer | 39. Nut |
| 11. Bearing (Oilite) | 40. Washer |
| 12. Bearing (Oilite) | 41. Bolt |
| 13. Bearing (Oilite) | 42. Nut |
| 14. Bearing (Oilite) | 43. Washer |
| 15. Steering Arm | 44. Bolt |
| 16. Nut | 45. Nut |
| 17. Washer | 46. Washer |
| 18. Spacer | 47. Bolt |
| 19. Bolt | 48. Drag Link Pin |
| 20. Nut | 49. Bracket |
| 21. Washer | 50. Bracket |
| 22. Washer | 51. Nut |
| 23. Bolt | 52. Washer |
| 24. Shimmy Dampener | 53. Bolt |
| 25. Cotter Pin | 54. Axle |
| 26. Nut | 55. Nut |
| 27. Washer | 56. Washer |
| 28. Spacer | 57. Bolt |
| 29. Bolt | 58. Yoke |

Trunnion and Oleo Assembly
Figure 203 (Sheet 2 of 2)

B. Cleaning, Inspection, and Repair of Nose Gear Steering Arm Assembly

- (1) Clean all parts using a suitable dry type cleaning solvent.
- (2) Inspect components for wear, cracks, nicks, corrosion, proper lubrication, and overall condition.
- (3) Repair of the steering arm consists of smoothing out minor scratches, nicks, and dents and replacement of defective parts.

C. Install Nose Gear Steering Arm Assembly (See Figure 203.)

- (1) Install bearings (14, 13, 12, and 11) in steering arm (15).
- (2) Place steering arm in position at top of trunnion and oleo assembly and install washers (10, 9, and 8) and safetywire bolt (7) to collar.
- (3) Install bearings (5 and 6) in each end of steering arm and connect bungee to steering arm by installing bolts (3), washers (2), and nuts (1).

D. Nose Gear Steering Adjustments

Refer to Chapter 27 (Flight Controls) for information on nose gear steering system adjustments.

3. Removal/Installation of Nose Gear Shimmy Dampener

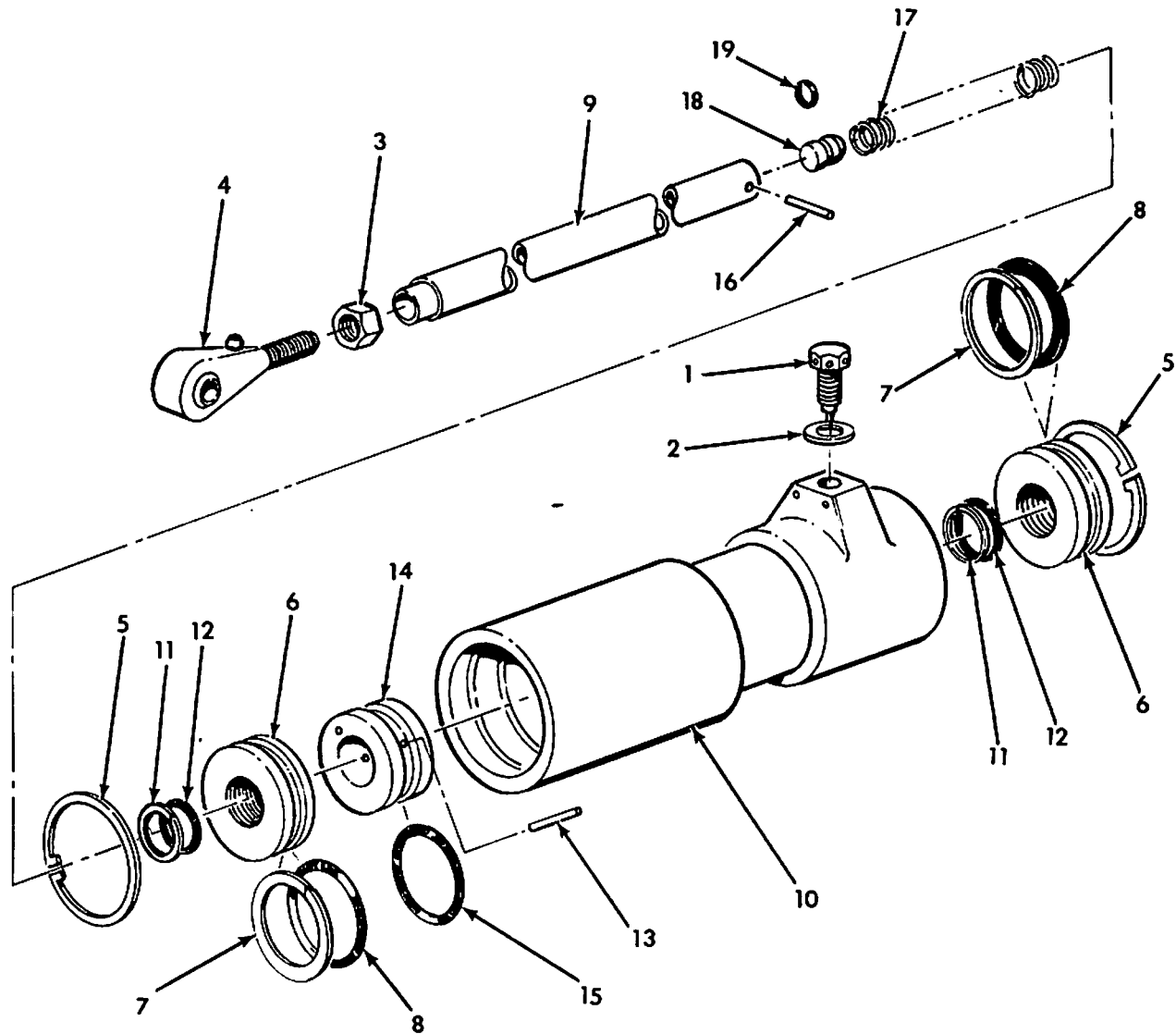
A. Remove Shimmy Dampener (See Figure 203.)

- (1) Remove nut (16), washer (17), spacer (18), and bolt (19) attaching shimmy dampener rod end to trunnion bracket.
- (2) Remove nut (20), washers (21 and 22), and bolt (23). Remove shimmy dampener (24) from nose gear.

B. Disassemble Shimmy Dampener (See Figure 204.)

- (1) Cut safety wire and remove bolt (1) and seal washer (2). Drain fluid into a container.
- (2) Loosen jam nut (3) and remove rod end (4).
- (3) Remove retainer rings (5), bearing heads (6), backup rings (7), and O-rings (8). Remove rod assembly (9) from housing (10).
- (4) Remove backup rings (11) and O-rings (12) from bearing heads (6).
- (5) Remove O-ring (15), pin (13), and piston (14) from rod assembly.
- (6) Cut safety wire and remove pin (16), spring (17), pressure piston (18), and O-ring (19).

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- | | |
|------------------|---------------------|
| 1. Bolt | 11. Backup Ring |
| 2. Seal Washer | 12. O-ring |
| 3. Jam Nut | 13. Pin |
| 4. Rod End | 14. Piston |
| 5. Retainer Ring | 15. O-ring |
| 6. Bearing Head | 16. Pin |
| 7. Backup Ring | 17. Spring |
| 8. O-ring | 18. Pressure Piston |
| 9. Rod Assembly | 19. O-ring |
| 10. Housing | |

Shimmy Dampener Assembly
 Figure 204

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C. Cleaning, Inspection, and Repair of Shimmy Dampener

- (1) Clean all parts using a suitable dry type cleaning solvent.
- (2) Inspect components for wear, cracks, nicks, corrosion, and overall condition.
- (3) Repair of the shimmy dampener consists of smoothing out minor scratches, nicks, and dents and replacement of defective parts.

D. Assemble Shimmy Dampener (See Figure 204.)

NOTE: Replace all O-rings during assembly.

- (1) Install O-ring (19) on pressure piston (18) and install spring (17) and pin (16) in rod assembly.
- (2) Install piston (14) on rod assembly and insert pin (13) through piston (14) and rod (9).
- (3) Install O-ring (15) on piston (14) and place rod assembly in housing (10).
- (4) Install O-rings (12) and backup rings (11) in bearing heads (6) and O-rings (8) and backup rings (7) on bearing heads (6).
- (5) Install one bearing head (6) on the rod end side of the housing (10) and install rod end (4) and jam nut (3) on rod assembly.

NOTE: Service shimmy dampener with MIL-H-5606 hydraulic oil before continuing assembly. Refer to Chapter 12 for servicing instructions.

- (6) During servicing, install second bearing head (6), retainer ring (5), jam nut (3), rod end (4), washer (2), and bolt (1). Safety-wire bolt (1).

E. Install Shimmy Dampener (See Figure 203.)

- (1) Place shimmy dampener (24) in position on nose gear and install bolt (23), washers (22 and 21), and nut (20).
- (2) Align hole in rod end with hole in trunnion bracket and install bolt (19), spacer (18), washer (17), and nut (16).

4. Removal/Installation of Nose Gear Scissors (See Figure 203.)

A. Remove Nose Gear Scissors

- (1) Remove cotter pin (25), nut (26), washers (27 and 28), and bolt (29). Remove bearings (30 and 31) from scissor halves (32 and 33).
- (2) Remove cotter pin (34), nut (35), washer (36), and bolt (37). Remove scissor half (33).
- (3) Remove cotter pin (38), nut (39), washer (40), and bolt (41). Remove scissor half (32).

B. Install Nose Gear Scissors (See Figure 203.)

- (1) Place scissors half (32) in position on yoke lugs and install bolt (41), washer (40), nut (39), and cotter pin (38).
- (2) Place scissors half (33) in position on trunnion lugs and install bolt (37), washers (36), nut (35), and cotter pin (34).
- (3) Install bushings (31 and 30) in scissor halves (33 and 32) and install bolt (29), spacer (28), washer (27), nut (26), and cotter pin (25).

5. Removal/Installation of Nose Gear Bracket Assembly

A. Remove Nose Gear Bracket Assembly (See Figure 203.)

- (1) Disconnect shimmy dampener rod end from bracket assembly.
- (2) Remove nut (42), washer (43), and bolt (44).
- (3) Remove nut (45), washer (46), bolt (47), and pin (48) and remove brackets (49 and 50) from nose gear trunnion assembly.

B. Install Nose Gear Bracket Assembly (See Figure 203.)

- (1) Place nose gear brackets (50 and 49) and pin (48) in position and install bolt (47), washer (46), and nut (45).
- (2) Install bolt (44), washer (43), and nut (42). Connect shimmy dampener rod end to bracket assembly.

6. Removal/Installation of Nose Gear Yoke Assembly

A. Remove Nose Gear Yoke Assembly (See Figure 203.)

- (1) Remove nose gear wheel assembly. Refer to Section 32-3-1.
- (2) Remove nuts (51), washers (52), and bolts (53) and remove axle (54).
- (3) Remove nut (55), washer (56), and bolt (57). Remove yoke (58) from oleo assembly.

B. Install Nose Gear Yoke Assembly (See Figure 203.)

- (1) Place yoke (58) in position on oleo assembly. Align holes and install bolt (57), washer (56), and nut (55).
- (2) Position axle (54) on yoke (58) and install bolts (53), washers (52), and nuts (51).
- (3) Install nose gear wheel assembly. Refer to Section 32-3-1.

7. Removal/Installation of Nose Gear Door Closer Mechanism Assembly**A. Remove Nose Gear Door Closer Mechanism Assembly (See Figure 201.)**

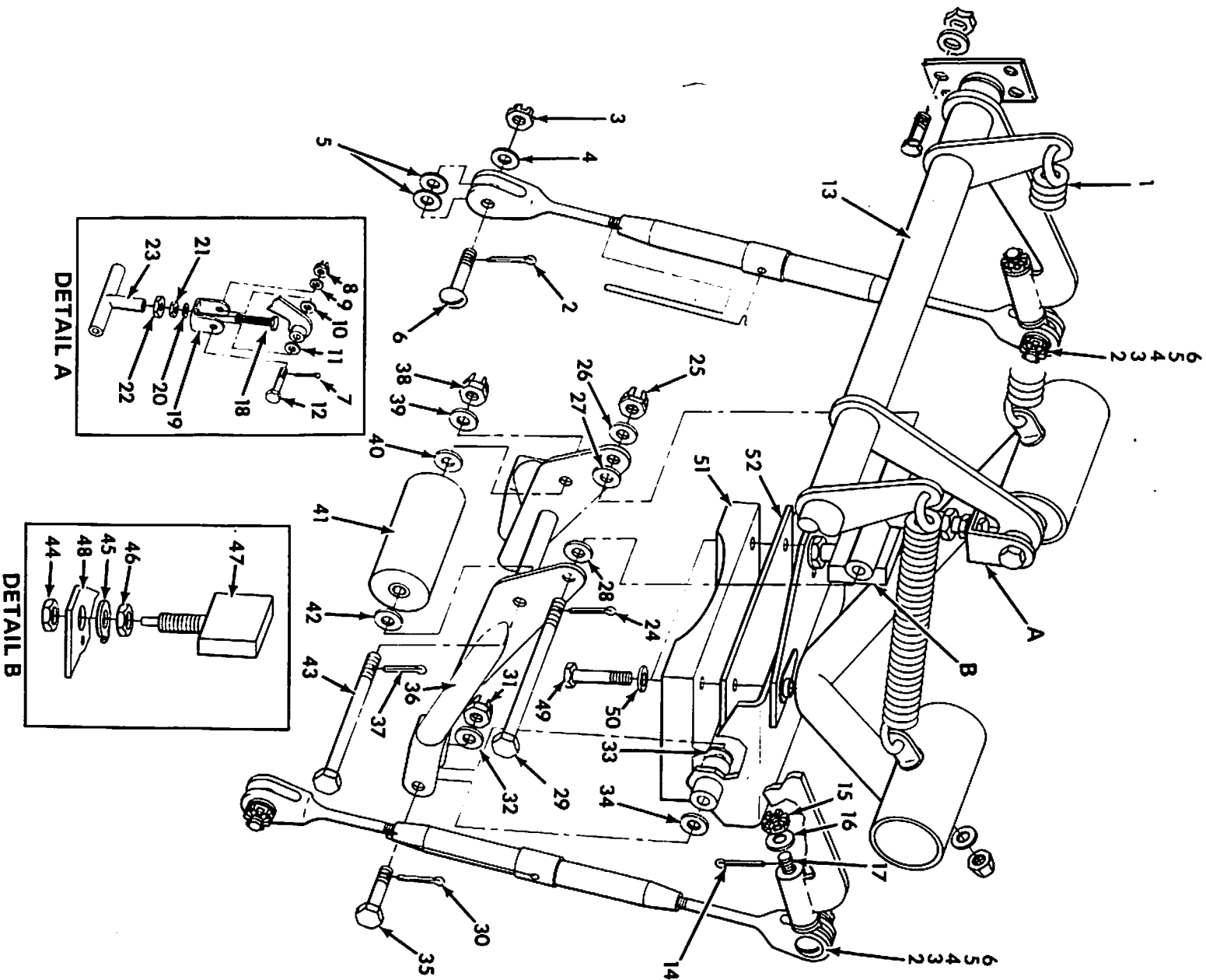
- (1) Disconnect closer mechanism from nose gear door by removing cotter pins (24), nuts (25), washers (26), and bolts (27).
- (2) Working through access in nose baggage compartment floor, remove nut (29), washer (30), and bolt (31).
- (3) Disconnect springs from bolts (35) and remove nuts (33), washers (34), and bolts (35).
- (4) Slide support tube (36) from spacer (37), drag brace (8), and up stop link assembly (38) and remove from wheel well wall.
- (5) Remove bolts, washers, and nuts attaching bellcrank supports to wheel well walls and remove door closing mechanism from wheel well.

B. Disassemble Nose Gear Door Closer Mechanism Assembly (See Figure 205.)

- (1) Remove spring (1) from bellcrank (13).
- (2) Remove cotter pin (2), nut (3), washer (4), washers (5), and bolt (6) and remove turnbuckle assembly.
- (3) Remove cotter pin (7), nut (8), washers (9, 10, and 11), and bolt (12). Remove bellcrank assembly (13).
- (4) Remove cotter pin (14), nut (15), washer (16), and eye bolt (17) from bellcrank (13).
- (5) Remove bolt (18), clevis (19), washer (20), nut (21), nut (22), and tee (23).
- (6) Remove cotter pin (24), nut (25), washers (26, 27, and 28), and bolt (29).
- (7) Remove cotter pin (30), nut (31), washers (32, 33, and 34), and bolt (35) from link assembly (36) and remove link assembly (36).
- (8) Remove cotter pin (37), nut (38), washers (39 and 40), roller (41), washer (42), and bolt (43) from link assembly (36).
- (9) Remove nut (44), washer (45), nut (46), and switch (47) from switch plate assembly (48).
- (10) Remove bolts (49), washers (50), up stop block (51), and shim (52).

C. Cleaning, Inspection, and Repair of Nose Gear Doors Closer Mechanism Assembly

- (1) Clean all parts using a suitable dry type cleaning solvent.
- (2) Inspect components for wear, cracks, nicks, corrosion, proper lubrication, and general condition.



Door Closer Mechanism Assembly
 Figure 205 (Sheet 1 of 2)

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1. Spring	27. Washer
2. Cotter Pin	28. Washer
3. Nut	29. Bolt
4. Washer	30. Cotter Pin
5. Washer	31. Nut
6. Bolt	32. Washer
7. Cotter Pin	33. Washer
8. Nut	34. Washer
9. Washer	35. Bolt
10. Washer	36. Link Assembly
11. Washer	37. Cotter Pin
12. Bolt	38. Nut
13. Bellcrank	39. Washer
14. Cotter Pin	40. Washer
15. Nut	41. Roller
16. Washer	42. Washer
17. Eye Bolt	43. Bolt
18. Bolt	44. Nut
19. Clevis	45. Washer
20. Washer	46. Nut
21. Nut	47. Switch
22. Nut	48. Switch Plate Assembly
23. Tee	49. Bolt
24. Cotter Pin	50. Washer
25. Nut	51. Up Stop Block
26. Washer	52. Shim

**Door Closer Mechanism Assembly
Figure 205 (Sheet 2 of 2)**

- (3) Repair of the nose gear door closer mechanism consists of smoothing out minor scratches, nicks, and dents and replacement of defective parts.

D. Assemble Nose Gear Doors Closer Mechanism Assembly (See Figure 205.)

- (1) Install shim (52) and up stop block (51) with washers (50) and bolts (49).
- (2) On switch plate assembly (48), install switch (47) with nut (46), washer (45), and nut (44).
- (3) Install roller (41) with bolt (43), washers (42, 40, and 39), nut (38), and cotter pin (37) on link assembly (36).
- (4) Connect link assembly (36) to weldment by installing bolts (35), washers (34, 33, and 32), nut (31), and cotter pin (30).
- (5) Connect tee to link assembly by installing bolt (29), washers (28, 27, and 26), nut (25), and cotter pin (24).

- (6) Install clevis on tee (23) by installing bolt (18), clevis (19), washer (20), nut (21), and nut (22).
- (7) Install eyebolts (17) through bellcrank arms and install washers (16), nuts (15), and cotter pins (14).
- (8) Connect clevis (19) to bellcrank by installing bolt (12), washers (11, 10, and 9), nut (8), and cotter pin (7).
- (9) Connect turnbuckles to bellcrank by installing bolts (6), washers (5 and 4), nuts (3), and cotter pins (2).
- (10) Connect springs (1) to bellcrank.

E. Install Nose Gear Doors Closer Mechanism Assembly (See Figure 201.)

- (1) Place nose gear door closer mechanism in position in the wheel well and install bellcrank and brackets with bolts, washers, and nuts. Align up stop link assembly (38) with mounting holes in wheel well structure.
- (2) Install support tube (36) through mounting holes, up stop link assembly (38), drag brace (8), and spacer (37).
- (3) Install eyebolts (35), washers (34), and nuts (33). Connect springs to eyebolts (35).
- (4) Working through access in nose baggage compartment floor, align holes in support tube with holes in mounting block and install bolt (31), washers (30), and nut (29).

F. Nose Gear Door Closer Mechanism Adjustments (See Figure 205.)

- (1) Brackets with stops are located on left and right side of the nose wheel well walls. These stops are adjustable by a screw adjustment. The stop should be adjusted to strike the outer bellcrank arms as the open doors reach a parallel position to Buttock Line zero and the linkage is 0.09 to 0.15 inch overcenter forward.
- (2) Adjust switch (47) to actuate 0.030 inch before up position of nose gear.
- (3) Adjust clevis (19) to length necessary to close doors properly when gear is up, on stop block (51).

8. Removal/Installation of Nose Gear Actuator

A. Remove Nose Gear Actuator (See Figure 201.)

NOTE: Disconnect hydraulic lines and cover and plug all ports.

- (1) Remove actuator rod end from actuator arm by removing cotter pin (45), nut (46), washer (47), and bolt (48).
- (2) Remove cotter pin (49), nut (50), washer (51), spacer (52), washer (53), and bolt (54). Remove actuator (55).

B. Disassemble Nose Gear Actuator (See Figure 206.)

- (1) Loosen and remove clamp (1) and switch bracket (2).
- (2) From the switch bracket (2), remove nut (3), washer (4), nut (5), and switch (6).
- (3) Remove retaining ring (7), washer (8), spring (9), pin (10), piston lock (11), backup ring (12), and O-ring (13).
- (4) Remove fittings (14) and O-rings (15) from actuator body (32).
- (5) Remove rod end (16), jam nut (17), retaining ring (18), and plug (19). Pull piston assembly with rod out of actuator body.
- (6) Remove backup ring (20) and O-ring (21) from plug (19). Remove backup ring (22) and O-ring (23).
- (7) Remove nut (24), washer (25), and piston head (26).
- (8) From piston head (26), remove backup ring (27) and O-ring (28).
- (9) Remove washer (29) from rod (30), and remove bushing (31) from actuator body (32).

C. Cleaning, Inspection, and Repair of Nose Landing Gear Actuator

- (1) Clean actuator components with a suitable dry cleaning solvent.
- (2) Inspect components for wear, cracks, nicks, corrosion, proper lubrication, and general condition.
- (3) Repair of the nose gear actuator consists of smoothing out minor scratches, nicks, and dents and replacement of defective parts.

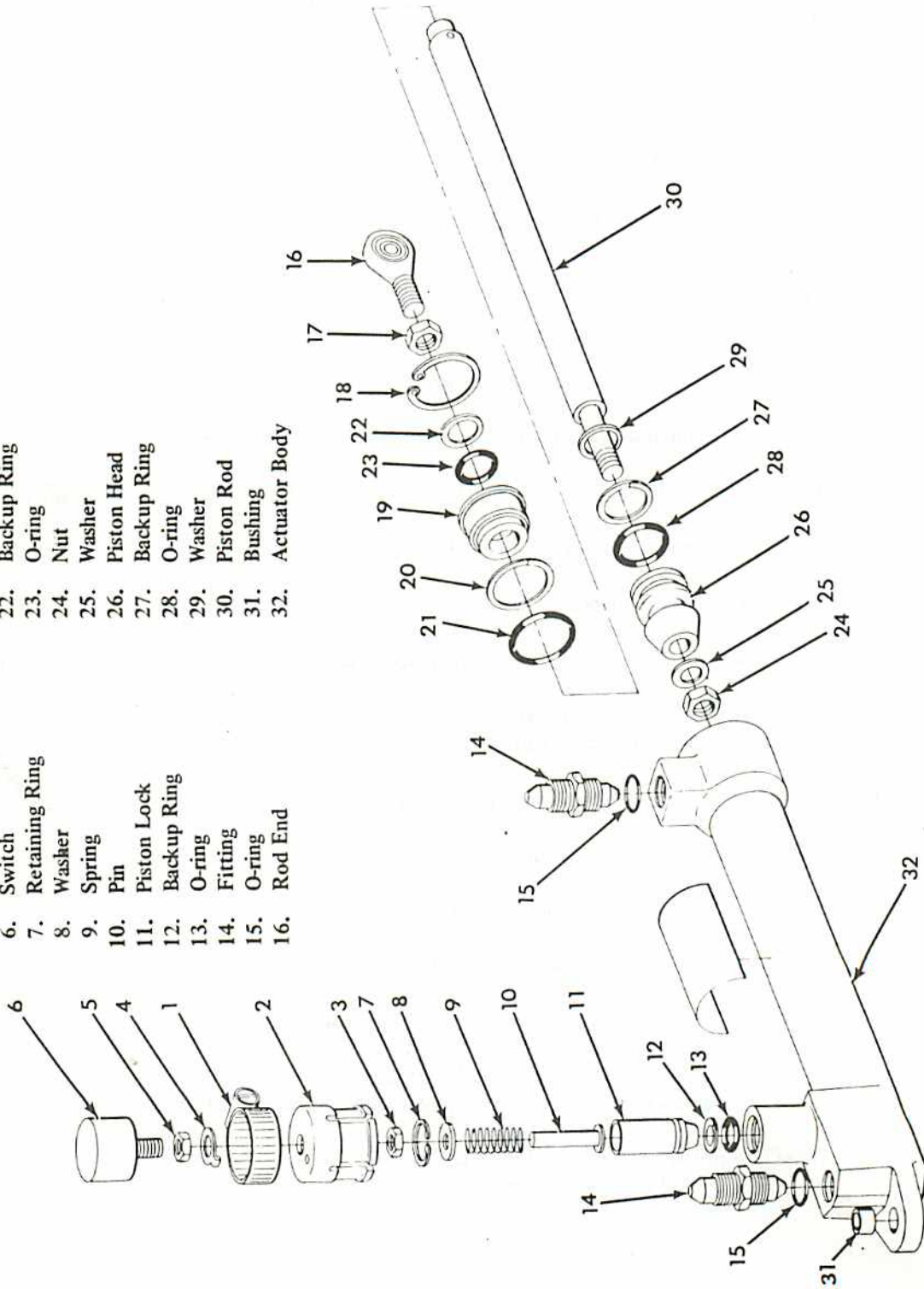
D. Assemble Nose Gear Actuator (See Figure 206.)

NOTE: Replace all O-rings during assembly.

- (1) Install bushing (31) in end lug of actuator body (32).
- (2) Place washer (29) on rod (30). Install new O-ring (28) and backup ring (27) on piston head (26).
- (3) Place piston head (26) on rod (30) and install washer (25) and nut (24).
- (4) Install O-ring (23) and backup ring (22) inside of plug (19). On outside of plug (19), install O-ring (21) and backup ring (20). Install plug assembly on piston rod (30).
- (5) Place piston head (26), rod (30), and plug (19) in end of actuator body and install retaining ring (18), jam nut (17), and rod end (16).

- 17. Jam Nut
- 18. Retaining Ring
- 19. Plug
- 20. Backup Ring
- 21. O-ring
- 22. Backup Ring
- 23. O-ring
- 24. Nut
- 25. Washer
- 26. Piston Head
- 27. Backup Ring
- 28. O-ring
- 29. Washer
- 30. Piston Rod
- 31. Bushing
- 32. Actuator Body

- 1. Clamp
- 2. Switch Bracket
- 3. Nut
- 4. Washer
- 5. Nut
- 6. Switch
- 7. Retaining Ring
- 8. Washer
- 9. Spring
- 10. Pin
- 11. Piston Lock
- 12. Backup Ring
- 13. O-ring
- 14. Fitting
- 15. O-ring
- 16. Rod End



Landing Gear Actuator Assembly
 Figure 206

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- (6) Install O-rings (15) on fittings (14) and install fittings (14) in port holes of actuator body (32).
- (7) Push piston rod (30) into actuator body (32) until actuator is in locked (retracted) position. Install O-ring (13), backup ring (12), piston lock (11), pin (10), spring (9), washer (8), and retaining ring (7).
- (8) Install switch (6) on switch bracket (2) with nut (5), washer (4), and nut (3). Secure switch bracket (2) to actuator body (32) with clamp (1).

E. Adjust Actuator Down Lock Switch (See Figure 206.)

Loosen screw on clamp (1). With actuator locked, push switch bracket (2) down on actuator until switch actuates, Mark position of bracket (2) on actuator. Raise bracket (2) 0.09 to 0.12 inch and tighten clamp screw to 20 to 30 inch-pounds.

F. Install Nose Gear Actuator (See Figure 201.)

- (1) Position end of actuator (55) in lugs of brace assembly and install bolt (54), washer (53), spacer (52), washer (51), nut (50), and cotter pin (49).
- (2) Install actuator rod end on actuator arm by installing bolt (48), washer (47), nut (46), and cotter pin (45).

G. Nose Landing Gear Actuator Adjustment

Adjustments are same as main gear. Refer to Section 32-1-1, Paragraph 5B and 5F.

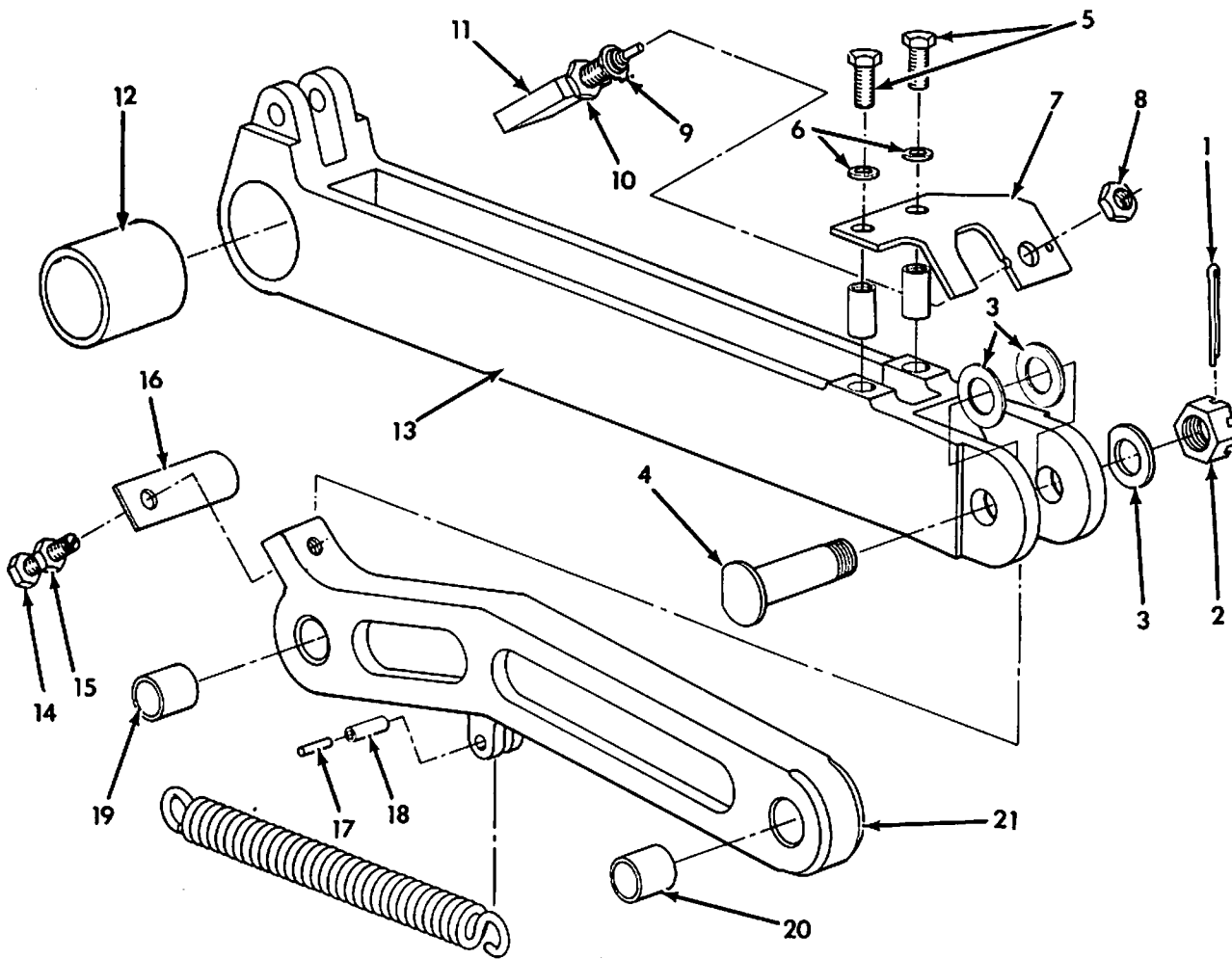
9. Removal/Installation of Nose Gear Brace Assembly

A. Remove Nose Gear Brace Assembly (See Figure 201.)

- (1) Remove nose gear door closer mechanism support tube as described in Paragraph 7.
- (2) Disconnect spring (4) from brace assembly and remove cotter pin (5), nut (6), and washers (7). Remove brace assembly (8).

B. Disassemble Nose Gear Brace Assembly (See Figure 207.)

- (1) Remove cotter pin (1), nut (2), washer (3), and pin (4) and separate upper and lower links.
- (2) On upper link, remove bolts (5), washers (6), and switch bracket (7).
- (3) Remove nut (8), washer (9), jam nut (10), and switch (11).



- | | |
|-------------------|---------------------|
| 1. Cotter Pin | 12. Bushing |
| 2. Nut | 13. Upper Link |
| 3. Washer | 14. Adjusting Screw |
| 4. Pin | 15. Nut |
| 5. Bolt | 16. Switch Striker |
| 6. Washer | 17. Pin |
| 7. Switch Bracket | 18. Bushing |
| 8. Nut | 19. Bushing |
| 9. Washer | 20. Bushing |
| 10. Jam Nut | 21. Lower Link |
| 11. Switch | |

Disassembly/Assembly of Nose Gear Brace Assembly
Figure 207

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- (4) Remove bushing (12) from upper link (13).
- (5) On lower link, remove adjusting screw (14), nut (15), and switch striker (16).
- (6) Remove pin (17) and bushings (18, 19, and 20) from lower link (21).

C. Cleaning, Inspection, and Repair of Nose Gear Brace Assembly

- (1) Clean brace assembly and components with a suitable dry cleaning solvent.
- (2) Inspect parts for wear, cracks, nicks, corrosion, proper lubrication, and general condition.
- (3) Repair of the nose gear brace assembly consists of smoothing out minor scratches, nicks, and dents and replacement of defective parts.

D. Assemble Nose Gear Brace Assembly (See Figure 207.)

- (1) On lower link (21), install bushings (20, 19, and 18) and install pin (17).
- (2) Install switch striker (16) with nut (15) and adjusting screw (14).
- (3) In upper link (13), install bushing (12).
- (4) Install switch (11) with jam nut (10), washer (9), and nut (8).
- (5) Install switch bracket (7) with washers (6) and bolts (5).
- (6) Assemble upper and lower links together with pin (4), washer (3), nut (2), and cotter pin (1).

E. Install Nose Gear Brace Assembly (See Figure 201.)

- (1) Position brace assembly (8) on drag link pin and install washers (7), nut (6), and cotter pin (5).
- (2) Connect spring (4) to brace assembly and install nose gear door closer mechanism support tube as described in Paragraph 7.

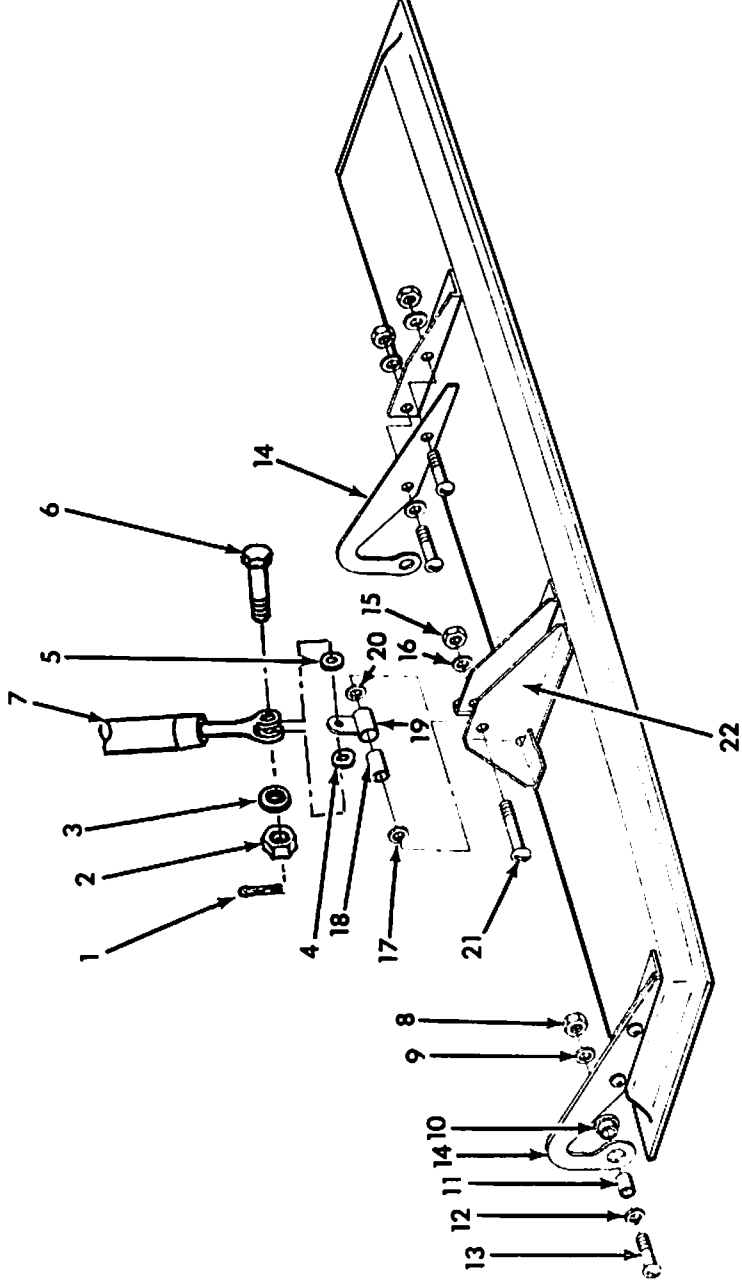
F. Brace Assembly Adjustments

Adjustments are the same as main gear except that adjustment template, Part No. 7YL10002 is used. Refer to Section 32-1-1, Paragraph 5A and 5F.

10. Removal/Installation of Nose Gear Doors

A. Remove Nose Gear Doors (See Figure 208.)

- (1) Disconnect retracting linkage from doors by removing cotter pins (1), nuts (2), washers (3), spacers (4 and 5), and bolt (6) and removing linkage (7) from door.



- 1. Cotter Pin
- 2. Nut
- 3. Washer
- 4. Spacer
- 5. Spacer
- 6. Bolt
- 7. Retracting Linkage
- 8. Nut
- 9. Washer
- 10. Bushing
- 11. Spacer

- 12. Washer
- 13. Bolt
- 14. Hinge
- 15. Nut
- 16. Washer
- 17. Washer
- 18. Spacer
- 19. Lug
- 20. Washer
- 21. Bolt
- 22. Bracket

Nose Landing Gear Door Assembly
 Figure 208

(2) Remove nuts (8), washers (9), bushings (10), spacers (11), washers (12), and bolts (13) from door hinges (14).

B. Disassemble Lug Assembly (See Figure 208.)

Remove nuts (15), washers (16 and 17), spacer (18), lugs (19), washers (20), and bolts (21) from bracket (22).

C. Assemble Lug Assembly (See Figure 208.)

(1) Place spacers (18) in lugs (19) and position lugs (19) in brackets (22).

(2) Install washers (17 and 20), bolts (21), washers (16), and nuts (15).

D. Install Nose Gear Doors (See Figure 208.)

(1) Place doors in position and install bushings (10) and spacers (11) in door hinges (14).

(2) Install bolts (13), washers (12 and 9), and nuts (8).

(3) Position retracting linkages (7) on lugs (19) and install bolts (6), spacers (5 and 4), washers (3), nuts (2), and cotter pin (1).

E. Nose Gear Doors Adjustments

Refer to Paragraph 7F for adjustments.

HYDRAULIC SYSTEMS – DESCRIPTION/OPERATION

1. General

The GA-7/Cougar aircraft contains two hydraulic systems, one for retracting and extending the landing gear and one for the main gear brake system.

2. Landing Gear Retraction and Extension System (See Figure 1.)

The hydraulic system for retracting and extending the landing gear consists of a power pack, position selector switch, hydraulic actuators, selector valve, dump valve, restrictors, hydraulic lines, and hose.

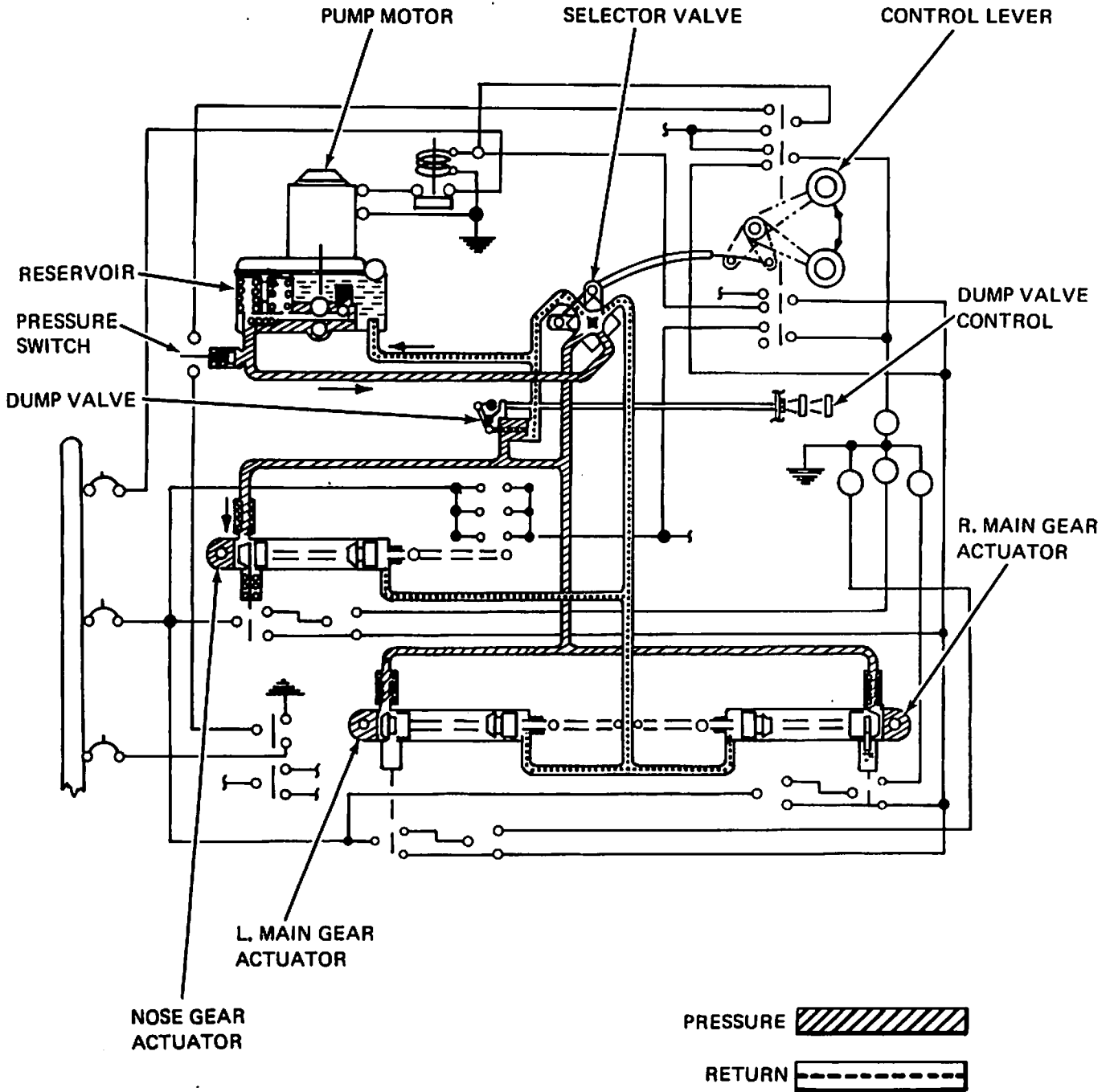
The hydraulic power pack consists of a reservoir, a DC electric motor-driven pump, and pressure control and relief valves. The power pack is a 12-volt unit located in the left side of the nose section. Actuation of the system is initiated by a selector valve control handle located on the lower, left center portion of the instrument panel, adjacent to the landing gear position indicator lights. The normal operating pressure for the system is 1500 psi.

3. Main Gear Brake Hydraulic System

An independent hydraulically actuated brake system is provided for each main wheel. Hydraulic master cylinders are connected to each rudder pedal. The master cylinders are connected to wheel cylinders through lines and hose assemblies. The brake hydraulic system is actuated by applying toe pressure to the pilot's or copilot's rudder pedals. Hydraulic pressure can be locked on the wheel cylinders by a parking brake valve which is actuated by a parking brake push-pull control knob beneath the instrument panel. The main gear brake system maintenance is covered in Section 32-4-2.

The gears are held in the UP position by system pressure. A pressure switch in the lines senses the pressure buildup as the gears reach full UP position and turns off the power pack. If the up pressure should fall below a predetermined amount, but not low enough to let the gears start to extend, the pressure switch will turn the power pack on to build up the operating pressure again.

The gears are held in the DOWN position by spring loaded, overcenter drag braces and by the actuators locking internally in the gear down position to hold the drag braces in their overcenter position.



**Hydraulic System – Landing Gear Retraction and Extension
Figure 1**

32G72-11

HYDRAULIC SYSTEM – TROUBLESHOOTING

TROUBLE	CAUSE	REMEDY
Landing gear retraction system fails to operate.	Landing gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear actuator or selector circuit wires broken.	Check wiring.
	Safety (squat) switch out of adjustment.	Adjust squat switch.
	Squat switch inoperative.	Replace switch.
	Pressure switch inoperative.	Replace switch.
	Pump solenoid inoperative.	Replace solenoid.
	Selector switch ground incomplete.	Check ground.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear actuator circuit wires broken.	Check wires.
	Landing gear selector circuit wires broken.	Check wires.
	Pump solenoid inoperative.	Replace solenoid.
	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
Hydraulic pump ground incomplete.	Check ground.	

TROUBLE	CAUSE	REMEDY
Landing gear retraction system fails to operate. (Continued)	Selector switch inoperative.	Replace switch.
	Pump ground incomplete.	Check ground.
	Hydraulic pump inoperative.	Replace or overhaul pump.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Battery low.	Check battery.
	Pressure head hose loose or disconnected.	Check hose.
Landing gear extension system fails to operate.	Gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Hydraulic pump inoperative.	Replace or overhaul pump.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Battery low.	Check battery.
Landing gear retraction extremely slow.	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Restriction in hydraulic lines.	Check hydraulic lines.
Pump stops operating during gear retraction.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for open circuit breaker.
	Pressure switch out of adjustment.	Readjust switch.
	Restriction or obstruction in system causing pressure to build up and shut off pump before gear has retracted.	Check system, locate and eliminate obstruction or restriction.

TROUBLE	CAUSE	REMEDY
Pump stops during gear extension.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for open circuit breaker.
Pump fails to shut off though gear has fully retracted.	Dump valve open.	Close dump valve.
	Pressure switch inoperative.	Replace switch.
	Pressure switch out of adjustment.	Adjust or replace switch.
	Pump solenoid sticking.	Replace solenoid.
	Internal leakage of system.	Check actuators and pump for internal leakage.
	External leakage of hydraulic system.	Check actuators, lines, and hoses for leakage.
	Pump relief valve out of adjustment.	Replace pump.
Pump fails to shut off though gear is fully extended.	Pump solenoid sticking.	Replace solenoid.
	Gear down limit switch(es) out of adjustment or failed.	Adjust or replace limit switch(es).
Gear stops part way up, but pump continues to run.	Pump high pressure relief valve out of adjustment.	Replace pump.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
All gears fail to free fall when dump valve control knob is pulled.	Dump valve fails to open.	Replace dump valve.
	Control cable loose or broken.	Connect or replace cable.

HYDRAULIC SYSTEM – MAINTENANCE PRACTICES1. Removal/Installation of Power Pack Assembly

NOTE: After removal and installation of any component of the hydraulic system, or when a hydraulic line has been disconnected for any reason, the affected hydraulic system should be bled, serviced, and tested. Refer to Paragraph 6 for testing and Chapter 12 for servicing.

A. Remove Power Pack Assembly

- (1) Disconnect electrical leads from power pack. Identify wires to ensure proper connections during assembly.
- (2) Place a suitable container beneath power pack and remove cap from end of tee fitting at bottom of power pack, and drain fluid. Replace cap on tee fitting.
- (3) Disconnect hydraulic lines from bottom of pump and drain fluid. Plug ends of hydraulic lines.
- (4) Remove 4 bolts, 8 washers, and 4 nuts attaching power pack to mounting bracket. Remove power pack.

B. Disassemble Power Pack Assembly (See Figure 201.)

- (1) Remove vent screw (1), washer (2), filler screw (3), and O-ring (4) and drain any fluid left in reservoir. Do not remove gears unless necessary.
- (2) Remove bolts (5), pump base (6), O-rings (7), screws (8), valve and gear case (9), and seal (10).
- (3) Remove through bolts (11 and 12), motor head (13), brush spring (14), and brush (15).
- (4) Remove thrust ball (16) from bearing in motor head, and remove armature (17) from motor frame (18).
- (5) Remove thrust washer (19) from reservoir (20).

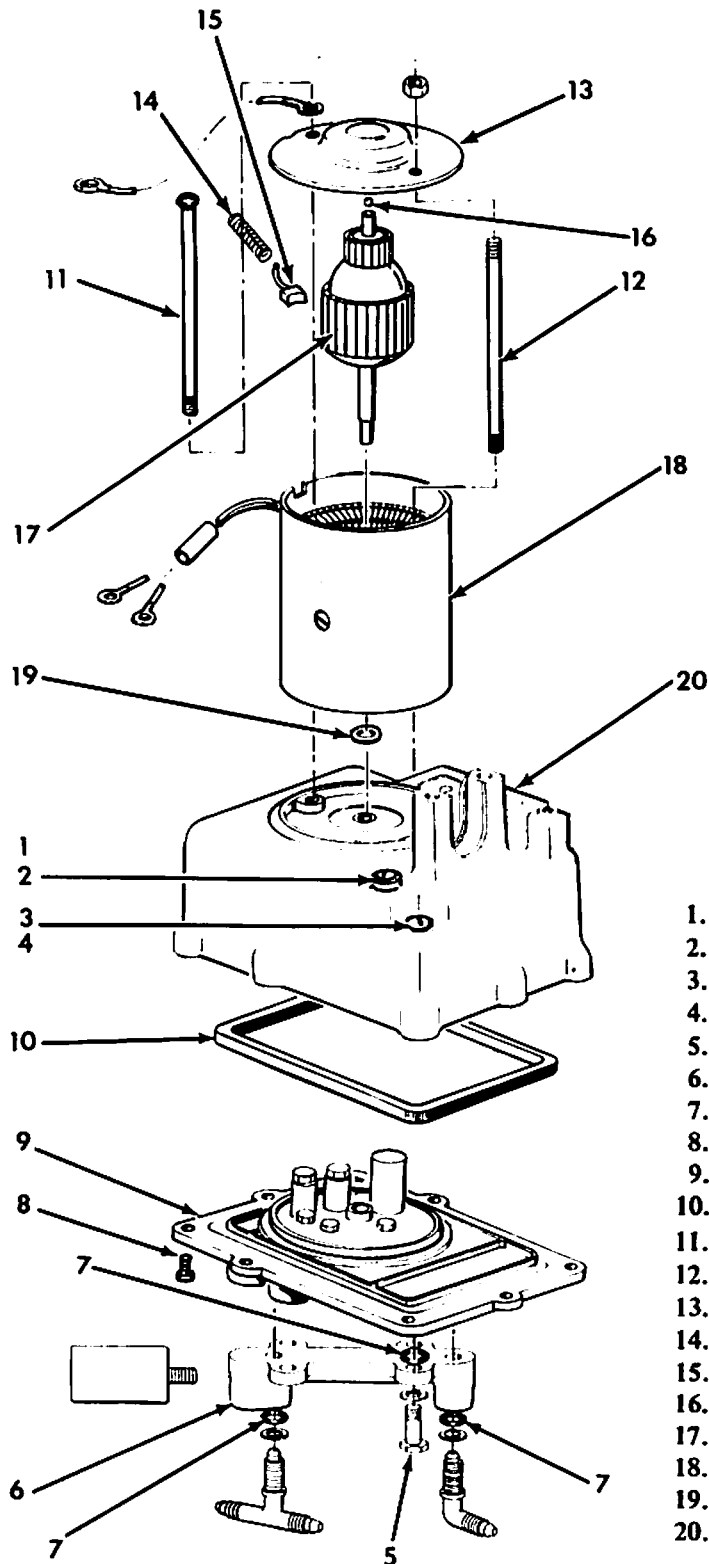
C. Cleaning, Inspection, and Repair of Power Pack Assembly

- (1) Clean hydraulic pump components with a dry type cleaning solvent and dry thoroughly. Discard all old O-rings and seal.
- (2) Inspect pump components for scratches, scores, chips, cracks, and wear. Inspect motor for worn brushes, excessive commutator wear, and excessive bearing wear.
- (3) Repair of motor consists of replacement of defective or worn parts. Repair of hydraulic pump consists of smoothing out minor scratches or nicks and replacement of defective or worn parts.

D. Assemble Power Pack Assembly (See Figure 201.)

- (1) Place washer or washers (19) (same number as removed) on the drive end of armature (17).

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1. Screw (Vent)
2. Washer
3. Screw (Filler)
4. O-ring
5. Bolt (4) and Washers (4)
6. Pump Base
7. O-rings
8. Screw (8)
9. Valve and Gear Case
10. Seal
11. Through Bolt
12. Through Bolt
13. Motor Head
14. Brush Spring
15. Brush
16. Thrust Ball
17. Armature
18. Motor Frame
19. Thrust Washer
20. Reservoir

Hydraulic Power Pack Assembly
 Figure 201

32G72-12

- (2) Place motor frame (18) on reservoir (20). Check aligning marks on frame and reservoir.
- (3) Lubricate the entire length of the drive end of armature shaft with light grease. Insert armature (17) through coils in motor frame (18) and insert end of armature shaft into reservoir.
- (4) Saturate felt oiling pad around commutator end bearing with SAE 20 oil. Allow excess oil to drain off.
- (5) Insert thrust ball (16) in bearing of motor head (13). To hold ball in position, place a small amount of grease inside of bearing.
- (6) Install brush (15), brush spring (14), motor head (13), and through bolts (12 and 11). Check freedom of rotation and end play of the armature within the assembly. A minimum of .005 inch end play is permissible. Adjust to this tolerance by adding thrust washers (19) as necessary.
- (7) Lubricate reservoir seal ring (10) with hydraulic fluid (MIL-H-5606) and place in recess provided in valve and gear case (9). Position case (9) on bottom of reservoir and secure with screws (8).
- (8) Invert pump and install O-ring seals (7) in bottom of valve and gear case (9). Install pump base (6) with bolts and washers (5). Torque bolts to 70 inch-pounds.

E. Install Power Pack Assembly

- (1) Place power pack assembly in position and align mounting holes in power pack with holes in mounting bracket and install attaching bolts, washers, and nuts.
- (2) Remove hydraulic line plugs and caps from fittings. Connect hydraulic lines and electrical connections.
- (3) Fill hydraulic reservoir with hydraulic fluid (MIL-H-5606) and install filler screw (3, Figure 201) with O-ring (4). Install vent screw (1) with washer (2). Refer to Chapter 12 for servicing of hydraulic power pack.
- (4) Install access panels.

2. Removal/Disassembly/Assembly/Installation of Landing Gear Actuators

Refer to Section 32-1-1 for removal, disassembly, assembly, and installation of landing gear actuators.

3. Removal/Installation of Hydraulic Emergency Dump Valve

A. Remove Hydraulic Emergency Dump Valve (See Figure 1.)

- (1) To gain access to the hydraulic emergency dump valve, remove access cover on left side of nose section and access panel in floor on left side of nose baggage compartment.
- (2) Using a rag to absorb any hydraulic fluid spillage, disconnect hydraulic lines from dump valve, and cap lines and fittings.
- (3) Disconnect valve control cable from lever on valve.

- (4) Remove two bolts, four washers, and two nuts attaching dump valve to aft, left, nose wheel well wall. Remove dump valve from aircraft.

B. Cleaning, Inspection, and Repair of Hydraulic Emergency Dump Valve

- (1) Clean dump valve with a dry type cleaning solvent and dry thoroughly. Replace O-rings inside of valve.
- (2) Inspect dump valve for scratches, scores, chips, and general condition.
- (3) Repair of the hydraulic dump valve consists of smoothing out minor scratches or nicks. Replace valve if leaking or damaged.

C. Install Hydraulic Emergency Dump Valve (See Figure 1.)

- (1) Place dump valve in position and install 2 bolts, 4 washers, and 2 nuts.
- (2) Connect hydraulic lines to dump valve fittings.
- (3) Connect control cable to lever on valve.

4. Removal/Installation of Hydraulic Restrictor Check Valve

A. Remove Hydraulic Restrictor Check Valve

- (1) Disconnect hydraulic hose from restrictor check valve and cap hose.
- (2) Remove restrictor check valve from actuator.

B. Disassemble Hydraulic Check Valve (See Figure 202.)

- (1) From the female end of restrictor check valve, remove the O-ring and screen.
- (2) Remove the valve cap, gasket, spring, disk, and seat from the valve body.

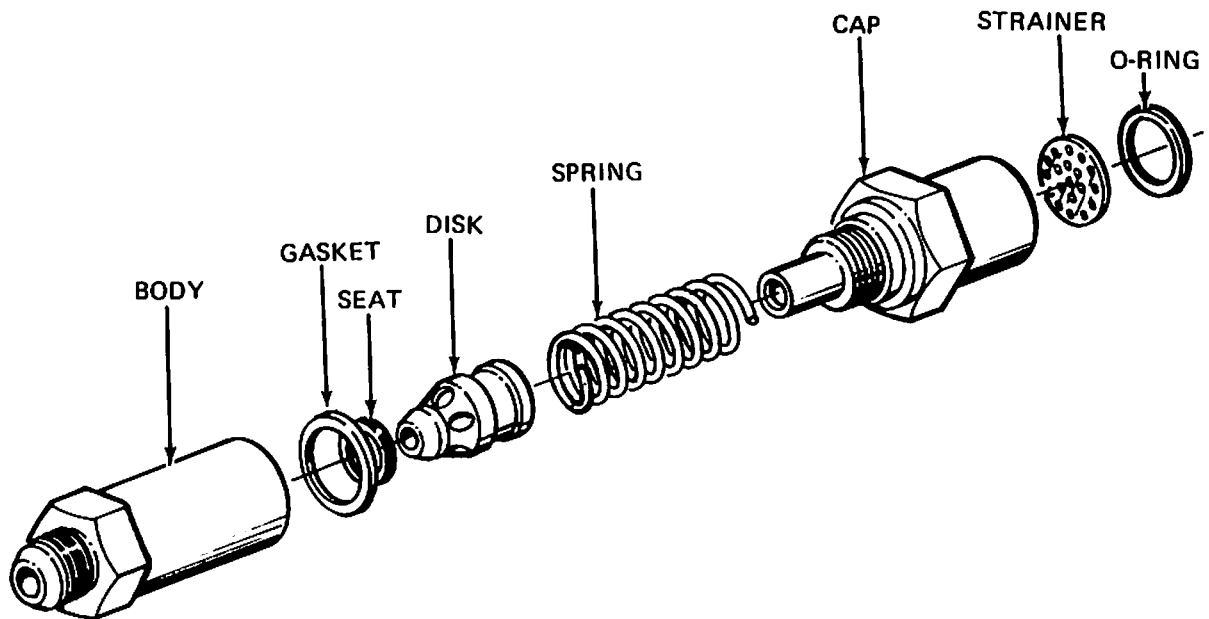
C. Cleaning, Inspection, and Repair of Hydraulic Restrictor Check Valve

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (1) Clean valve components with a dry type cleaning solvent and dry thoroughly. Discard old O-ring and gasket.
- (2) Inspect valve components for scratches, gouges, scores, cracks, and wear.
- (3) Repair of the valve consists of smoothing out minor scratches and replacement of defective parts.

D. Assemble Hydraulic Check Valve (See Figure 202.)

- (1) Install seat in valve body. Install disk, spring, gasket, and cap in valve body.
- (2) In female end of valve, install strainer and O-ring.



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**Hydraulic Restrictor Check Valve
Figure 202**

E. Install Hydraulic Check Valve

- (1) Install hydraulic restrictor check valve on actuator.
- (2) Connect hydraulic hose to hydraulic restrictor check valve.

5. Hydraulic Fluid Contamination Check

A. Check Hydraulic Fluid

At the first 50-hour and first 100-hour inspection, thereafter at each 500-hour inspection or 1 year, whichever should occur first, a sample of hydraulic fluid should be taken and examined for sediment and discoloration. This may be done as follows:

- (1) Place aircraft master switch in OFF position.

- (2) In the nose section beneath the power pack, remove cap from tee fitting and drain a small sample of hydraulic fluid into a nonmetallic container.
- (3) Install cap on tee fitting and tighten.
- (4) Analyze drained hydraulic fluid.
- (5) If the drained fluid is clear and is not appreciably darker in color than new fluid, continue to use the present fluid.
- (6) If the fluid color is doubtful, place fluid sample in a nonmetallic container and insert a strip of polished copper in the fluid sample.
- (7) Keep copper strip in the sample fluid for 6 hours at a temperature of 70°F or more. A slight darkening of the copper strip is permissible, but there should be no pitting or etching visible up to 20X magnification.

6. Testing Hydraulic System

The hydraulic system should be tested after performing any service or repairs to ensure that it functions properly.

A. Test the landing gear hydraulic system as follows:

- (1) Place aircraft on jacks. (Refer to Lifting and Jacking, Chapter 7.) Connect aircraft to an external power source, if available.
- (2) With landing gear down, master switch ON, and circuit breaker in, place landing gear control handle in the UP position. The hydraulic pump should start operating immediately and the landing gear retract. The landing gear position lights should all go out on the instrument panel when the gear is fully retracted and locked in position, and the hydraulic pump should stop operating.
- (3) Place landing gear control handle in the DOWN position. The landing gear should extend and lock in position. The three green gear position lights on the instrument panel should illuminate when the gears are all down and locked.
- (4) Inspect the hydraulic components for leakage of hydraulic fluid.
- (5) Recycle the landing gear several times to ensure proper operation.
- (6) Check operation of dump valve by retracting the landing gear and pulling the dump valve control knob all the way out. The landing gear should extend and lock in position.

CAUTION: PRIOR TO LOWERING AIRCRAFT AND REMOVING JACKS, ENSURE THAT THE THREE GREEN LANDING GEAR POSITION LIGHTS ON INSTRUMENT PANEL ARE ILLUMINATED, INDICATING THAT ALL GEARS ARE DOWN AND LOCKED.

- (7) Lower aircraft and remove jacks.

WHEELS AND TIRES – DESCRIPTION/OPERATION**1. General**

The GA-7/Cougar aircraft is equipped with 15 x 6.00-6, 4-ply tires on the nose gear and 6.00-6 Type III, 6-ply tires on the main gear. The main gear tires should be rotated periodically to obtain maximum tire life. All wheels are of the split wheel design for easy servicing and the main wheels have independent disc-type brake systems. The wheels and tires are balanced to within 5 inch-ounces at the factory. It is recommended that replacement tires be balanced to this specification to prevent excessive vibrations in the landing gear assemblies.

LANDING GEAR WHEEL ASSEMBLIES – MAINTENANCE PRACTICES

I. Removal/Installation of Main Landing Gear Wheel Assembly

A. Remove Main Gear Wheel Assembly (See Figure 201.)

- (1) Place aircraft on jacks. (Refer to Chapter 7.)
- (2) Remove bolt (1) and washer (2) which attach the brake pressure plate (4) and backplate (3) to the brake cylinder assembly (5).
- (3) Remove screws (6), lock washers (7), dust shield (8), cotter pin (9), and axle nut (10) from wheel assembly. Remove wheel assembly from main gear assembly.

B. Disassemble Main Gear Wheel Assembly (See Figure 201.)

- (1) Match-mark wheel halves and brake discs prior to disassembly to expedite reassembly in the same relative positions.
- (2) Deflate tire by removing valve core.
- (3) Break tire bead loose from wheel halves.

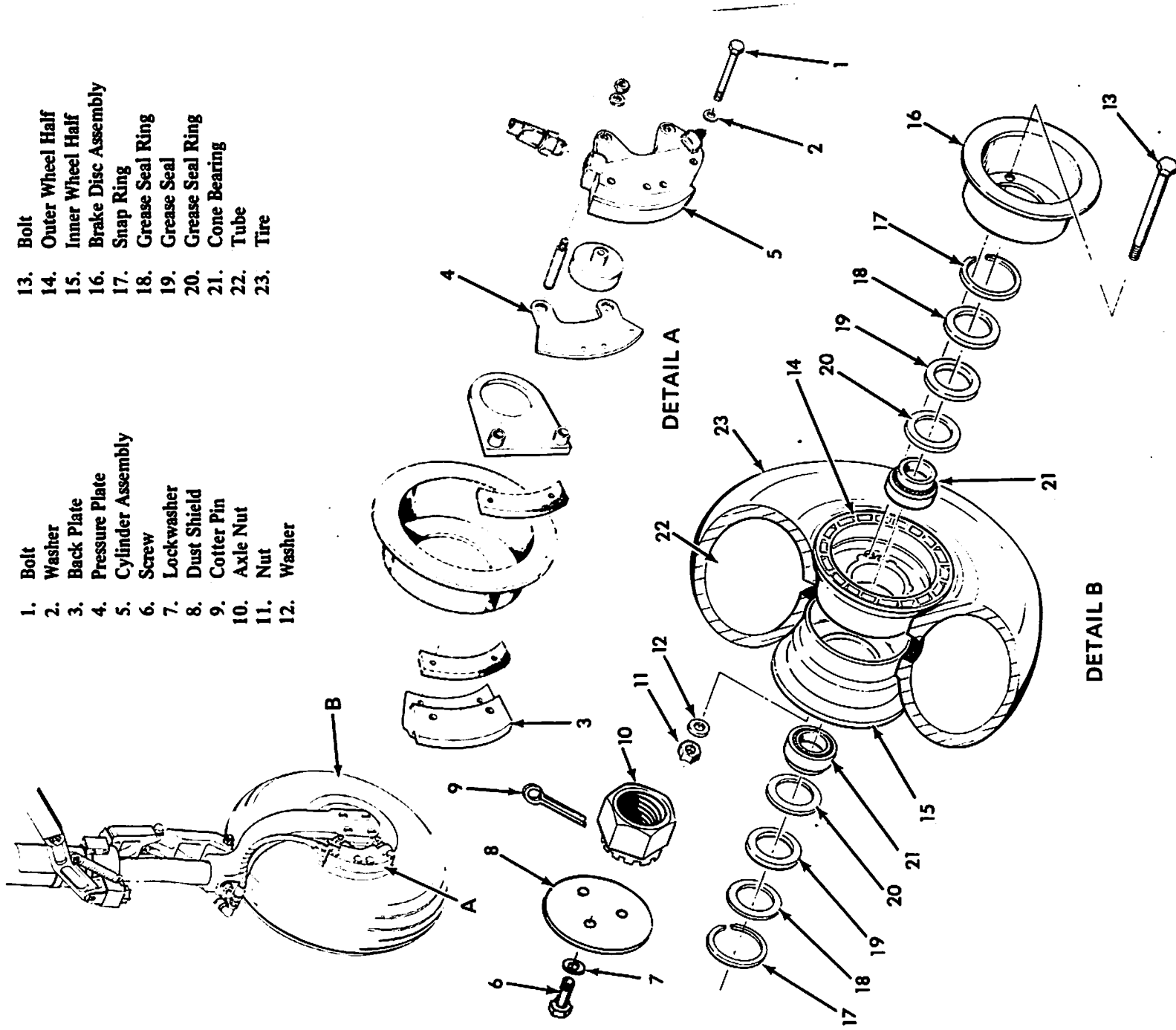
NOTE: Care should be taken to prevent damage to wheel halves or tire when breaking tire bead loose from wheel halves.

WARNING: DO NOT ATTEMPT TO SEPARATE WHEEL HALVES WHILE TIRE IS UNDER PRESSURE. SERIOUS INJURY COULD RESULT.

- (4) Remove nuts (11), washers (12), and bolts (13) and separate wheel halves (14 and 15) and brake disc assembly (16).
- (5) Remove snap rings (17), grease seal rings (18), grease seals (19), grease seal rings (20), and cone bearings (21) from both wheel halves.
- (6) Remove tube (22) from tire (23).

C. Cleaning, Inspection, and Repair of Main Gear Wheel Assemblies

- (1) Clean bearings (21) and grease seals (19) with cleaning solvent and dry thoroughly with clean air blasts. Clean other components with cleaning solvent.
- (2) Inspect bearings (21) for pitting, wear, or discoloration. Repack bearings in accordance with lubrication chart in Chapter 12. Inspect other components for cracks, nicks, scoring, distortion, and corrosion.
- (3) Repair of main wheel assemblies consists of smoothing out minor scratches and nicks, cleaning thoroughly, applying zinc chromate primer and paint, and replacing defective parts.



Main Landing Gear Wheel Assembly
Figure 201

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D. Assemble Main Gear Wheel Assembly (See Figure 201.)

- (1) Position tube (22) in tire (23) and align red dot on tire with index mark on tube. If there is no mark on tube, align red dot on tire with tube seam. If there is no seam on tube, align red dot on tire with valve stem of tube.
- (2) Place inner wheel half (15) in tire (23) and position valve stem through hole in inner wheel half.
- (3) Position outer wheel half (14) and brake disc assembly (16) in tire (23) and install bolts (13), washers (12), and nut (11).

NOTE: Care must be taken not to pinch tube between wheel halves.

CAUTION: IMPROPER TORQUE OF BOLTS (13) MAY RESULT IN WHEEL FAILURE.

- (4) Torque bolts (13) to 150 inch-pounds. Torque value may be indicated on wheel.
- (5) Install bearings (21), grease seal ring (20), grease seal (19), grease seal ring (18), and snap ring (17).
- (6) Inflate tire to 40 ± 2 psi.
- (7) If new tire was installed, balance to within 5 inch-ounces.

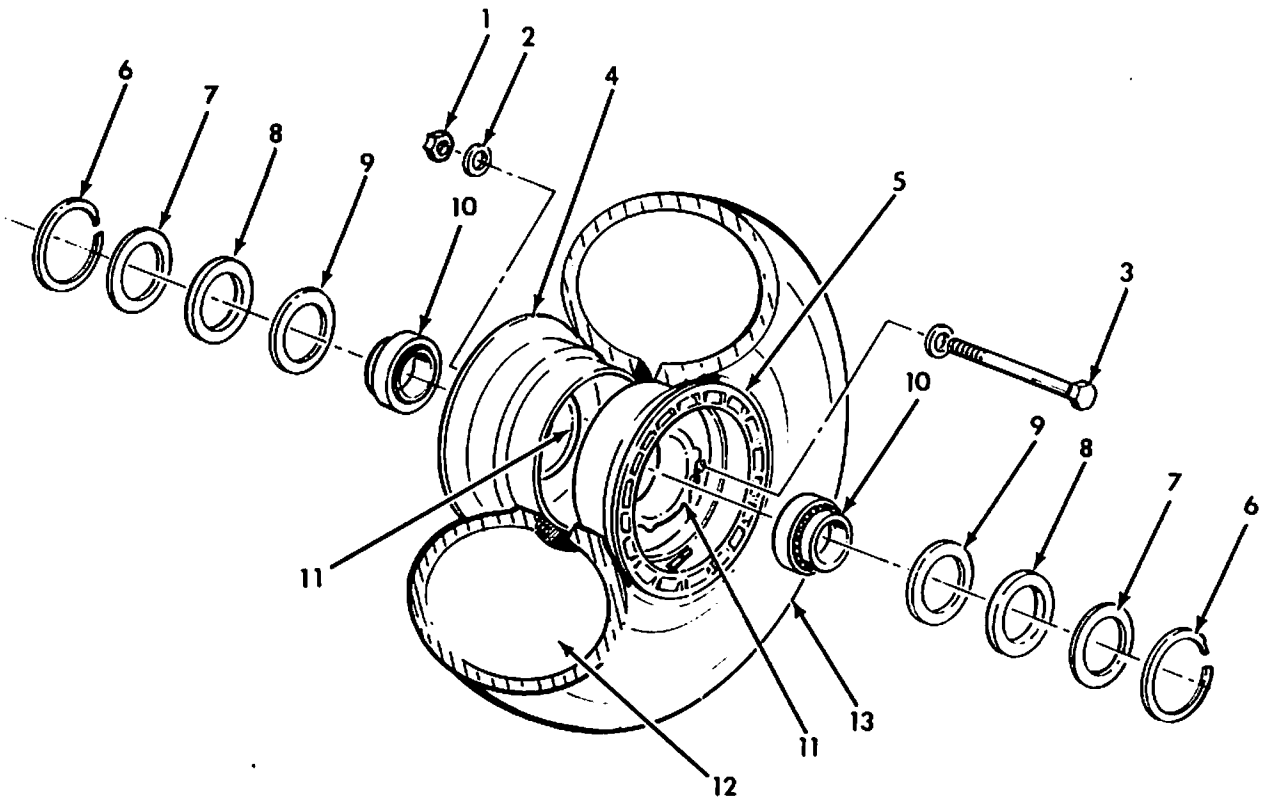
E. Install Main Gear Wheel Assembly (See Figure 201.)

- (1) Position wheel on axle.
- (2) Check brake anchor bolts for freedom of movement in torque plate assembly and for adequate lubrication.
- (3) Install axle nut (10) and tighten until a slight drag is evident when wheel is rotated. Back off the nut to the next castellation and install cotter pin (9).
- (4) Position brake back plate assembly (3) and install washers (2) and bolts (1). Torque bolt (1) to 90 inch-pounds.
- (5) Install dust shield (8), lock washers (7), and screws (6).
- (6) Remove jacks from aircraft.

2. Removal/Installation of Nose Landing Gear Wheel Assembly

A. Remove Nose Gear Wheel Assembly (See Figure 201, Section 32-2-1.)

- (1) Support aircraft on jacks. (Refer to Chapter 7.)
- (2) Remove cotter pin (42) and axle nut (43). Remove wheel assembly from nose landing gear.



- | | |
|---------------------|---------------------|
| 1. Nut | 8. Grease Seal |
| 2. Washer | 9. Grease Seal Ring |
| 3. Bolt | 10. Cone Bearing |
| 4. Wheel Half | 11. Bearing Cup |
| 5. Wheel Half | 12. Tube |
| 6. Snap Ring | 13. Tire |
| 7. Grease Seal Ring | |

**Nose Gear Wheel Assembly
Figure 202**

32G72-15

B. Disassemble Nose Gear Wheel Assembly (See Figure 202.)

WARNING: DO NOT ATTEMPT TO SEPARATE WHEEL HALVES WITH THE TIRE UNDER PRESSURE. SERIOUS INJURY COULD RESULT.

- (1) Deflate tire by removing valve core.
- (2) Break tire beads loose from wheel halves.

NOTE: Care should be taken to prevent damage to wheel halves when breaking beads loose.

- (3) Remove nuts (1), washers (2), bolts (3), and remove wheel halves (4) and (5).
- (4) Remove snap ring (6), grease seal ring (7), grease seal (8), grease seal ring (9), and bearing (10) from each wheel half.

NOTE: Bearing cups (11) should not be removed unless necessary for replacement of damaged cups.

- (5) To replace bearing cups, heat wheel halves in boiling water for 15 minutes. Using an arbor press, press out damaged cups and press in new cups while wheel halves are still hot.
- (6) Remove tube (12) from tire (13).

C. Cleaning, Inspection, and Repair of Nose Gear Wheel Assembly

- (1) Clean bearings (10), grease seal rings (7 and 9), and grease seal (8) with cleaning solvent and dry thoroughly with clean air blasts from an air hose.
- (2) Inspect wheel components for cracks, nicks, scratches, proper lubrication, and corrosion.
- (3) Repair of the nose gear wheel assembly consists of smoothing out minor scratches, nicks, and gouges and replacement of defective parts.

D. Assemble Nose Gear Wheel Assembly (See Figure 202.)

- (1) Position tube (12) in tire (13). Align red dot on tire with index mark on tube. If there is no mark on tube, align red dot on tire with tube seam. If there is no seam on tube, align red dot on tire with valve stem of tube.
- (2) Position wheel half (5) in tire and insert tube valve stem through hole in wheel half.
- (3) Position wheel half (6) in tire and install bolts (3), washers (2), and nuts (1).

NOTE: Care should be taken not to pinch tube between wheel halves.

CAUTION: IMPROPER TORQUE OF BOLTS (3) MAY RESULT IN WHEEL FAILURE.

- (4) Torque bolts (3) to 90 inch-pounds. Torque value may be indicated on wheel.

- (5) Install bearings (10), grease seal rings (9), grease seals (8), grease seal rings (7), and snap rings (6).
 - (6) Inflate nose gear tire to 40 ± 2 psi.
 - (7) If new tire was installed, balance wheel and tire to within 5 inch-ounces.
- E. Install Nose Gear Wheel Assembly (See Figure 201, Section 32-2-1.)
- (1) Position nose wheel assembly on axle of nose gear and install axle nut (43) and tighten until a slight drag is evident when wheel is rotated. Back off the nut to the next castellation and install cotter pin (42), dust shield (41), lockwasher (40), and screws (39).
 - (2) Remove jacks from aircraft.

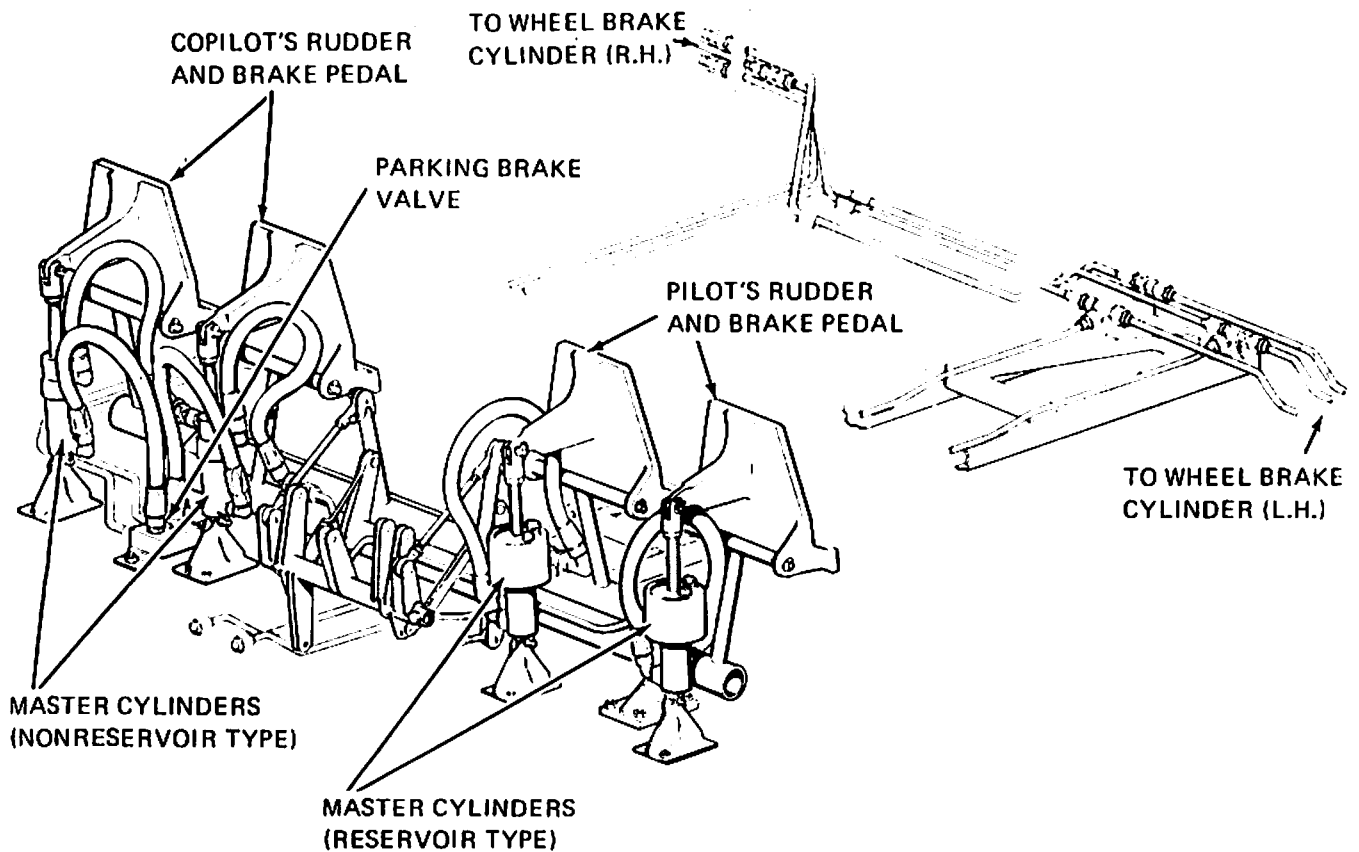
BRAKES – DESCRIPTION/OPERATION

1. General

The GA-7/Cougar aircraft utilizes a dual hydraulic brake system (Figure 1) consisting of master cylinders, brake pedals, brake cylinders, and brake disc. Four master cylinders are used in the system, one cylinder for each of the brake pedals. The two master cylinders on the pilot's side are reservoir type cylinders and the cylinders on the copilot's side are nonreservoir type cylinders. When brake pedals on copilot's side are in neutral position, the ports in the two cylinders on copilot's side are open, allowing direct flow of fluid from the two cylinders on the pilot's side.

The aircraft is also equipped with a parking brake. The parking brake system consists of a hydraulic valve, mechanically operated by a parking brake control knob located beneath the instrument panel. The control knob is connected to a lever on the valve by a cable. When the knob is pulled, the lever on the valve closes a port in the valve and locks hydraulic pressure on the brakes.

The wheel brake assemblies (Figure 201) are dual-piston single-cylinder brakes and consist mainly of a cylinder, pistons, pressure plate, back plate, and a torque plate.



Hydraulic Brake System
 Figure 1

32G72-16

BRAKES – MAINTENANCE PRACTICES

I. Removal/Installation of Master Cylinder

A. Remove Master Cylinder

NOTE: After removal of any component of the brake system, or when any hydraulic line is disconnected for any reason, the brake system should be bled and thoroughly checked for leaks and proper operation. (Refer to Paragraph 4 for instructions on bleeding the hydraulic brake system.)

- (1) Bleed fluid from brake system by removing the bleeder valve from the bottom of brake assembly on wheel.
- (2) Disconnect flexible hose assembly at master cylinder connection.
- (3) Remove cotter pin and withdraw clevis pin which connects the clevis on the master cylinder to the rudder pedal.
- (4) Remove cotter pin and withdraw clevis pin which attaches the mounting lug of the master cylinder to the mounting bracket.

B. Disassemble Master Cylinder Assembly – Nonreservoir Type (See Figure 201.)

- (1) Remove fittings from inlet and outlet ports of cylinder.

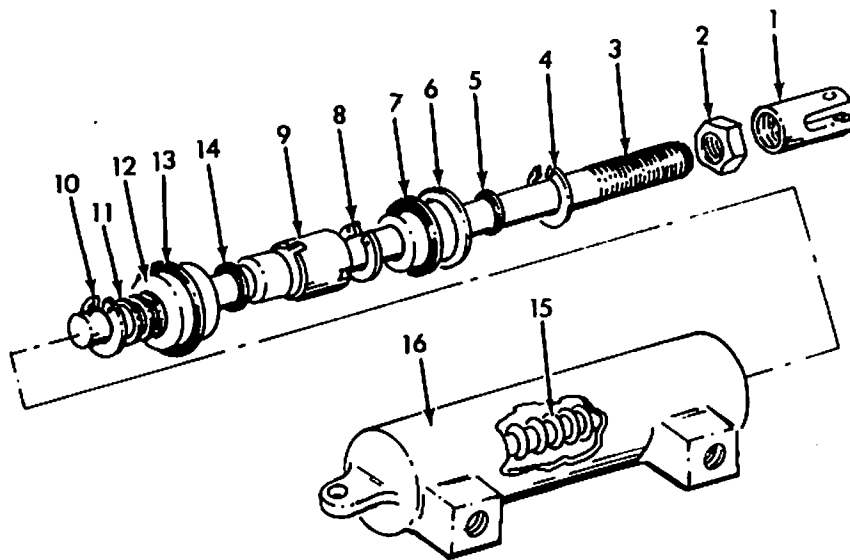
NOTE: Note distance from mounting hole in clevis (1) and mounting hole in housing (16) before removing clevis. This distance must be maintained upon reassembly.

- (2) Remove clevis (1) and check nut (2) from shaft (3).
- (3) Remove snap ring (4) using special pliers, Truarc No. 1120.
- (4) Remove O-ring (5) and end cap (6).
- (5) Remove piston and shaft assembly from housing (16).
- (6) Remove O-ring (7), snap ring (8), and spacer (9).

NOTE: Do not attempt to remove the thrust collar from shaft (3). These parts are pressed together. If either of the parts are damaged, replace both.

- (7) Remove snap ring (10), spring (11), piston (12), and O-rings (13 and 14).
- (8) Remove spring (15) from housing (16).

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- | | |
|------------------------|---------------|
| 1. Clevis | 9. Spacer |
| 2. Nut | 10. Snap Ring |
| 3. Shaft Assembly | 11. Spring |
| 4. Snap Ring | 12. Piston |
| 5. O-ring | 13. O-ring |
| 6. End Cap and Bearing | 14. O-ring |
| 7. O-ring | 15. Spring |
| 8. Snap Ring | 16. Housing |

Master Brake Cylinder – Nonreservoir Type
Figure 201

32G72-17

C. Cleaning, Inspection, and Repair of Master Cylinder – Nonreservoir Type

- (1) Wipe all components clean with cloth dampened with brake fluid. Immerse all seals in hydraulic brake fluid (MIL-H-5606) and apply a coating of brake fluid to bore of cylinder housing (16).
- (2) Inspect snap rings and springs for cracks and general condition. Replace all O-rings with new O-rings.
- (3) Repair of the master cylinder consists of replacement of O-rings and any component found to be defective.

D. Assemble Master Cylinder – Nonreservoir Type (See Figure 201.)

- (1) Assemble spacer (9), new O-rings (13 and 14), and spring (11) on shaft (3) and lock in place with snap rings (8 and 10).
- (2) Assemble new O-rings (5 and 7) and end cap (6) on shaft (3).

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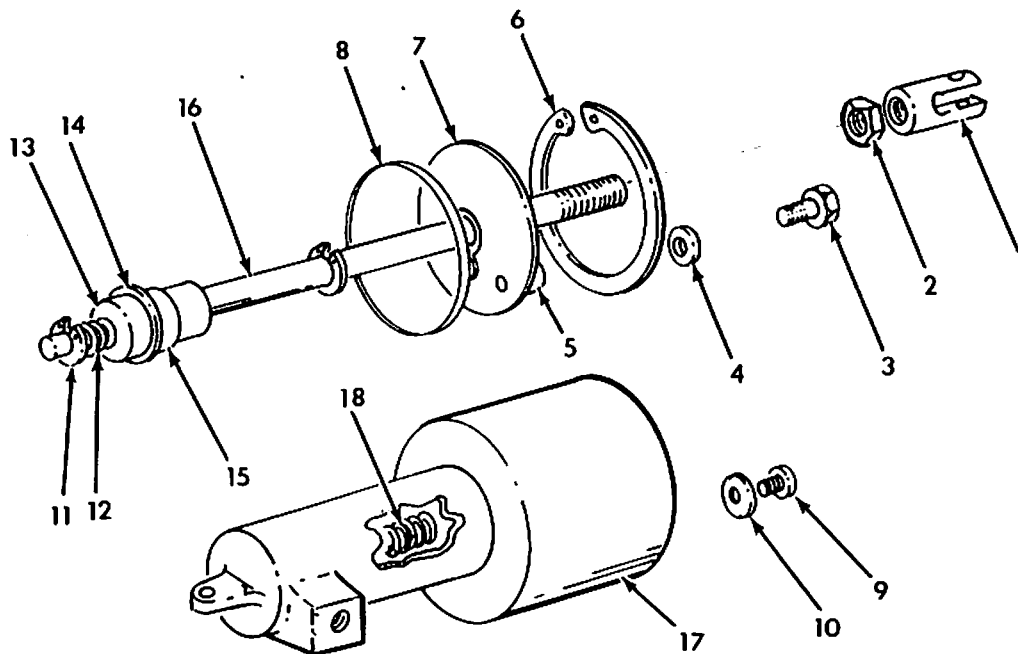
- (3) Engage bottom of shaft and piston assembly into small diameter of spring (15) and install in housing (16). Use caution when installing in housing to prevent damage to O-ring seals.
- (4) Depress shaft into housing and lock in position with snap ring (4).
- (5) Install check nut (2) and clevis (1). Adjust clevis to dimensions noted before disassembly.

CAUTION: DO NOT OVERTIGHTEN FITTINGS IN MASTER CYLINDER PORTS. OVERTIGHTENING COULD CRACK THE CASTING.

- (6) Install fittings in inlet and outlet ports.

E. Disassemble Master Cylinder – Reservoir Type (See Figure 202.)

- (1) Remove fitting from cylinder housing outlet port.
- (2) Remove clevis (1) and check nut (2) from shaft (16). Note distance from mounting hole in clevis (1) and mounting hole in brake cylinder housing (17) before removing clevis. This distance must be maintained upon reassembly.



- | | |
|-------------------------|----------------------|
| 1. Clevis | 10. Washer |
| 2. Check Nut | 11. Snap Ring |
| 3. Bolt | 12. Spring |
| 4. Spacer | 13. Piston |
| 5. Filler Plug | 14. O-ring |
| 6. Snap Ring | 15. O-ring |
| 7. Cover Plate Assembly | 16. Shaft |
| 8. Rubber Seal | 17. Cylinder Housing |
| 9. Screw | 18. Spring |

Master Brake Cylinder – Reservoir Type
Figure 202

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- (3) Remove bolt (3) and spacer (4).
- (4) Remove filler plug (5).
- (5) Remove snap ring (6), using special pliers, Truarc No. 3, and remove cover plate (7) and seal (8).
- (6) Using a 1/8-inch allen wrench, remove screw (9) and washer (10).
- (7) Remove shaft assembly from housing (17) and remove snap ring (11), spring (12), piston (13), and O-rings (14 and 15) from shaft (16).

NOTE: Do not attempt to remove the thrust collar from shaft (16). These parts are pressed together. If either part is faulty, replace both. Also, do not attempt to remove the bushing from cover plate (7). These parts are swaged together and should be ordered together should either part be faulty.

- (8) Remove spring (18) from housing (17).

F. Cleaning, Inspection, and Repair of Master Cylinder – Reservoir Type

- (1) Wipe all components clean with cloth dampened with brake fluid.
- (2) Inspect springs and snap rings for cracks and general condition.
- (3) Repair of the master cylinder consists of replacement of O-rings and any other components found to be defective.

G. Assemble Master Cylinder – Reservoir Type (See Figure 202.)

NOTE: Use new O-rings at reassembly of master cylinder.

- (1) Immediately before reassembly, immerse all seals except seal (8) in hydraulic fluid (MIL-H-5606, see Chapter 12) and apply a coating of hydraulic fluid to bore of the cylinder housing (17).
- (2) Assemble O-rings (15 and 14), piston (13), spring (12), on shaft (16), and lock in place with snap ring (11).
- (3) Engage bottom of shaft and piston assembly into small diameter of spring (18), and install assembly into housing (17).

NOTE: Use a new screw (9) and washer (10) and snap ring (6) at reassembly.

- (4) Depress shaft assembly into housing (17) and lock in position with screw (9) and washer (10).
- (5) Install rubber seal (8), cover plate (7), and lock in place with snap ring (6).
- (6) Install filler plug (5).
- (7) Position spacer (4) in place under lever and secure with bolt (3).

(8) Install nut (2) and clevis (1) on shaft (16). Adjust clevis (1) to dimension noted before disassembly.

(9) Install fitting in cylinder housing outlet port.

H. Install Master Cylinder

(1) Position master cylinder on mounting bracket and install clevis pin and cotter pin.

(2) Position master cylinder clevis to rudder pedal connection and install clevis pin and cotter pin.

(3) Connect flexible hose assembly to master cylinder connection.

(4) Service hydraulic brake system with an approved hydraulic fluid conforming to MIL-H-5606. (Refer to Chapter 12.)

2. Removal/Installation of Parking Brake Valve Assembly (See Figure 1.)

A. Remove Parking Brake Valve Assembly

(1) Disconnect hydraulic lines from nipples of brake valve. Cap lines and fittings.

(2) Remove bolt, washer, nut, and cotter pin attaching control cable to parking brake valve.

(3) Remove two screws and washers attaching brake valve to bracket and remove valve.

B. Install Parking Brake Valve Assembly

(1) Position parking brake valve on mounting bracket and install mounting screws and washers.

(2) Remove caps and connect hydraulic lines to nipples on parking brake valve assembly.

(3) Install parking brake control cable on valve with bolt, washer, nut, and cotter pin.

3. Removal/Installation of Wheel Brake Assembly

A. Remove Wheel Brake Assembly (See Figure 203.)

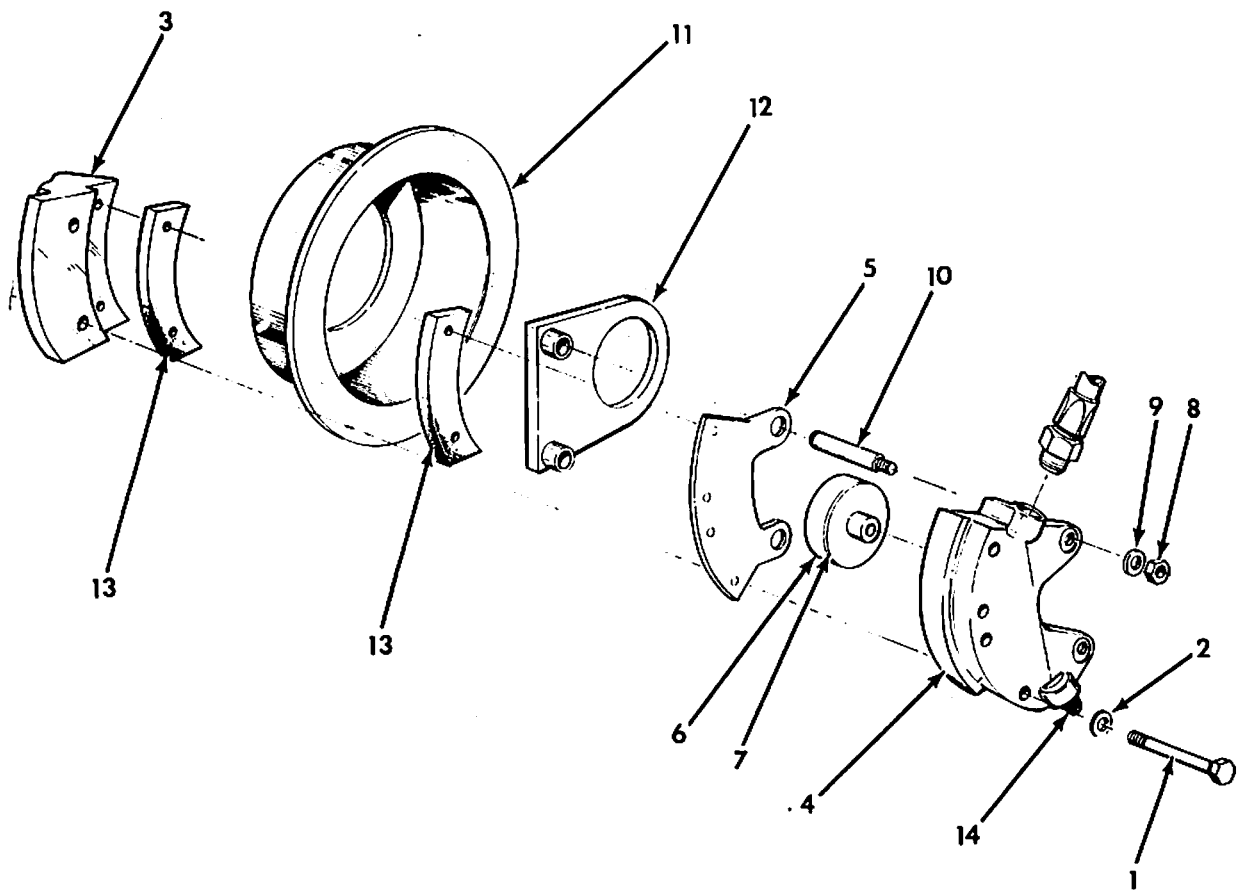
NOTE: Brake disc (11) is removed during wheel disassembly. Torque plate (12) can be removed after wheel has been removed. Refer to 32-4-1 for wheel removal.

(1) Disconnect hydraulic line at wheel brake assembly fitting.

(2) Remove bolts (1) and washers (2) and remove backplate (3).

(3) Pull anchor bolts (10) out of torque plate assembly (12) and remove brake cylinder assembly (4).

(4) Slide pressure plate (5) off anchor bolts (10).



- 1. Bolt
- 2. Washer
- 3. Backplate
- 4. Cylinder
- 5. Pressure Plate
- 6. Piston
- 7. O-ring

- 8. Nut
- 9. Washer
- 10. Anchor Bolt
- 11. Brake Disc
- 12. Torque Plate
- 13. Lining
- 14. Bleeder

**Wheel Brake Assembly
Figure 203**

32G72-19

- (5) Blow lightly with compressed air into hydraulic line fitting to force piston (6) from cylinder (4) and slide O-ring (7) off piston (6).
- (6) Anchor bolts (10) are pressed into brake cylinder assembly (4). Do not remove unless necessary. If removal is necessary, remove nuts (8) and washers (9) and press out anchor bolts (10).

B. Cleaning, Inspection, and Repair of Brake Assembly

WARNING: CLEANING SOLVENT (P-S-661 OR EQUIVALENT) IS TOXIC AND FLAMMABLE. USE IN A WELL VENTILATED AREA. AVOID BREATHING FUMES AND KEEP AWAY FROM FLAMES.

- (1) Clean all parts with cleaning solvent, Federal Specification No. P-S-661 or equivalent. (See Chapter 12.) Thorough cleaning is important to prevent brake malfunction.
- (2) Inspect all parts for wear, cracks, damage, or distortion and make the following detailed inspections:
 - (a) Inspect piston for deep scratches.
 - (b) Inspect bore of cylinder housing for deep scratches.
 - (c) Inspect brake linings for damage, deterioration, and excessive wear.
 - (d) Inspect anchor bolts for nicks or damage.
 - (e) Inspect brake disc for excessive wear (minimum thickness of 0.206 inch).
- (3) Repair of the wheel brake assembly consists of smoothing out minor scratches, nicks, or gouges and replacement of defective parts.

C. Install Wheel Brake Assembly (See Figure 203.)

NOTE: Keep brake lining (13) dry and completely free from hydraulic fluid. Install new O-ring (7) with clean hydraulic fluid.

- (1) Lubricate piston (6), cylinder bore (4), and new O-ring (7) with clean hydraulic fluid.
- (2) If removed, assemble anchor bolts (10) into cylinder (4) by driving bolts in with soft mallet. Install washers (9) and nuts (8).
- (3) Assemble O-ring (7) on piston (6) and install in cylinder (4). Hold piston in cylinder until pressure plate (5) is installed.
- (4) Slide pressure plate (5) onto anchor bolts (10).
- (5) Insert anchor bolts (10) into torque plate assembly (12), and install washers (2), bolts (1), and backplate (3). Torque bolts (1) to 75 to 90 inch-pounds.
- (6) Install brake assembly and wheel on aircraft. (Refer to Section 32-4-1.)
- (7) Connect hydraulic lines and service brake system. (Refer to Chapter 12 for servicing.)

4. Bleeding Hydraulic Brake System

A. Bleed Brakes and Master Cylinders

NOTE: When servicing the hydraulic brake system, use an approved hydraulic fluid conforming to MIL-H-5606. (See Chapter 12.)

- (1) Remove filler plugs from top of master cylinders (pilot's side) and insert one end of clear (see through) overflow lines in cylinders. Place other end of overflow lines in a suitable container containing enough hydraulic fluid to cover the ends of the lines.
- (2) Connect a clean hydraulic source to the bleeder at the bottom of the wheel brake cylinders.
- (3) Fill the hydraulic brake system until the overflow lines show no more air bubbles. Remove the overflow lines.
- (4) Remove the source of fluid and pressure and allow the fluid to drain back through the system until the fluid level is approximately 1/4 inch below the top of the reservoir in the master cylinder.
- (5) Secure the bleeder at the wheel brake cylinder and install filler plugs in master cylinders.

Procedure: Metallic Brake Lining Conditioning

METALLIC BRAKE LINING CONDITIONING PROCEDURE

The brake lining material used in this brake assembly is an iron based metallic composition. This material must be properly conditioned (glazed) in order to provide optimum service life.

Dynamometer tests have shown that at low braking energies, unglazed linings experience greater wear and the brake discs can become severely scored.

Conditioning may be accomplished as follows:

1. Perform two (2) consecutive full stop braking applications from 30 to 35 kts. Do not allow the brake discs to cool substantially between stops.
2. On aircraft with tail wheels, exercise caution during stopping to prevent tail lifting. Due to the efficiency of these brakes, extremely hard braking could result in lifting the tail from the ground.

This conditioning procedure will wear off high spots and generate sufficient heat to glaze the linings. Once the linings are glazed, the braking system will provide many hours of maintenance free service.

Visual inspection of the brake disc will indicate the lining condition. A smooth surface, without grooves, indicates the linings are properly glazed. If the disc is rough (grooved), the linings must be reglazed. The conditioning procedure should be performed whenever the rough disc condition is evident.

Light use, such as in taxiing, will cause the glaze to be worn rapidly.

Use caution in performing this procedure, as higher speeds with successive stops could cause the brakes to overheat resulting in warped discs and/or pressure plates.

July 1, 1985

NOSE WHEEL STEERING – DESCRIPTION/OPERATION**1. General**

The nose gear is steerable through steering springs attached between arms connected to the rudder pedal bars and a steering arm mounted to the top of the nose gear trunion assembly. The nose gear steering system provides nose gear steering through an arc of approximately 18 degrees each side of centerline and is capable of swiveling the nose gear through approximately 35 degrees with differential braking. When the nose gear retracts, the steering linkage becomes free to rotate with movement of the rudder pedals. The rudder pedal action is not impeded by the nose wheel steering mechanism.

NOSE WHEEL STEERING – MAINTENANCE PRACTICES

1. Removal/Installation of Nose Wheel Steering Assembly

Refer to Section 32-2-1 for removal and installation of steering arm. The steering linkage is covered in Chapter 27 (Flight Controls).

LANDING GEAR POSITION AND WARNING SYSTEM – DESCRIPTION/OPERATION

1. General (See Figure 1.)

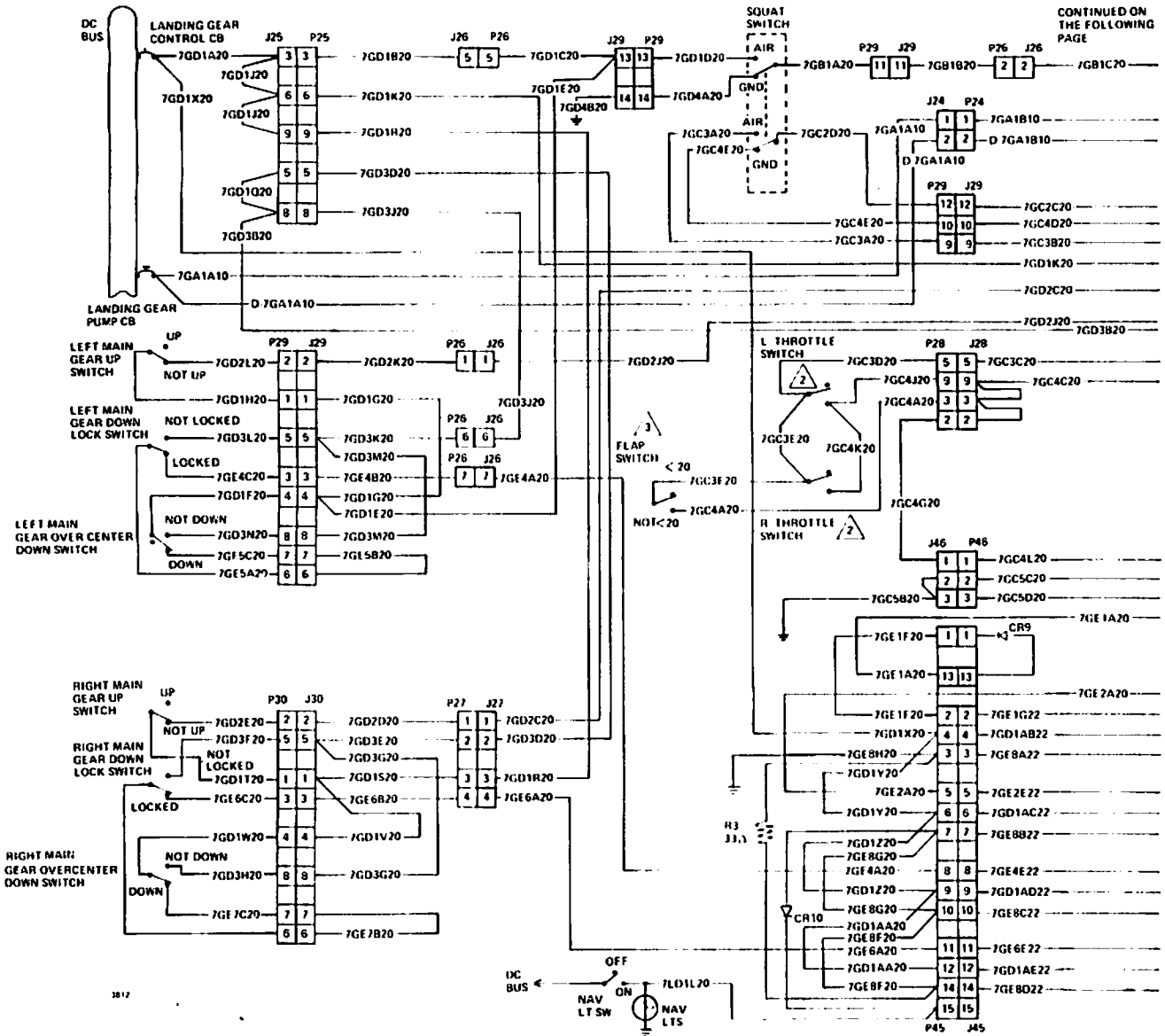
The GA-7/Cougar is equipped with a landing gear position and warning system. The gear positions are indicated by three green lights located next to the landing gear control handle on the instrument panel. An amber light, located with the green lights, will alert the pilot if the landing gear is in an unsafe configuration (i.e., landing gear handle in down position and gear not down and locked). An aural sound (warning horn) will be activated under certain inflight conditions to alert the pilot that landing gear is not extended.

During a normal landing, the landing gear position indicator lights will inform the pilot of landing gear position. Moving the landing gear control handle to the DOWN position will cause the landing gear to extend. As the landing gear is moving from the up position to the down position, the amber (NOT SAFE) light should be illuminated. Once the landing gear is down and locked, the amber light should be out and the green lights (gear down and locked) should be illuminated. If either landing gear does not extend and lock, the NOT SAFE light will remain illuminated and alert the pilot to a landing gear malfunction. The gear down and locked lights will glow dimly when the navigation lights are ON.

The warning horn will alert the pilot, during landing approach, if the landing gear has not been extended. This inflight warning can be initiated in two ways. (1) The warning will be activated when the throttle(s) are retarded to the point that the manifold pressure of the engine drops below 13 inches of mercury or (2) the flaps are greater than 15 degrees and the landing gear is not extended. The aural sound will continue until the landing gear is down and locked. The warning system is activated by two microswitches located in the control quadrant, actuated by the throttle levers, or a microswitch mounted on the flap torque tube.

In the event the aircraft is sitting on the ground, and the landing gear control is placed in the "UP" position, a safety switch (squat switch) will prevent the hydraulic pump from actuating. The squat switch is located on the left main landing gear. An aural sound will be emitted from warning horn.

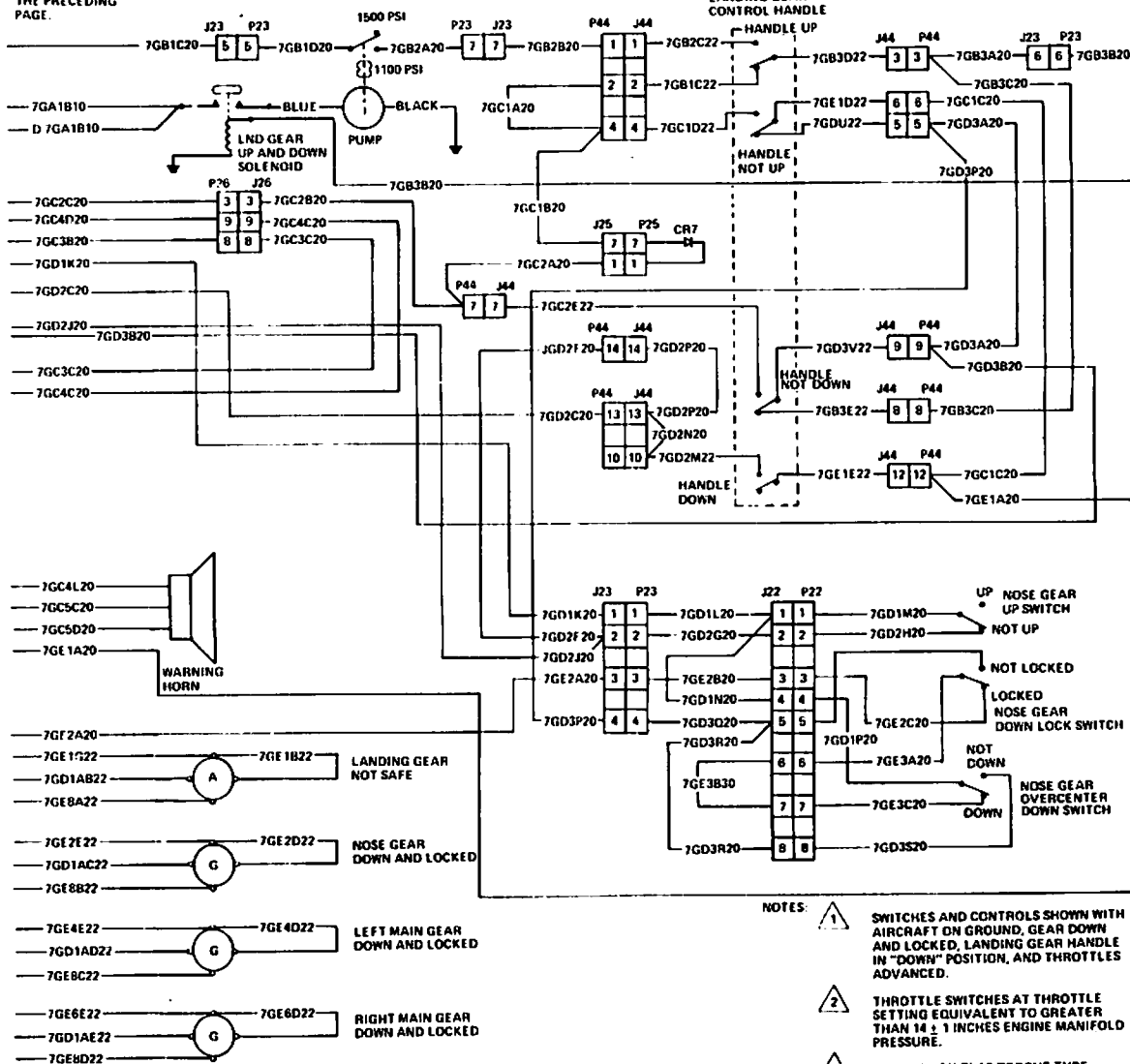
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Landing Gear Warning System Wiring Diagram
Figure 1 (Sheet 1 of 2)

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CONTINUED FROM
THE PRECEDING
PAGE.



Landing Gear Warning System Wiring Diagram
Figure 1 (Sheet 2 of 2)

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LANDING GEAR POSITION AND WARNING SYSTEM – MAINTENANCE PRACTICES

1. Adjustment of Landing Gear Up/Power Reduced Warning Switch

A. Adjust Landing Gear Up/Power Reduced Warning Switch (See Figure 201.)

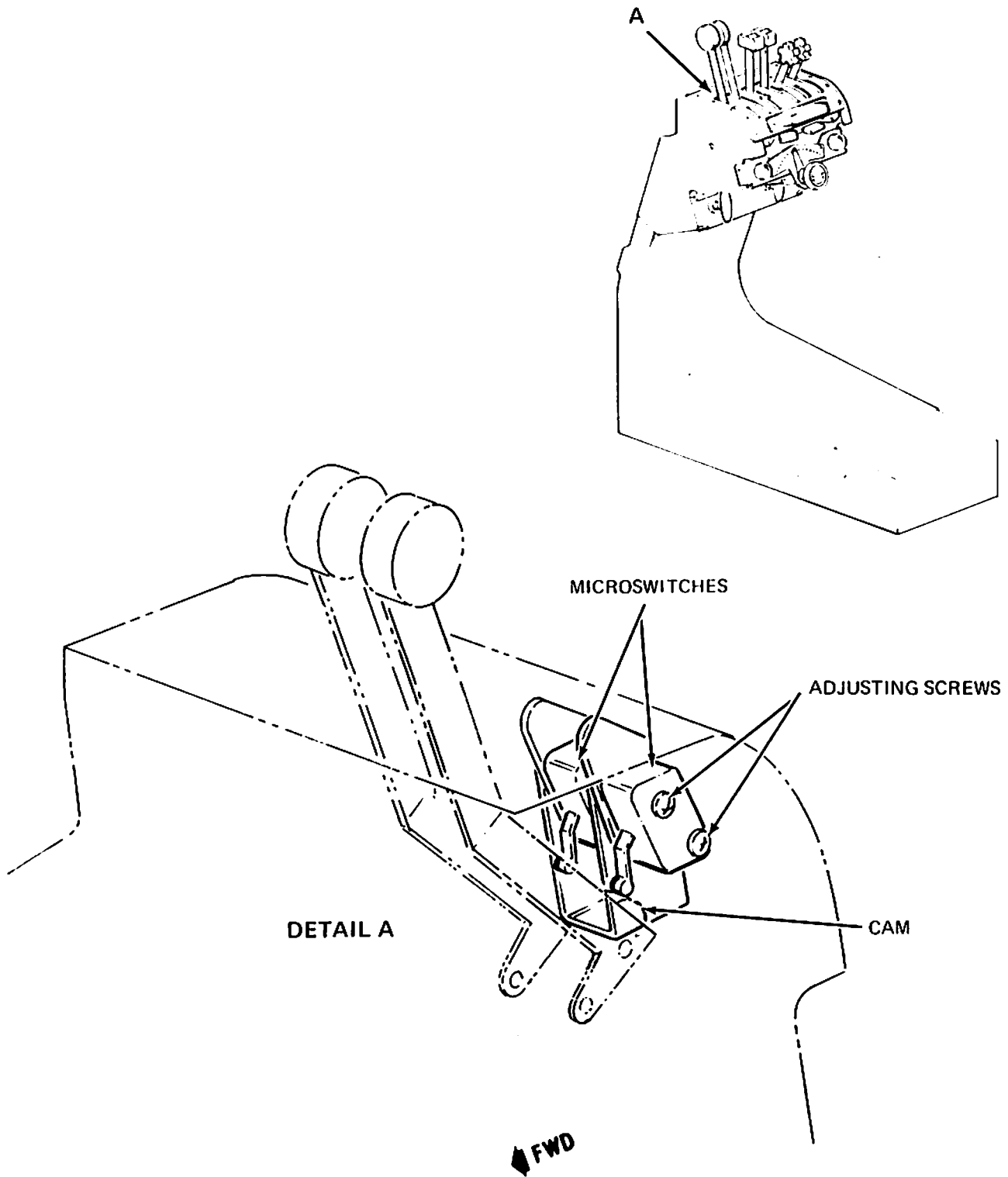
NOTE: This adjustment will require flying the aircraft.

- (1) With the aid of a qualified pilot, fly the aircraft to an elevation of 1000 feet. Bring aircraft to approach speed with propellers set for high rpm.
- (2) Retard the throttle levers to the point where the manifold pressure is 14 ± 1 inches of mercury. Mark the quadrant cover adjacent to the throttle levers in such a manner that the levers can be returned to the same position after the aircraft is landed.
- (3) Land the aircraft and shut down the engines.
- (4) Place the aircraft on jacks in accordance with Chapter 7. Apply DC power to the aircraft.
- (5) Retract the landing gear.
- (6) Position the throttle levers to the mark made in Step (2).
- (7) Remove the quadrant cover.
- (8) Loosen the screws on the microswitches located adjacent to the throttle levers.
- (9) Position microswitches to the point where warning horn is activated.
- (10) Tighten the screws to secure microswitches.
- (11) Advance throttles. Warning horn should silence.
- (12) Retard throttles to the point that warning is again activated.
- (13) Lower landing gear. Warning should be deactivated.
- (14) Remove DC power from aircraft.
- (15) Remove aircraft from jacks. Refer to Chapter 7.

2. Adjustment of Landing Gear Up/Flaps Extended Warning Switch

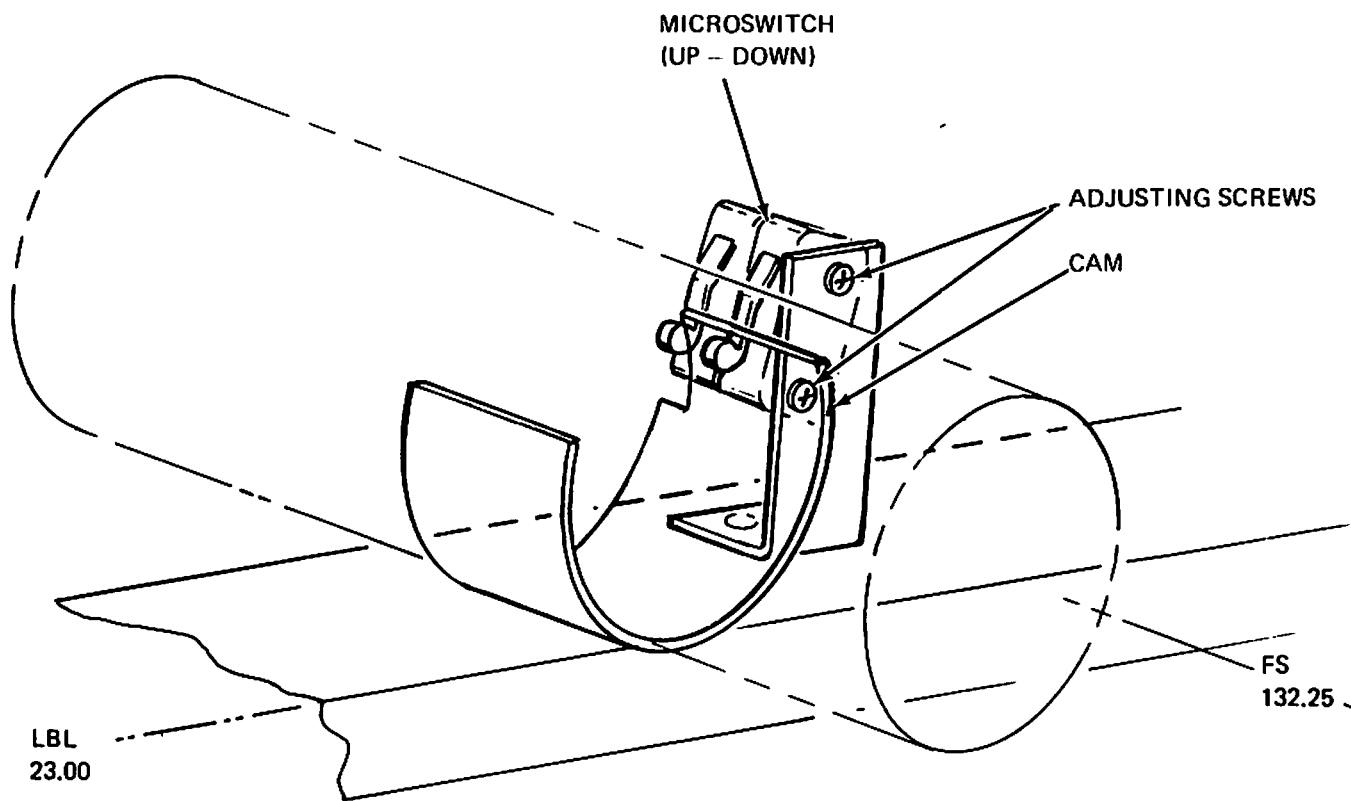
A. Adjust Landing Gear Up/Flaps Extended Warning Switch (See Figure 202.)

- (1) Place the aircraft on jacks in accordance with Chapter 7.
- (2) Apply DC power to the aircraft. Retract landing gear.



**Landing Gear Up/Power Reduced Microswitch
Figure 201**

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Landing Gear Up/Flaps Extended Microswitch

Figure 202

32G72-22

- (3) Remove furnishings to gain access to flap torque tube.
- (4) Extend flaps until flap indicator is positioned approximately midway between 10 and 15 degrees.
- (5) Loosen set screw on cam mounted on flap torque tube.
- (6) Position cam to the point where warning horn is activated.
- (7) Tighten set screw on cam.
- (8) Slightly retract flaps. Warning horn should silence and landing gear light should extinguish.
- (9) Extend flaps to the point that warning is again activated.
- (10) Lower landing gear. Warning should be deactivated.
- (11) Remove DC power from aircraft.
- (12) Remove aircraft from jacks. Refer to Chapter 7.

CHAPTER 33**LIGHTS****TABLE OF CONTENTS**

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LIGHTS - DESCRIPTION

1. General

The lights are divided into two systems, interior and exterior. The interior light system consists of the instrument lights, cabin lights, console lights, and baggage compartment light. The exterior light system consists of the landing light, navigation lights, strobe lights, and courtesy (step and wingwalk) lights.

BULB CHART

Interior Lights		
Quantity	Type Light	Bulb Part Number
5	Instrument Panel	1816 (G.E.)
4	Cabin	1414 (Wemac)
1	Baggage Compartment	1816 (G.E.)
2	Console	1816 (G.E.)
N/A	Avionics Equipment	N/A
Exterior Lights		
Quantity	Type Light	Bulb Part Number
1	Landing	4509 (G.E. or Westinghouse)
2	Navigation - (Wing Tips)	31-3078-9 (Grimes)
1	Navigation - (Tail Cone)	1073 (Grimes)
2	Strobe - (Wing Tips)	31-3078-9 (Grimes)
1	Strobe - (Tail Cone)	30-0876-7 (Grimes)
2	Courtesy - (Step and Wingwalk)	2690A42 (Industrial Devices)

NOTE: Do not order bulb replacements from part numbers listed. Refer to Illustrated Parts Catalog for part numbers.

INTERIOR LIGHT SYSTEM – DESCRIPTION/OPERATION**1. General**

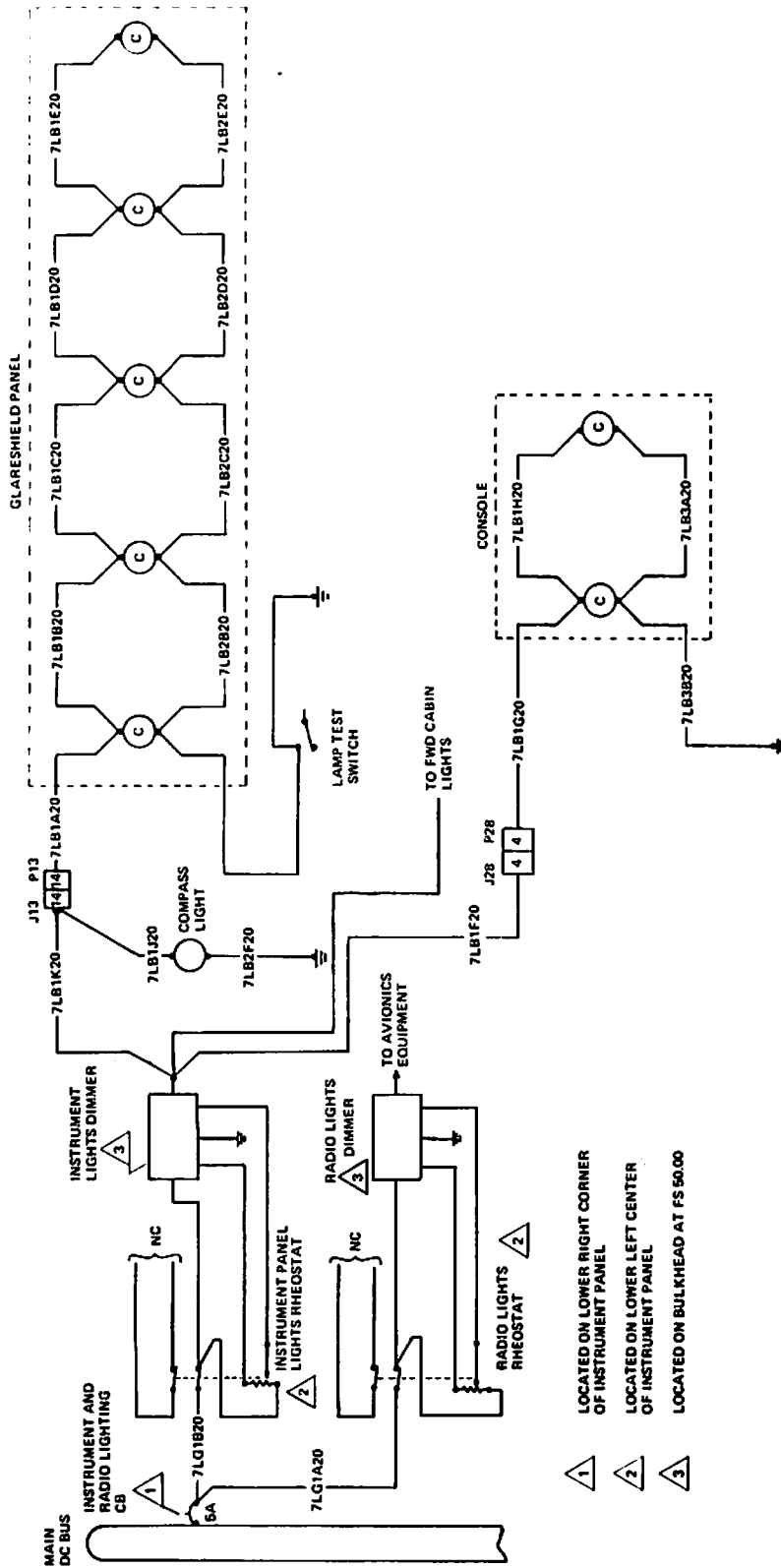
The interior light system consists of the instrument panel lights, cabin overhead and map lights, console lights, avionics equipment lights, and baggage compartment light. The brightness of the lights is controlled by two dimming controls. One control regulates the instrument panel and console lights and the other control regulates the lighting in the avionics equipment.

2. Instrument Panel (See Figure 1.)

The instrument panel is illuminated by five lights in the glareshield panel and by the lights in the individual instruments and avionics equipment. The brightness of the lights is controlled by two dimming controls located on the lower left of the instrument panel.

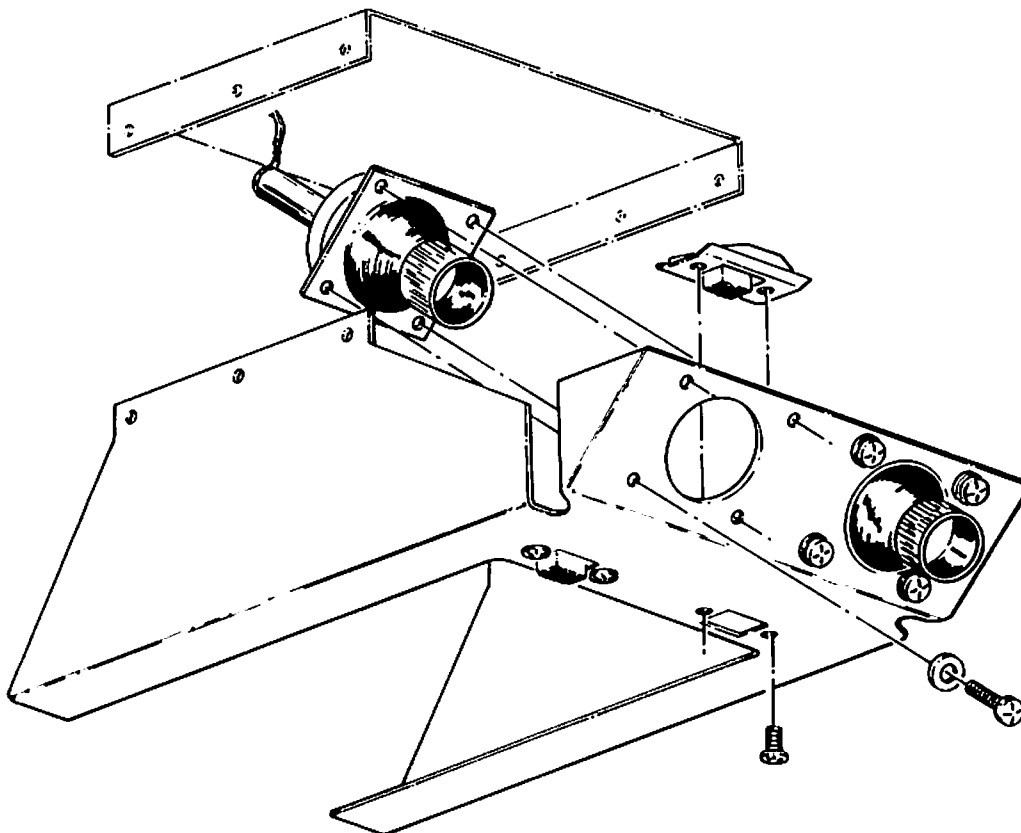
3. Cabin and Map Lights (See Figures 2 and 3.)

The four cabin lights are mounted on brackets in the cabin overhead. Two lights are positioned above the rear passenger seats and two above the pilot/copilot seats. Electrical power is supplied directly to the cabin lights from the battery through a 5-amp fuse, a cabin lights ON/OFF switch, and an individual ON/OFF switch for each light. Each light can be positioned individually. The bracket for the forward lights also houses the audio speaker.



**Instrument Panel Lights – Wiring Diagram
Figure 1**

33G72-1

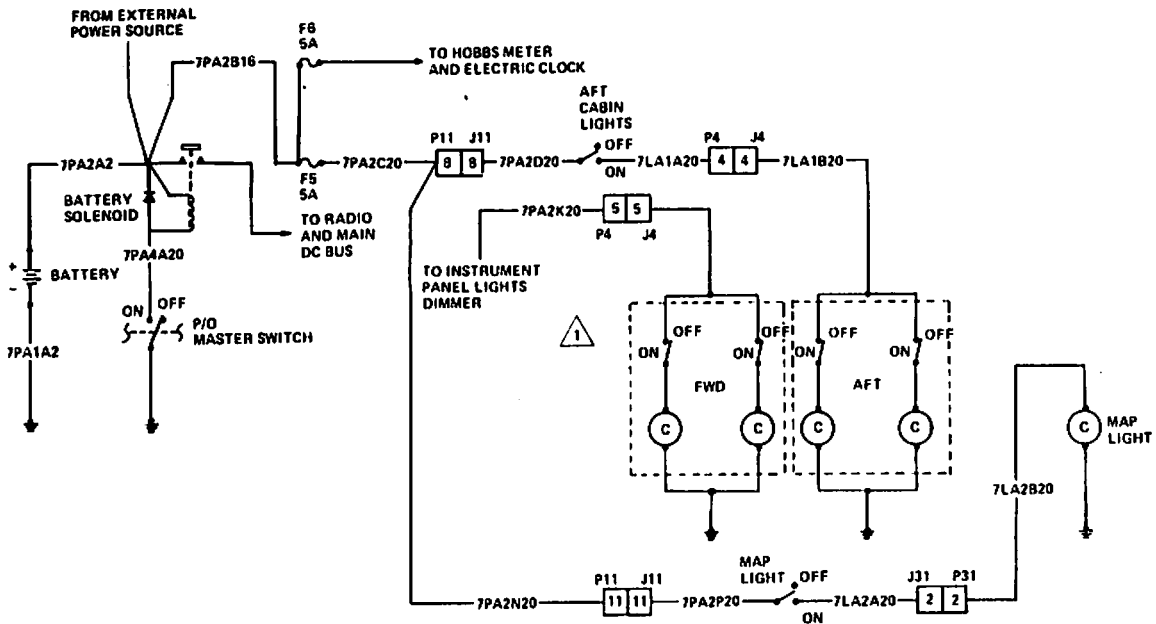


**Cabin Lights – Exploded View
Figure 2**

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1 SLIDE SWITCHES (4) MOUNTED ON LIGHT MOUNTING BRACKET



Cabin and Map Lights – Wiring Diagram
 Figure 3

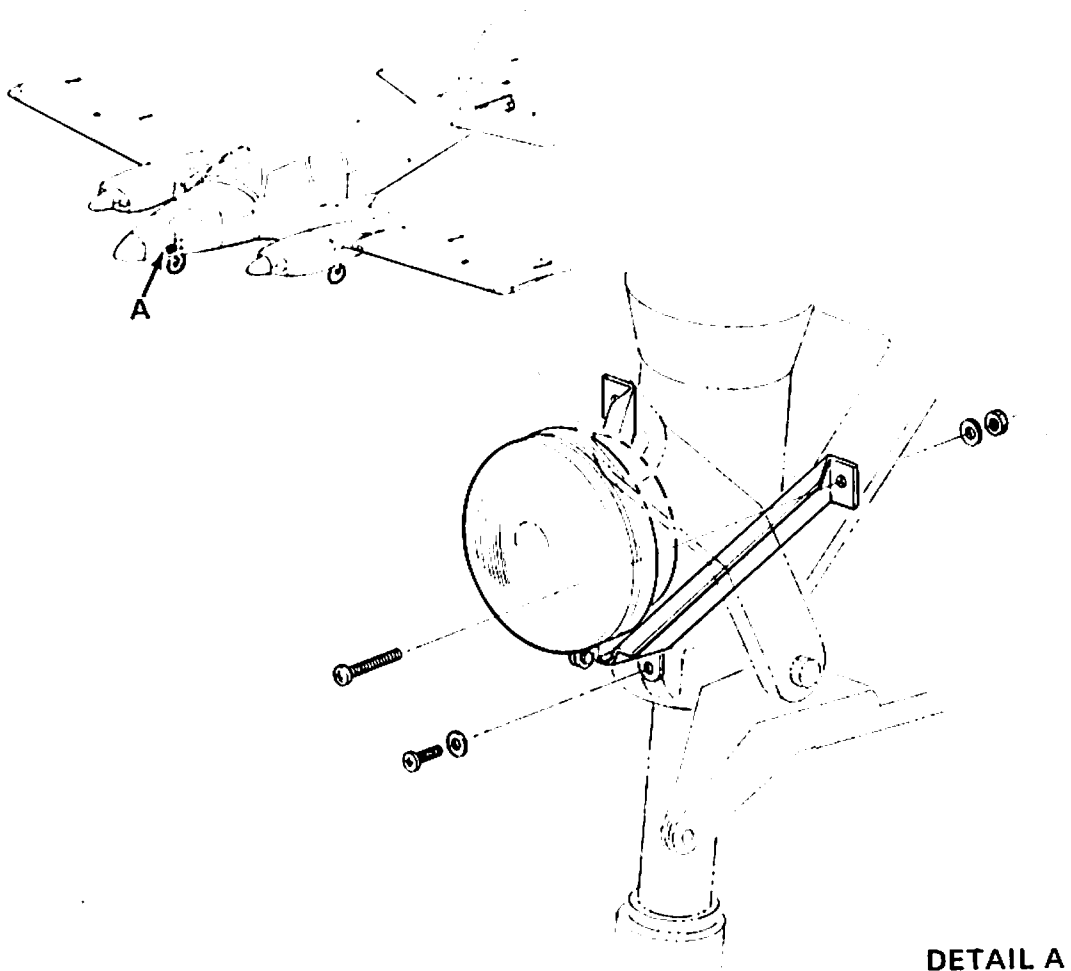
33G72-3

EXTERIOR LIGHT SYSTEM – DESCRIPTION/OPERATION**1. General**

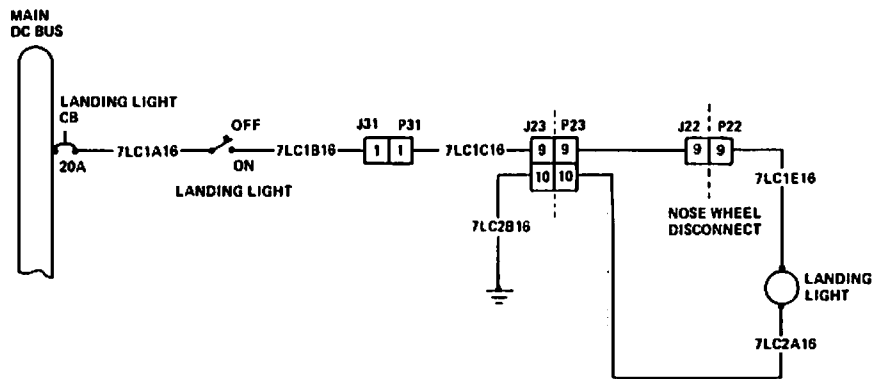
The exterior light system consists of the landing light, navigation lights, strobe lights, and courtesy (step and wingwalk) lights. The landing light is located on the nose landing gear. The navigation lights are located on each wing tip and the aft end of the tail cone. The strobe lights are also located on each wing tip and the aft end of the tail cone. The courtesy lights (step and wingwalk) are located on the right side and underneath the fuselage at approximately the trailing edge of the right wing.

2. Landing Light (See Figures 1 and 2.)

The landing light serves the dual purpose of landing light and taxi light. The light is mounted on the nose landing gear. Electrical power for the landing light is from the main DC bus through a 20-amp circuit breaker (located on lower right of instrument panel), through a control switch (rocker type, located on the lower left of instrument panel), to the light.

**DETAIL A****Landing Light – Exploded View
Figure 1**

33G72-4



**Landing Light – Wiring Diagram
Figure 2**

33G72-6

3. Navigation Lights (See Figures 3 and 4.)

The navigation lights are located on each wing tip and the aft end of the tail cone. The lights are controlled by a single switch on the instrument panel. Electrical power for the lights is from the main DC bus through a 10 amp circuit breaker, through the NAV LTS ON-OFF switch to the three lights.

4. Strobe Lights (See Figures 5 and 6.)

The strobe light system consists of three strobe lights and a strobe light power supply. One white strobe (anticollision) light is installed on each wing tip and the aft end of the tail cone. The power supply is mounted in the aft fuselage beneath the vertical stabilizer.

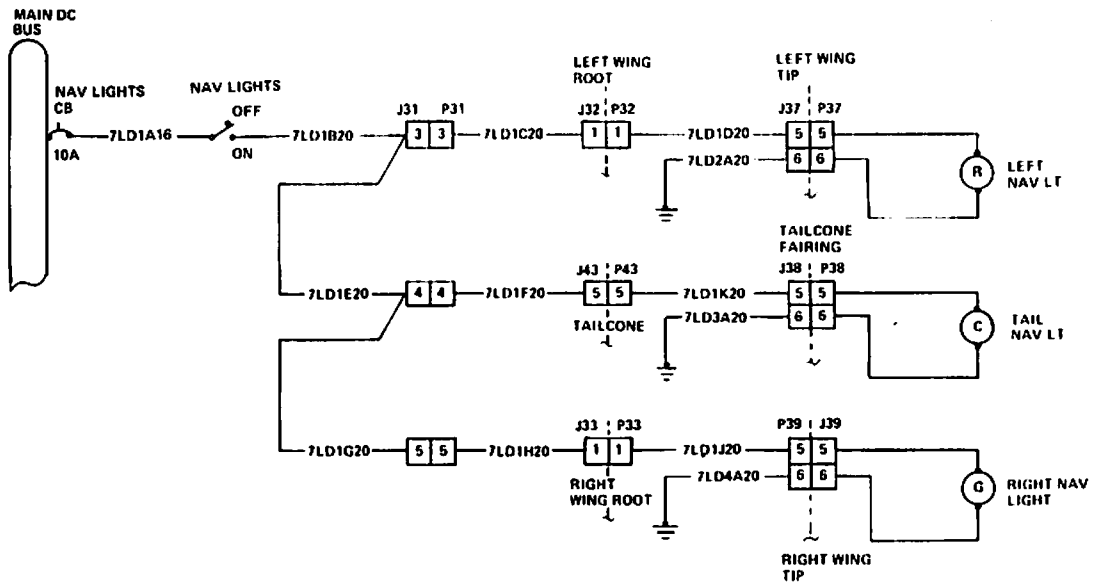
Electrical power is supplied from the main DC bus through a 10-amp circuit breaker, through the Strobe Lights ON-OFF switch to the strobe light power supply. With the Strobe Lights switch in the ON position, the power supply supplies energy for the three strobe lights. The iodine quartz lamp will produce an extremely high intensity flash. The strobe lights are vibration resistant.

5. Courtesy Lights (See Figure 7.)

The courtesy lights consist of the wingwalk, step, and baggage compartment lights. The lights can be controlled from outside the aircraft or from the inside. The wingwalk light is located on the right side of the fuselage at approximately the trailing edge of the wing. The step light is located beneath the fuselage just above the step on the right side. The baggage compartment light is mounted on the rear of the aft cabin overhead light mounting bracket.

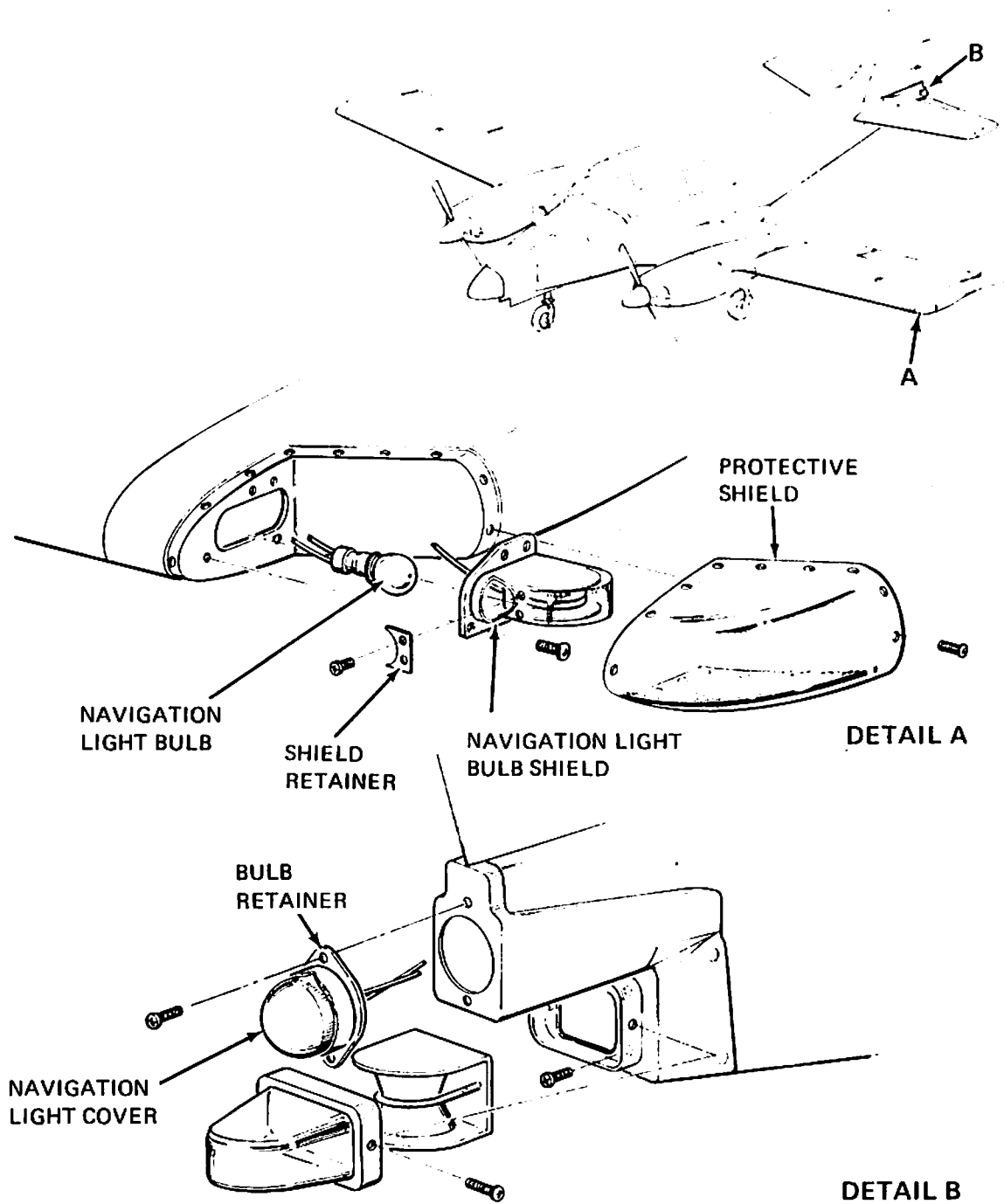
Power for the courtesy lights is from the battery through a 5-amp fuse, through the internal control switch, through the external control switch to the lights. The internal switch has a built-in light that will glow when the courtesy lights are on.

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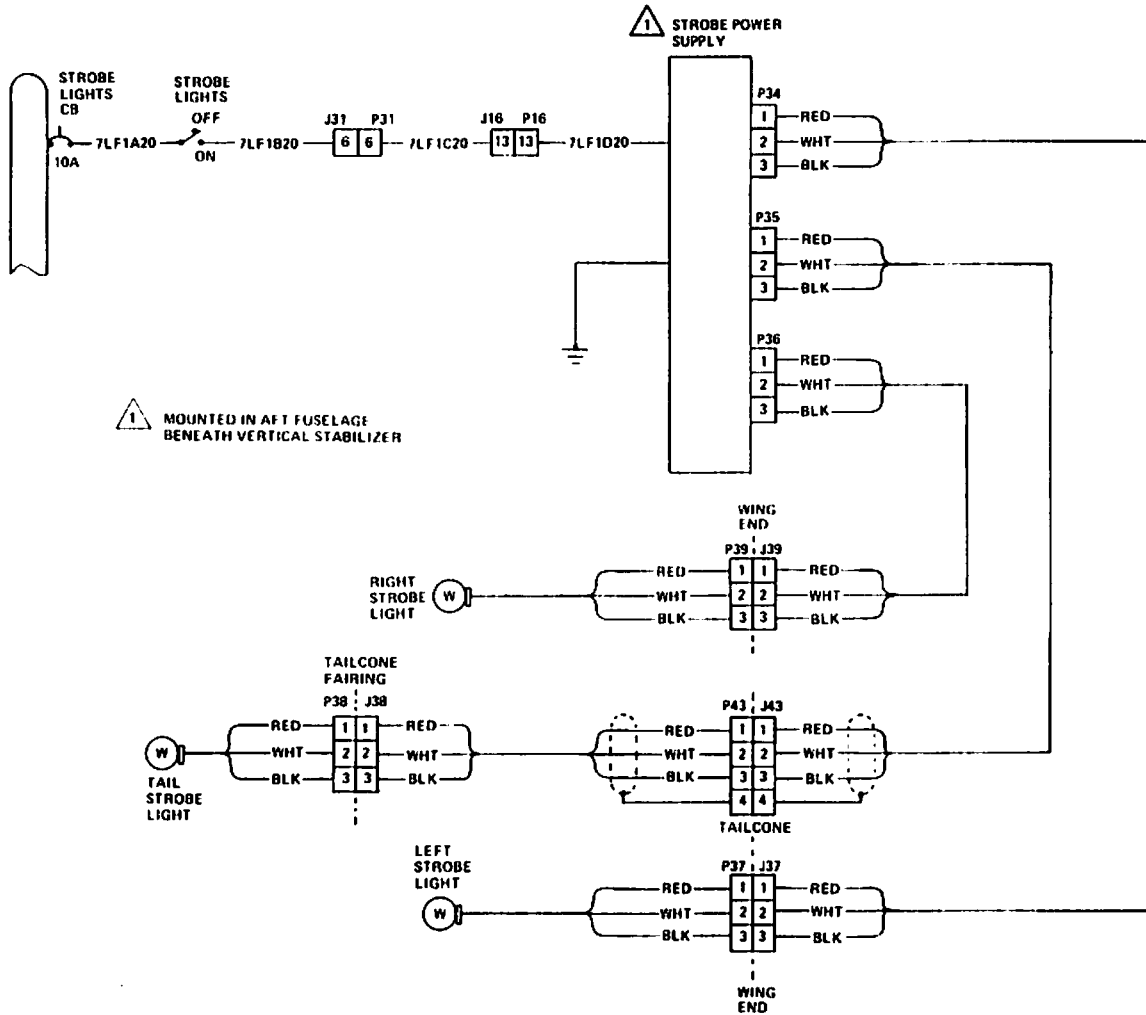
Navigation Lights -- Wiring Diagram
 Figure 3

33G72-6



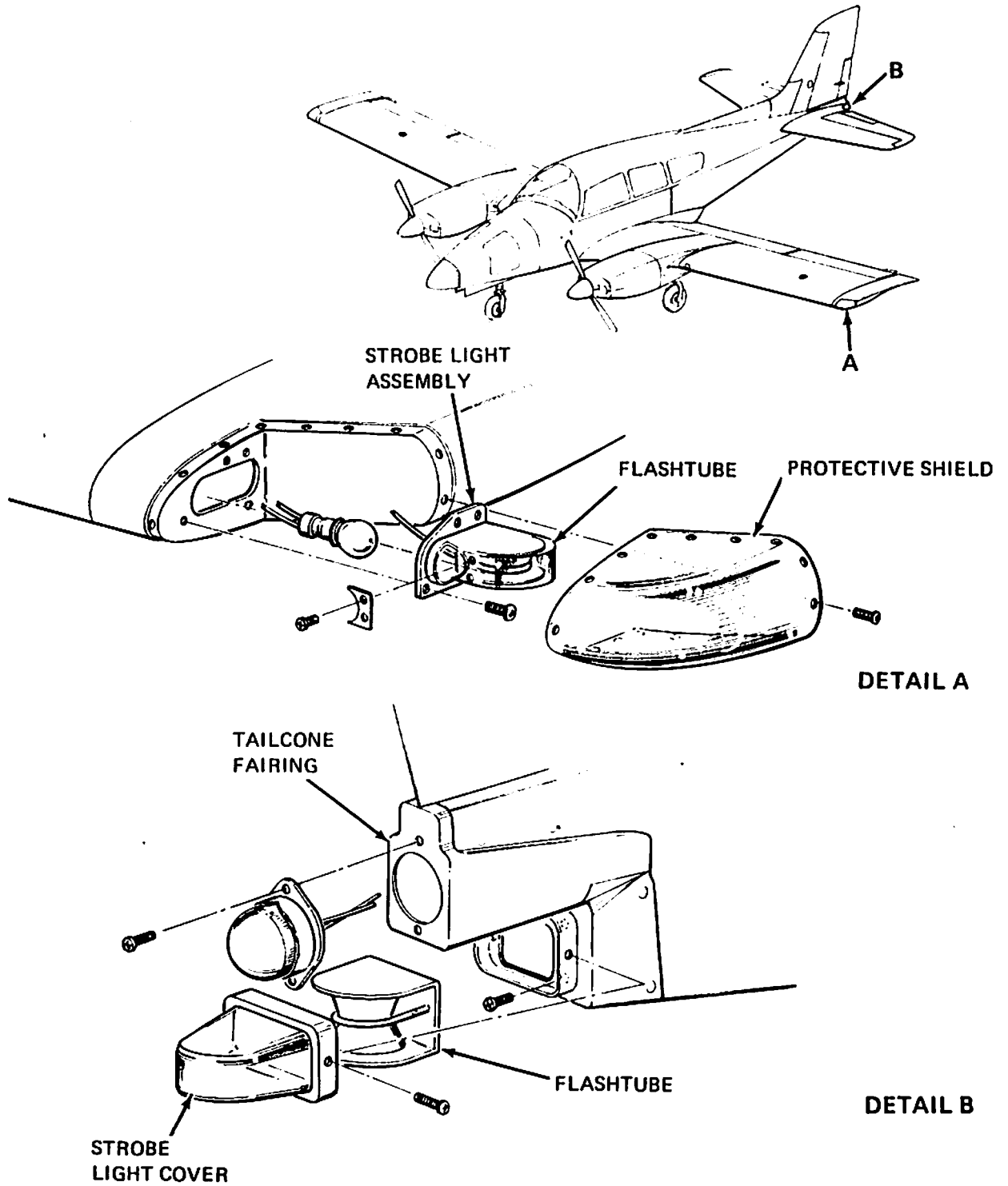
Navigation Lights – Exploded View
Figure 4

33G72-7



**Strobe Lights – Wiring Diagram
Figure 5**

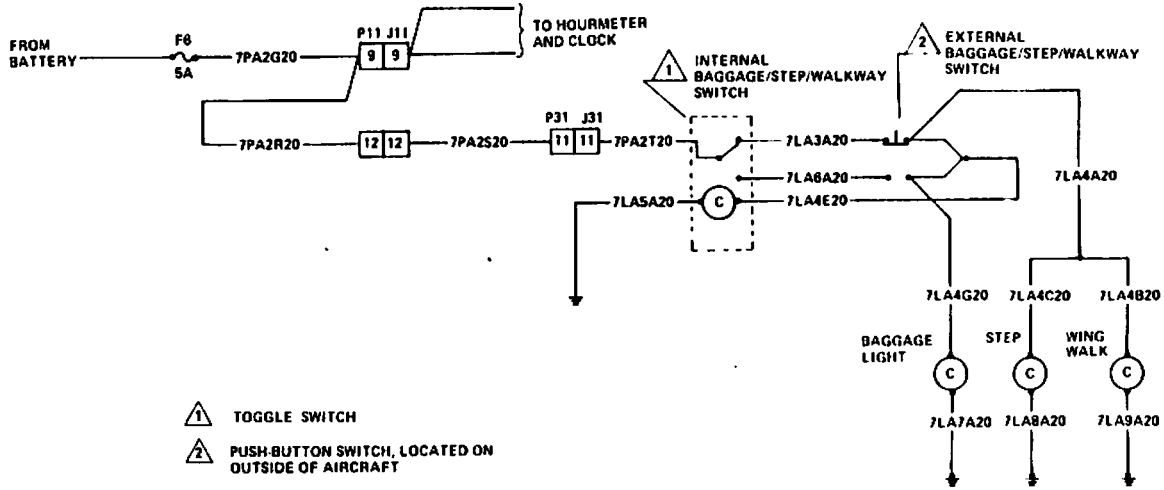
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**Strobe Lights – Exploded View
Figure 6**

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Baggage/Step/Walkway — Wiring Diagram
 Figure 7

33G72-10

EXTERIOR LIGHT SYSTEM – MAINTENANCE PRACTICES

1. Replacement of Landing Light (See 33-4-1, Figure 1.)

A. Replacement

- (1) Locate landing light on nose wheel landing gear.
- (2) Remove the clamp that secures the lamp to the light assembly.
- (3) Pull lamp forward and disconnect the wires from the rear of the lamp.
- (4) Place new light in light assembly and attach wires to lamp terminals.
- (5) Replace clamp around lamp and tighten to secure lamp to light assembly.
- (6) Perform operational test of landing light.

2. Replacement of Navigation Lights (See 33-4-1, Figure 4.)

A. Replacement of Wing Tip Navigation Lights

- (1) Remove screws attaching protective shield to wing tip.
- (2) Remove the screws which hold the navigation light shield to the navigation and strobe light assembly.
- (3) Remove the lamp and replace.
- (4) Replace the lamp shield and secure with screws.
- (5) Replace protective shield on wing tip.
- (6) Perform operational test of navigation lights.

B. Replacement of Tail Navigation Light

- (1) Remove the two screws which hold the lamp retainer to the tail cone.
- (2) Remove the retainer and lens.
- (3) Remove the lamp and replace.
- (4) Replace lens and retainer. Secure with two screws.
- (5) Perform operational test of navigation lights.

3. Replacement of Strobe Lights (See 33-4-1, Figure 6.)

A. Replacement of Wing Tip Strobe Lights

- (1) Remove hardware attaching wing tip to the wing.
- (2) Disconnect wires from plug on end of wing.
- (3) Remove wing tip.
- (4) Remove protective shield from wing tip.
- (5) Remove the navigation and strobe light assembly from wing tip.
- (6) Remove flashtube and replace.
- (7) Attach the navigation and strobe light assembly to wing tip.
- (8) Replace light protective shield on wing tip.
- (9) Connect wires from navigation and strobe lights to plug on end of wing.
- (10) Attach wing tip to wing.
- (11) Perform operational check of strobe lights.

B. Replacement of Tail Strobe Light (See 33-4-1, Figure 6.)

- (1) Remove tail cone fairing. (Refer to Chapter 53.)
- (2) Disconnect wires from plug at end of tail cone.
- (3) Remove the screws which attach strobe light assembly to tail cone fairing.
- (4) Remove flashtube and replace.
- (5) Attach strobe light assembly to tail cone fairing.
- (6) Connect wires from navigation and strobe light to plug at end of tailcone.
- (7) Replace tail cone fairing (Refer to Chapter 53.)
- (8) Perform operational test of strobe lights.

4. Exterior Lights Operational Test/Adjustment

A. Operational Test of Landing Light

- (1) Place Master switch to ON.

- (2) Place Landing Light switch ON. Observe that landing light is ON.
- (3) Place Landing Light switch to OFF.
- (4) Place Master switch to OFF.

B. Operational Test of Navigation Lights

- (1) Place Master switch to ON.
- (2) Place NAV LTS switch to ON. Observe that navigation lights on each wing tip and on tail are ON.
- (3) Place NAV LTS switch to OFF.
- (4) Place Master switch to OFF.

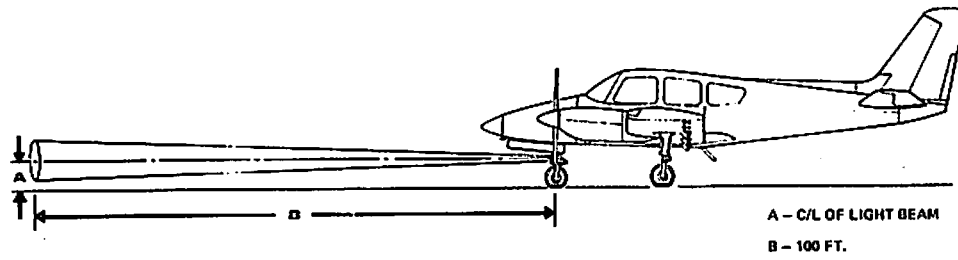
C. Operational Test of Strobe Lights

- (1) Place Master switch to ON.
- (2) Place Strobe light switch to ON. Observe that strobe lights on each wing tip and on tail are flashing.
- (3) Place Strobe light switch to OFF.
- (4) Place Master switch to OFF.

D. Adjustment of Landing Light (See Figure 201.)

NOTE: Before adjusting light, ensure tires are properly inflated.

- (1) Position aircraft on flat surface.
- (2) Adjust light in accordance with Figure 201.



**Landing Light Adjustment
Figure 201**

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CHAPTER 34

NAVIGATION

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NAVIGATION SYSTEM - DESCRIPTION/OPERATION

1. General

All GA-7/Cougar aircraft will not have identical navigational equipment installed. The basic items that provide minimum requirements to comply with FAA regulations are available on all aircraft. More diverse navigational items are available as a customer option. It is the intent of this manual to present procedures and instructions adequate for minor inspection and minor flight line maintenance of all navigation equipment that may be installed on the aircraft, including the optional equipment.

Overhaul or shop maintenance of the navigation equipment must be performed in accordance with the individual manufacturer's data and by an appropriately certified technician.

PITOT AND STATIC SYSTEMS – DESCRIPTION/OPERATION**1. General**

The pitot and static systems supply impact (pitot) and atmospheric (static) pressure to various instruments. Some of these instruments require static pressure only; others require both static and pitot pressure for operation. (See Figure 1.) Both systems operate independently of each other.

The pitot and static systems consist of plastic and metal tubing which convey ram air pressure (impact) and atmospheric pressure (static) to the airspeed indicator, vertical speed indicator (optional), altimeter, and altitude hold unit (optional).

2. Pitot System

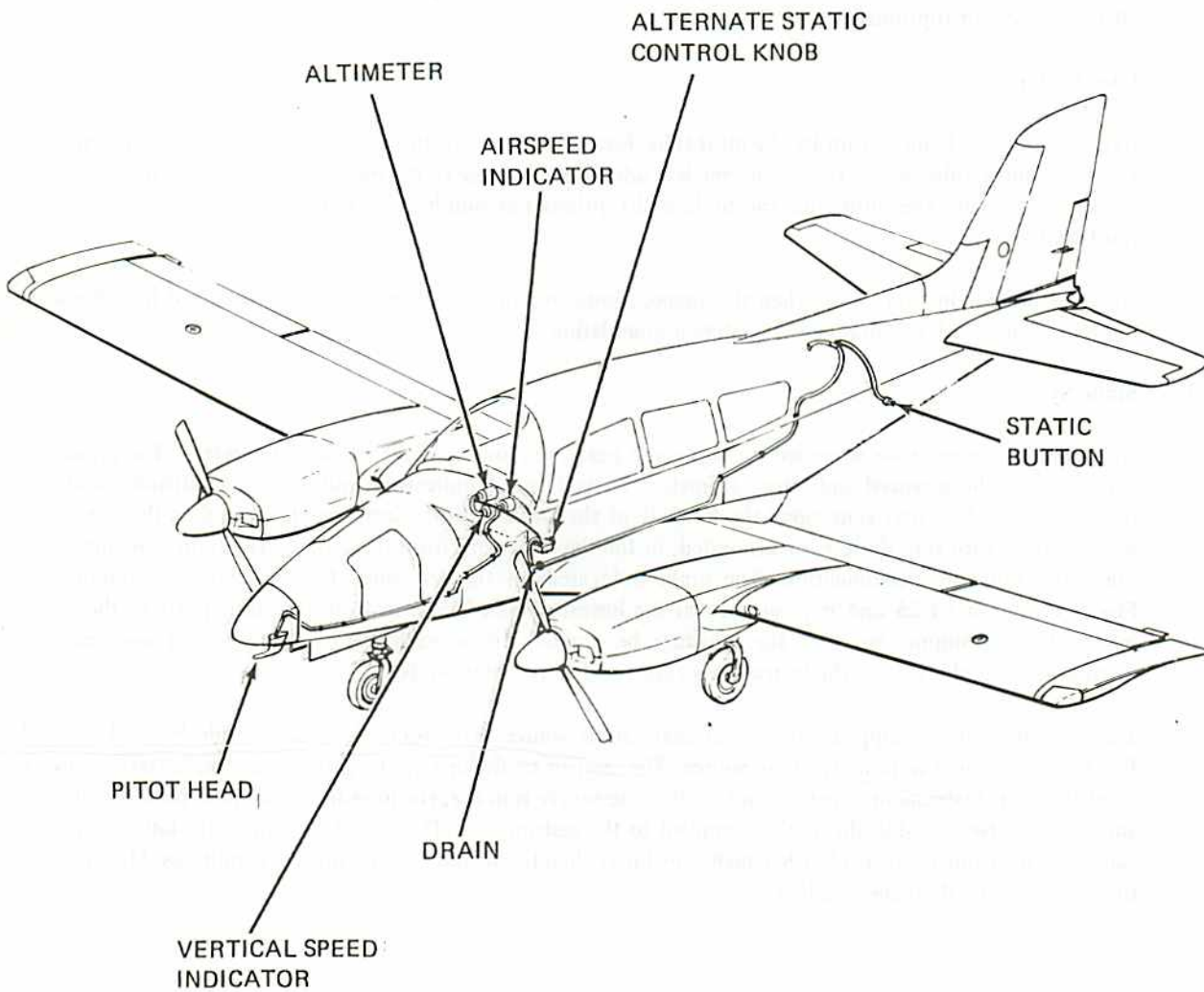
Ram air pressure is picked up by the pitot tube, located underneath the nose cap, at centerline of the aircraft. From the pitot tube, a line runs along the left side of the fuselage to the instrument panel and attaches to the airspeed indicator. The pitot tube can be heated (optional) or non-heated. Refer to Chapter 30 for details on pitot heat system.

At the 100-hour inspection or when the airspeed indicator fails to operate properly the pitot line should be disconnected in order to drain any moisture accumulation.

3. Static System

Atmospheric air pressure is sensed by two static ports, one on each side of the aft fuselage. The pressure is conveyed to the airspeed indicator, altimeter, vertical speed indicator (optional), and altitude hold unit (optional) by a line that runs along the left side of the airplane to the instruments located on the instrument panel. A moisture trap drain is incorporated, in the line that runs from the static ports to the instruments, to drain any moisture accumulation. The drain is located on the left side of the aircraft at approximately Fuselage Station 61.25 and is positioned at the lowest point of the run from the static ports to the instruments. It is recommended that the moisture be drained during each static system test or more often if fluctuations are observed in the instruments connected to the static system.

The aircraft is also equipped with an alternate static source. The alternate source would be used if a malfunction exists in the primary static source. The control knob for switching to the alternate static source is located on the instrument panel. When the alternate source is in use, the lines from the static ports are blocked and pressure from inside the cabin is applied to the instruments. The use of the alternate static source will cause the instruments to read either higher or lower than the readings under normal conditions. Most installations cause a slightly higher reading.



Pitot and Static System
Figure 1

34G72-1

PITOT AND STATIC SYSTEMS -- TROUBLESHOOTING

I. Troubleshooting Pitot and Static Pressure Systems

TROUBLE	PROBABLE CAUSE	REMEDY
Airspeed indicator fails to indicate.	Static buttons blocked or obstruction in pitot or static lines.	Check all lines and fittings for obstruction and clean as necessary.
	Water in static system.	Drain static system.
	Pitot line kinked or disconnected.	Check all pitot lines and repair as required.
Airspeed indicator fluctuates or indicates incorrectly.	Leak in pitot or static systems.	Tighten all connections and test system until no leakage is evident. See leakage test procedure in this chapter.
	Defective instrument.	Replace instrument.
	Instrument leakage.	Test instrument individually and replace if necessary.
Altimeter fails to operate.	Clogged static line.	Check all lines and fittings and blow out as required.
	Defective instrument.	Replace instrument.
Altimeter fluctuates.	Leak in static system.	Tighten all connections and test system until no leakage is evident. See leakage test procedure in this chapter.
	Instrument leakage.	Replace instrument.
	Defective instrument.	Replace instrument.
Vertical speed indicator fails to operate, fluctuates, or reads incorrectly.	Obstruction in static lines.	Remove, inspect, and clean all static lines.
	Defective instrument.	Replace instrument.
	Instrument leakage.	Test instrument individually and replace if necessary.

PITOT AND STATIC SYSTEMS – MAINTENANCE PRACTICES

1. Removal/Installation of Pitot Tube (See Figure 201.)

A. Removal

- (1) Remove nose cap to gain access to pitot tube attaching hardware.
- (2) Disconnect pitot tube air inlet line.
- (3) Disconnect pitot heater element plug. (Applicable to heated pitot tube only.)
- (4) Remove hardware attaching pitot tube to mounting bracket.
- (5) Remove pitot tube assembly.

B. Installation

- (1) Place pitot tube assembly in position and install attaching hardware.
- (2) Connect pitot tube air inlet line.
- (3) Connect pitot tube heater element plug. (Applicable to heated pitot tube only.)
- (4) Replace nose cap.
- (5) Perform leakage test of pitot system. (See test procedure in this chapter.)

2. Pitot and Static Pressure System Leakage Test

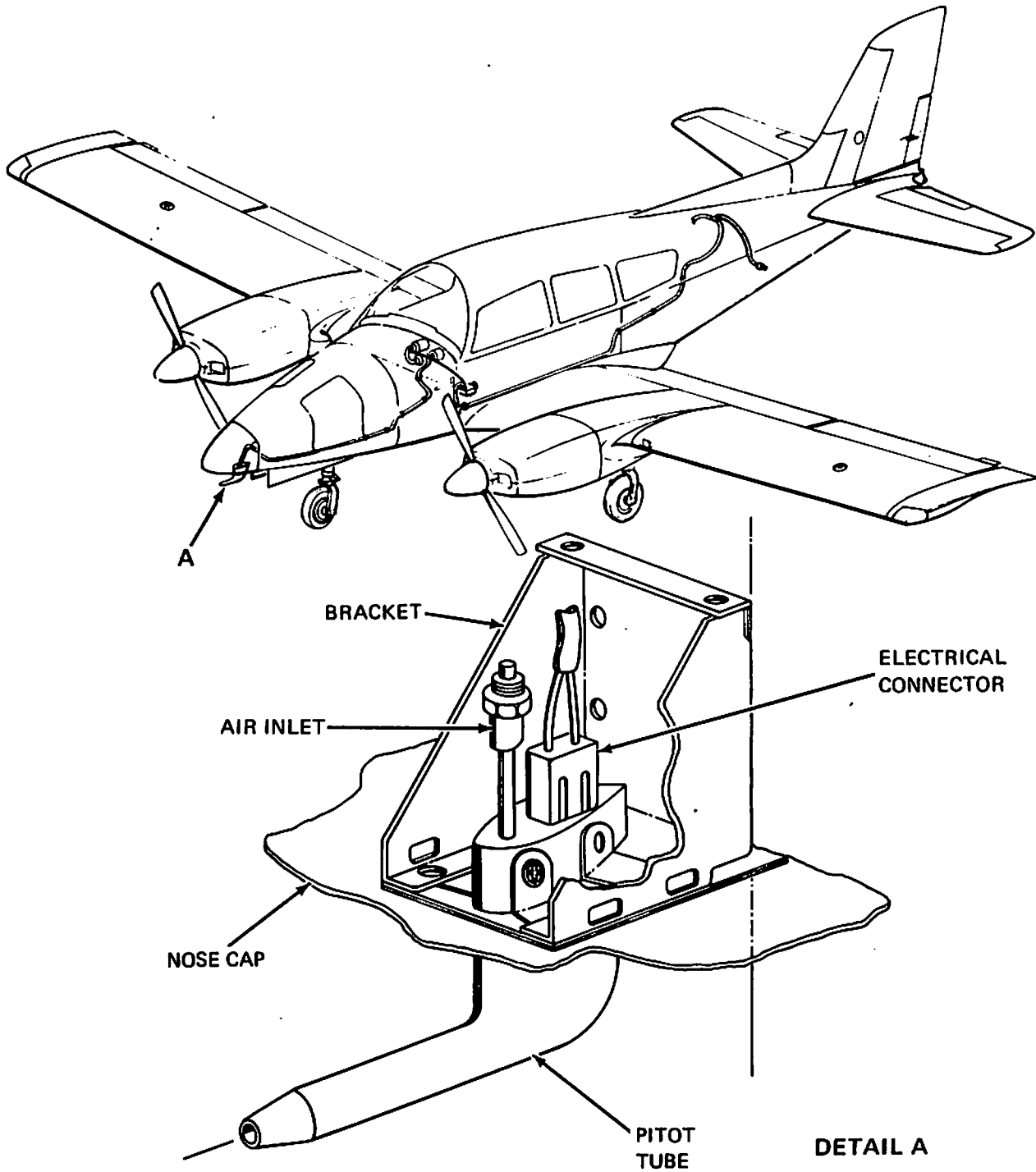
A. Pitot System Leakage Test

CAUTION: NEVER APPLY SUCTION TO THE PITOT TUBE UNLESS THE AIRSPEED INDICATOR IS DISCONNECTED.

- (1) Place a surgical type rubber hose, approximately 24 inches long, over the pitot tube.
- (2) Apply pressure by closing the opposite end of the tube and slowly roll up rubber hose until the airspeed indicator registers between 120 to 150 mph.
- (3) Secure the rolled-up end of the hose to prevent it from unrolling.
- (4) After 2 or 3 minutes, recheck the airspeed indicator. Any leakage in the system will result in a lower airspeed indication. If the reading has decreased more than 1 mph per minute, an undesirable leak exists somewhere in the system.

NOTE: Be sure the hose is not losing pressure.

- (5) To eliminate the leak, check all connections and tighten all fittings in the system as necessary and apply thread sealant sparingly as required. Inspect the pitot line for deterioration. Replace if necessary.



Pitot Tube Installation
Figure 201

34G72-2

(6) Repeat Steps (1) through (4).

B. Static System Leakage Test

CAUTION: NEVER APPLY POSITIVE PRESSURE TO THE STATIC SYSTEM UNLESS ALL INSTRUMENTS ARE DISCONNECTED.

FAR 91.170 requires that static systems and altimeters be checked every 24 months for IFR. The most common method of testing static systems is covered in FAR 43, Appendix E, "Altimeter System Test and Inspection." Additional information may be found in FAA Advisory Circular No. AC 43-203A. An approved alternate method specifically for the GA-7/Cougar is listed below. Perform test as follows:

- (1) Ensure that the altimeter has been tested and approved by an appropriately rated facility per FAR Part 43, Appendix E, prior to aircraft system test.
- (2) Seal off one static port opening with plastic tape. This must provide an airtight seal.
- (3) Attach a source of suction to the remaining static port. If an alternate static source is installed, ensure that control is in OFF position.

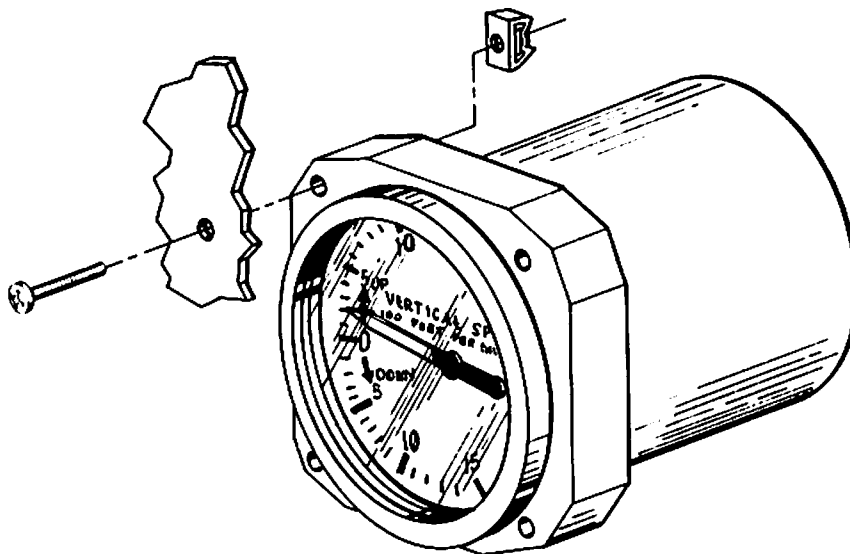
NOTE: One method of applying suction is to insert a hypodermic syringe into the static port and slowly withdraw the plunger of the syringe. Ensure that the syringe does not leak and an airtight seal is maintained during test.

- (4) Slowly apply suction until the altimeter indicates a 1000-foot increase in altitude.
- (5) Secure the suction source to maintain a closed system. Leakage shall not exceed a decrease of 100 feet of altitude per minute, as indicated on the altimeter.
- (6) If the leakage rate exceeds 100 feet per minute, check and retighten all connections and fittings.
- (7) Repeat Steps (1) through (5).
- (8) If the leakage rate is still too high, disconnect the static lines from the individual instruments.
- (9) Proceeding one at a time, and using suitable fittings, connect the lines together so that the altimeter is the only instrument still connected to the static pressure system.
- (10) Repeat the leakage test to determine whether the static pressure system or the instruments disconnected from the system are the cause of leakage. If the instruments are at fault, they must be repaired by an appropriately rated repair station or replaced. If the static pressure system is at fault, repeat the procedure given in Step (6).
- (11) Remove tape from static ports. Ensure ports are not blocked by gum/glue residue from tape.

VERTICAL SPEED INDICATOR – DESCRIPTION/OPERATION

1. General

The vertical speed indicator (Figure 1), located on the instrument panel, measures the rate of change in static pressure when the aircraft is climbing or descending. By means of a pointer and dial this instrument will indicate the rate of ascent or descent of the aircraft in feet per minute. But due to the lag of the instrument, the aircraft will be climbing or descending before the instrument starts to change and the instrument will continue to change after the aircraft has resumed level flight. In rough air the lag of the instrument should not be considered a malfunction. The vertical speed indicator is not furnished as standard equipment.



**Vertical Speed Indicator
Figure 1**

VERTICAL SPEED INDICATOR – TROUBLESHOOTING

1. Troubleshooting Vertical Speed Indicator

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer fails to respond.	Obstruction in static line.	Disconnect all instruments connected to the static line. Inspect and clear all static lines.
Pointer oscillates.	Leaks in static lines or instrument.	Disconnect all instruments connected to the static line. Check individual instruments for leaks. Replace if necessary. Check lines and connections for leaks. (Refer to 34-1-1.)
	Defective mechanism.	Replace instrument.
Rate of climb indicates when aircraft is banked.	Water in static line.	Remove cap at low place in static line and drain line.
Pointer has to be set before every flight.	Temperature compensator inoperative.	Replace instrument.
Pointer cannot be reset to zero.	Diaphragm distorted.	Replace instrument.
Instrument reads very low during climb or descent.	Instrument case broken or leaking.	Replace instrument.

VERTICAL SPEED INDICATOR – MAINTENANCE PRACTICES

1. Removal/Installation of Vertical Speed Indicator

A. Removal

- (1) Gain access to the connections on the rear of the indicator from outside the aircraft through forward baggage compartment and opening in bulkhead at Fuselage Station 50.00.
- (2) Locate vertical speed indicator on instrument panel and loosen fitting to disconnect tubing from rear of indicator.
- (3) Remove three screws and nuts securing vertical speed indicator to instrument panel and remove indicator.

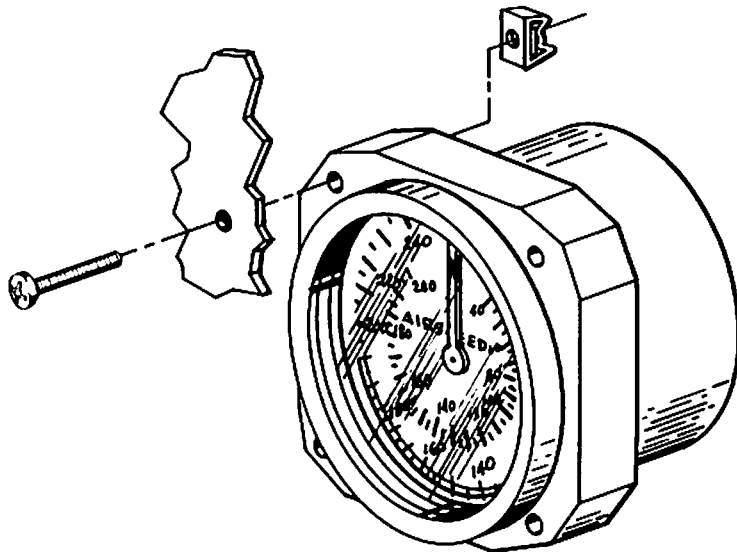
B. Installation

- (1) Position vertical speed indicator in place on instrument panel and install three screws and nuts securing vertical speed indicator to instrument panel.
- (2) Connect tubing to back of indicator. Secure by tightening fitting.
- (3) Perform test of vertical speed indicator. (Refer to manufacturer's manual for test procedure.)

AIRSPEED INDICATOR -- DESCRIPTION/OPERATION

1. **General**

The airspeed indicator (Figure 1), located on the instrument panel, provides a means of indicating the speed of the aircraft passing through the air. The airspeed indication is derived from the differential pressure between pitot air pressure and static air pressure. This instrument has its diaphragm vented to the pitot air source and its case vented to the static air system. As the aircraft increases speed, the pitot air pressure increases, causing the diaphragm to expand. A mechanical linkage picks up this motion and moves the instrument pointer to the indicated speed. The instrument dial is calibrated in knots and miles per hour, and also has the safe operating range marked on the dial.



Airspeed Indicator
Figure 1

34G72-4

AIRPEED INDICATOR – TROUBLESHOOTING

1. Troubleshooting Airspeed Indicator

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer of airspeed indicator does not indicate properly.	Leak in instrument case or in pitot lines.	Check for leak and seal. (Refer to 34-1-1.)
Pointer of airspeed indicator.	Defective mechanism.	Replace instrument.
Instrument reads high.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct. (Refer to 34-1-1.)
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct. (Refer to 34-1-1.)
Airspeed changes as aircraft is banked.	Water in pitot line.	Disconnect pitot line from airspeed indicator. Blow out pitot line from cockpit to pitot tube.

**AIRSPPEED INDICATOR - MAINTENANCE PRACTICES****1. Removal/Installation of Airspeed Indicator****A. Removal**

- (1) Gain access to the connections on the rear of the indicator from underneath and behind the instrument panel or from outside the aircraft through forward baggage compartment and the opening in bulkhead at Fuselage Station 50.00.
- (2) Locate airspeed indicator on instrument panel and loosen fittings to disconnect tubing from the connections on back of indicator.
- (3) Remove four mounting screws securing airspeed indicator to instrument panel and remove indicator.

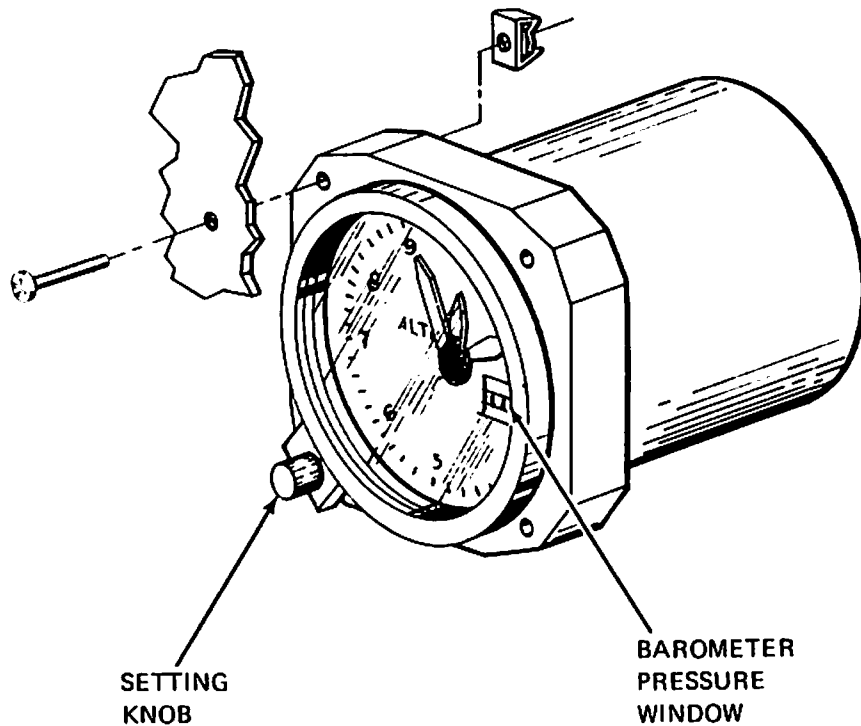
B. Installation

- (1) Position airspeed indicator in place on instrument panel and install four screws securing airspeed indicator to instrument panel.
- (2) Connect tubing to connections on back of indicator.
- (3) Perform test of airspeed indicating system. (Refer to 34-1-1.)

ALTIMETER – DESCRIPTION/OPERATION

1. General

The altimeter (Figure 1), located on the instrument panel, indicates altitude in feet above sea level. The indicator has three pointers and a dial scale. The long pointer is read in hundreds of feet, the middle pointer in thousands of feet, and the short pointer in ten thousands of feet. A barometric pressure window is located on the right side of the indicator dial. The barometric pressure indication is set by the knob located on the lower left corner of the instrument. The altimeter consists of a sealed diaphragm that is connected to the pointers through a mechanical linkage. The instrument case is vented to the static air system. As static air pressure changes, the diaphragm changes, causing the pointers to move through the mechanical linkage.



Altimeter
Figure 1

34G72-5

ALTIMETER – TROUBLESHOOTING

1. Troubleshooting the Altimeter

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive scale error.	Improper calibration.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
High or low reading.	Improper venting.	Eliminate leak in static pressure system. (Refer to 34-1-1.)
Setting knob is hard to turn.	Wrong lubrication or lack of lubrication.	Replace instrument.
Inner reference marker fails to move when setting knob is rotated.	Out of engagement.	Replace instrument.
Setting knob setscrew loose or missing.	Not tight when altimeter was reset.	Tighten instrument screw, if loose. Replace instrument, if screw is missing.
Cracked or loose glass cover.	Case gasket hardened.	Replace instrument.
Dull or discolored markings.	Age.	Replace markings.
Barometric scale and reference markers out of synchronism.	Slippage of mating parts.	Replace instrument.
Barometric scale and reference markers out of synchronism with pointers.	Drift in mechanism.	Reset pointers, per AC 43.131, Chapter 7, dated June 12, 1969.
Altimeter sticks at altitude or does not change with change of altitude.	Water or restriction in static line.	Remove static lines from all instruments, and blow line clear from cockpit to static ports.
Altimeter changes reading as aircraft is banked.	Water in static line.	Remove drain cap from static line and drain water from line.
Altimeter requires resetting frequently.	Temperature compensator inoperative.	Replace instrument.

ALTIMETER – MAINTENANCE PRACTICES**1. Removal/Installation of Altimeter****A. Removal**

- (1) Gain access to the connections on the rear of the altimeter from underneath and behind the instrument panel or from outside the aircraft through the forward baggage compartment and the opening in the bulkhead at Fuselage Station 50.00.
- (2) Locate altimeter on instrument panel and loosen fittings to disconnect tubing from tee connection on back of instrument.
- (3) Remove three screws securing altimeter to instrument panel and remove altimeter.

B. Installation

- (1) Position altimeter in place on instrument panel and install three mounting screws securing altimeter to instrument panel.
- (2) Connect tubing to tee connection on back of altimeter.
- (3) Perform static system leakage test and recertify altimeter. (Refer to 34-1-1.)

**AIR TEMPERATURE GAUGE – DESCRIPTION/OPERATION****I. General**

The outside air temperature gauge is located in the upper center of the windshield. The gauge is a mechanically operated instrument actuated by expansion of a metallic element to give the temperature indication on the face of the instrument. The range of temperature readings is from 144°F (64°C) to -64°F (-54°C).

AIR TEMPERATURE GAUGE – MAINTENANCE PRACTICES**I. Removal/Installation of Air Temperature Gauge (See Figure 201.)****A. Removal**

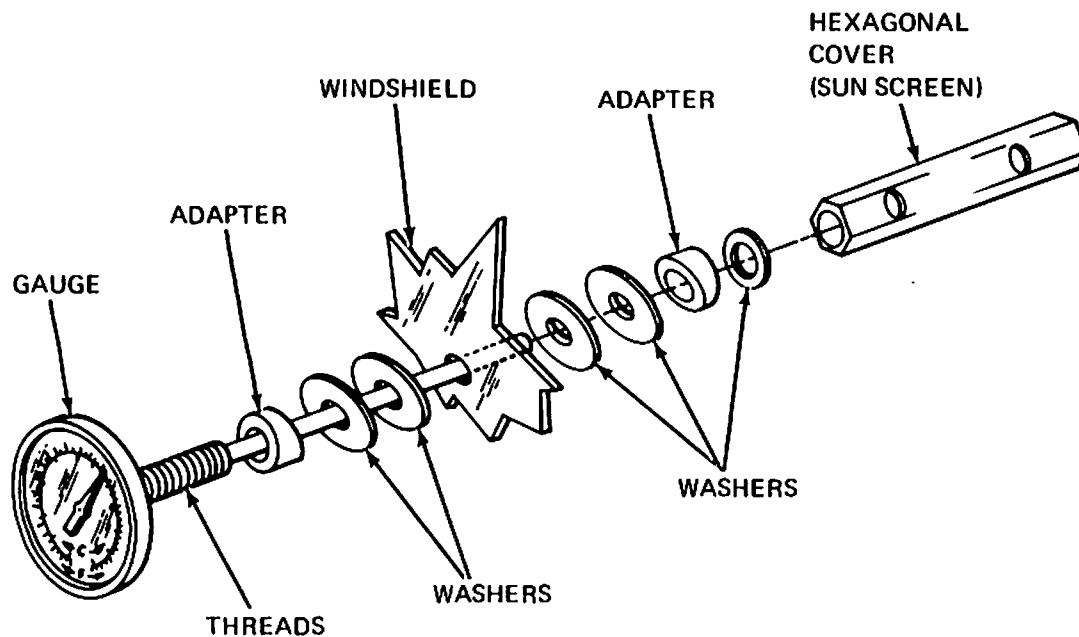
- (1) Hold the gauge on the inside of the windshield.
- (2) From outside the aircraft, unscrew and remove hexagonal (sun screen) gauge cover.
- (3) Remove washers and tube adapter from outside of windshield.
- (4) Remove gauge, tube adapter, and washers from inside of windshield.

B. Installation

- (1) Assemble tube adapter and washers on gauge stem. (See Figure 201.)
- (2) Apply one or two drops of Loctite sealant, grade EV to the gauge stem threads.
- (3) Insert gauge stem through mounting hole from inside the windshield.
- (4) Assemble tube adapter and washers on gauge stem on outside of windshield.
- (5) Apply a small bead of Presstite soft putty around gauge stem between rubber washer and metal washer on outside of windshield.

CAUTION: DO NOT OVERTIGHTEN OR STEM THREADS WILL SEPARATE FROM GAUGE CASE.

- (6) Install hexagonal cover (sun screen) on gauge stem and tighten snug tight, using hands only.



Air Temperature Gauge Installation
Figure 201

34G72-6

PRESSURE SYSTEM – DESCRIPTION/OPERATION**1. General (See Figure 1.)**

The pressure system consists of two engine-driven dry-air pumps, two inlet filters, two regulators, a pressure manifold, an inline filter, a directional and horizon gyro, and a differential pressure gauge with source indicator, plus necessary tubing and fittings.

2. Operation

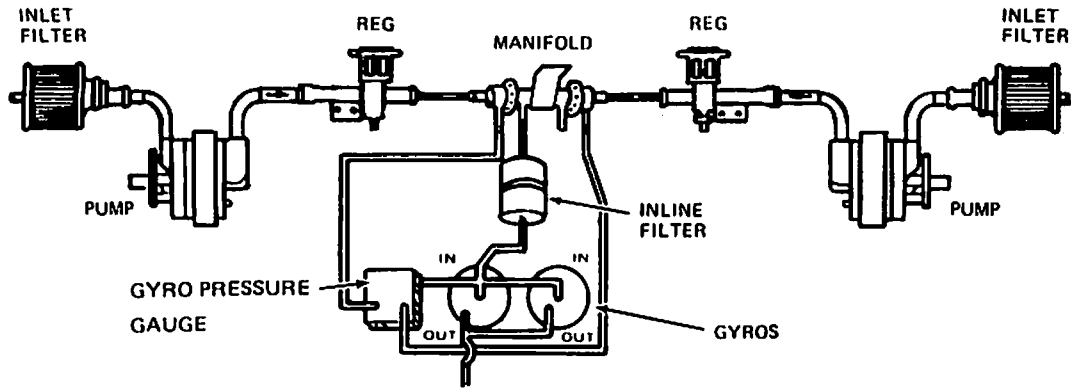
The operation of the pressure instrument system is relatively simple. When the engine-driven dry-air pump begins to rotate, it draws air in through the inlet filter. The air is discharged from the pump to the pressure regulator. The dry-air pump is of the dry type, therefore no oil separator is required.

The pressure regulator is set to a pre-determined value and regulates the pressure by dumping excess air overboard. See the regulator adjustment procedure in this section for the proper setting of the regulator. The air goes from the pressure regulator to the pressure manifold.

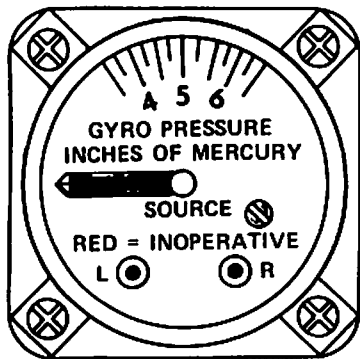
The manifold serves several purposes. First it is a check valve assembly. Should an air pump malfunction occur, the check valve will prevent the flow of air from one inlet side of the manifold to the other. Prior to entering the check valves in the manifold, there are porting provisions for outputs to the source indicators on the pressure gauge. After passing through the check valves, the air enters the body of the manifold. The body of the manifold has two outlet ports – one that feeds the gyro system and one for a deice system. In the GA-7/Cougar, the deice port is closed off. The air from the gyro outlet on the manifold is sent to the inline air filter.

The inline air filter is located between the manifold and the gyros. Its purpose is to filter the air before it is applied to the gyro instruments. This is a replaceable 0.3 micron filter.

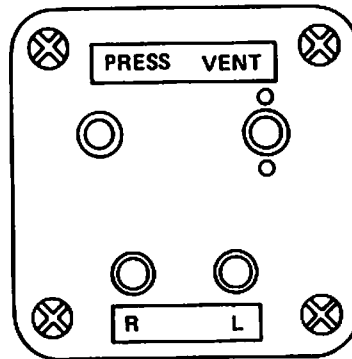
The pressure indicator is a multipurpose device. It serves as a differential pressure indicator and as a source indicator. (See Figure 2.) The indicator measures the pressure applied to the gyros and indicates that there is flow through the gyros. There are two source indicators in the gauge. These are red ball type indicators. Each indicator is connected to the applicable port on the pressure manifold. When the pumps are operating correctly, the red balls will be retracted out of sight. Should an air pump malfunction occur, the red ball for that pump will appear in the dial face.



**Pressure System
Figure 1**



FRONT



REAR

**Differential Pressure Gauge
Figure 2**

34G72-7

PRESSURE SYSTEM – TROUBLESHOOTING

1. Pressure System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
No pressure.	Pumps inoperative.	Replace pumps.
	Inline filter completely plugged.	Replace inline filter.
	Pressure manifold bad.	Replace manifold.
	Pressure lines between manifold and gyros plugged or disconnected.	Replace plugged line or reconnect disconnected line.
Low pressure.	Inline filter partially plugged.	Replace filter.
	Pressure line partially plugged.	Replace line.
	Pressure regulator improperly set.	Adjust regulator. (See procedure in this section.)
Erratic pressure.	Oil in pump.	Replace pump.
Oil in pressure pump.	Engine drive seal defective.	Replace oil seal.
High pressure.	Pressure regulator improperly set.	Adjust regulator. (See procedure in this section.)
Gyro(s) will not erect, pressure gauge reading correct.	Gyro(s) defective.	Replace gyro(s).
Gyro(s) tumble, pressure gauge reading correct.	Gyro(s) defective.	Replace gyro(s).
Pressure gauge indicates frequent need for pressure regulator adjustment.	Inline filter nearly plugged (differential pressure system).	Replace filter.
	Defective regulator.	Replace regulator.
Frequent pump replacement.	Partially restricted pump discharge or restricted pressure hose.	Replace hose.

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TROUBLE	PROBABLE CAUSE	REMEDY
Frequent pump replacement. (Continued)	Incorrect pressure pump.	Replace with correct pump.
No pressure at low rpm. Pressure O.K. at high rpm.	Oil in pump.	Replace pump.
Both source indicators retract on instrument pressure gauge when only one engine is in operation.	Defective manifold/check valve.	Replace manifold.

PRESSURE SYSTEM – MAINTENANCE PRACTICES

1. Servicing

A. Pump inlet filter

Refer to Chapter 12 for inlet filter servicing.

B. Inline filter

Refer to Chapter 12 for inline filter servicing.

NOTE: Change the inline filter each 500 hours of service or sooner if environmental conditions are adverse. The inline filter is to be changed each time a pressure pump is replaced. Sharp pieces of carbon rotor or vane may have been discharged from the previous pump and can damage filters, valves, or gyros.

2. Pressure Pump Removal/Installation (See Figure 201.)

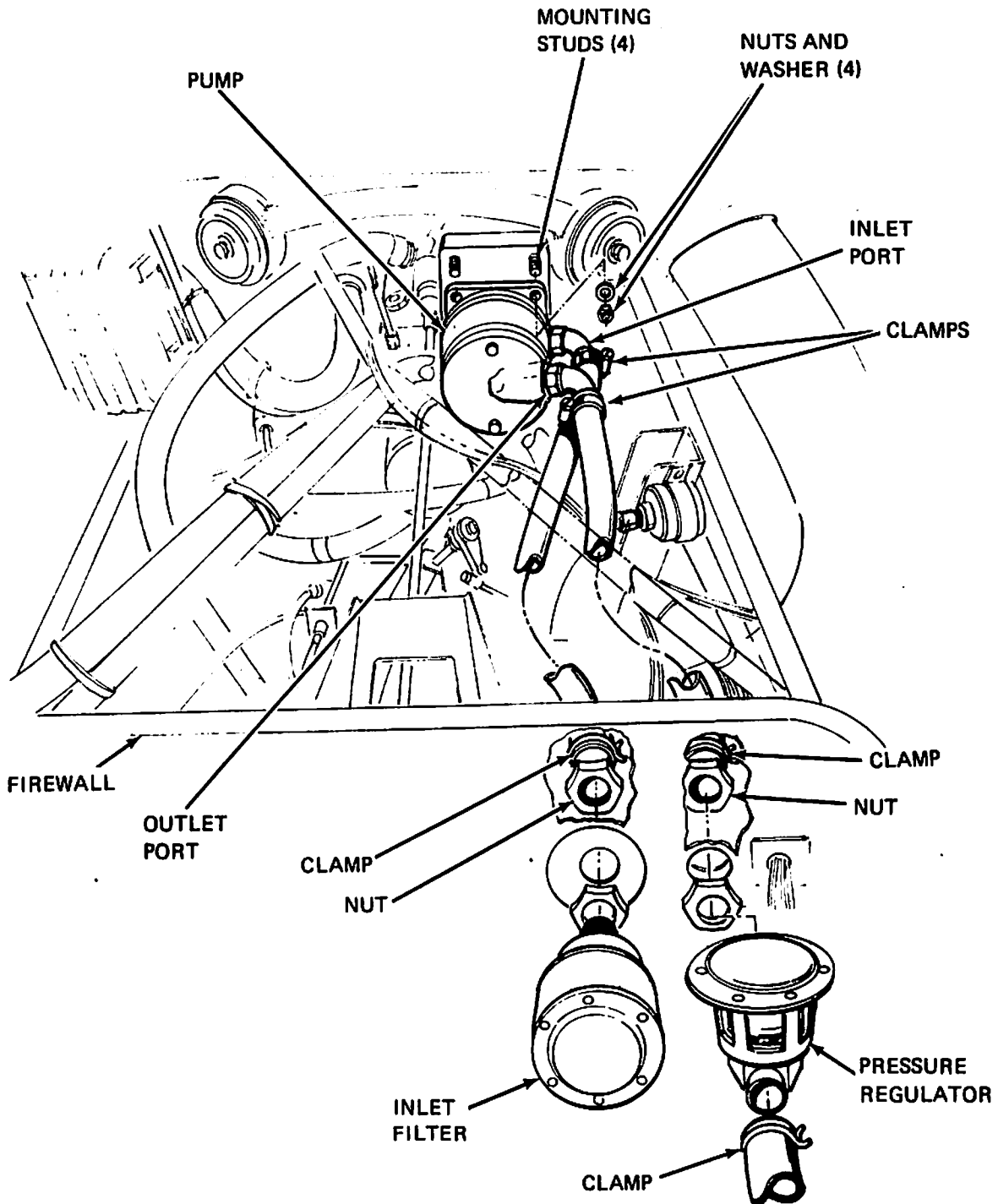
A. Removal

- (1) Loosen the two clamps which secure pressure lines to pressure pump.
- (2) Remove the inlet and outlet pressure lines from pump.
- (3) Remove the four nuts and washers which secure pressure pump to engine accessory pad.
- (4) Pull pump from engine.
- (5) Remove gasket and discard.
- (6) Cover opening in accessory pad to prevent foreign material from entering engine.

B. Installation

NOTE: Before installing a new dry-air pump, follow the following steps for installing the pump inlet and outlet fittings.

1. Place the pump, with drive coupling down, in a jaw-protected vise. Place vise clamp across the mounting flange only. Clamping across the center housing will cause an internal failure of the carbon rotor.
2. If anti-seize is used on the fittings, always omit the first two lead threads. Wrap fitting threads with teflon tape.
3. Install the fittings hand tight. With a box end wrench, tighten to the desired position, a maximum of 1-1/2 turns beyond hand tight. Never overtorque the fittings.



Location of Pressure Pump, Inlet Filter, and Pressure Regulator
• Figure 201

34G72-8

- (1) Position pump and new gasket on engine accessory pad. Rotate pump slightly (if necessary) so that its splined shaft mates with female spline in engine.

NOTE: Always verify that the pump is the correct type. Always use a new mounting gasket when installing the pump. Never use a pump that has been dropped.

- (2) Slide pump onto the mounting studs on engine accessory pad. Secure the pump to the engine with four nuts and washers.
- (3) Torque the four pump mounting nuts to 40 to 50 inch-pounds.
- (4) Install lines on pump inlet and outlet fittings. Secure with hose clamps.

NOTE: Always ensure that lines and hoses are clean and free of any debris, oils, or solvents. Replace any hard or brittle hose.

3. Pressure Regulator Removal/Installation (See Figure 201.)

A. Removal

- (1) One pressure regulator is mounted on the firewall of each engine nacelle.
- (2) Remove the access panel on the bottom of the engine nacelle and the access panel on top of the engine cowl.
- (3) Through access opening beneath engine nacelle, loosen hose clamp and remove hose from regulator.
- (4) Through access opening in top of engine cowl, loosen hose clamp and remove hose from regulator.
- (5) While holding regulator to prevent it from turning, use a 1-inch open end wrench to remove nut securing regulator to firewall.
- (6) Remove regulator from inside engine nacelle.

B. Installation

- (1) Position regulator on firewall from inside the engine nacelle.
- (2) Install nut on forward side of firewall and torque to standard value. Refer to Chapter 91.
- (3) Attach the two pressure hoses and secure with hose clamps.
- (4) Perform operational test. Make adjustment as necessary. See test/adjustment procedure in this section.
- (5) Replace access panels on engine nacelle and engine cowl.

4. Pressure Pump Inlet Filter Removal/Installation (See Figure 201.)

A. Removal

- (1) One inlet filter is mounted on the firewall of each engine nacelle.
- (2) Remove the access panel on the bottom of the engine nacelle and the access panel on top of the engine cowl.
- (3) Through access opening in top of engine cowl, loosen hose clamp and remove hose from inlet filter.
- (4) While holding filter to keep it from turning, use a 1-inch open end wrench to remove nut securing filter to firewall.
- (5) Remove filter from inside engine nacelle.

B. Installation

- (1) Position filter on firewall from inside the engine nacelle.
- (2) Install nut on forward side of firewall and torque to standard value. Refer to Chapter 91.
- (3) Attach hose to filter and secure with hose clamp.
- (4) Replace access panels on engine nacelle and engine cowl.

5. Inline Filter Removal/Installation (See Figure 202.)

A. Removal

- (1) The inline filter is mounted beneath the instrument panel deck at Fuselage Station 50.00.
- (2) Gain access to the inline filter.
- (3) Loosen the hose clamps that secure the two pressure hoses to the filter. Remove hoses.
- (4) Remove screw from clamp that secures filter to bulkhead. Remove filter.

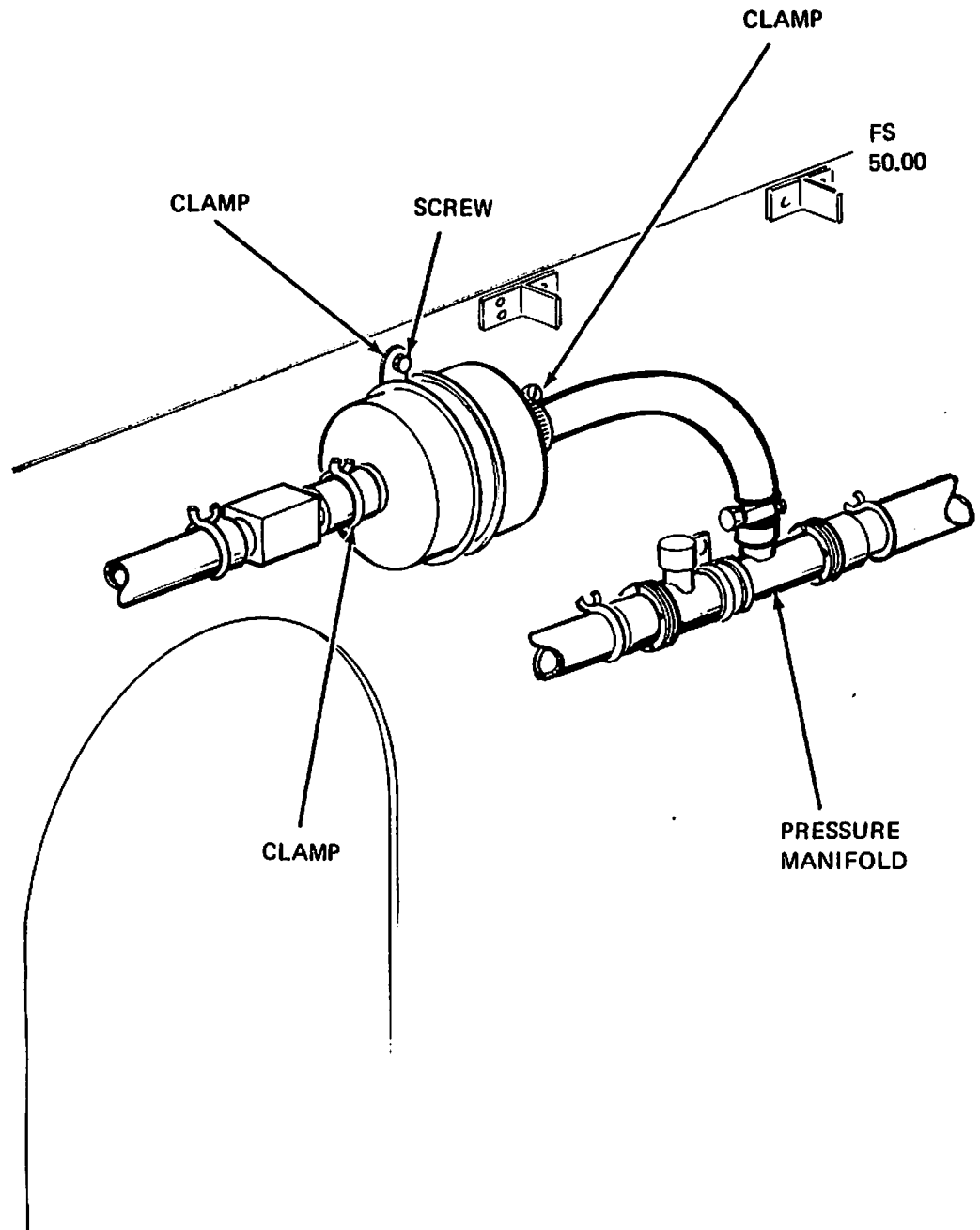
B. Installation

- (1) Place clamp around filter. Attach clamp to bulkhead at Fuselage Station 50.00 with screw.
- (2) Attach two pressure hoses to filter and secure with hose clamps.

6. Pressure Gauge Removal/Installation

A. Removal

- (1) Pressure gauge is located on top right side of instrument panel.



**Location of Inline Filter
Figure 202**

34G72-9

- (2) Using clamp removal tool, remove spring clamps from three pressure lines attached to back of pressure gauge. Remove lines. Access to the back of the pressure gauge is from below and behind the right side of the instrument panel.
- (3) Remove four Phillips screws securing pressure gauge to instrument panel.
- (4) Remove pressure gauge from instrument panel.
- (5) Cap all open lines.

B. Installation

- (1) Place pressure gauge in instrument panel and secure with four Phillips screws.
- (2) Attach the two pressure lines from the pressure manifold to the left (L) and right (R) inputs of the pressure gauge. Secure with spring clamps.
- (3) Attach the pressure line, from tee connector back of directional gyro, to the pressure input connection. Secure with spring clamp.
- (4) Perform operational check of pressure system. Refer to operational check in this section.

7. Pressure System Adjustment/Test

The pressure regulator can be adjusted in two ways, with the engines running or with a test set without the engines running. One available test set is by the Airborne Manufacturing Company, model Airborne 343 Test Kit. Instructions on how to use the test set are furnished with the kit.

A. Pressure regulator adjustment with engine running.

NOTE: Perform adjustment routine on both engines.

WARNING: ENSURE THAT PROPELLER AREAS ARE CLEAR PRIOR TO STARTING ENGINES.

- (1) Start engine in accordance with Pilot's Operating Handbook.
- (2) Adjust engine speed to 2200 rpm.
- (3) Adjust regulator for an indication of 5.0 psi on pressure gauge.
- (4) Vary engine speed from 2100 rpm to 2400 rpm and ensure that pressure gauge indication remains between 4.5 and 6.0 psi. If necessary, readjust regulator to ensure that proper range of pressure is obtained.
- (5) Bend locking tab to secure regulator adjustment.
- (6) Shut down engine in accordance with Pilot's Operating Handbook.
- (7) Perform adjustment routine on opposite engine.

B. Pressure System Operational Test

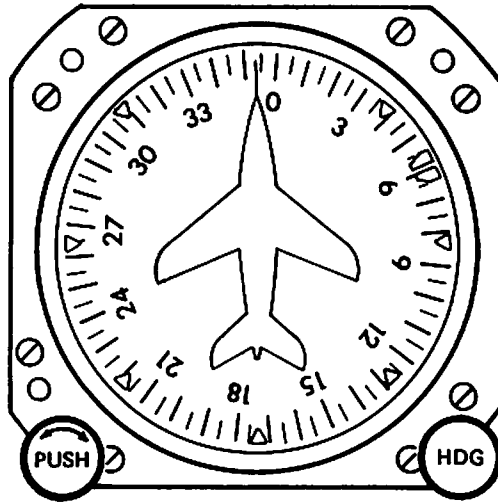
NOTE: It is necessary to operate the aircraft engines in order to operationally test the pressure system.

WARNING: ENSURE THAT PROPELLER AREAS ARE CLEAR PRIOR TO STARTING ENGINES.

- (1) Start engines in accordance with Pilot's Operating Handbook.
- (2) Set both engine speeds to 2100 rpm.
- (3) Check that pressure gauge indicates between 4.5 and 6.0 psi and that pressure-driven gyro instruments operate properly. Red balls in source indicators are retracted.
- (4) Vary engine speed between 2100 and 2400 rpm.
- (5) Check that pressure gauge indicates between 4.5 and 6.0 psi for all power settings.
- (6) Shut down left engine in accordance with Pilot's Operating Handbook. Red ball for left source indicator is visible. Pressure indication remains between 4.5 and 6.0 psi.
- (7) Shut down right engine in accordance with Pilot's Operating Handbook. Red balls for both source indicators are visible. Pressure indication returns to zero.

DIRECTIONAL GYRO – DESCRIPTION/OPERATION**1. General**

The directional gyro (Figure 1), located on the instrument panel, is a flight instrument incorporating an air-driven gyro stabilized in the vertical plane. This instrument operates off the pressure system. (See Chapter 34.) The gyro is rotated at high speed by the pressure in the airtight case and simultaneously allows atmospheric air pressure to enter the instrument against the gyro buckets. Due to gyroscopic inertia, the spin continues to point in the same direction even though the aircraft yaws to the right or left. This relative motion between the gyro and the instrument case is shown on the instrument dial, which is similar to a compass card. The dial, when set to agree with the aircraft magnetic compass, provides a positive indication free from swing and turning error. Due to internal friction, spin axis error, and air turbulence, the gyro should be set at least every 15 minutes for accurate operation.



Directional Gyro
Figure 1

34G72-10

DIRECTIONAL GYRO – TROUBLESHOOTING

1. Troubleshooting Directional Gyro

TROUBLE	PROBABLE CAUSE	REMEDY
Excess drift in either direction.	Setting error.	Reset gyro.
	Defective instrument.	Replace instrument.
	High or low pressure. If pressure is not correct check for the following: a. Regulator improperly adjusted.	a. Adjust relief valve. (Refer to 34-2-1.)
	b. Incorrect gauge reading.	b. Replace gauge. (Refer to 34-2-1.)
	c. Pump failure.	c. Repair or replace pump. (Refer to 34-2-1.)
	d. Vacuum line kinked or leaking.	d. Check and repair. Check for collapsed inner wall of hose.
Dial spins during turn.	Limits (55 degrees bank) or gimbal exceeded.	Recage gyro in level flight.
Dial spins continuously.	Defective mechanism.	Replace instrument.

DIRECTIONAL GYRO – MAINTENANCE PRACTICES

1. Removal/Installation of Directional Gyro

A. Removal

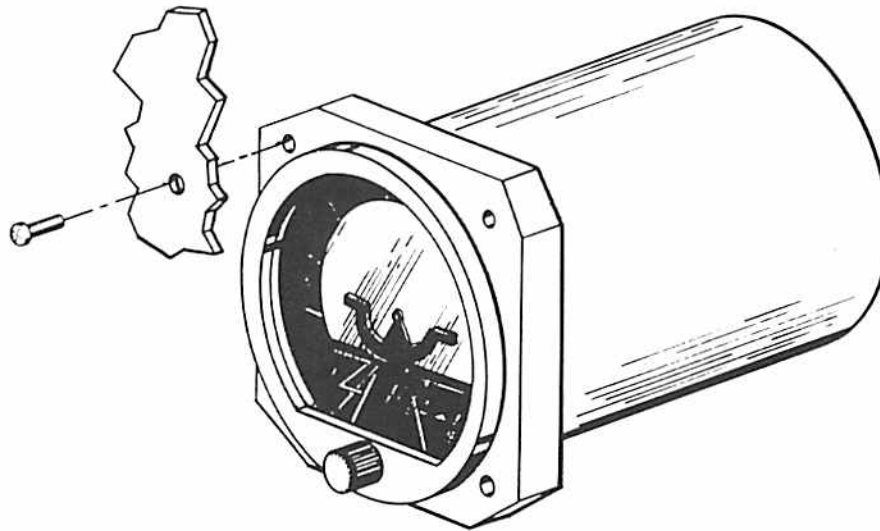
- (1) Gain access to the connections on the rear of the instrument from underneath and behind the instrument panel or from outside the aircraft through forward baggage compartment and the opening in bulkhead at Fuselage Station 50.00.
- (2) Disconnect lines from fittings on back of gyro.
- (3) Remove reset and heading knobs.
- (4) Remove three mounting screws and slide gyro backward out of instrument panel.

B. Installation

- (1) Position directional gyro in place on instrument panel and install three mounting screws.
- (2) Install reset and heading knobs.
- (3) Connect lines to fitting on back of gyro.

ATTITUDE GYRO – DESCRIPTION/OPERATION1. General

The attitude gyro (Figure 1), located on the instrument panel, is essentially an air-driven gyroscope rotating in a horizontal plane and is operated on the same principal as the directional gyro. Due to the gyroscopic inertia, the spin axis continues to point in the vertical direction, providing a constant visual reference to the attitude of the aircraft relative to pitch and roll axis. A bar across the face of the indicator represents the horizon and aligning the miniature aircraft to the horizon bar simulates the alignment of the aircraft to the actual horizon. Any deviation simulates the deviation of the aircraft from the true horizon. The attitude gyro is marked for different degrees of bank.



Attitude Gyro
Figure 1

34G72-11

ATTITUDE GYRO – TROUBLESHOOTING

I. Troubleshooting the Attitude Gyro

TROUBLE	PROBABLE CAUSE	REMEDY
Bar fails to respond.	Insufficient pressure.	Check pump and tubing.
	Filters dirty.	Replace filter. (Refer to 34-2-1.)
Bar does not settle.	Insufficient pressure.	Check line and pump. Adjust regulator. (Refer to 34-2-1.)
	Defective instrument.	Replace instrument.
Bar oscillates or shimmies.	Instrument loose in panel.	Tighten mounting screws.
	Pressure too high.	Adjust regulator. (Refer to 34-2-1.)
	Defective mechanism.	Replace instrument.
Instrument does not indicate level flight.	Instrument not level in panel.	Loosen screws and level instrument.
	Aircraft out of trim.	Trim aircraft.
Instrument tumbles in flight.	Low pressure.	Reset regulator. (Refer to 34-2-1.)
	Dirty filters.	Replace filters. (Refer to 34-2-1.)
	Line to filter restricted.	Replace line.
	Plug missing or loose in instrument.	Replace or tighten plug.

ATTITUDE GYRO – MAINTENANCE PRACTICES

1. Removal/Installation of Attitude Gyro

A. Removal

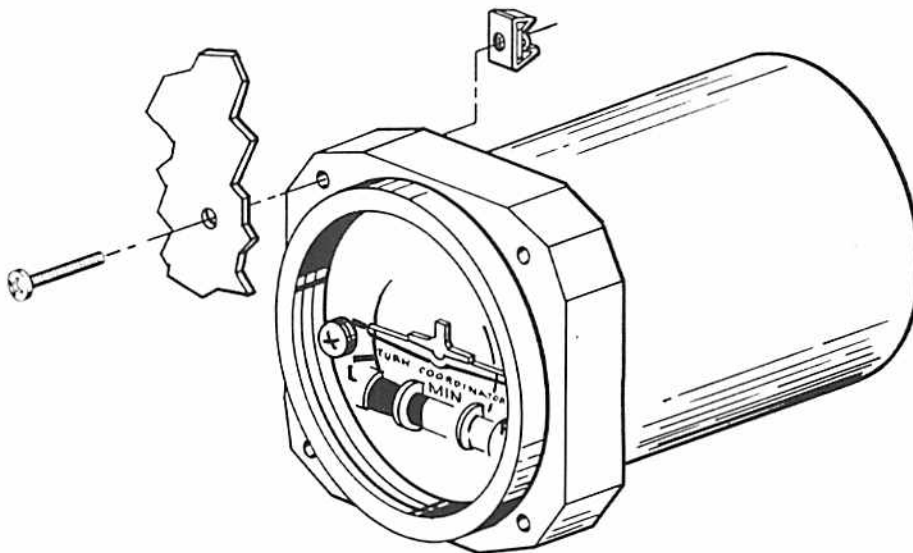
- (1) Gain access to the connections on the rear of the instrument from underneath and behind the instrument panel or from outside the aircraft through the forward baggage compartment and the opening in the bulkhead at Fuselage Station 50.00.
- (2) Loosen clamps and disconnect lines from gyro.
- (3) Remove the four mounting screws that secure gyro to instrument panel and remove gyro.

B. Installation

- (1) Position attitude gyro in place on instrument panel and install four mounting screws.
- (2) Connect lines and install clamps in place at back of gyro.

TURN COORDINATOR – DESCRIPTION/OPERATION1. General

The turn coordinator is one of the most important instruments in instrument flight. The instruments are electrically driven; therefore they will operate only when the master switch is on. The sensitive element in the instrument is a gyro. The turn coordinator (Figure 1) consists of a small aircraft silhouette that will indicate whenever the aircraft is rotating about either the yaw or roll axis and an inclinometer (ball sealed in a curved glass with damping fluid) to indicate if the aircraft is slipping while in a turn. During a standard rate turn or any turn where the aircraft controls are properly coordinated, the ball in the inclinometer will remain in the center.



Turn Coordinator
Figure 1

34G72-12

TURN COORDINATOR – TROUBLESHOOTING

1. Troubleshooting the Turn Coordinator

TROUBLE	PROBABLE CAUSE	REMEDY
Aircraft silhouette fails to respond.	Foreign matter lodged in instrument.	Replace instrument.
	Master switch OFF.	Place master switch ON.
	Turn coordinator circuit breaker open.	Close circuit breaker.
Incorrect sensitivity.	Out of calibration.	Replace instrument.
Incorrect turn rate.	Out of calibration.	Replace instrument.
	Aircraft not in coordinated turn.	Trim aircraft for coordinated turn. Ball will center in inclinometer.
Ball sticky.	Flat spot on ball.	Replace instrument.
Ball not in center when aircraft is correctly trimmed.	Instrument not level in panel.	Level instrument.

TURN COORDINATOR – MAINTENANCE PRACTICES

1. Removal/Installation of Turn Coordinator

A. Removal

- (1) Gain access to the connections on the rear of the instrument from underneath and behind the instrument panel or from outside the aircraft through the forward baggage compartment and the opening in the bulkhead at Fuselage Station 50.00.
- (2) Disconnect electrical plug from indicator.
- (3) Remove the four mounting screws and nuts that secure indicator to instrument panel and remove indicator.

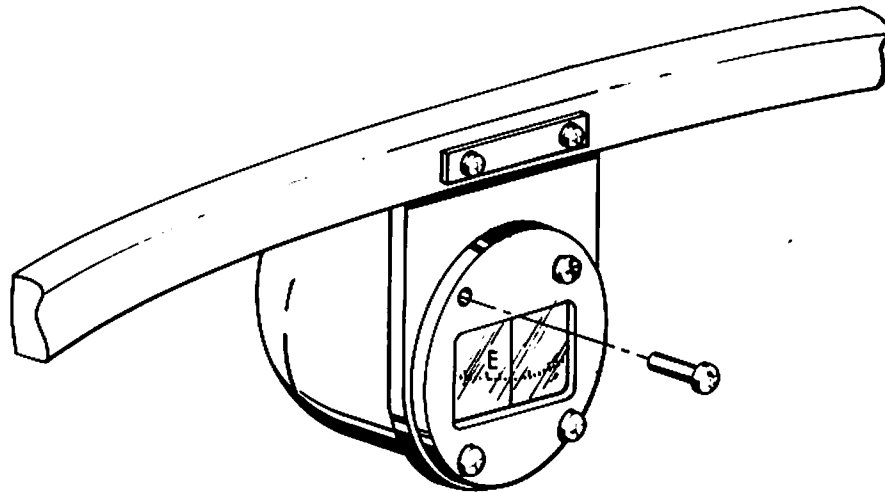
B. Installation

- (1) Position instrument in place on instrument panel and install the four mounting screws and nuts.
- (2) Connect electrical lead to rear of indicator.

MAGNETIC COMPASS – DESCRIPTION/OPERATION

1. **General**

The magnetic compass (Figure 1), located on the top center of the windshield frame, is the liquid filled, compensating type, incorporating two adjustable magnets. No maintenance is required for the magnetic compass except to swing it on a compass rose. Adjustments may be made to the instrument by the two screws located on the front face using a non-magnetic screwdriver of brass, aluminum, or non-magnetic stainless steel.



Magnetic Compass
Figure 1

34G72-13

MAGNETIC COMPASS – TROUBLESHOOTING

1. Troubleshooting the Magnetic Compass

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive card error.	Compass not properly compensated.	Compensate instrument.
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Insufficient liquid.	Replace instrument.
Card sluggish.	Weak card magnet.	Replace instrument.
	Excessive pivot friction or broken jewel.	Replace instrument.
Liquid leakage.	Loose bezel screws.	Replace instrument.
	Broken cover glass.	Replace instrument.
	Defective sealing gaskets.	Replace instrument.
Discolored markings.	Age.	Replace instrument.
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity of wiring.
Card does not move when compensating screws are turned.	The gears that turn compensating magnets are stripped.	Replace instrument.

MAGNETIC COMPASS – MAINTENANCE PRACTICES

1. Removal/Installation of Magnetic Compass

A. Removal

- (1) Remove two mounting screws and nuts.**
- (2) Disconnect electrical lead and remove compass.**

B. Installation

- (1) Connect electrical lead to magnetic compass.**
- (2) Position magnetic compass in place and install mounting screws and nuts.**
- (3) Perform compass swing. (Refer to FAA AC 43.13-1.)**

TRANSPONDER – DESCRIPTION/OPERATION

1. General

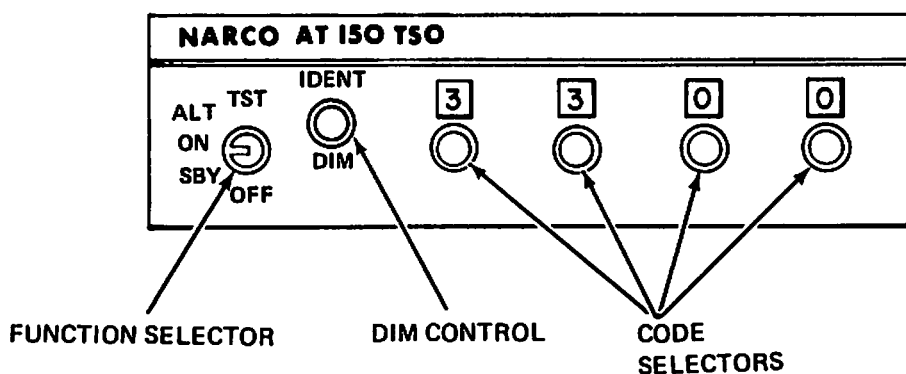
The transponder is radar beacon equipment designed to fulfill the role of the airborne beacon under the requirements of the Air Traffic Control Radar Beacon System (ATCRBS).

The use of the transponder enables the air traffic controller to identify the aircraft and therefore provides more positive control. Range and azimuth are established by the return from the transponder's pulsed transmitter in reply to a routing interrogation from the ground radar site.

The transponder reply is a set of pulses, selected in number, and positioned in time, one with respect to the other. Information is conveyed to the ground in this manner. An identity code number, selected at the front panel by the pilot, is transmitted as a Mode A reply. Mode C, altitude reporting, is an additional capability designed into the transponder. However, in order to convey altitude information, the transponder must be used in conjunction with an encoding altimeter and be operated in "ALT" mode.

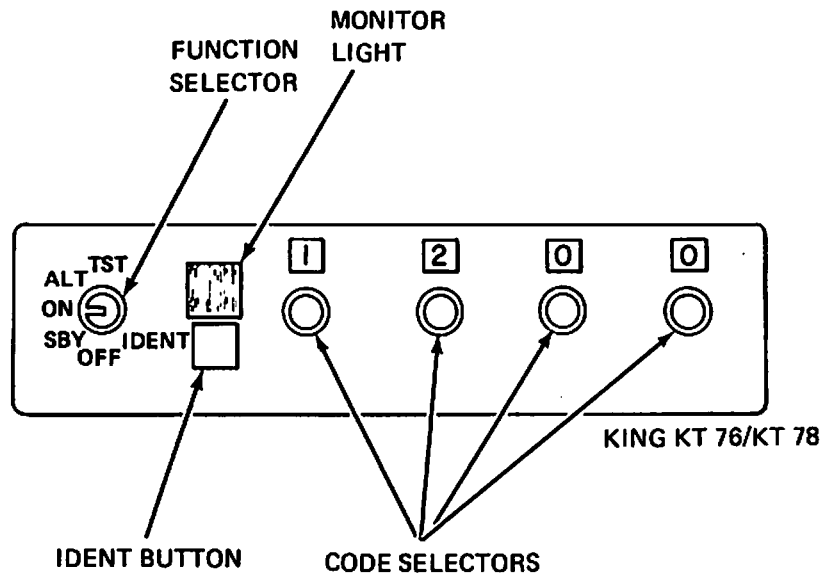
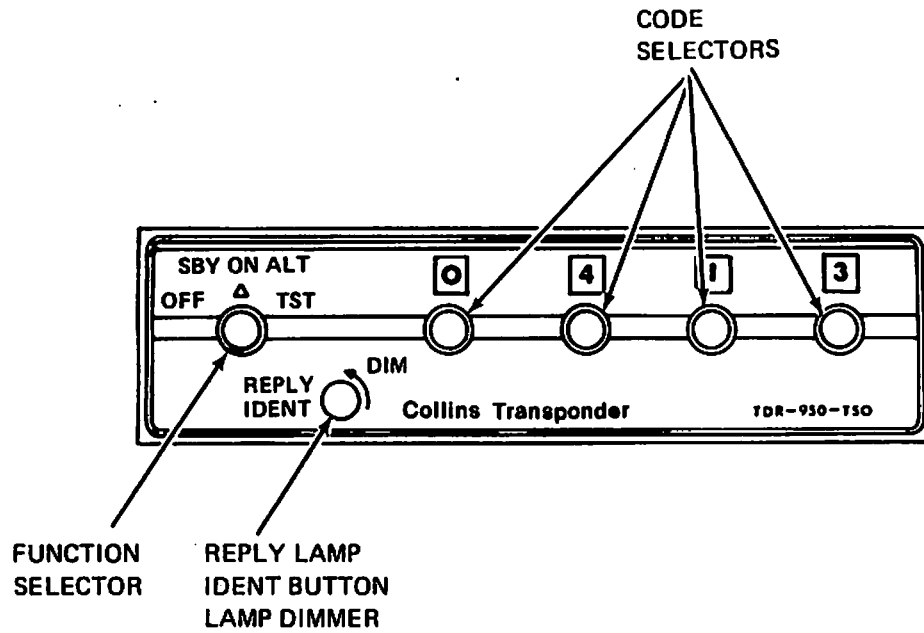
An additional feature of the transponder and beacon system is the S.P.I. (Special Pulse, Identification). After the ident button is pressed, the transponder, when interrogated, will reply with a special pulse that will cause the associated pip on the controllers display to "bloom," effecting immediate recognition.

All operating controls for the transponder are mounted on its front panel. Many GA-7/Cougar aircraft are equipped with either a NARCO AT 150A/King KT 76/KT 78/Collins TDR 950 transponder. Operating controls for all models are shown in Figure 1.



**Transponders
Figure 1 (Sheet 1 of 2)**

34G72-14-1



34G72-14-2

**Transponders
Figure 1 (Sheet 2 of 2)**

TRANSPONDER – MAINTENANCE PRACTICES**1. Removal/Installation of Transponder****A. Removal**

- (1) Ensure that master power switch is in the OFF position.
- (2) Locate transponder in avionics panel on the instrument panel.
- (3) Turn locking screw counterclockwise to release transponder unit from its mounting case. Use 5/64-inch hex wrench.

CAUTION: DO NOT PULL TRANSPONDER FREE OF MOUNT BY GRASPING THE CONTROL KNOBS.

- (4) Grasp the body of the transponder and carefully slide transponder from avionics panel mount. A slight left to right movement might help in disconnecting unit from connector plug.

B. Installation

- (1) Ensure that master power switch is in the OFF position.
- (2) Grasp the transponder by the sides and carefully slide transponder into avionics panel mount until plug connection is fully engaged.
- (3) Turn locking screw clockwise to secure transponder unit to its mounting case. Use 5/64-inch hex wrench.

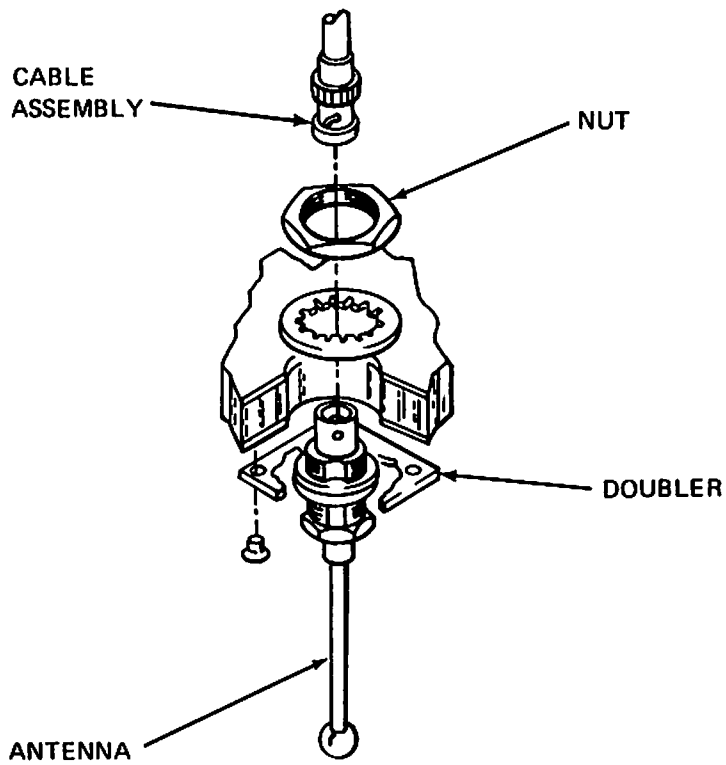
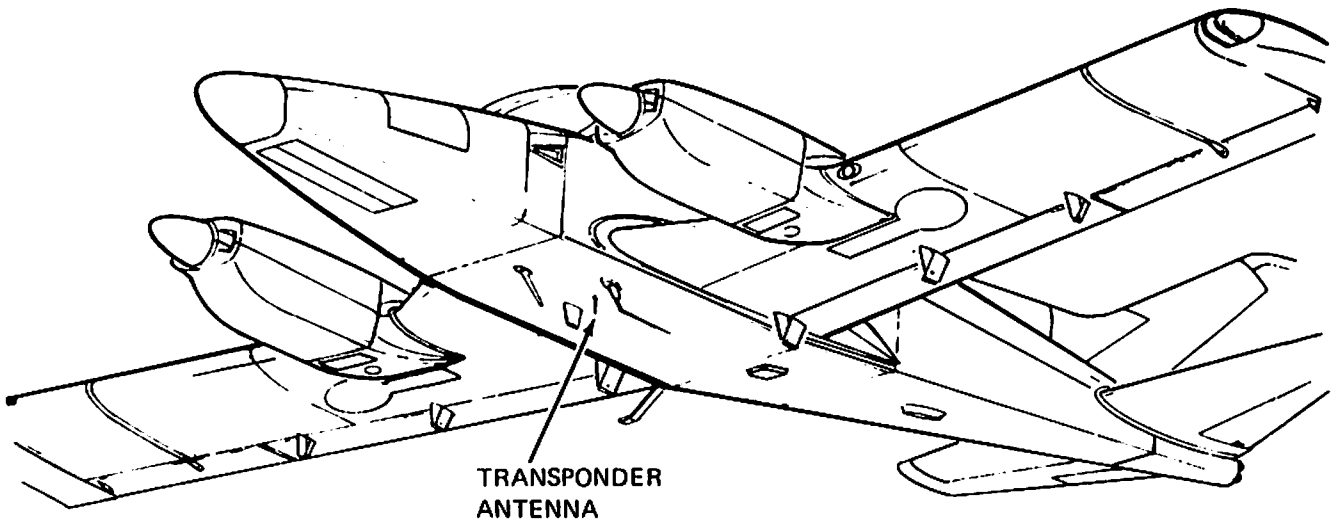
2. Removal/Installation of Transponder Antenna (See Figure 201.)**A. Removal**

- (1) Ensure that master power switch is in the OFF position.
- (2) Transponder antenna is mounted at Fuselage Station 89.15 and Buttock Line Left 17.700.
- (3) Remove the interior furnishings required to gain access to antenna.
- (4) Remove sealant from around coax connector.
- (5) Disconnect coax cable from antenna.
- (6) Loosen nut and remove antenna.

B. Installation

- (1) Ensure master switch is OFF.
- (2) Position transponder antenna into mounting hole.

- (3) Install nut securing antenna to the fuselage.
- (4) Connect coax cable to antenna.
- (5) Apply polysulfide sealant around attaching nut.
- (6) Replace removed interior furnishing.



**Transponder Antenna Installation
Figure 201**

34G72-15

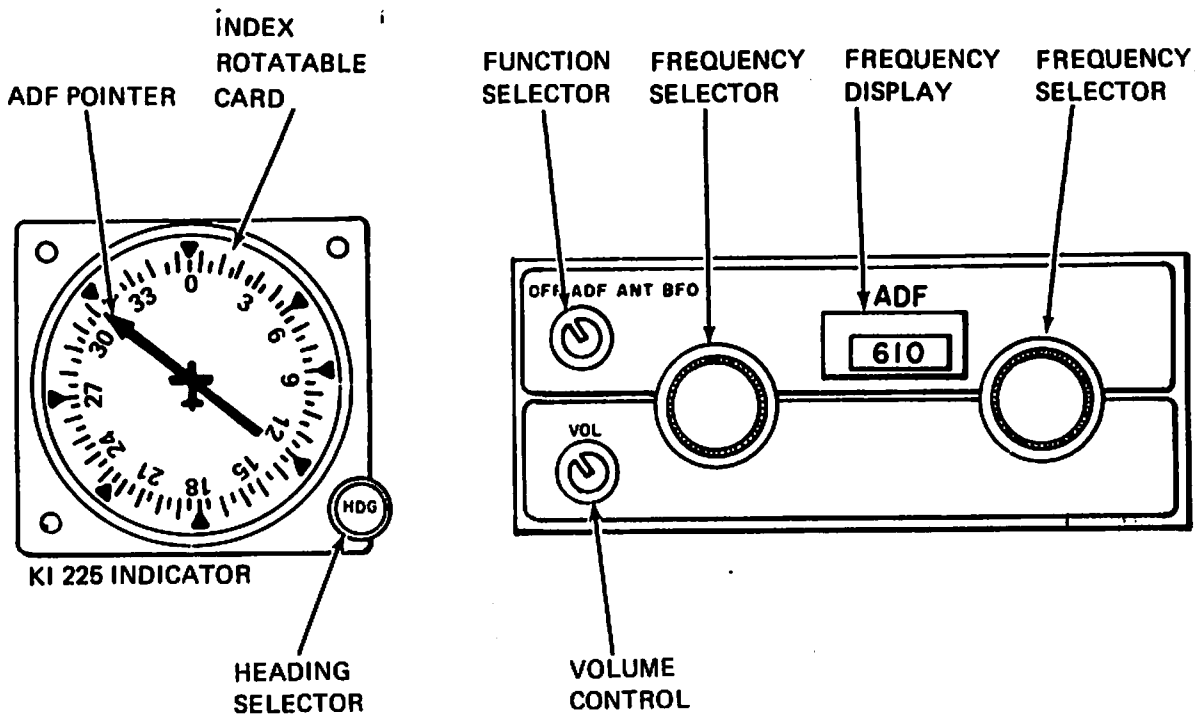
ADF SYSTEM – DESCRIPTION/OPERATION

1. General

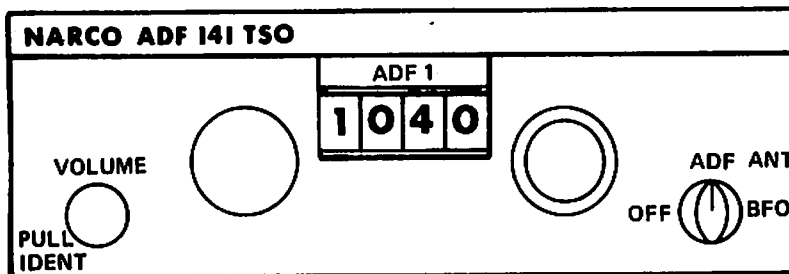
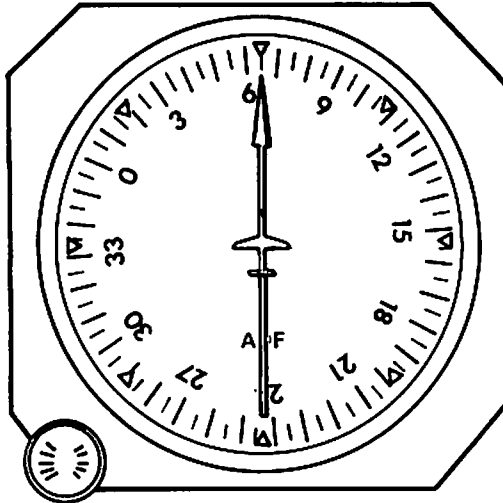
The automatic direction finder (ADF) system consists of a receiver, an indicator, R.F.I. filter, antennas, related cables, and associated wiring. The receiver and the indicator are located on the instrument panel. All operating controls for the ADF are located on the receiver and the indicator.

Several different models of ADF equipment are available for installation in the aircraft. Three different models are described in this section. (See Figures 1, 2, and 3.)

The receiver operates within the frequency range of 200 KHz to 1699 KHz. The channels may be selected in 1-KHz increments. The receiver provides both aural reception and bearing information.



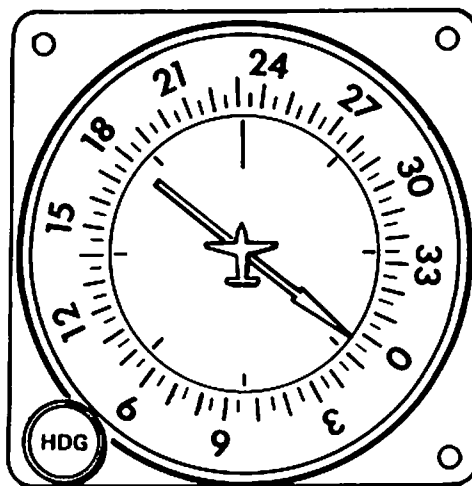
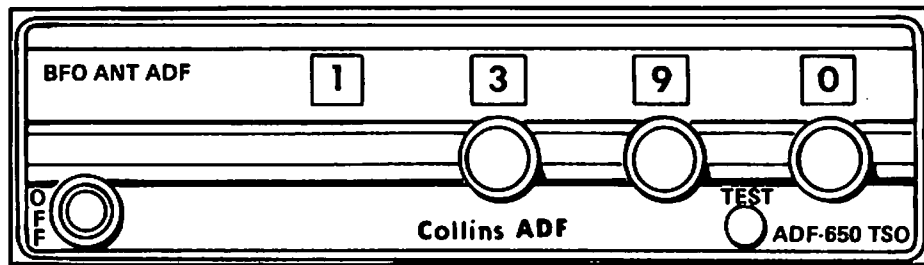
King KR 85/KI 225 Automatic Direction Finder
 Figure 1



**NARCO ADF 141
Figure 2**

34G72-17

GRUMMAN AMERICAN AVIATION
GA-7/COUGAR
MAINTENANCE MANUAL



Collins ADF 650 with IND 650 Indicator
Figure 3

34G72-18

ADF SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of ADF Indicator

A. Removal

- (1) Gain access to connection on rear of instrument from underneath and behind the instrument panel.
- (2) Disconnect electrical connector.
- (3) Remove the three screws securing instrument to instrument panel and remove indicator.

B. Installation

- (1) Position indicator in place on instrument panel and install three mounting screws.
- (2) Connect electrical wiring to rear of indicator.

2. Removal/Installation of ADF Receiver

A. Removal

- (1) Ensure that master power switch is in the OFF position.
- (2) Locate ADF receiver in avionics panel on the instrument panel.
- (3) Loosen ADF receiver unit by turning locking screw counterclockwise. Use 5/64-inch hex wrench.

CAUTION: DO NOT PULL ADF RECEIVER FREE FROM INSTRUMENT PANEL BY GRASPING THE CONTROL KNOBS.

- (4) Pull the ADF receiver unit straight forward. Be extremely careful not to bend connector pins. A slight left to right movement might help to release unit from connector plug.

B. Installation

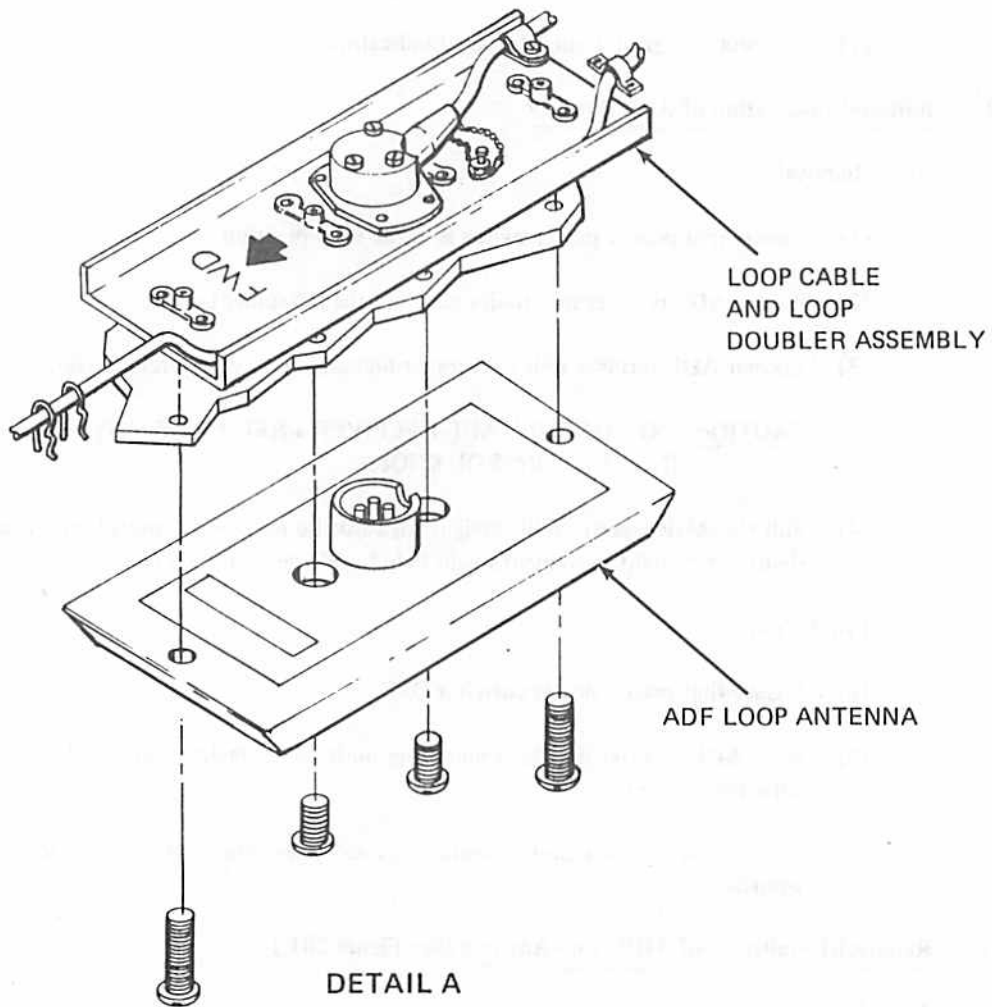
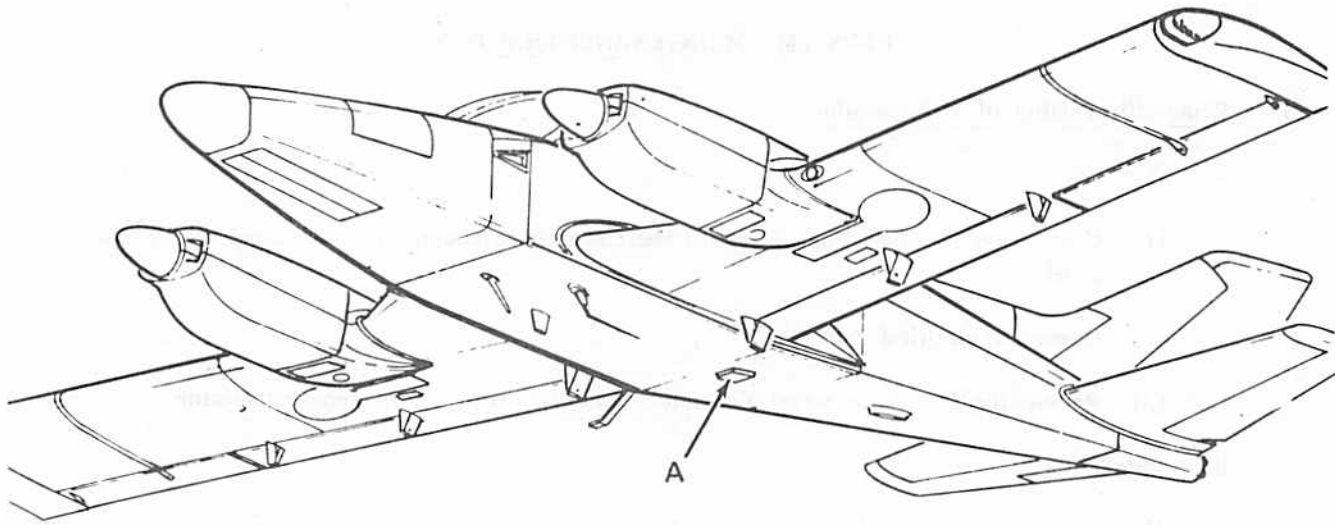
- (1) Ensure that master power switch is OFF.
- (2) Slide ADF receiver unit into mounting position on instrument panel. Be extremely careful not to bend connector pins.
- (3) Secure ADF receiver unit to mounting case by turning locking screw clockwise. Use 5/64-inch hex wrench.

3. Removal/Installation of ADF Loop Antenna (See Figure 201.)

A. Removal

NOTE: This procedure is applicable for loop antennas furnished by NARCO, King, or Collins.

- (1) Prepare aircraft for safe maintenance.



ADF Loop Antenna Installation
Figure 201

34G72-19

- (2) Locate ADF loop antenna on bottom of fuselage at Fuselage Station 150.500.
- (3) Remove the two screws attaching loop antenna to fuselage.
- (4) Disconnect loop antenna and remove antenna.
- (5) From outside the aircraft, remove the two screws that attach loop cable and loop doubler assembly to fuselage.
- (6) From inside the aircraft, remove the access plate in the floor of the baggage compartment.
- (7) Remove antenna loop cable and loop doubler assembly and the coax cable that runs along the left side of the aircraft to the back of the ADF receiver mounted on the instrument panel.

B. Installation

- (1) Prepare aircraft for safe maintenance.
- (2) Through the access opening in baggage compartment floor, align loop cable and loop doubler assembly with holes in fuselage floor at Fuselage Station 150.500. Ensure that the arrow on doubler points to the forward end of the aircraft.

NOTE: The loop cable and loop doubler assembly are furnished as one unit. The loop cable must not be cut. Store excess cable underneath baggage compartment floor.

- (3) Run loop cable along left side of aircraft and connect to back of ADF receiver mounted in the instrument panel.
- (4) From outside the aircraft, install the two screws that secure the loop cable and loop doubler assembly to the fuselage.
- (5) Plug loop antenna into loop antenna connector and secure with two screws.
- (6) Replace access cover plate in baggage compartment.

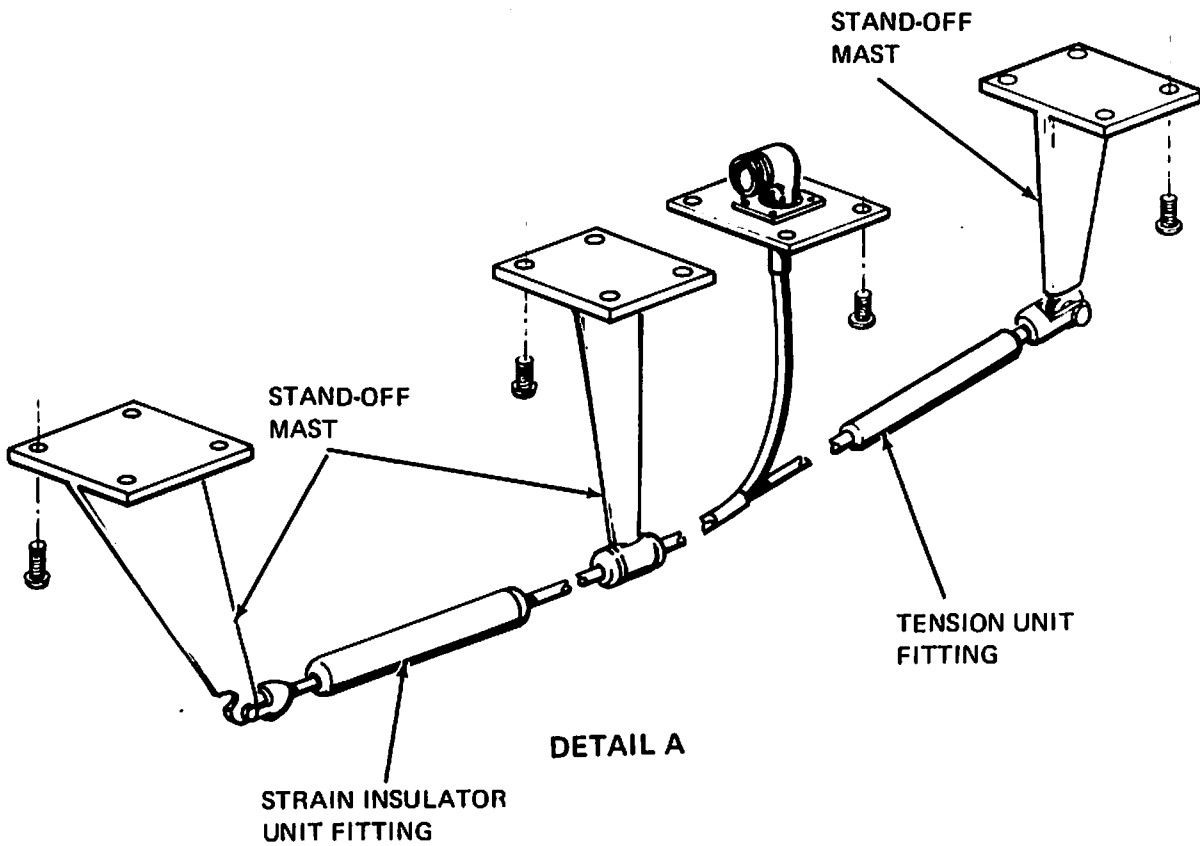
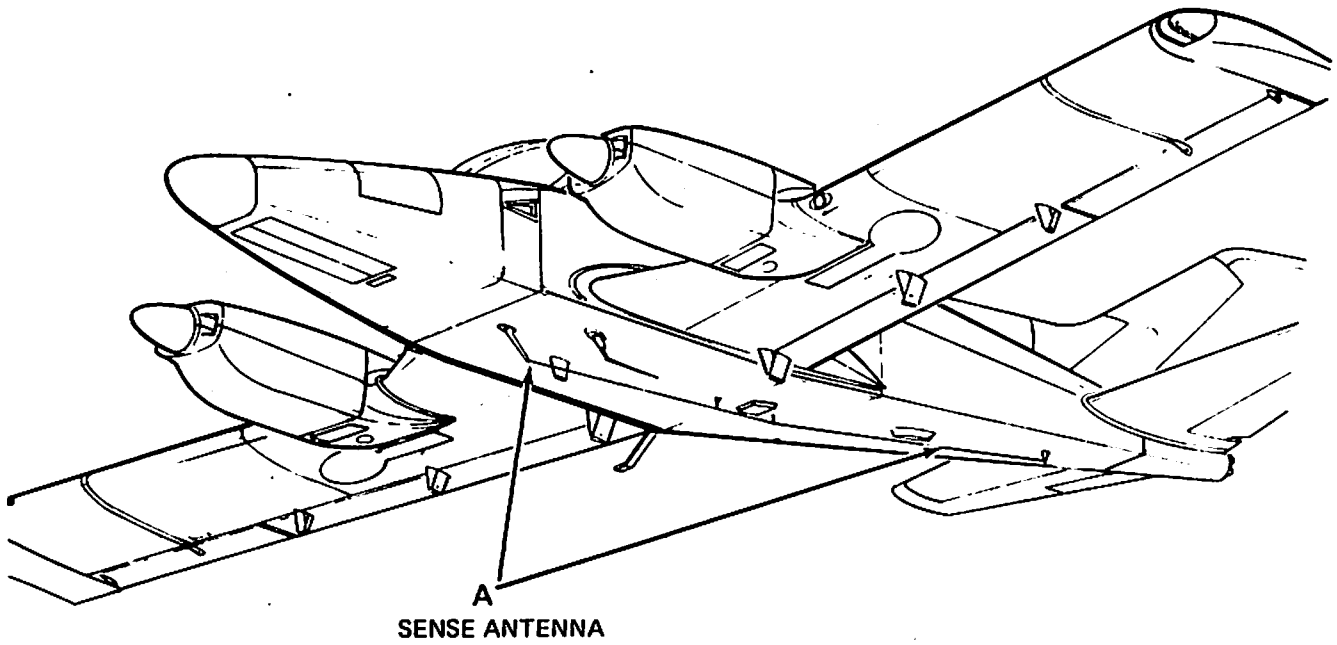
4. Removal/Installation of ADF Sense Antenna (See Figure 202.)

The ADF sense antenna is a wire antenna running underneath the fuselage from Fuselage Station 57.000 to Fuselage Station 256.000.

NOTE: ADF sense antenna and loop antenna are sometimes built into a single unit. Use ADF loop procedure for these type installations.

A. Removal

- (1) Disconnect wire antenna from connector on bottom of fuselage at Fuselage Station 155.75.



**ADF Sense Antenna Installation
Figure 202**

34G72-20

(2) Remove the three-standoff mast by removing the four attaching screws for each mast.

B. Installation

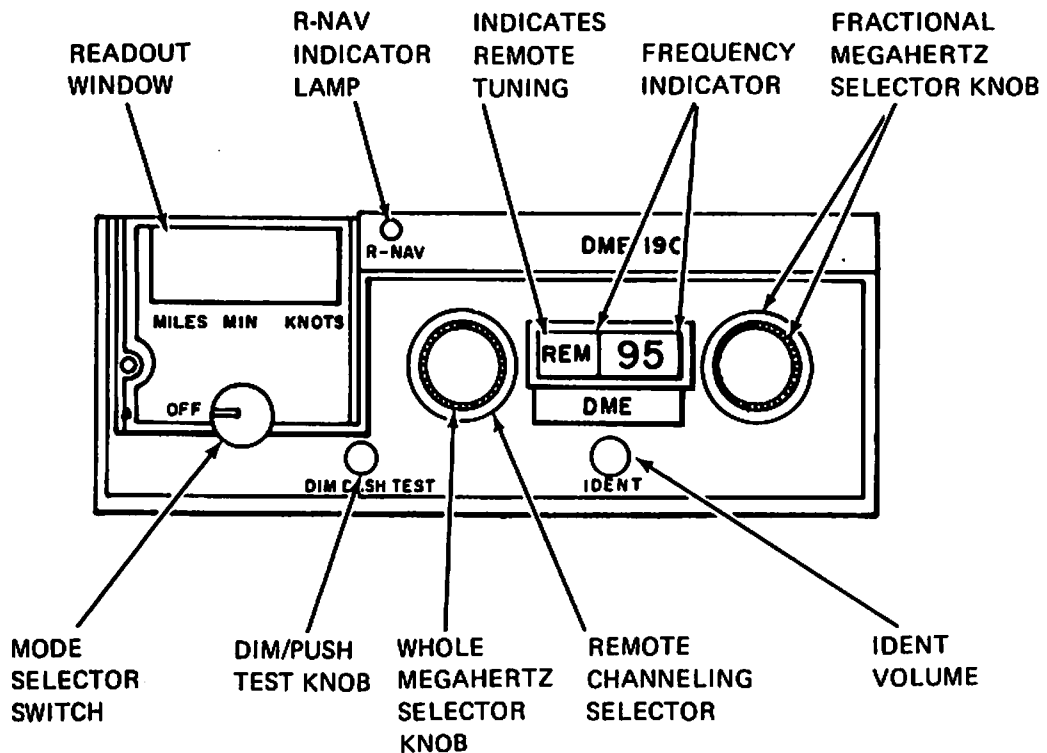
- (1) Attach the three-standoff mast to the bottom of the fuselage with four attaching screws on each mast.
- (2) Connect wire antenna to connector on bottom of fuselage at Fuselage Station 155.75.
- (3) Cover connection with shrink tubing.

DME SYSTEM – DESCRIPTION/OPERATION

I. General

A typical Distance Measuring Equipment (DME) system consists of a panel-mounted 200-channel UHF transmitter-receiver and an externally mounted antenna. The transceiver has a selector knob that changes the DME's mode of operation to provide the pilot with distance-to-station, time-to-station, or ground speeds up to 250 knots. The transceiver has a maximum slant range of 199.9 nautical miles. It is possible to channel DME system from a remote location.

All operating controls for the DME are mounted on its front panel. The DME 190 shown in Figure 1 depicts a typical installation.



**NARCO DME 190 Distance Measuring Equipment
Figure 1**

34G72-21

DME SYSTEM – MAINTENANCE PRACTICES**1. Removal/Installation of DME Transmitter-Receiver****A. Removal**

- (1) Locate DME transmitter-receiver in instrument panel.
- (2) Ensure that master power switch is OFF.
- (3) Turn locking screw counterclockwise to release DME unit from its mounting case. Use 5/64-inch hex wrench.

CAUTION: DO NOT PULL DME TRANSMITTER-RECEIVER FREE OF MOUNT BY GRASPING THE CONTROL KNOBS.

- (4) Grasp the body of the transmitter-receiver and, with a slight rocking motion while pulling outward, free receiver from connector plug and slide receiver from instrument panel mount.

B. Installation

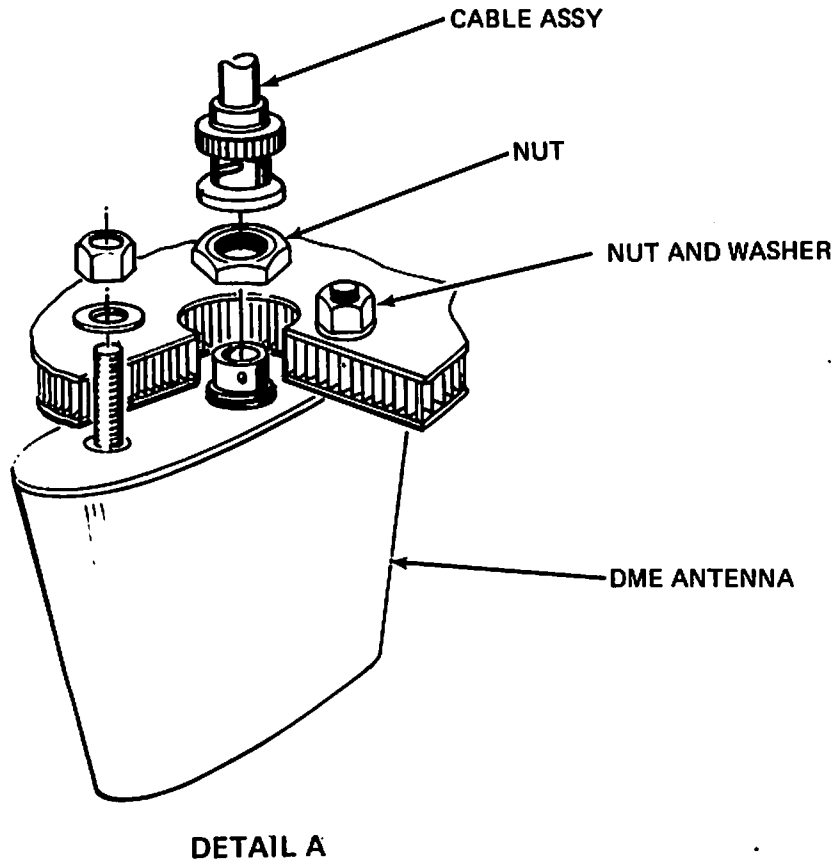
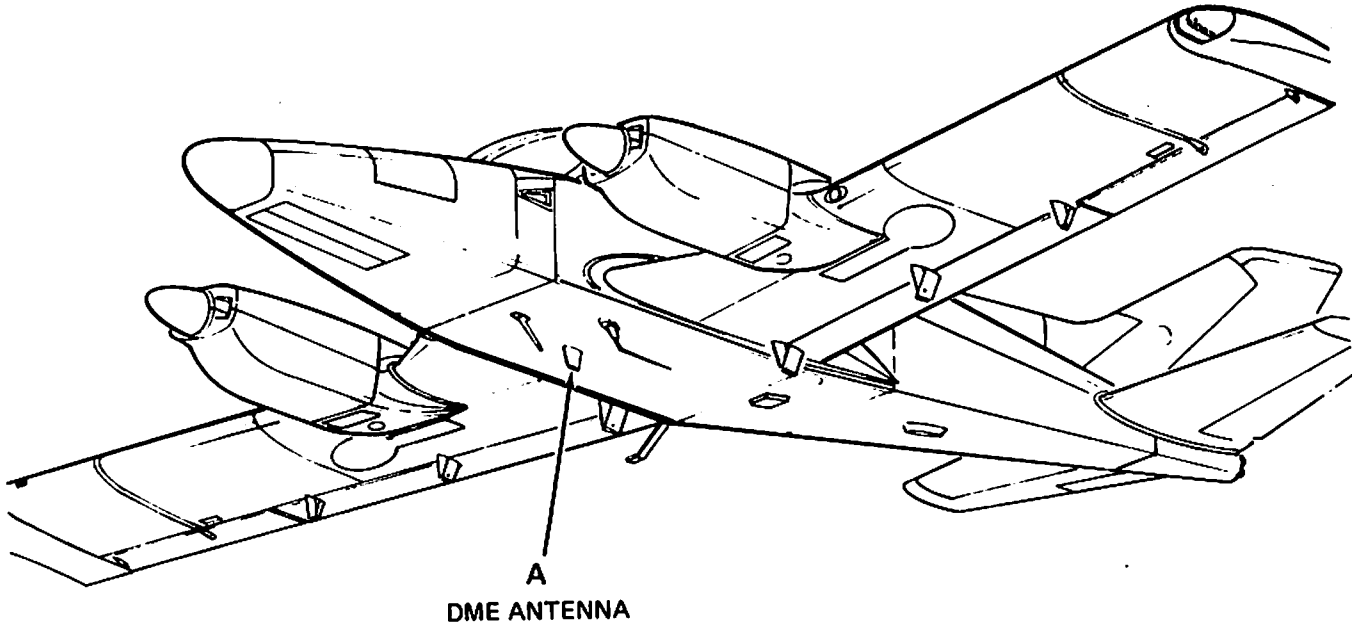
- (1) Ensure that master power switch is OFF.
- (2) Grasp the transmitter-receiver by the sides and carefully slide transmitter-receiver into instrument panel mount until connector plug is fully engaged.
- (3) Turn locking screw clockwise to secure DME unit to its mounting case. Use 5/64-inch hex wrench.

2. Removal/Installation of DME Antenna (See Figure 201.)**A. Removal**

- (1) The DME antenna is mounted at Fuselage Station 89.15, Buttock Line Right 17.700.
- (2) Remove the interior furnishings required to gain access to the antenna connector.
- (3) Remove sealant from around coax connector.
- (4) Disconnect coax cable from antenna.
- (5) From outside the aircraft, remove the two screws securing DME antenna to bottom of fuselage.

B. Installation

- (1) From outside the aircraft, attach the DME antenna to the bottom of the fuselage with two screws.
- (2) From inside the aircraft, attach coax cable.
- (3) Apply polysulfide sealant around antenna connector.
- (4) Replace removed interior furnishings.



**DME Antenna Installation
Figure 201**

34G72-22

VOR SYSTEM – DESCRIPTION/OPERATION

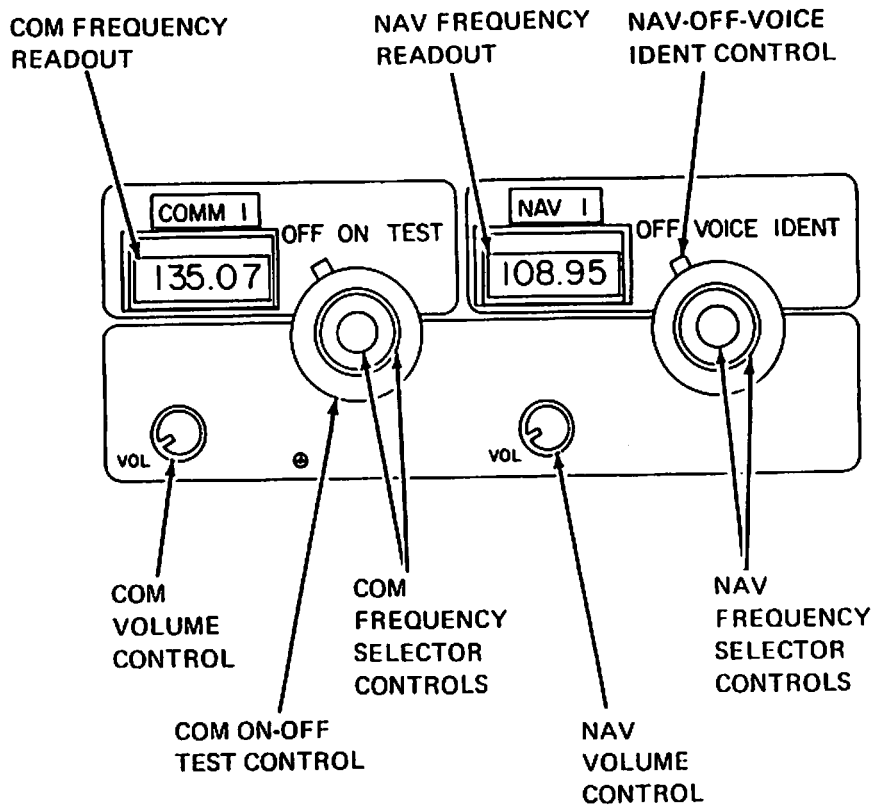
1. **General**

The primary and most widely used system of navigation in the United States today is the very high frequency omnidirectional range (VOR). The VOR system consists of both ground stations and airborne radio equipment. This chapter defines and discusses the airborne portion of the system only. A more detailed coverage of the use and procedures applicable to the VOR system is presented in the manufacturer's technical data.

2. **King KX 175B NAV/COM Transceiver**

The King KX 175B NAV/COM combines, in a single unit, a 720-channel VHF COM transceiver and an independent 200-channel VHF NAV receiver. The NAV receiver supplies VOR/LOC information to navigational converters and provides frequency selection for remote-mounted distance measuring equipment and glide slope receivers.

All operating controls for the NAV/COM unit are on the front panel and are identified in Figure 1.



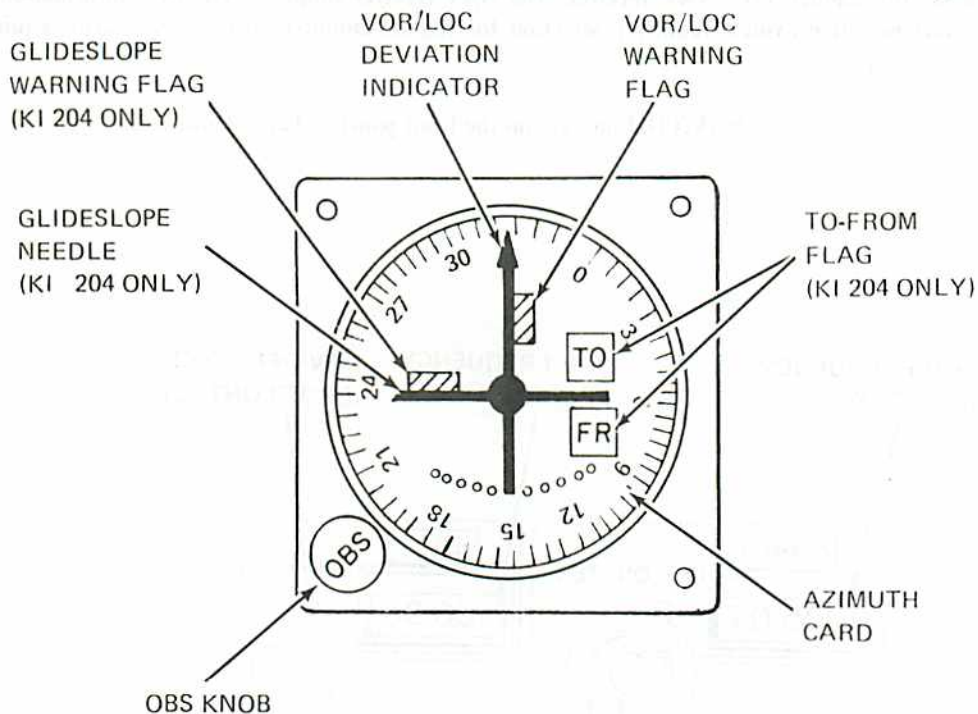
**King KX 175B NAV/COM Transceiver
Figure 1**

3. King KI 203/204 VOR/LOC Indicator

The King KI 203/204 VOR indicator is designed to operate with KX 175B to provide OMNI (VOR) or LOCALIZER (LOC) information. The VHF navigational receiver receives and detects the OMNI or LOCALIZER information. The KI 203 converts this information to DC signals which drive the LEFT-RIGHT needle and TO-OFF-FROM flag of the visual indicator.

The KI 204 ILS indicator performs the same functions as the KI 203. In addition, it contains a 40-channel glide slope receiver and the visual indicators include an UP-DOWN glide slope needle with an OFF warning flag.

All operating controls for the indicator are mounted on the front panel and are identified in Figure 2.



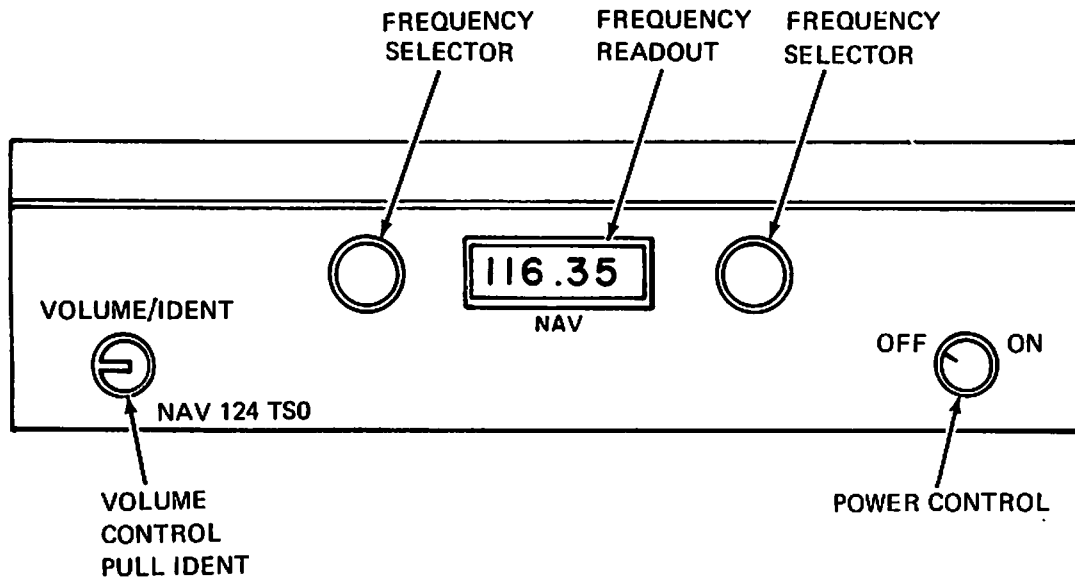
King KI 203/204 VOR/LOC-GS Indicator
 Figure 2

34G72-24

4. NARCO NAV 124 Navigation Receiver

The NARCO NAV 124 is a fully independent NAV receiver designed to drive the HSI or RNAV computer.

All operating controls for the NAV 124 are mounted on the front panel. (See Figure 3.)



NAV 124 Receiver
 Figure 3

34G72-25

5. NARCO NAV 121-NAV 122 Navigation System

The NARCO NAV 121-NAV 122 navigation system consists of a panel-mounted unit that provides navigational information. The NAV 121 and NAV 122 systems are similar with regard to VOR reception. The NAV 122 system has the added capability of receiving and displaying glide slope information to enable full ILS approaches rather than the localizer only approaches possible with the NAV 121.

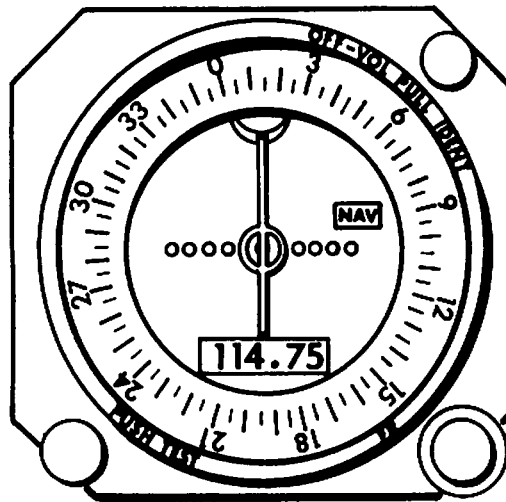
The NAV 121 provides 200-channel VOR/LOC functions only.

The NAV 122 system receives and displays the same VOR and ILS localizer signals as the NAV 121 system. In addition, the NAV 122 system receives and displays the UHF glideslope signals to provide full ILS approach display.

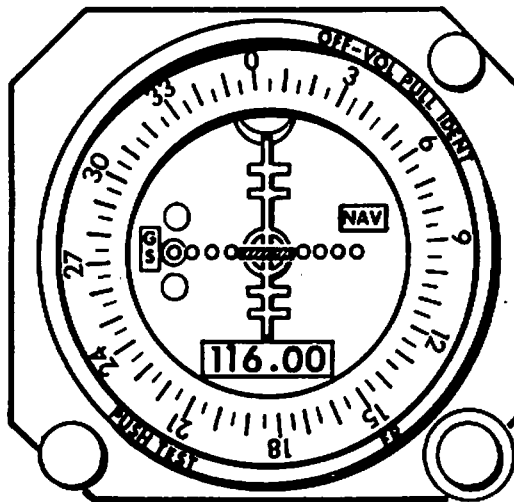
All operating controls for the navigation system are located on the front panel and are identified in Figure 4.

6. Collins VIR-351/IND-350/IND-351 Navigation System (See Figure 5.)

Station frequency selection is made with TO/FREQ/FROM control in the **FREQ** position. In the **FROM** position, the bearing from the selected VOR station is shown in the electronic display. The bearing, in degrees, is followed by the letter **F** when in the **FROM** position. The heading to the selected station (radial + 180 degrees) may be displayed by selecting the **TO** position (no letter appears after the bearing displayed). Three dashes will appear in the electronic display if no signal is received or if a localizer frequency is selected and you have selected the **TO** or **FROM** position.



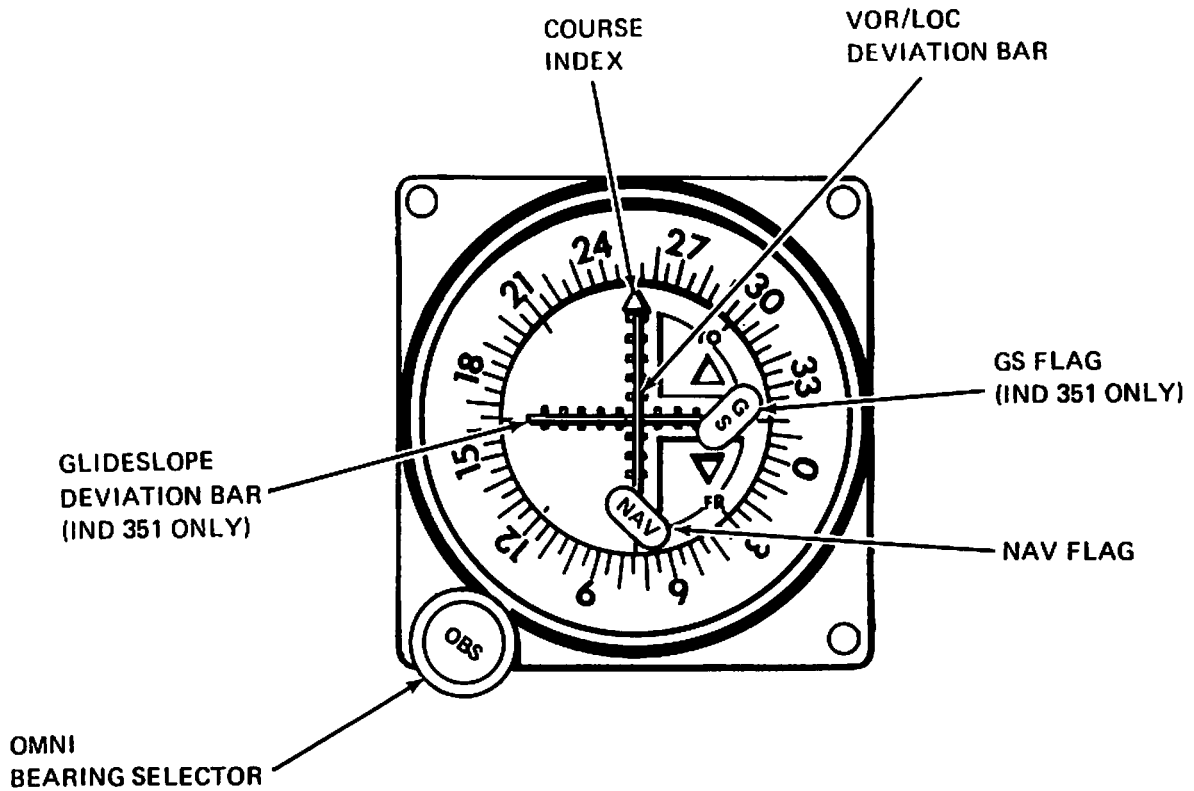
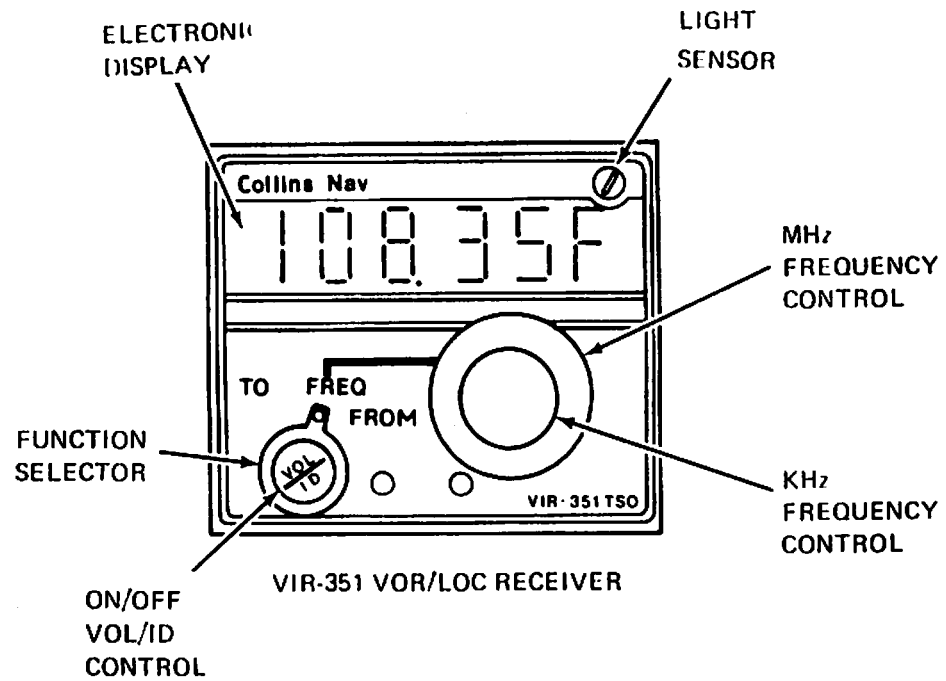
NAV 121 UNIT



NAV 122 UNIT

NARCO NAV 121-NAV 122 Navigation System
Figure 4

34G72-26



IND-350/351 VOR/LOC/GS Indicator
Figure 5

34G72-27

The VOR/LOC deviation bar in the IND-350 or IND-351 indicates the direction and amount of deviation from a selected VOR or localizer course. Appearance of the NAV flag indicates that unreliable information is being supplied to the VOR/LOC deviation bar. The GS flag (IND-351 only) indicates an unreliable glide slope signal when tuned to a localizer frequency. The TO/FROM arrow indicates the bearing of a selected station is to or from the aircraft when flying a selected course. The TO/FROM arrow is not visible when the receiver is tuned to a localizer frequency.

37 Vacuum Systems
NO contend

There is no 38-57

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DOORS – DESCRIPTION/OPERATION

1. **General**

The doors covered in this chapter consist of a passenger entrance door, aft baggage compartment door, and forward baggage compartment door. The nose landing gear doors are covered in Chapter 32 of this manual.

2. **Entrance Door**

The entrance door is located on the right-hand side of the fuselage and provides easy access to the passenger compartment.

3. **Aft Baggage Compartment Door**

The aft baggage compartment door is a key-operated door located on the right-hand side of the aft fuselage. It provides access to the baggage compartment behind the rear passenger seats.

4. **Forward Baggage Compartment Door (Optional)**

A forward baggage compartment door, located on the right-hand side of the nose section, is provided as optional equipment. The door is secured by a key-operated lock and two push-type latches.

ENTRANCE DOOR – DESCRIPTION/OPERATION**1. General**

The entrance door, for the pilot and passengers, is located between Fuselage Stations 70.00 and 111.90 on the right-hand side of the fuselage. The structure is bonded aluminum with a Plexiglas window. The door is attached to the fuselage at the forward end of the door by two hinges and secured by a latch assembly at the aft end. The door is also secured from the inside and top of the fuselage with a catch assembly at the top of the door. A tinted window for the door is available as optional equipment.

ENTRANCE DOOR – MAINTENANCE PRACTICES

1. Servicing

A. Latch Lubrication

Lubricate door latches in accordance with instructions in Chapter 12 of this manual.

B. Door Hinges Lubrication

Lubricate door hinges in accordance with instructions in Chapter 12 of this manual.

2. Removal/Installation

A. Entrance Door Removal (See Figure 201.)

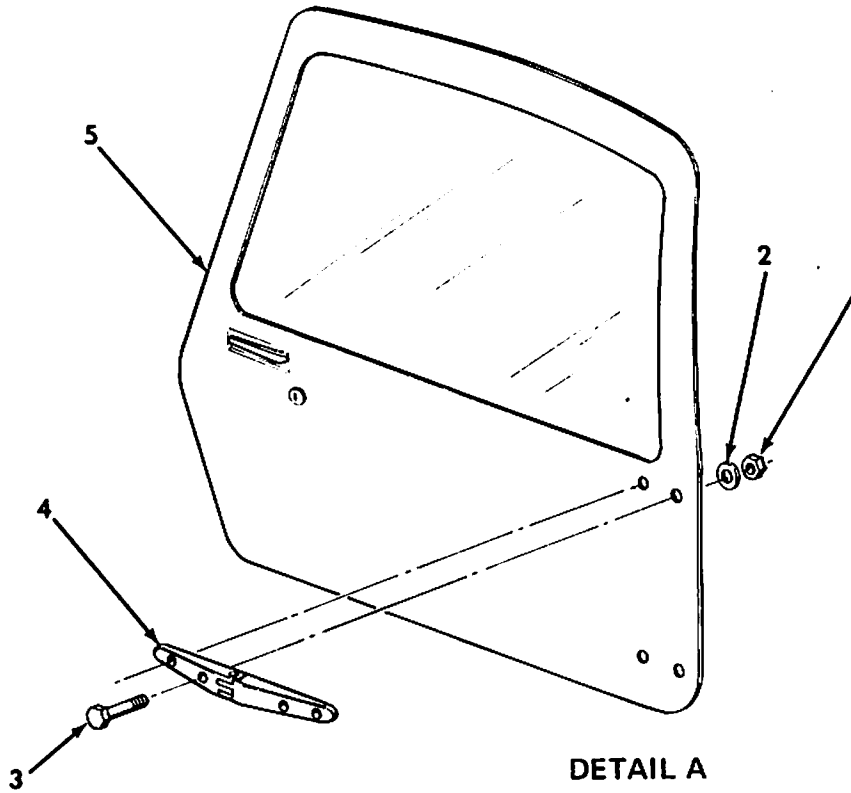
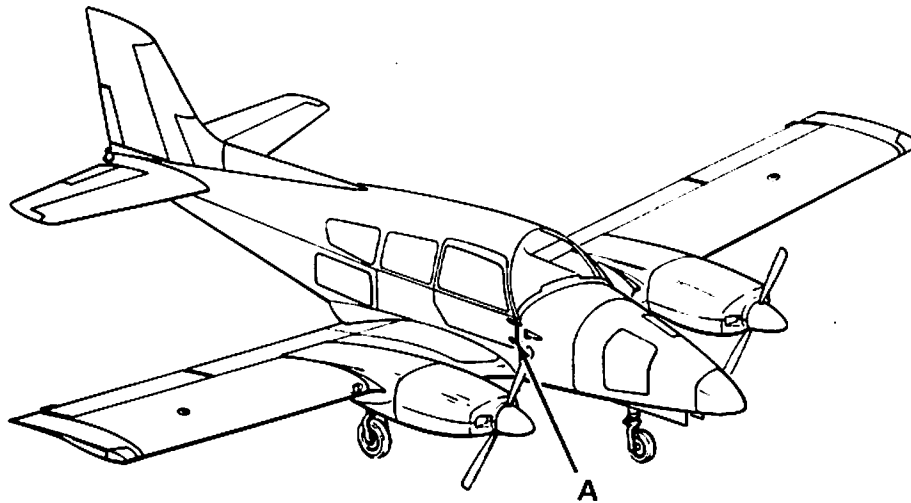
- (1) Remove interior trim from inside of door to gain access to door hinge halves attaching hardware. Refer to Chapter 25 for trim removal.
- (2) With assistant holding door during removal, remove nuts (1), washers (2), and bolts (3) securing hinge halves (4) to door (5).
- (3) Remove entrance door from aircraft.

B. Entrance Door Installation

- (1) Place door in door frame and align holes in door (5) with holes in door hinges (4).
- (2) Place bolts (3) through door hinges (4) and door (5) and with assistant holding door and bolts in position, install washers (2) and nuts (1) on bolts.
- (3) Install door trim in accordance with instructions in Chapter 25 of this manual.

C. Entrance Door Lower Latch Removal (See Figure 202.)

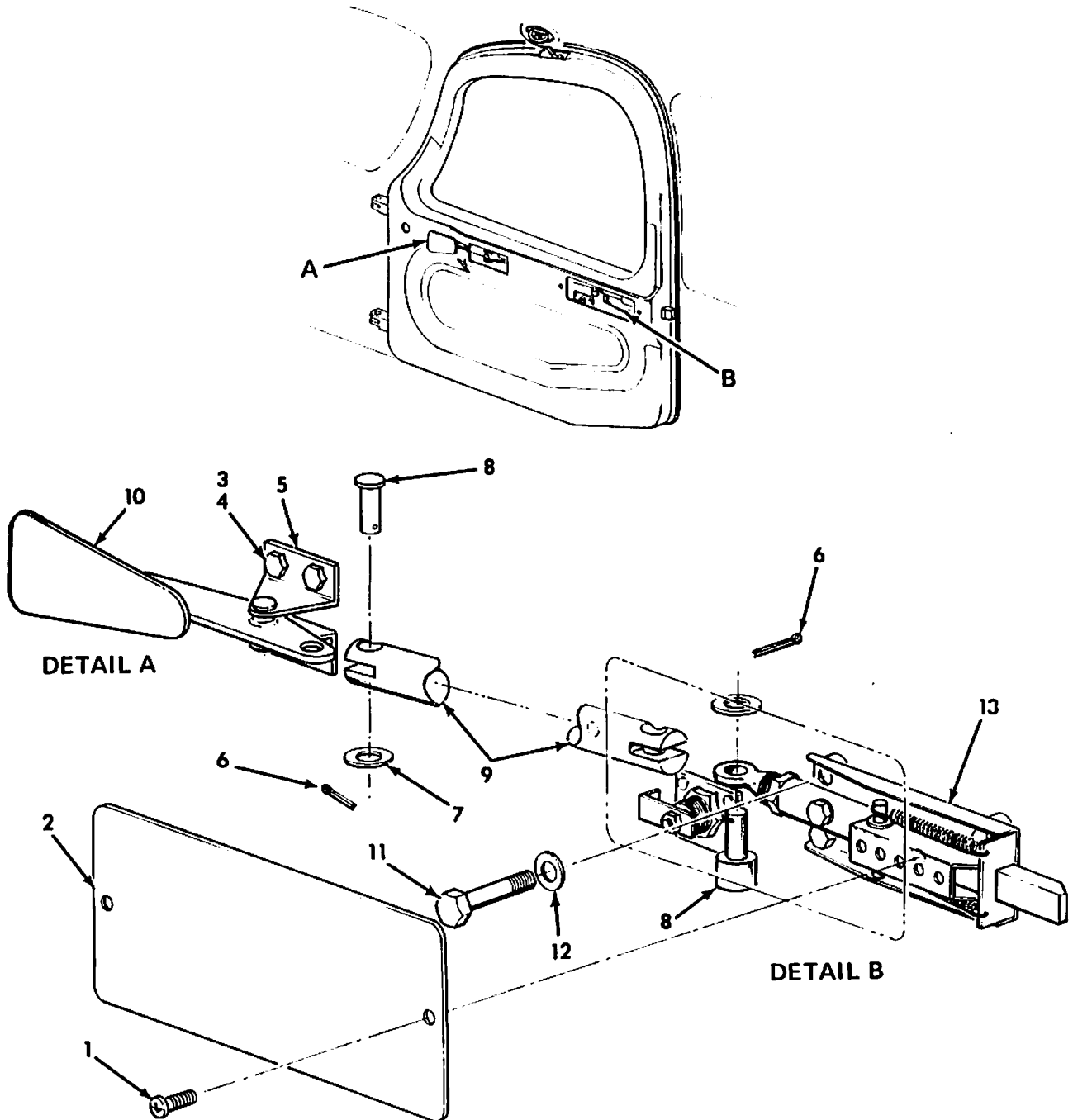
- (1) Remove door trim around latch in accordance with instructions in Chapter 25 of this manual.
- (2) Remove screws (1) from cover plate (2). Remove cover plate (2).
- (3) Remove bolts (3) and washers (4) attaching brackets (5).
- (4) Remove cotter pin (6), washer (7), and pin (8) from end of rod (9).
- (5) Remove rod (9) and handle (10) from door by lifting handle straight away from door and moving forward until rod (9) is clear of door inner skin.
- (6) Remove bolts (11) and washers (12) securing channel (13).
- (7) Remove channel (13) with bolt assembly from door.



- 1. Nut
- 2. Washer
- 3. Bolt
- 4. Hinge
- 5. Door

Entrance Door Removal/Installation
Figure 201

52G72-1



- | | |
|----------------|-------------|
| 1. Screw | 8. Pin |
| 2. Cover Plate | 9. Rod |
| 3. Bolt | 10. Handle |
| 4. Washer | 11. Bolt |
| 5. Bracket | 12. Washer |
| 6. Cotter Pin | 13. Channel |
| 7. Washer | |

**Entrance Door Lower Latch Removal/Installation
Figure 202**

52G72-2

D. Entrance Door Lower Latch Installation (See Figure 202.)

- (1) Place channel (13) in position and install washers (12) and bolts (11).
- (2) Place rod (9) and handle (10) in position and install pin (8), washer (7), and cotter pin (6).
- (3) Install washers (4) and bolts (3).
- (4) Place cover plate (2) in position and install screws (1).
- (5) Install door trim. Refer to Chapter 25.

E. Entrance Door Upper Latch Removal (See Figure 203.)

- (1) On top of fuselage, remove roll pin (1), handle (2), and seal (3).
- (2) On the inside of fuselage, remove trim from around latch. Refer to Chapter 25.
- (3) Unlatch door by turning latch handle. Loosen four screws (4) and remove latch assembly.

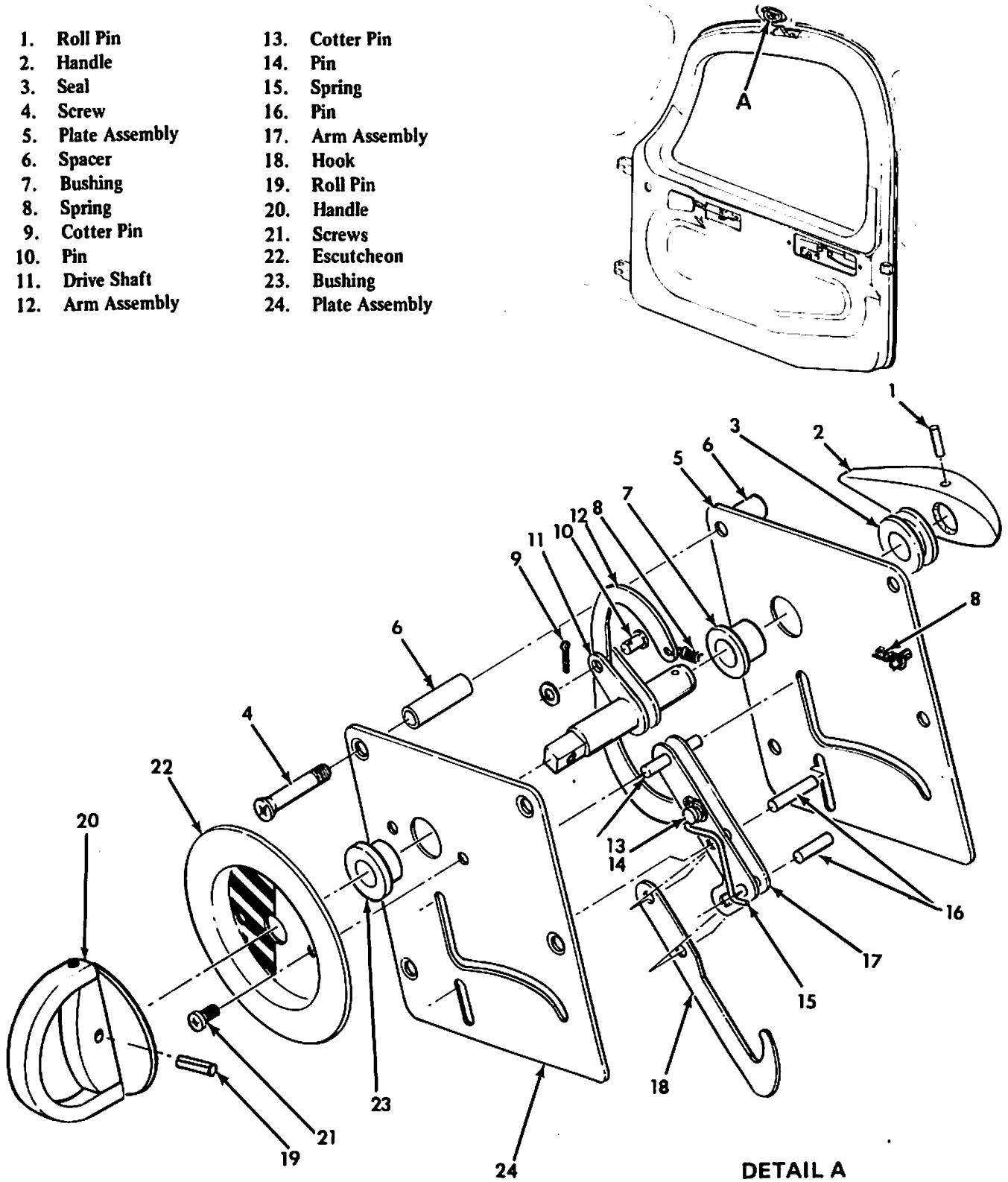
F. Disassemble Upper Latch (See Figure 203.)

- (1) Remove plate assembly (5), spacers (6), bushing (7), and spring (8).
- (2) Remove cotter pin (9) and pin (10) from drive shaft (11) and arm assembly (12). Remove drive shaft (11).
- (3) Remove cotter pin (13), pin (14), and spring (15).
- (4) Remove pin (16), arm assembly (17), and hook (18).
- (5) Remove set screw (19), handle (20), screws (21), escutcheon (22), and bushing (23) from plate assembly (24).

G. Assemble Upper Latch (See Figure 203.)

- (1) Install bushing (23) in plate assembly (24).
- (2) Place escutcheon (22) and handle (20) in position on plate assembly (24) and install screws (19 and 21).
- (3) Align holes in hook (18) and arm assembly (17), and install pins (16), spring (15), pin (14), and cotter pin (13) on arm assembly (12).
- (4) Install drive shaft (11) and align holes in drive shaft (11) with holes in arm assembly (12) and install pin (10), cotter pin (9), and spring (8).
- (5) Install bushing (7), spacers (6), and screws (4) in plate assembly (5).

- | | |
|-------------------|--------------------|
| 1. Roll Pin | 13. Cotter Pin |
| 2. Handle | 14. Pin |
| 3. Seal | 15. Spring |
| 4. Screw | 16. Pin |
| 5. Plate Assembly | 17. Arm Assembly |
| 6. Spacer | 18. Hook |
| 7. Bushing | 19. Roll Pin |
| 8. Spring | 20. Handle |
| 9. Cotter Pin | 21. Screws |
| 10. Pin | 22. Escutcheon |
| 11. Drive Shaft | 23. Bushing |
| 12. Arm Assembly | 24. Plate Assembly |



**Entrance Door Upper Latch Removal/Installation
Figure 203**

52G72-3

H. Entrance Door Upper Latch Installation (See Figure 203.)

- (1) Place latch assembly in position and tighten screws (4).**
- (2) Install interior trim around latch assembly. Refer to Chapter 25.**
- (3) On top of fuselage, install seal (3), handle (2), and roll pin (1).**

AFT BAGGAGE DOOR – DESCRIPTION/OPERATION

1. General

The aft baggage door is located on the right-hand side of the aft fuselage between Fuselage Stations 146 and 176. The door is key-operated and hinged to the fuselage structure with a strap hinge. A restraint chain is attached to the door and fuselage to prevent damage to hinges due to overtravel of the door. The door provides an opening, measuring approximately 28 by 14 inches, for access to the aft baggage compartment.

AFT BAGGAGE DOOR – MAINTENANCE PRACTICES

1. Servicing

A. Hinge Lubrication

Lubricate hinge in accordance with instructions in Chapter 12 of this manual.

B. Latch Lubrication

Lubricate door latch in accordance with instructions in Chapter 12 of this manual.

2. Removal/Installation

A. Remove Aft Baggage Door (See Figure 201.)

- (1) Remove interior trim around baggage door hinge in accordance with instructions in Chapter 25 of this manual.
- (2) Remove cotter pin (1) attaching restraint chain (2) to baggage door (3).
- (3) Remove four nuts (4), washers (5), and bolts (6) attaching door hinge to fuselage structure.
- (4) Remove baggage compartment door from aircraft.

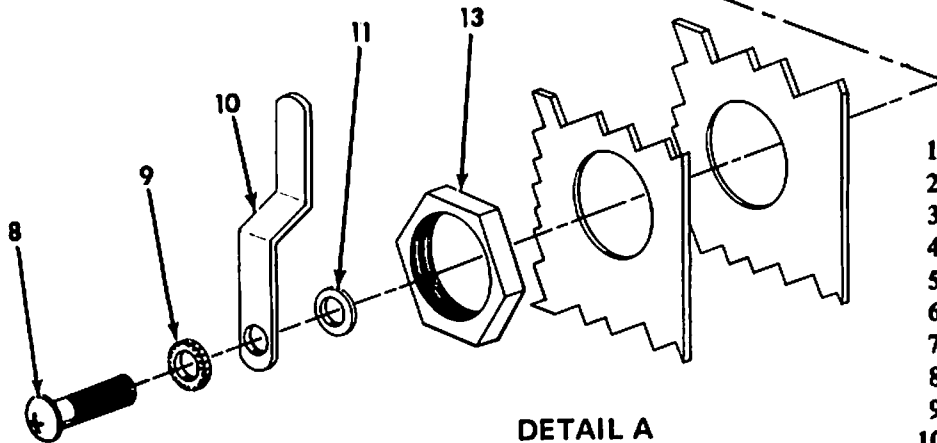
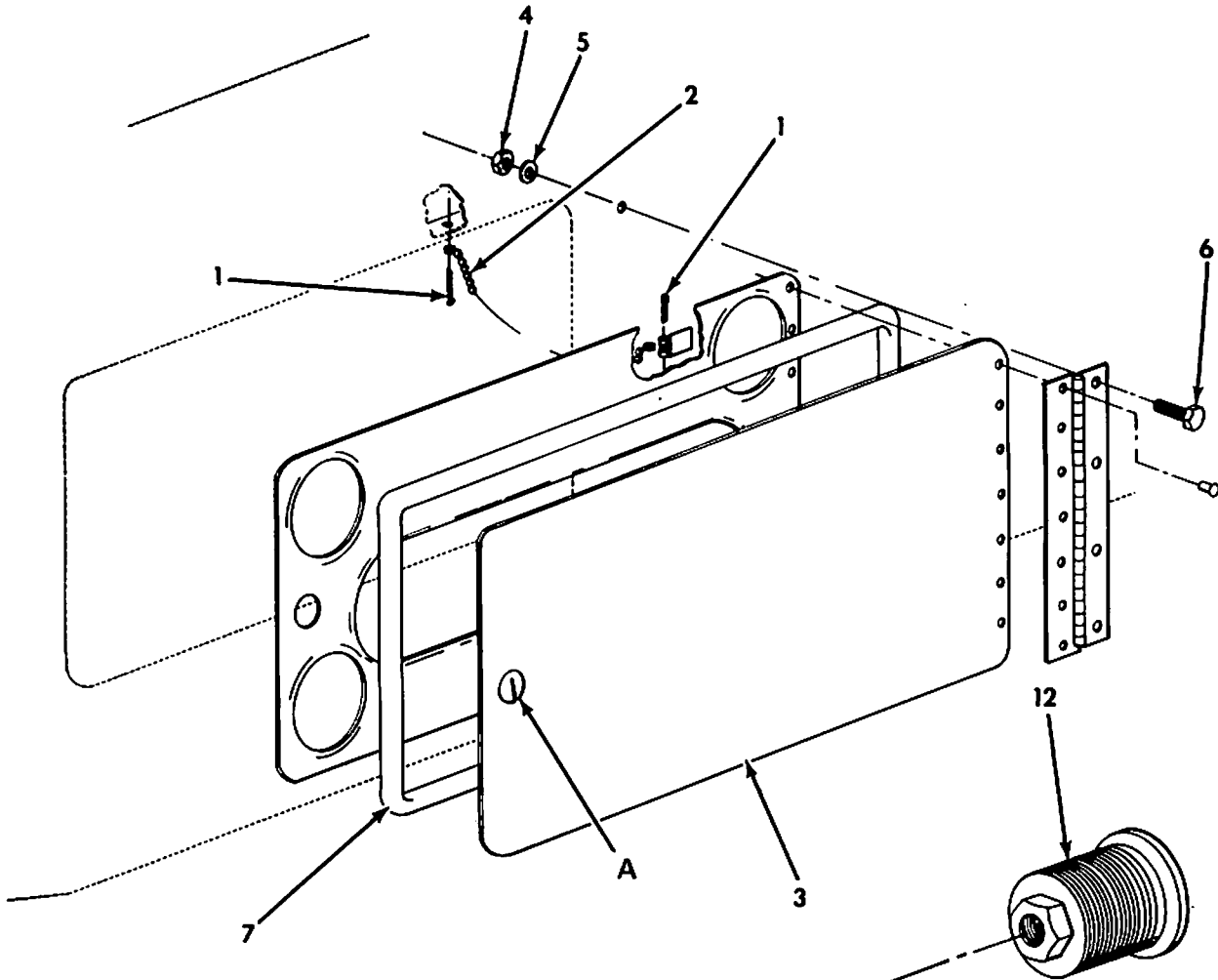
B. Install Aft Baggage Door (See Figure 201.)

- (1) Position door in door frame and align holes in door hinge with holes in fuselage structure.
- (2) Install bolts (6), washers (5), and nuts (4).
- (3) Attach restraint chain (2) to baggage door (3) with cotter pin (1).
- (4) Install interior trim around door hinge in accordance with instructions in Chapter 25 of this manual.

C. Remove Door Seal (See Figure 201.)

WARNING: METHYL ETHYL KETONE IS TOXIC AND FLAMMABLE. USE IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (1) Use a cloth moistened with methyl ethyl ketone to soften the vinyl tape foam adhesive holding the seal (7) to the door.
- (2) Use a fiber scraper to lift the seal as the adhesive softens and remove seal from door.



DETAIL A

- 1. Cotter Pin
- 2. Chain
- 3. Door
- 4. Nut
- 5. Washer
- 6. Bolt
- 7. Seal
- 8. Screw
- 9. Lockwasher
- 10. Latch
- 11. Washer
- 12. Camlock
- 13. Nut

**Aft Baggage Door Removal/Installation
Figure 201**

52G72-4

D. Install Door Seal (See Figure 201.)

WARNING: METHYL ETHYL KETONE IS TOXIC AND FLAMMABLE. USE IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

NOTE: Methyl ethyl ketone will attack the paint on the door surfaces to which the seal is cemented. Repainting of surfaces is necessary prior to installing new seal.

- (1) Remove any adhesive remaining on door after removing seal, with a cloth moistened with methyl ethyl ketone. Dry surface thoroughly and repaint surfaces if necessary.
- (2) Install 0.06 by 0.50-inch vinyl tape foam, No. 4516 (3M Company) strips on the two surfaces where flat sides of seal would contact surfaces of door.
- (3) Install seal (7) and apply pressure on seal until adhesive has dried.
- (4) Install interior trim in accordance with instructions in Chapter 25 of this manual.

E. Remove Aft Baggage Door Lock Assembly (See Figure 201.)

- (1) Remove interior trim from door in accordance with instructions in Chapter 25 of this manual.
- (2) Remove screw (8), lockwasher (9), lock latch (10), and washer (11) from camlock (12).
- (3) Remove camlock retainer nut (13) and remove camlock (12).

F. Install Aft Baggage Door Lock Assembly (See Figure 201.)

- (1) Place camlock (12) in position in the hole in door so that key slot will be vertical when door is installed.
- (2) Install camlock retainer nut (13) on camlock (12).
- (3) Install washer (11), lock latch (10), lockwasher (9), and screw (8).
- (4) Install door trim in accordance with instructions in Chapter 25 of this manual.

FORWARD BAGGAGE DOOR – DESCRIPTION/OPERATION**1. General**

The forward baggage door is available as optional equipment. The door is of bonded aluminum structure and is located on the right-hand side of the nose section between Fuselage Stations 17.12 and 40.00. Two hinges attach the door to the fuselage at Fuselage Stations 23.25 and 34.48. When closed, the door is secured by two latches and a key-operated lock.

FORWARD BAGGAGE DOOR – MAINTENANCE PRACTICES

1. Servicing

A. Hinge Lubrication

Lubricate hinges in accordance with instructions in Chapter 12 of this manual.

B. Latch Lubrication

Lubricate door latches in accordance with instructions in Chapter 12 of this manual.

2. Removal/Installation

A. Remove Forward Baggage Door (See Figure 201.)

(1) Open baggage door and remove nuts (1), washers (2), spacers (3), washers (4), and bolts (5) from hinge (6).

(2) Remove baggage door.

B. Install Forward Baggage Door

(1) Position door in door frame and align holes in hinges with holes in hinge brackets.

(2) Install washers (4) on bolts (5). Position spacers (3) inside of hinge brackets and install bolt through hinge, spacers, and brackets.

(3) Install washers (2) and nuts (1).

C. Remove Latch Assemblies (See Figure 201.)

(1) Open door and through access holes remove nuts (7), washers (8), washers (9), and bolts (10).

(2) Remove latch assemblies (11) from door.

D. Install Latch Assemblies (See Figure 201.)

(1) Position latch assemblies (11) in door and align holes in latch assemblies with holes in supports.

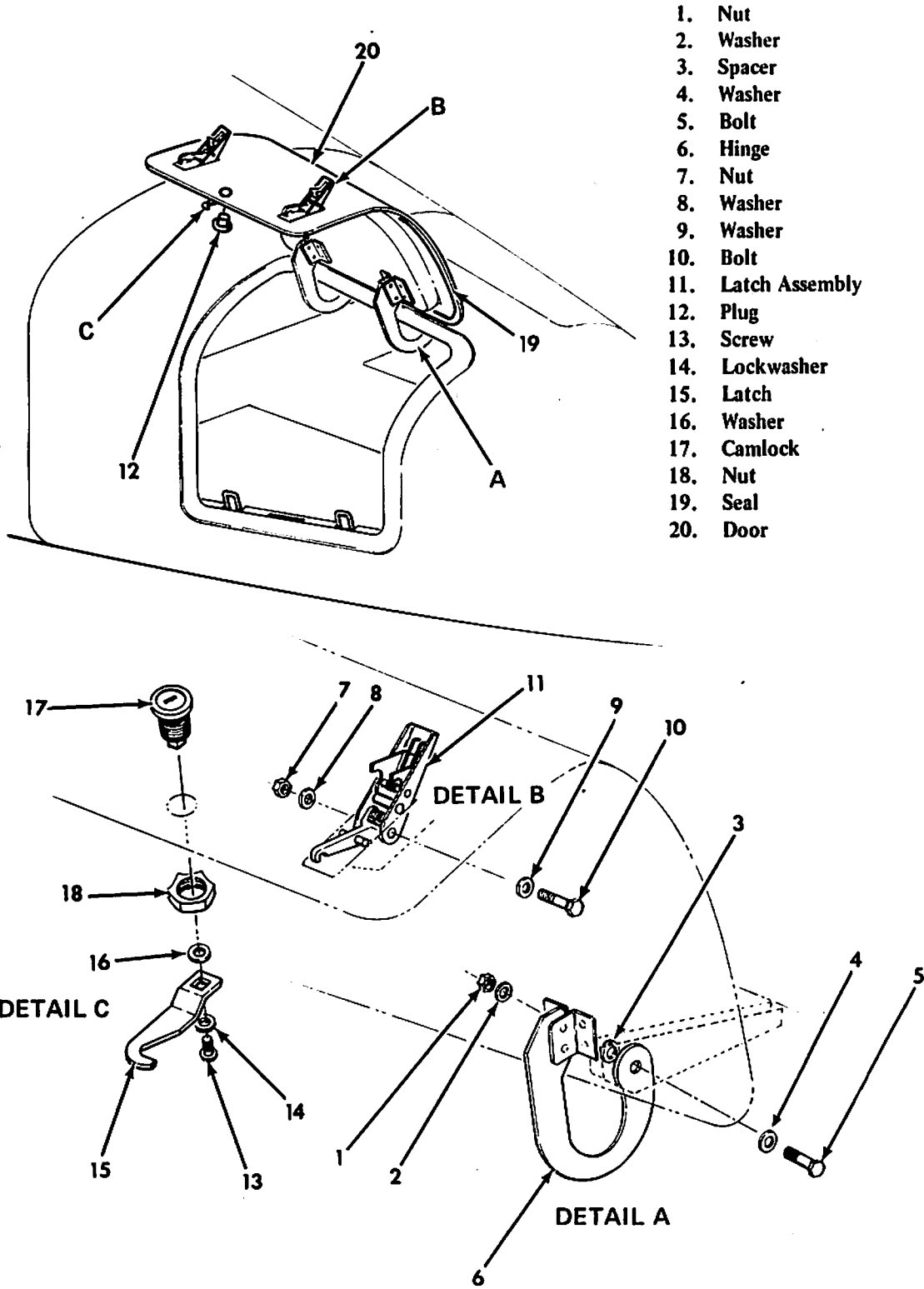
(2) Install bolts (10), washers (9), washers (8), and nuts (7).

E. Remove Door Lock (See Figure 201.)

(1) Open door and remove plug (12) to gain access to lock.

(2) Remove screw (13), lockwasher (14), latch (15), and washer (16) from camlock (17).

(3) Remove camlock retainer nut (18) and remove camlock (17).



- 1. Nut
- 2. Washer
- 3. Spacer
- 4. Washer
- 5. Bolt
- 6. Hinge
- 7. Nut
- 8. Washer
- 9. Washer
- 10. Bolt
- 11. Latch Assembly
- 12. Plug
- 13. Screw
- 14. Lockwasher
- 15. Latch
- 16. Washer
- 17. Camlock
- 18. Nut
- 19. Seal
- 20. Door

**Forward Baggage Door Removal/Installation
Figure 201**

52G72-5

F. Install Door Lock (See Figure 201.)

- (1) Place camlock (17) in door so that key slot is vertical.
- (2) Install camlock retainer nut (18) on camlock (17).
- (3) Install washer (16), latch (15), lockwasher (14), screw (13), and plug (12).

G. Remove Forward Baggage Door Seal (See Figure 201.)

WARNING: METHYL ETHYL KETONE IS TOXIC AND FLAMMABLE. USE IN A WELL VENTILATED AREA. AVOID BREATHING FUMES AND KEEP AWAY FROM FLAMES.

- (1) Use a cloth moistened with methyl ethyl ketone to soften the vinyl tape adhesive holding the seal (19) to the door (20).
- (2) Use a fiber scraper to lift the seal as the adhesive softens and remove seal from door.

H. Install Forward Baggage Door Seal (See Figure 201.)

WARNING: METHYL ETHYL KETONE IS TOXIC AND FLAMMABLE. USE IN A WELL VENTILATED AREA. AVOID BREATHING FUMES AND KEEP AWAY FROM FLAMES.

NOTE: Methyl ethyl ketone will attack the paint on the door surfaces to which the seal is cemented. Repainting of surfaces is necessary prior to installing new seal.

- (1) Remove any adhesive remaining on door after seal was removed, with a cloth moistened with methyl ethyl ketone. Dry surface thoroughly and repaint surfaces if necessary.
- (2) Install 0.06 by 0.50 inch vinyl tape (3M Company) strips on the door surface where flat side of seal would contact surface of door.
- (3) Install seal (19) on door (20) and apply pressure on seal until adhesive has dried.

CHAPTER 53

FUSELAGE

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FUSELAGE – DESCRIPTION/OPERATION

I. General

The fuselage assembly consists of a bonded fuselage assembly, nose cap, nose section assembly, fairings, left- and right-hand aft fuselage covers, tail cone assembly, entrance step assembly, and a passenger boarding handle.

The bonded fuselage assembly is a one-piece bonded aluminum assembly using 1/2-inch-thick lightweight aluminum honeycomb panels to form the lower cabin area. The aft section and cabin overhead are composed of sheet aluminum panels bonded together with high-strength adhesive and formed to aluminum stiffeners and bulkheads. Bulkheads inside the cabin compartment provide support for the floor panels and attaching provisions for other equipment. Supports are incorporated into the fuselage assembly for mating with wing assemblies.

The nose cap is made of laminated Fiberglas and is secured to the nose section assembly with screws and washers.

The nose section assembly is a bonded aluminum assembly which houses the nose landing gear, landing gear hydraulic pump, battery and associated equipment, and various (optional) avionic equipment. The nose section assembly is riveted to the fuselage assembly.

Fairings are riveted to the fuselage assembly and wing assemblies at the leading and trailing edges of the wing roots.

Aft fuselage covers close off the aft fuselage section just forward of the tail cone assembly on each side of the vertical stabilizer. These covers are secured with screws and washers.

The tail cone assembly is a riveted, aluminum section which closes off the tail section. The tail cone assembly houses the white navigational light and an anticollision light. The tail cone assembly is secured to the tail section with screws and washers.

The entrance step assembly and passenger boarding handle are attached directly to the fuselage with screws and bolts.

FUSELAGE – MAINTENANCE PRACTICES**1. General**

Most fuselage maintenance requirements will consist of removal and replacement of detachable components or structural repairs as outlined in Chapter 20. When access is required to remove or repair an area of the fuselage, refer to appropriate chapters of this manual for removal and installation of specific items or equipment.

2. Removal/Installation of Fuselage Components**A. Remove Nose Cap Assembly (See Figure 201.)**

CAUTION: USE CARE WHEN REMOVING NOSE CAP ASSEMBLY SO PITOT TUBE ASSEMBLY IS NOT DAMAGED.

Remove screws and washers securing nose cap assembly to nose section assembly and remove nose cap assembly.

B. Install Nose Cap Assembly (See Figure 201.)

CAUTION: USE CARE WHEN INSTALLING NOSE CAP ASSEMBLY SO PITOT TUBE ASSEMBLY IS NOT DAMAGED.

Position nose cap assembly to nose section assembly and secure with screws and washers.

C. Remove Nose Section Assembly (See Figure 201.)

(1) Remove nose cap assembly. (Refer to Paragraph A.)

(2) Remove nose section doors. (Refer to Chapter 52.)

(3) Release the quick-release fasteners securing the two cover panels inside nose section to gain access to the hydraulic and electrical compartments.

(4) Remove battery, battery box, electrical equipment, and wiring from nose section. (Refer to Chapter 24.)

(5) Disconnect and remove landing light wiring. (Refer to Chapter 24.)

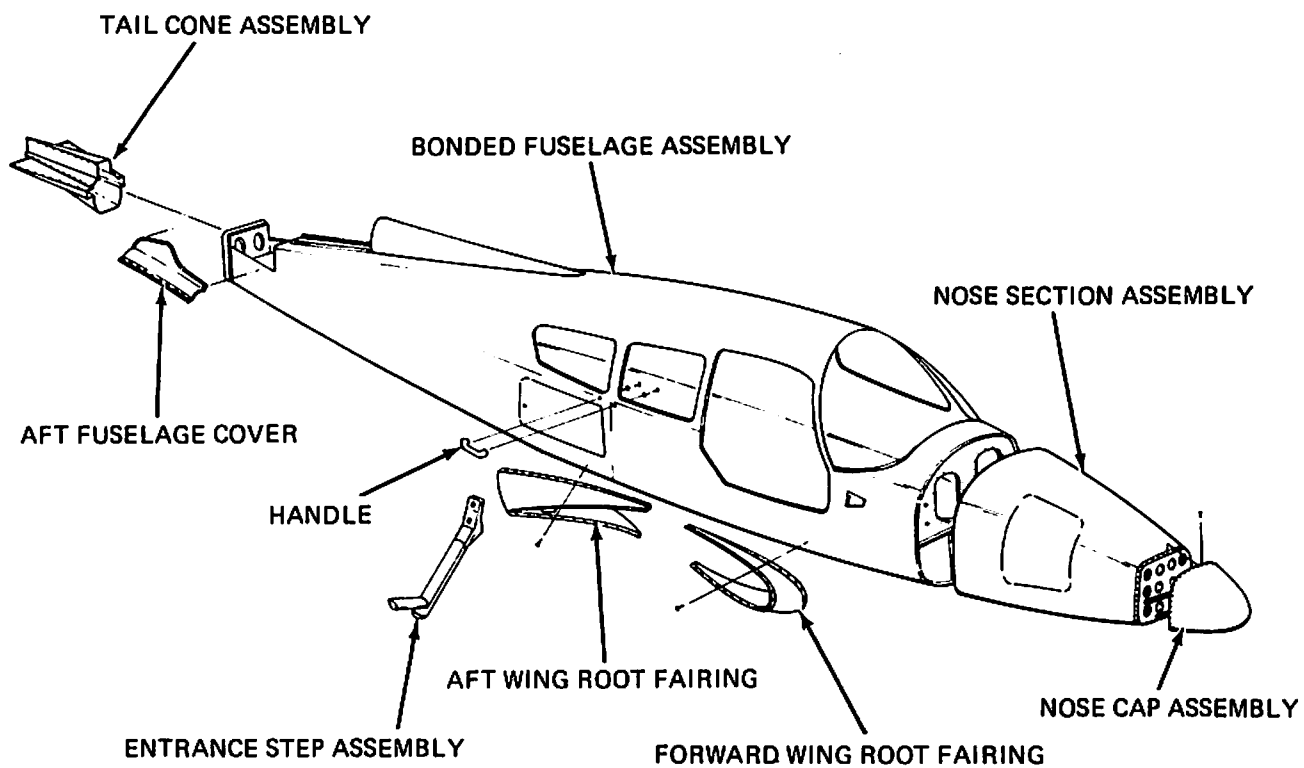
(6) Remove nose landing gear doors. (Refer to Chapter 32.)

(7) Remove nose landing gear including hydraulic pump and associated equipment, wiring, and tubing. (Refer to Chapter 32.)

(8) If installed, remove optional avionic equipment and wiring. (Refer to Chapter 22.)

(9) Remove avionic equipment deck from nose section by removing screws and washers.

(10) Remove pitot tube assembly and associated wiring and tubing. (Refer to Chapter 34.)



**Fuselage Assembly
Figure 201**

53G72-1

- (11) Remove bob weight assembly. (Refer to Chapter 27.)
- (12) Remove gyro pressure exhaust line. (Refer to Chapter 34.)
- (13) Remove nose section assembly from fuselage in accordance with instructions in Chapter 20.

D. Install Nose Section Assembly (See Figure 201.)

- (1) Install nose section assembly to fuselage assembly in accordance with instructions in Chapter 20.
- (2) Install gyro pressure exhaust line. (Refer to Chapter 34.)
- (3) Install bob weight assembly. (Refer to Chapter 27.)
- (4) Install pitot tube assembly and associated wiring and tubing. (Refer to Chapter 34.)
- (5) Install avionic equipment deck, using screws and washers.
- (6) Install any avionic equipment and wiring that was removed. (Refer to Chapter 22.)
- (7) Install nose landing gear, including hydraulic pump and associated equipment, wiring, and tubing. (Refer to Chapter 32.)
- (8) Install nose landing gear doors. (Refer to Chapter 32.)
- (9) Connect landing light wiring. (Refer to Chapter 24.)
- (10) Install battery box, battery, electrical equipment, and wiring. (Refer to Chapter 24.)
- (11) Install the two cover panels inside nose section.
- (12) Install nose section doors. (Refer to Chapter 52.)
- (13) Install nose cap assembly. (Refer to Paragraph B.)

E. Remove Fairings (See Figure 201.)

- (1) Remove the left-hand forward and aft wing root fairings and the right-hand forward wing root fairing by removing rivets.
- (2) Remove right-hand aft wing root fairing by removing rivets and disconnecting entrance step light wiring.

F. Install Fairings (See Figure 201.)

- (1) Connect entrance step light wiring to right-hand aft wing root fairing and position fairing. Secure fairing with rivets.
- (2) Position left-hand forward and aft wing root fairings and right-hand forward wing root fairing and secure with rivets.

G. Remove Aft Fuselage Covers (See Figure 201.)

Remove left- and right-hand aft fuselage covers by removing screws and washers.

H. Install Aft Fuselage Covers (See Figure 201.)

Position left- and right-hand aft fuselage covers and secure using screws and washers.

I. Remove Tail Cone Assembly (See Figure 201.)

(1) Remove left- and right-hand aft fuselage covers.

(2) Remove screws and washers securing tail cone assembly and slide tail cone assembly back far enough to reach navigational light wiring connector and disconnect wiring. Remove tail cone assembly.

J. Install Tail Cone Assembly (See Figure 201.)

(1) Position tail cone assembly so that navigational light wiring may be connected and connect wiring.

(2) Position tail cone assembly and secure with screws and washers.

(3) Install left- and right-hand aft fuselage covers.

K. Remove Entrance Step Assembly (See Figure 201.)

(1) Remove right-hand aft wing root fairing. (Refer to Paragraph E(2).)

(2) Remove bolts, washers, and nuts and remove step assembly.

L. Install Entrance Step Assembly (See Figure 201.)

(1) Position step assembly and install bolts, washers, and nuts.

(2) Install right-hand aft wing root fairing. (Refer to Paragraph F(1).)

M. Remove Passenger Boarding Handle (See Figure 201.)

Remove handle by removing screws and lockwashers.

N. Install Passenger Boarding Handle (See Figure 201.)

Position handle and install screws and lockwashers.

3. Painting of Fuselage Components

If new components have not been painted, paint with matching paint. Touch up fasteners and rivets after installation, using matching paint.

CHAPTER 55**STABILIZERS****TABLE OF CONTENTS**

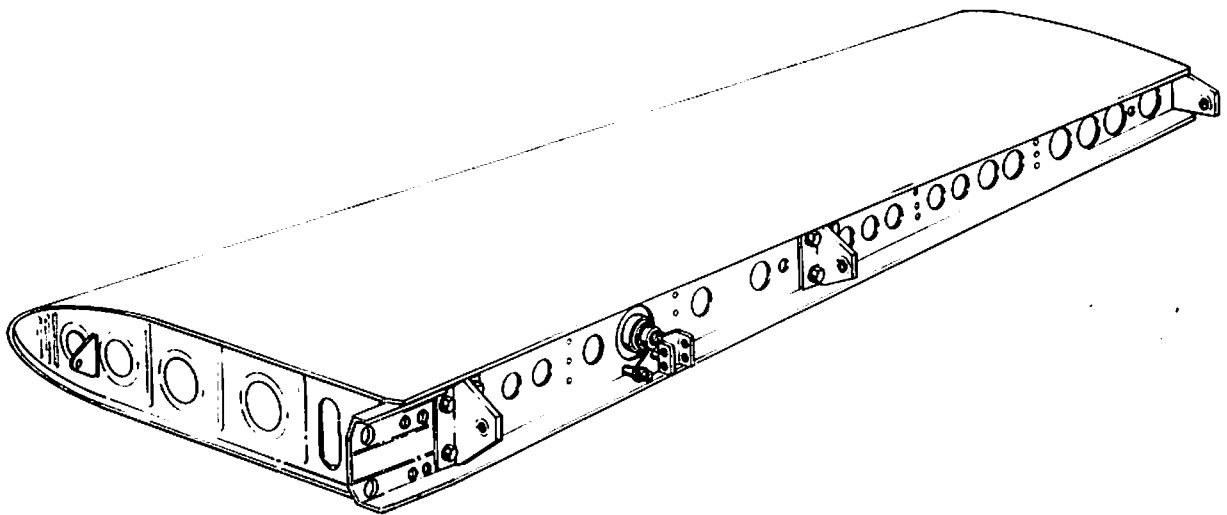
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STABILIZERS – DESCRIPTION/OPERATION**1. General**

The horizontal and vertical stabilizers on the GA-7/Cougar aircraft are the fixed empennage structures to which the elevators and rudder are connected. In addition to providing attachment points for the control surfaces, the stabilizers assist in ensuring directional and longitudinal stability of the aircraft.

HORIZONTAL STABILIZERS – DESCRIPTION/OPERATION**1. General (See Figure 1.)**

The horizontal stabilizers on the GA-7/Cougar aircraft are of conventional dual spar and rib structure, with the skin bonded to the ribs and spars. The horizontal stabilizers have a tapered chord, wider at the root than at the tip. The horizontal stabilizer angle of incidence is zero degree.



Horizontal Stabilizer
Figure 1

HORIZONTAL STABILIZERS – MAINTENANCE PRACTICES

1. Removal/Installation

A. Horizontal Stabilizer Removal (See Figure 201.)

- (1) Remove tail cone and left-hand and right-hand aft fuselage covers below vertical fin. (Refer to Chapter 53.)
- (2) Remove appropriate elevator and elevator trim cables and chain. (Refer to Chapter 27.)

NOTE: Before removing horizontal stabilizer mounting bolts, place stand beneath both horizontal stabilizers to prevent their falling.

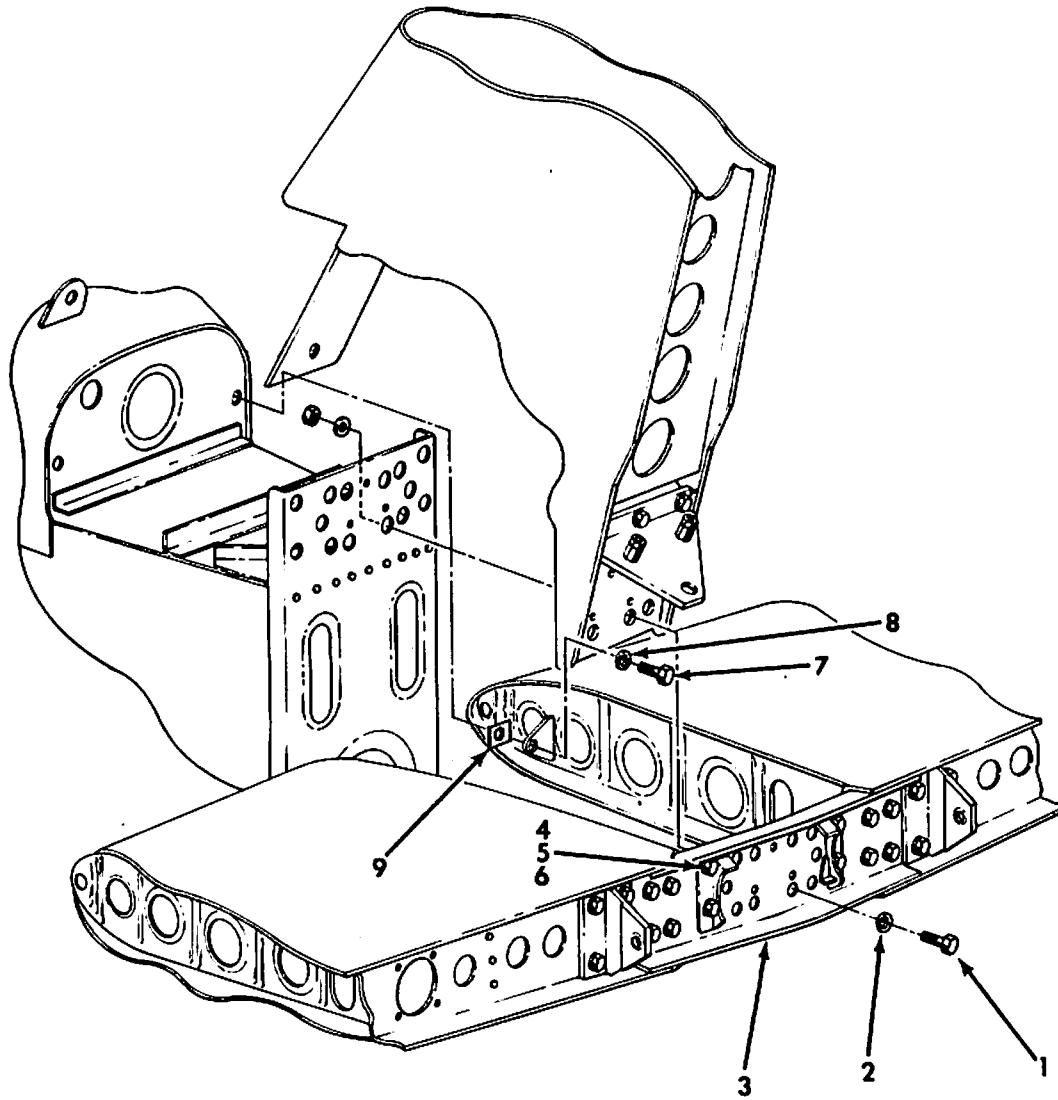
- (3) Remove four bolts (1) and four washers (2) that attach stabilizer to splice plate (3).
- (4) Remove two bolts (4), four washers (5), and two nuts (6) that attach stabilizer and elevator stop bracket to rear of fuselage assembly.
- (5) Remove forward attachment bolt (7) and two washers (8).
- (6) Remove and retain for reassembly shim (9) from beneath forward attachment bolts.
- (7) Stabilizer may now be removed from aircraft.

B. Horizontal Stabilizer Installation (See Figure 201.)

- (1) Place stabilizer half in correct position at rear of aircraft and install two bolts (4), four washers (5), and two nuts (6) through elevator stop bracket and splice plate (3) into rear of fuselage assembly. Torque to standard value. (Refer to Chapter 91.)
- (2) Align forward bracket assembly with attachment fitting on fuselage assembly.
- (3) Position shim (9) in place on forward bracket assembly.
- (4) Install bolt (7) and two washers (8). Torque to standard value. (Refer to Chapter 91.)
- (5) Install elevator and connect elevator and elevator trim cables and chain. (Refer to Chapter 27.)
- (6) Install left-hand and right-hand aft fuselage covers and tail cone. (Refer to Chapter 53.)

2. Cleaning/Painting

Clean and paint horizontal stabilizers. (Refer to Chapter 20.)



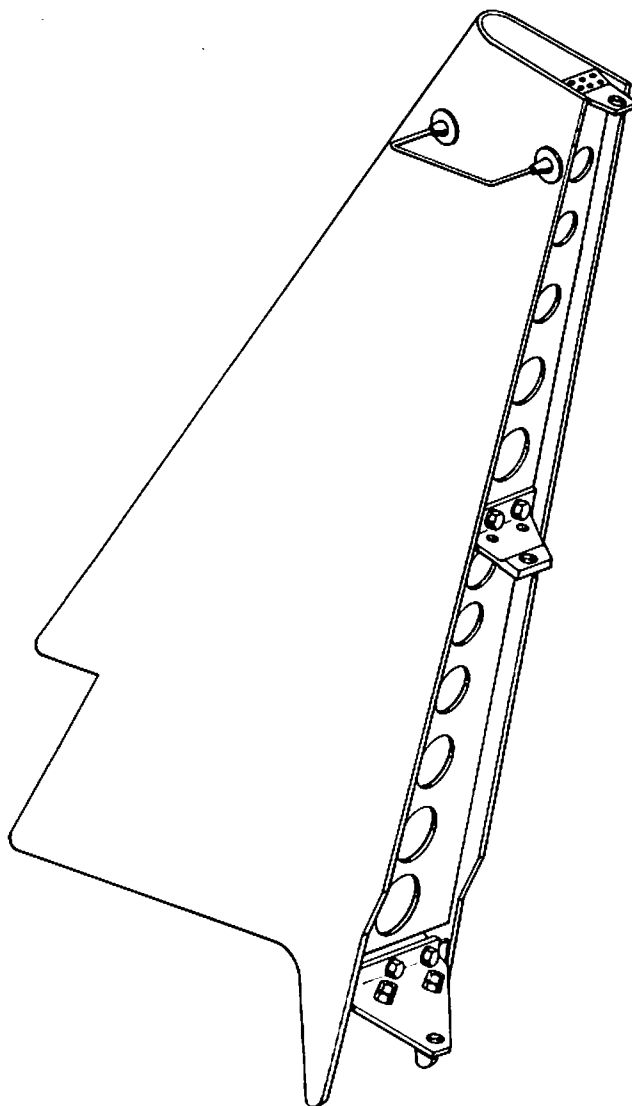
**Horizontal Stabilizer Removal/Installation
Figure 201**

55G72-2

VERTICAL STABILIZER – DESCRIPTION/OPERATION

1. **General** (See Figure 1.)

The vertical stabilizer on the GA-7/Cougar aircraft is of conventional dual spar and rib construction, with its skin bonded to the ribs and spars. The stabilizer has a tapered chord, with the maximum chord at the root and the minimum chord at the tip.



Vertical Stabilizer
Figure 1

55G72-3

VERTICAL STABILIZER – MAINTENANCE PRACTICES

1. Removal/Installation of Vertical Stabilizer

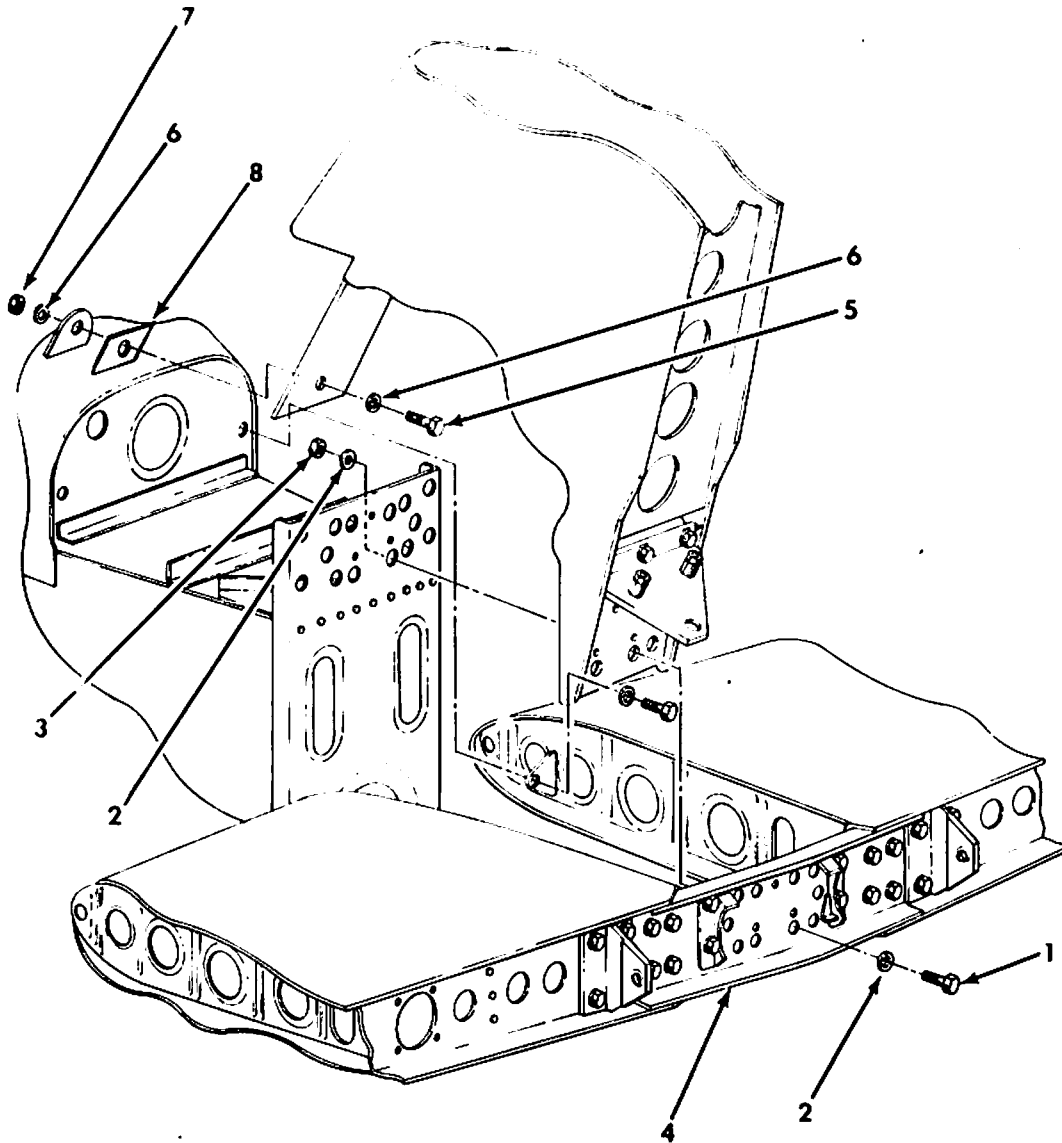
A. Remove Vertical Stabilizer (See Figure 201.)

NOTE: Removal of the vertical stabilizer necessitates prior removal of the rudder. If the rudder is being replaced, this can be accomplished without removing the vertical stabilizer. (Refer to Chapter 27 for rudder removal and replacement.) For vertical stabilizer removal, proceed as follows:

- (1) Remove tail cone and aft fuselage inspection covers. (Refer to Chapter 53.)
- (2) Remove vertical fin leading edge fairing.
- (3) Remove rudder and rudder trim cables and chain. (Refer to Chapter 27.)
- (4) Disconnect antenna. Connect suitable hoist to vertical stabilizer.
- (5) Remove four elevator trim pulleys. (Refer to Chapter 27.)
- (6) Remove nine bolts (1), eighteen washers (2), and nine nuts (3) that attach vertical stabilizer rear attachment point to horizontal stabilizer splice plate (4).
- (7) Remove bolt (5), two washers (6), and nut (7) that attaches vertical stabilizer forward spar to fuselage fitting.
- (8) Remove and retain shim (8) from vertical stabilizer forward attach fitting.
- (9) Remove vertical stabilizer from aircraft.

B. Install Vertical Stabilizer (See Figure 201.)

- (1) Hoist vertical stabilizer in location on rear of aircraft so that the rear attachment point holes are aligned with holes in horizontal stabilizer splice plate (4). Secure with nine bolts (1), eighteen washers (2), and nine nuts (3). Torque to standard value. (Refer to Chapter 91.)
- (2) Install four elevator trim pulleys. (Refer to Chapter 27.)
- (3) Align hole in forward spar in stabilizer with mounting hole in fuselage fitting.
- (4) Install shims (8) as required for alignment.
- (5) Install bolt (5), two washers (6), and nut (7). Torque to standard value. (Refer to Chapter 91.)
- (6) Install rudder and connect rudder and trim controls. (Refer to Chapter 27.)
- (7) Connect antenna.
- (8) Install vertical fin leading edge fairing.



**Vertical Stabilizer Removal/Installation
Figure 201**

55G72-4

(9) Install tail cone and aft fuselage inspection covers. (Refer to Chapter 53.)

2. Cleaning/Painting

Clean and paint vertical stabilizer. (Refer to Chapter 20.)

CHAPTER 56

WINDOWS

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WINDOWS – DESCRIPTION

1. **General**

The windshield is constructed of Plexiglas with a 1/4 inch thickness. The passenger door window and the cabin windows are constructed of Plexiglas with a 1/8 inch thickness. Tinted Plexiglas is optional for all windows and windshield.

2. **Windshield**

The Plexiglas windshield is sealed in position using approved sealant and seals and is secured by retainers which are riveted to the fuselage assembly.

3. **Cabin Windows**

The cabin windows consist of a passenger door window, a pilot's window, an emergency exit window, and three standard cabin windows. All windows, except the emergency exit window, are held in position by retainers which are secured with screws. Sealing of the windows is accomplished by using a sealing compound and vinyl foam tape. The emergency exit window is secured in place by means of a mechanical latching mechanism. The pilot's window incorporates a 6-inch by 11.5-inch direct-vision window made of 1/4 inch Plexiglas.

WINDOWS – MAINTENANCE PRACTICES

1. Windshield Removal/Installation

A. Windshield Removal (See Figure 201.)

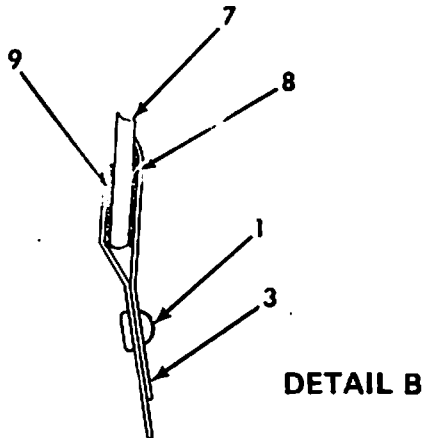
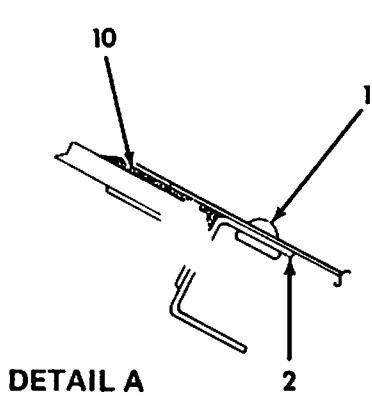
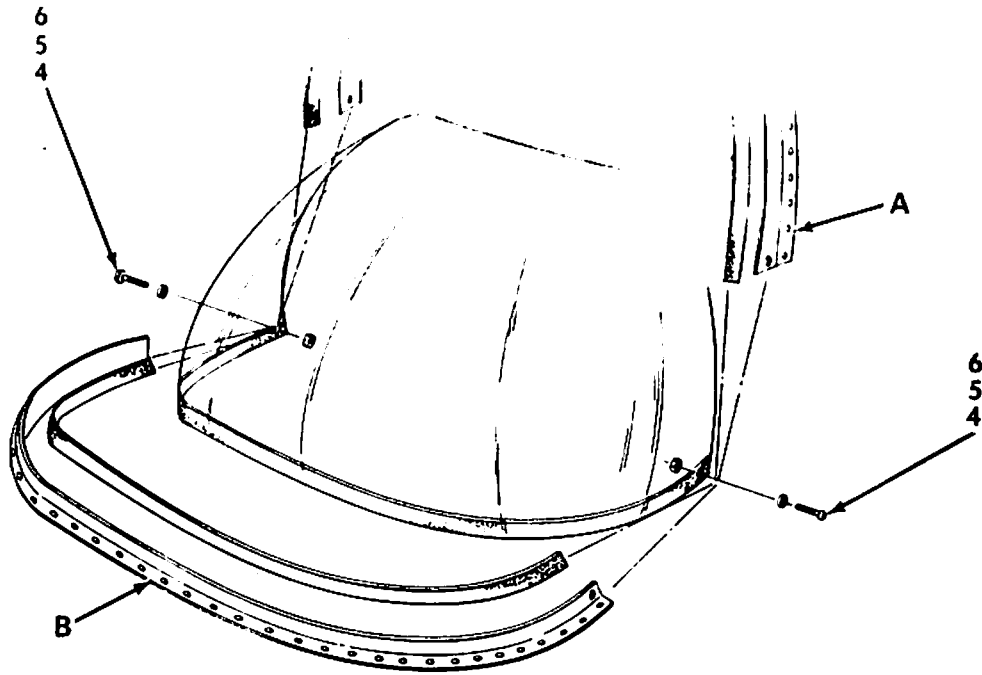
- (1) Remove forward trim panels from around windshield. (Refer to Chapter 25.)
- (2) Remove glareshield and deck assemblies. (Refer to Chapter 25.)
- (3) Remove rivets (1) securing upper and lower retainers (2 and 3).
- (4) Remove screws (4), washers (5), and nuts (6) securing ends of upper and lower retainers (2 and 3) and remove retainers.
- (5) Remove windshield (7) by pushing outwards and breaking bond.

B. Windshield Installation (See Figure 201.)

WARNING: WHEN USING TRICHLOROETHYLENE OR MEK, ENSURE THAT THE WORKING AREA IS WELL-VENTILATED AND THAT PROTECTIVE EQUIPMENT (GLOVES, EYE PROTECTION) IS WORN. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: AVOID ALLOWING TRICHLOROETHYLENE OR MEK TO CONTACT PAINTED SURFACES. THESE SOLVENTS HAVE A CORROSIVE EFFECT UPON PAINTED SURFACES.

- (1) Remove sealant residue and any seal particles from forward fuselage assembly and from retainers (2 and 3) with trichloroethylene or methyl ethyl ketone. Wipe surface with a clean, dry cloth before solvent evaporates.
- (2) Lightly sand the surface of windshield which mates with upper forward fuselage with No. 60 grit sandpaper until surface is rough. Do not extend sanding beyond bond line width.
- (3) Clean the roughed Plexiglas with isopropyl alcohol to remove particles caused by sanding.
- (4) Apply a coat of No. 1206 primer (Dow Corning Corp.), or equivalent, to wet the bonding surface of windshield. Allow to air-dry for 10 to 15 minutes at room temperature.
- (5) Apply a thin layer (0.015 to 0.03 inch thick) of RTV-732 silicone rubber adhesive/sealant (Dow Corning Corp.), or equivalent, to bond area of windshield and upper forward fuselage.
- (6) Position seal (9) along lower forward fuselage which will mate with the lower edge of windshield.
- (7) Position windshield to mate with fuselage and apply pressure to remove entrapped air bubbles from sealant.



- | | |
|-------------|---------------|
| 1. Rivet | 6. Nut |
| 2. Retainer | 7. Windshield |
| 3. Retainer | 8. Seal |
| 4. Screw | 9. Seal |
| 5. Washer | 10. Seal |

**Windshield Removal/Installation
Figure 201**

56G72-1

(8) Ensure that mating surfaces of windshield, fuselage, and retainers (2 and 3) are clean and free of oil and grease. If cleaning is necessary, proceed as outlined below.

(a) Clean mating surface of windshield with a clean cloth moistened with aliphatic naphtha.

WARNING: WHEN USING TRICHLORETHYLENE OR MEK, ENSURE THAT THE WORKING AREA IS WELL-VENTILATED AND THAT PROTECTIVE EQUIPMENT (GLOVES, EYE PROTECTION) IS WORN. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: DO NOT ALLOW TRICHLORETHYLENE OR MEK TO CONTACT PAINTED SURFACES. THESE SOLVENTS HAVE A CORROSIVE EFFECT UPON PAINTED SURFACES.

(b) Clean mating surfaces of the fuselage and retainers with a clean cloth moistened with trichlorethylene or methyl ethyl ketone. Wipe surfaces with a clean, dry cloth before solvent evaporates.

(9) Position seals (8 and 10) around edge of windshield.

(10) Mix equal parts of EP-711 and EP-890 sealant (Coast Pro Seal Co.), or equivalent, until a uniform grey color is achieved (3 to 5 minutes). Apply sealant to windshield where retainers (2 and 3) mate with windshield. Do not apply sealant over seals (8 and 10).

(11) Mix 10 parts CS-3204, Class A-2 sealing compound with 1 part accelerator (Chem Seal Corp.), or equivalent. Using a brush, apply a coat of sealing compound to the fuselage where retainers (2 and 3) will mate.

(12) Position retainers (2 and 3) and install rivets (1).

(13) Install screws (4), washers (5), and nuts (6) at ends of retainers.

(14) Remove any sealant which was squeezed out from around the retainers.

(15) Install glareshield and deck assemblies. (Refer to Chapter 25.)

(16) Install forward trim panels. (Refer to Chapter 25.)

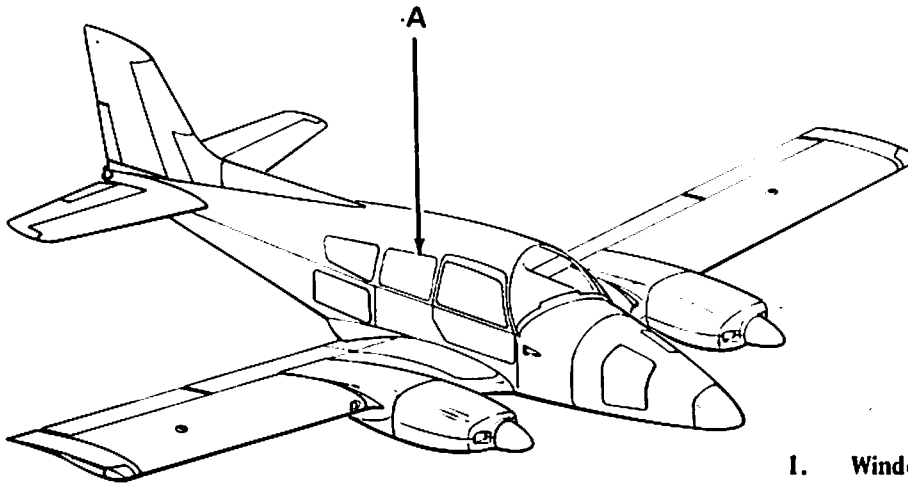
2. Window Removal/Installation

A. Window Removal (See Figure 202.)

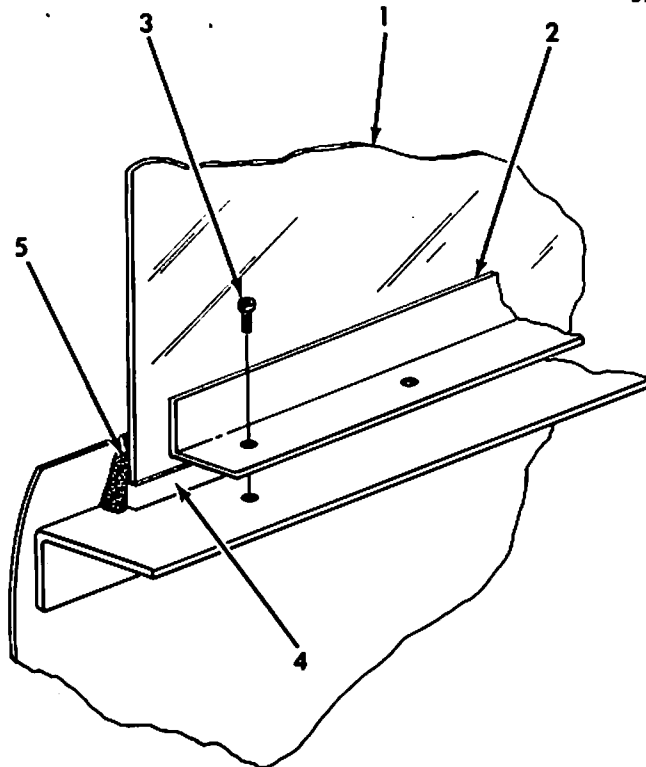
(1) Remove window moulding. (Refer to Chapter 25.)

(2) Remove all windows with the exception of emergency exit window by removing screws (3) and retainers (2) and press window from fuselage.

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1. Window
2. Retainer
3. Screw
4. Seal
5. Extruded Sealant



DETAIL A
TYPICAL

Window Removal/Installation
Figure 202

56G72-2

B. Window Installation (See Figure 202.)

WARNING: WHEN USING TRICHLOROETHYLENE OR MEK, ENSURE THAT THE WORKING AREA IS WELL-VENTILATED AND THAT PROTECTIVE EQUIPMENT (GLOVES, EYE PROTECTION) IS WORN. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: AVOID ALLOWING TRICHLOROETHYLENE OR MEK TO CONTACT PAINTED SURFACES. THESE SOLVENTS HAVE A CORROSIVE EFFECT UPON PAINTED SURFACES.

- (1) Remove sealant residue and any seal particles from fuselage assembly where window mates, using trichloroethylene or methyl ethyl ketone. Wipe surface with a clean, dry cloth before solvent evaporates.
- (2) Clean area around edge of window (1) where seal (4) is to be placed, with a clean cloth moistened with aliphatic naphtha.
- (3) Apply seal (4) around edge of window.
- (4) Apply extruded sealant No. 579.6 (Presstite Engineering Co.), or equivalent, by hand to fuselage assembly where window is to be mated.
- (5) Position window (1) and secure by using retainers (2) and screws (3).
- (6) Clean area of any extruded sealant that was squeezed out during window installation.
- (7) Install window moulding. (Refer to Chapter 25.)

3. Emergency Exit Window Removal/Installation**A. Emergency Exit Window Removal**

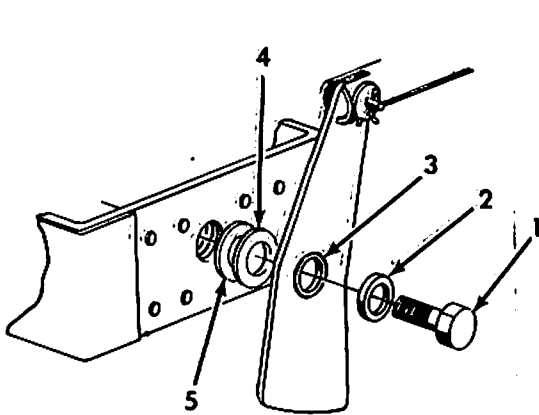
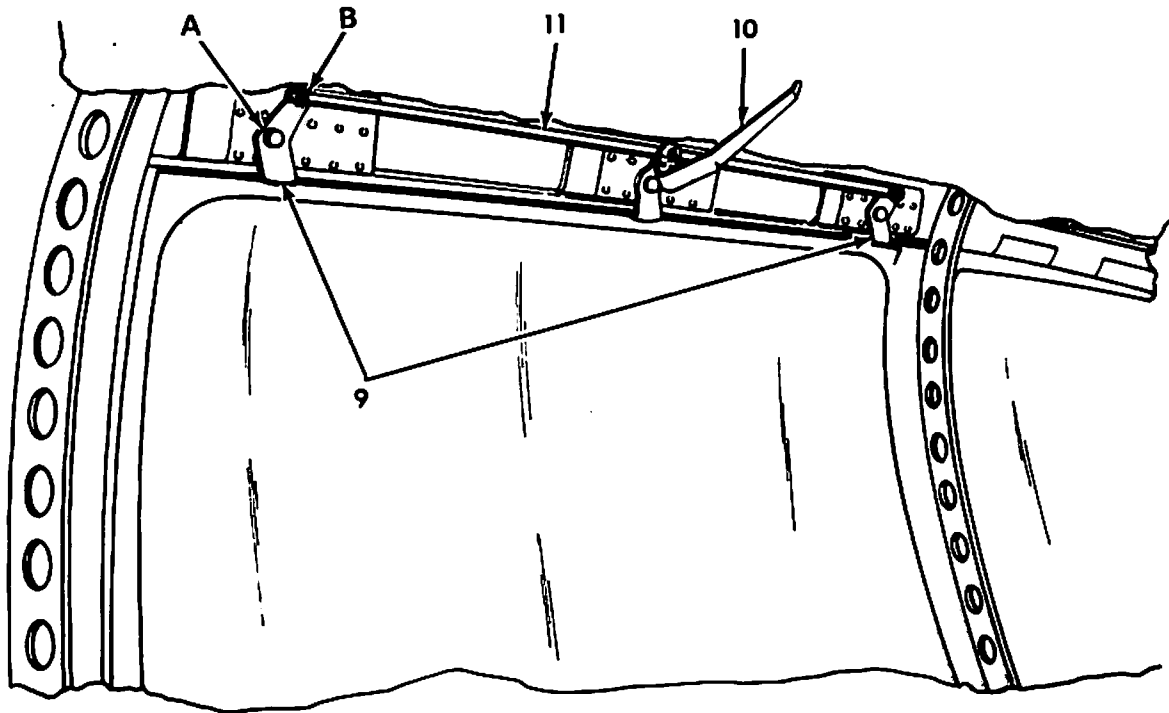
Release emergency exit window latch from inside fuselage assembly and remove emergency exit window.

B. Emergency Exit Window Installation

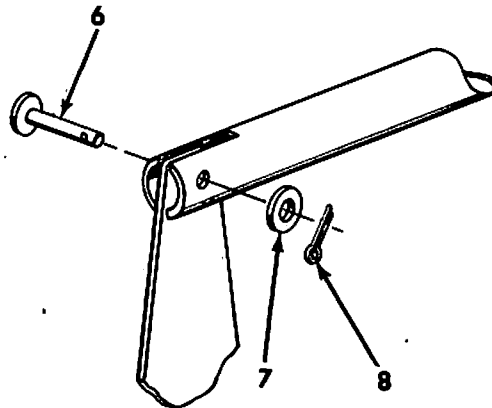
Position emergency exit window and secure latch.

4. Emergency Exit Window Latch Removal/Installation**A. Emergency Exit Window Latch Removal (See Figure 203.)**

- (1) Release emergency exit window latch from inside fuselage assembly and remove emergency exit window.
- (2) Remove upholstery trim and insulation to gain access to latch assembly. (Refer to Chapter 25.)
- (3) Remove bolt (1), washer (2), bushing (3), washer (4), and shim (5) from three locations and remove assembly.



**DETAIL A
TYPICAL**



**DETAIL B
TYPICAL**

- | | |
|------------|---------------------|
| 1. Bolt | 7. Washer |
| 2. Washer | 8. Pin |
| 3. Bushing | 9. Latch |
| 4. Washer | 10. Handle Assembly |
| 5. Shim | 11. Connector |
| 6. Pin | |

**Emergency Exit Window Latch Removal/Installation
Figure 203**

56G72-3

- (4) Remove pins (6), washers (7), and pins (8) separating latches (9) and handle assembly (10) from connector (11).

B. Emergency Exit Window Latch Installation (See Figure 203.)

- (1) Assemble latches (9) and handle assembly (10) with connector (11) by installing pins (8), washers (7), and pins (6).
- (2) Position above assembly to fuselage assembly and secure by installing bolts (1), washers (2), bushings (3), washers (4), and shim (5) at three locations.
- (3) Install insulation and upholstery trim. (Refer to Chapter 25.)
- (4) Install emergency exit window.

5. Windshield and Window Cleaning and Minor Repair

It is recommended that Plexiglas in the windshield and cabin windows be kept clean and and unscratched. The following procedures are recommended:

A. Cleaning

CAUTION: DO NOT USE GASOLINE, ALCOHOL, BENZINE, ACETONE, CARBON TETRACHLORIDE, OR GLASS WINDOW CLEANER. THESE FLUIDS CAN DAMAGE THE PLEXIGLAS.

- (1) If large deposits of mud and/or dirt have accumulated on the Plexiglas, flush with clean water. Rubbing with your hand is recommended to dislodge excess dirt and mud without scratching the Plexiglas.
- (2) Wash with soap and water. Use a sponge or heavy wadding of a soft cloth. DO NOT rub, as the abrasive action of the dirt and mud residue will cause fine scratches in the surface.
- (3) Grease and oil spots may be removed with a soft cloth soaked in kerosene.
- (4) After cleaning, wax the Plexiglas surface with a thin coat of hard polish or wax. Buff with a soft cloth.

B. Minor Repair

If a severe scratch or marring occurs, jeweler's rouge is recommended. Follow directions, rub out scratch, smooth, apply wax, and buff.

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WINGS – DESCRIPTION**1. General (See Figure 1.)**

The GA-7/Cougar wing is composed of three major structural areas. The three areas are the inboard wing assembly, the nacelle, and the outboard wing assembly. The main supports for the wing are two spars of I-beam type design. The wings incorporate the flaps, ailerons, fuel tanks, main landing gear, and wing tip assembly. The GA-7/Cougar has a wing span of 36.86 feet.

The two spars are riveted and bolted to two support beams mounted across the fuselage of the aircraft at Fuselage Station 99 and Fuselage Station 125. The two spars form a continuous run from wing tip to wing tip. The wing ribs are riveted to the two spars and the wing skin is riveted and bonded to the ribs. The wing is contoured to the fuselage by wing root fairings. These fairings are riveted and bonded to the fuselage and wing. The wing has many access panels that provide for full access to internal parts of the wing.

The flaps and ailerons are hinged on external pivots. Refer to Chapter 27 for information on flight control system.

Integrated into the outboard wing assembly is an integral fuel tank. Refer to Chapter 28 for information on the fuel system.

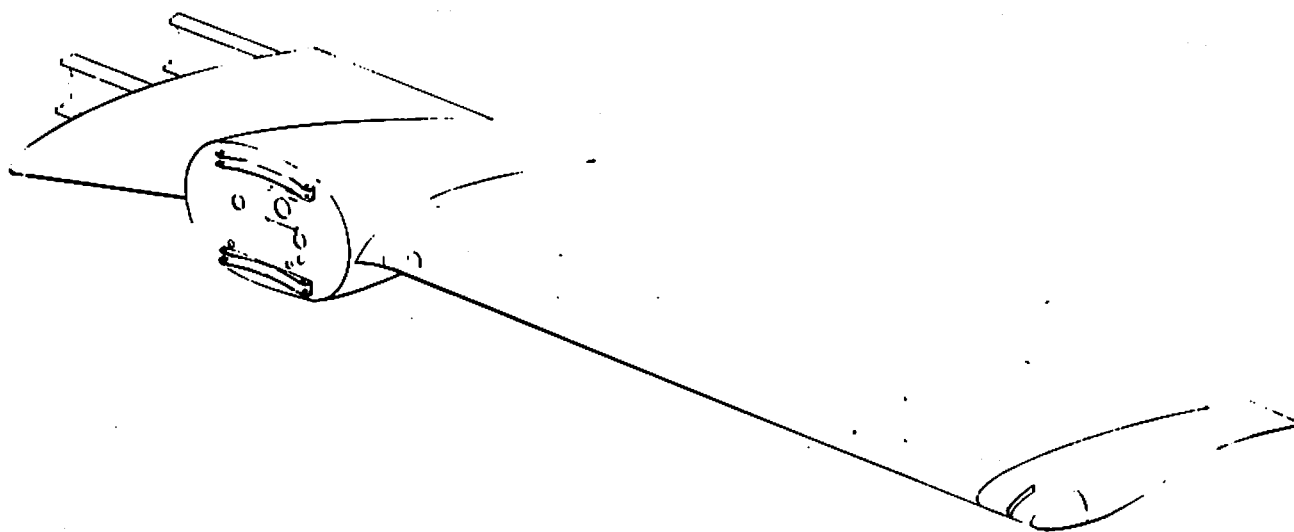
The main landing gear is attached to the bottom of the wing. The landing gear is hydraulically operated and retracts into a wheel well just inboard of the fuel tanks. Refer to Chapter 32 for information on the landing gear.

2. Nacelle

The interface between the nacelle and the wing occurs at the front inboard and outboard spars and rear inboard and outboard spars. The engine mounts bolt to the two main nacelle rib assemblies. These rib assemblies are integrated into the wing and landing gear structural assemblies. The skin of the nacelle is riveted to the nacelle structure. The lower nacelle skin has a large access panel. The panel provides for access to the area between the nacelle firewall and the internal wing structure.

3. Wing Tip

The wing tips are the outermost parts of the wing assemblies. They are constructed of Fiberglas and attached to the wing structure with screws. The wing tips house the navigation/strobe light assemblies. Refer to Chapter 33 for removal/installation of navigation/strobe lights.

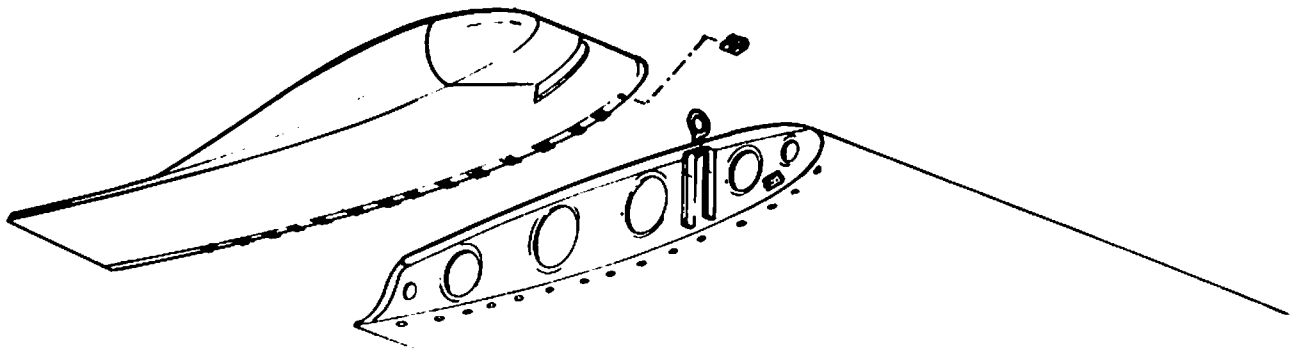


**Wing Assembly
Figure 1**

57G72-1

Wing Tip Assembly
Figure 201

57G72-2



WINGS – MAINTENANCE PRACTICES

1. Removal/Installation of Wing Tip (See Figure 201)

A. Removal of Wing Tip

- (1) Remove the 30 screws which attach the wing tip to the wing.
- (2) Lower the wing tip a few inches away from the wing in order to reach inside and disconnect the navigation/strobe light wires.
- (3) Remove wing tip assembly.

B. Installation of Wing Tip

NOTE: Before installing wing tip, check condition and position of all clip nuts.

- (1) Align wing tip with outboard edge of wing and connect navigation/strobe light wires.
- (2) Fit wing tip to edge of wing and secure with 30 screws.

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CHAPTER 61

PROPELLERS

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PROPELLERS – DESCRIPTION/OPERATION**I. General**

The GA-7/Cougar is equipped with a pair of two-blade, constant-speed, full-feathering, aluminum-alloy propellers manufactured by Hartzell Propeller, Inc., Piqua, Ohio. The propeller Model Number is HC-F2YL-2UF/FC7663D-3. Each propeller is controlled by a governor, mounted on the engine. The governor supplies oil under pressure to control the pitch of the propeller blades.

The propeller is controlled by an oil-operated propeller governor installed on a mounting pad at the rear of the engine. The governor-boosted oil pressure, acting on the blade actuating piston, changes the propeller blade to a low pitch angle (high rpm). Counterweights, mounted on the blades, utilize centrifugal force to move the propeller blades toward the high pitch angle (low rpm). A combination of centrifugal force, internal spring force, and compressed air trapped between the propeller cylinder head and piston changes the blades to the feathered position when the governor oil pressure is relieved. Centrifugal responsive pins, which engage a shoulder on the propeller piston rod, prevent the propeller from feathering when it is not rotating. When propeller speed is above 700 rpm, centrifugal force disengages the spring-loaded pins and allows the propeller to be feathered when the propeller control lever is moved to the full aft, feather position. The propeller blades will also feather in the absence of compressed air, but a little slower.

Emergency feathering is accomplished by moving the propeller control lever to the aft limit of travel. Unfeathering in flight is accomplished by placing the propeller control lever to increase rpm position, and starting the engine. If installed, the optional unfeathering system uses accumulator air and oil to force the propeller to the low pitch condition.

Pitch control level is by means of pitch control levers on the center console.

The propeller blade angle measured at the 30 inch station is as follows:

Low Pitch: $11.5^{\circ} \pm 0.1^{\circ}$

Feather Angle: $80^{\circ} - 82^{\circ}$

PROPELLER ASSEMBLY -- DESCRIPTION/OPERATION

1. General

The compact propellers used on the GA-7/Cougar represent new concepts in basic design, combining simplicity, light weight, and rugged construction. Aluminum alloy forgings are used throughout, and the hub shell is made in two halves, bolted together along the plane of rotation. The hub shell contains the pitch change components and blade roots. The hydraulic cylinder is mounted at the front of the propeller hub.

PROPELLER ASSEMBLY – MAINTENANCE PRACTICES

NOTE: Inspection and maintenance instructions contained in this chapter are current only as of the writing date. Refer to Hartzell Propeller, Inc., service letters, and other publications for complete maintenance instructions. In the event of conflict between these instructions and manufacturer's instructions, the manufacturer's data will take precedence.

1. Propeller Care

It is essential that the propeller be properly maintained according to the instructions contained herein and in accordance with the manufacturer's instructions. Instructions in this section deal with servicing and replacing the propeller assembly. For breakdown and overhaul instructions, refer to applicable publications supplied by Hartzell Propeller, Inc., Piqua, Ohio or your authorized Grumman American Dealer.

The propeller should be watched closely to detect minor problems before they become major ones. Propellers are subjected to engine vibrations and stresses coming from the airstream. Grit, gravel, and other foreign objects striking a moving propeller cause considerably more damage than the same objects would striking other portions of the aircraft. Nicks and gouges on the blades set up conditions for stress concentrations which can lead to fatigue and cracks. Remember, the lowest-priced maintenance is preventive maintenance.

Avoid engine run-ups and aircraft operation in areas with trash, loose gravel, or other materials which could be pulled into the blades. When taking off from dirt or grass strips, allow the aircraft to build up ground speed before opening the throttle if sufficient runway is available. Keep the blades clean and free from stains or foreign matter. A light coat of machine oil is beneficial in coastal areas, but do not use coatings which will flow or build up.

DO NOT move the aircraft by pushing or pulling on the blades. Use a towbar.

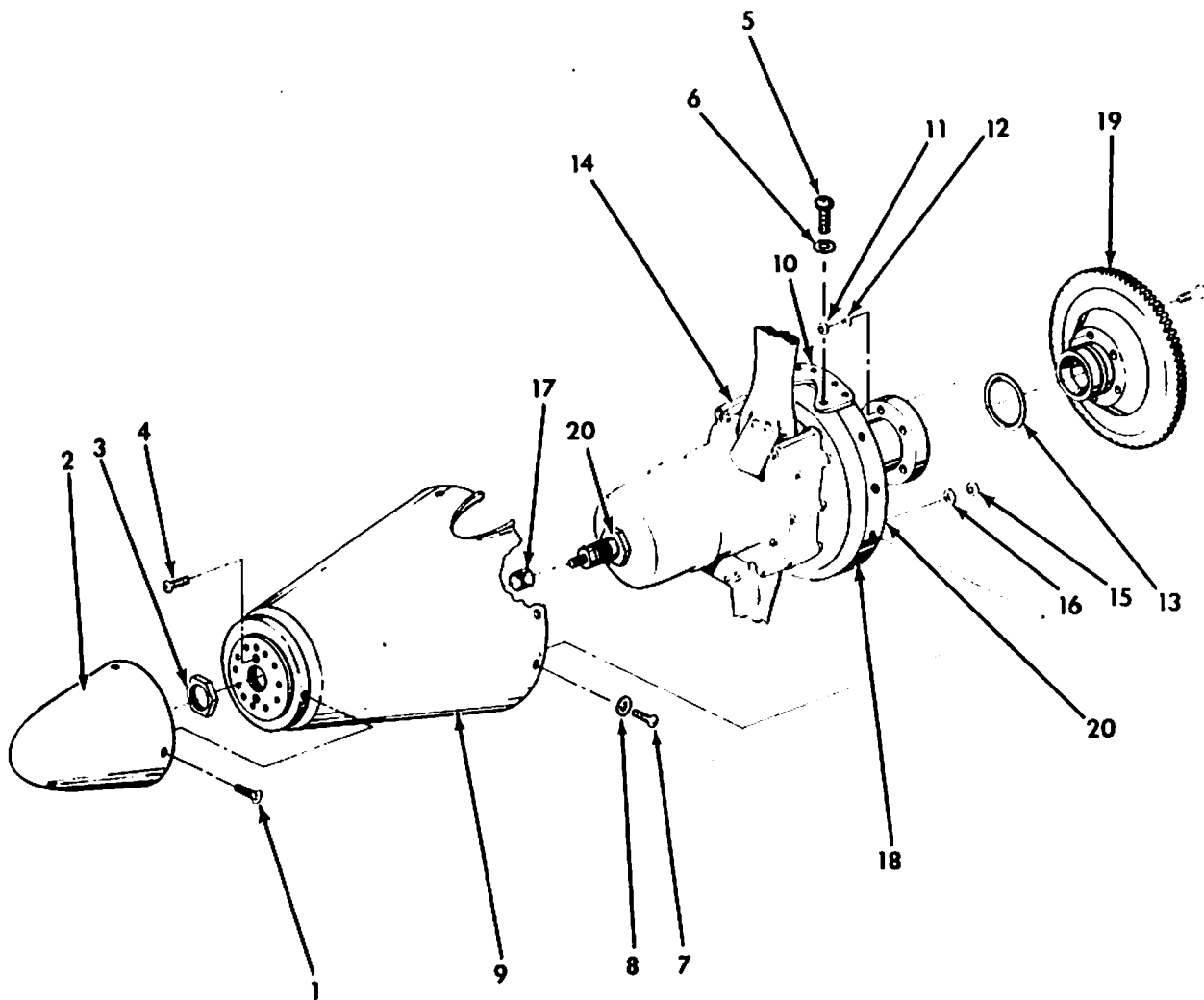
2. Removal/Installation**A. Spinner Removal (See Figure 201.)**

- (1) Place the master and magneto switches in the OFF position. Install the control wheel lock.
- (2) Remove engine cowling. (Refer to Chapter 71.) Remove screws (1) and dome (2).

WARNING: NEVER WORK ON A PROPELLER ASSEMBLY WITHOUT BLEEDING OFF THE AIR CHARGE. FAILURE TO COMPLY CAN RESULT IN PARTS, LUBRICANTS, AND AIR PRESSURE BEING EXPELLED WITH CONSIDERABLE FORCE AS PARTS ARE LOOSENED OR REMOVED.

- (3) Remove valve cap (17) and depress valve core until all pressure is bled off.
- (4) Cut lock wire and remove nut (3) and screws (4).
- (5) Remove screws (5) and washers (6). Remove screws (7) and washers (8). Note position and number of shims (20).
- (6) Remove spinner (9) and fillet assemblies (10).

NOTE: Removal of bulkhead (18) requires removal of propeller assembly (14).



- | | |
|---------------------|------------------------|
| 1. Screw | 11. Nut |
| 2. Dome | 12. Washer |
| 3. Nut | 13. O-Ring |
| 4. Screw | 14. Propeller Assembly |
| 5. Screw | 15. Nut |
| 6. Washer | 16. Washer |
| 7. Screw | 17. Valve Cap |
| 8. Washer | 18. Bulkhead |
| 9. Spinner | 19. Mounting Flange |
| 10. Fillet Assembly | 20. Shims (Not Shown) |

**Propeller Assembly
Figure 201**

61G72-1

B. Spinner Installation (See Figure 201.)

NOTE: Install shims (20) as required to obtain 0.03 inch longitudinal interference fit between spinner (9) and bulkhead (18).

- (1) Install fillet assemblies (10) and spinner (9). Install washers (6) and screws (5). Install washers (8) and screws (7).
- (2) Install nut (3). Tighten to a torque of 15 to 20 foot-pounds.
- (3) Install screws (4). Secure nut (3) to screws (4) with lock wire.
- (4) Charge air valve to placard specifications with nitrogen or dry filtered air. Install valve cap (17).
- (5) Install dome (2) and screws (1). Install engine cowling. (Refer to Chapter 71.)

C. Propeller Removal (See Figure 201.)

- (1) Remove spinner per Paragraph 2.A.

CAUTION: PROPELLER BLADES AND HOUSINGS ARE ALUMINUM ALLOY. DO NOT PRY ON HOUSINGS OR PULL ON THE PROPELLER BLADES TO BREAK HOUSINGS FREE FROM FLANGE ON ENGINE CRANKSHAFT.

- (2) Remove lock wire and loosen all nuts (11) a few turns. Move propeller assembly (14) forward to contact nuts (11) again.
- (3) Repeat procedures in Step (2) until all nuts (11) and washers (12) can be removed. Remove propeller assembly (14).
- (4) Remove and discard O-ring (13).
- (5) Remove nuts (15) and washers (16). Remove bulkhead (18).

D. Propeller Installation (See Figure 201.)

- (1) Install bulkhead (18) to propeller assembly (14). Secure with washers (16) and nuts (15).

NOTE: Make sure faying surfaces and studs are free of contaminants.

- (2) Clean faying surfaces of propeller assembly (14) and crankshaft mounting flange (19). Coat new O-ring (13) with engine oil (Refer to Chapter 12) and install in mounting groove.
- (3) Install propeller assembly (14) onto studs on crankshaft flange (19). Install washers (12) and start nuts (11). Tighten each nut (11) a few turns in sequence until propeller assembly (14) is flush with mounting flange (19). Tighten nuts (11) to a torque of 40 to 50 foot-pounds. Secure nuts (11) with lock wire.
- (4) Install spinner per Paragraph 2.B.

3. Propeller Inspection Procedures

A. Preflight Inspection

- (1) Inspect blades for nicks, gouges, and other damage. Inspect spinner and other visible hub parts for damage or cracks. Repair before flying.
- (2) Inspect for evidence of grease or oil leakage.
- (3) Remove spinner tip and check air pressure once monthly as shown below.

TEMPERATURE (°F)	PRESSURE (± 1 PSI)
70 to 100	41
40 to 70	38
0 to 40	36
-30 to 0	33

B. 100-Hour Inspection

- (1) Remove spinner per Paragraph 2.
- (2) Inspect blade for nicks and cracks.
- (3) Inspect hub parts for cracks or wear.
- (4) Inspect all visible parts for wear and safety.
- (5) Inspect for evidence of grease or oil leakage.

NOTE: Record which zerk fitting is used to lubricate the hub. At the next inspection, use the other zerk fitting to lubricate the hub. Continue to alternate fitting used in subsequent inspections.

- (6) Locate the two zerk fittings on the propeller hub. Remove one fitting and apply lubricant at the other fitting until it appears at the opening. Reinstall zerk fitting. Refer to manufacturer's instructions for type of lubricant.
- (7) Check air pressure. See Step A (3).
- (8) Enter inspection in propeller log book.

C. 1500-Hour or 4-Year Inspection

NOTE: Recommended overhaul period is 1500 hours or 4 years, whichever occurs first.

- (1) Remove propeller (Paragraph 2) for overhaul per applicable Hartzell overhaul manual. Overhaul must be performed by FAA rated propeller repairmen.

- (2) Perform a magnetic inspection of all ferrous parts. Perform a dye penetrant inspection of all nonferrous metal parts.
- (3) Inspect and refinish blades. Anodize and paint blades.
- (4) Inspect all parts for wear. Replace worn parts. Replate steel parts as necessary. Bake replated parts at 375°F for 3 hours.
- (5) Reassemble, lubricate, and balance.
- (6) Enter overhaul in propeller log book.

4. Minor Blade Repair (See Figure 202.)

WARNING: NICKS, GOUGES, AND SCRATCHES ON THE BLADE SURFACES MUST BE REMOVED PRIOR TO FLIGHT. OPERATING A BLADE WITH THESE PROBLEMS MAY PRODUCE A CONDITION IN WHICH FATIGUE CRACKS WILL OCCUR. MINOR DAMAGE CAN BECOME DETRIMENTAL. DAMAGE TO THE OUTER 18 INCHES OF THE PROPELLER BLADE MUST BE TREATED AS CRITICAL.

A. Tools Required

- (1) Fine cut round and flat files.
- (2) Emery tape or cloth.
- (3) 10X magnifying glass.
- (4) Crocus cloth.
- (5) Dye penetrant kit.
- (6) Power equipment with suitable grinding and polishing accessories.

B. Repair Methods

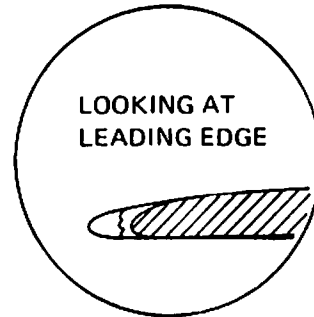
NOTE: All methods which will result in moving metal on the blade such as cold rolling or like methods are not acceptable. These methods only cover and possibly conceal damage, and do nothing to relieve the cause of stress concentrations. Damage having larger dimensions than those shown in Figure 202 should be referred to the manufacturer or to a qualified propeller repair station for repair or replacement. There is normally sufficient material available to allow a number of repairs before replacement is required. Repairs must be accomplished parallel to the blade axis, and repairs that form a continuous line across the blade section are not acceptable.

- (1) Determine the needed amount of rework by using the applicable formula given below. Examples are shown in Figure 202.

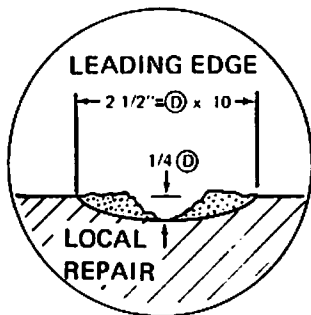
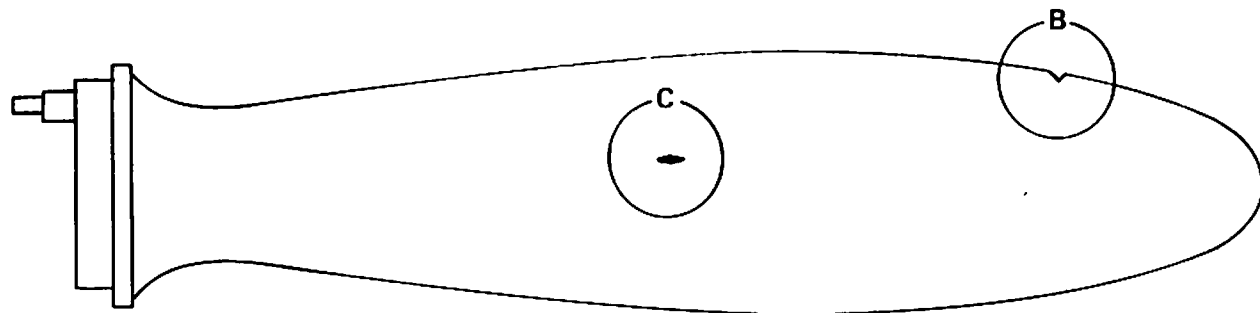
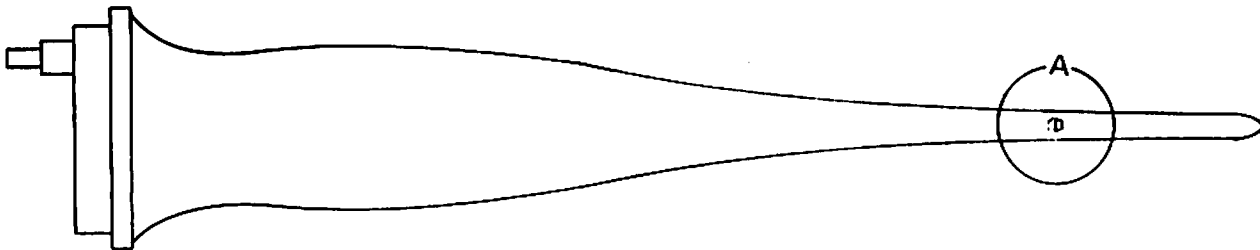
Leading or Trailing Edge (depth of damage) X 10 = (Width of repair)

Face and Camber (Depth of damage) X 20 = (Width or repair)

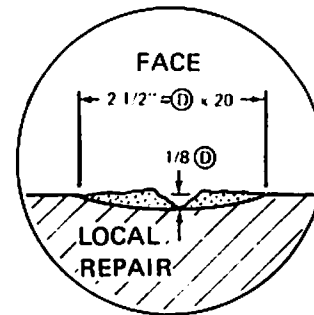
**NOTE: LOCAL WIDTH OR THICKNESS
 REPAIR DEPTH MAY NOT EX-
 CEED DIMENSIONS SHOWN.**



DETAIL A



DETAIL B



DETAIL C

**Blade Repair Limitations
 Figure 202**

61G72-2

- (2) For damaged areas in the leading or trailing edge, begin with a round file and remove damaged material to the bottom of the damaged area. Remove material from this point out on both sides, providing a smooth faired depression, maintaining the original airfoil concept. Using emery cloth, fair the area smoothly, removing all traces of initial filing and rework. Crocus cloth may then be used to polish the area. When all rework has been completed, inspect the reworked area with a 10X magnifying glass and dye penetrant. Make sure no indications of damage or cracks remain.
- (3) Damaged areas on the face or camber sections of the blade are to be reworked employing the same methods as the leading edge. However, repairs that form a continuous line across the blade section are not acceptable.
- (4) All repaired areas are to be chemically treated to prevent corrosion. Alodine or Hartzell Polane paint must be properly applied to the repaired area prior to return to service.
- (5) Steel hub parts must not be permitted to rust. When the cadmium plating is worn off, the surface should be cleaned, treated, and painted with Hartzell Polane paint. Replate and bake parts at overhaul. Inspect all parts for wear or fretting and lubricate per Chapter 12.

5. Propeller Blade Track Check

Propeller blade track is defined as that condition in which both blade tips rotate in the same plane. More than 0.0625 inch difference measured at the blade tips is an indication of bent blades or improper installation. Check blade track as follows:

NOTE: The accuracy of the blade track check depends upon the stability of the surface on which the measurements are made.

- A. Place the master and magneto switches in the OFF position. Remove one spark plug from each cylinder so that the propeller may be easily rotated.
- B. Secure a board or other smooth surface immediately below propeller tip travel and move one blade to its lowest point of travel.
- C. Move the blade tip through its full fore-and-aft travel, and make a small pencil mark at each extreme of travel.
- D. Center the blade tip between these marks and carefully mark a line on the board for the full width of the tip.
- E. Move the other blade into the same position and repeat Steps C and D. The lines should not be separated by more than 0.0625 inch.

PROPELLER CONTROL SYSTEM – DESCRIPTION/OPERATION

1. **General**

The propeller control system provides the pilot with a means of ensuring maximum utilization of engine power under varying flight conditions. The control system also allows the propeller to be feathered.

The propeller control system consists of a propeller governor, mounted on the accessory case, and a propeller pitch control on the forward console.

An optional unfeathering accumulator, mounted on the left-hand side of the firewall, allows the propeller to be unfeathered in flight.

PROPELLER CONTROL SYSTEM – MAINTENANCE PRACTICES**1. Removal/Installation****A. Propeller Pitch Control Cable Assembly Removal**

NOTE: The propeller pitch control system for each engine is basically removed and installed in the same manner. Therefore, removal and installation procedures are given for only one of the controls.

- (1) Remove seat and interior furnishings as required to gain access to the control routing from back side of control quadrant to where control cable assembly enters the wing. (Refer to Chapter 25.)
- (2) Remove the two forward access panels from underside of wing between the fuselage and the wing nacelle.
- (3) Remove access panel from underside of wing nacelle.
- (4) Remove upper and lower engine cowl assemblies. (Refer to Chapter 71.)
- (5) Disconnect control cable from governor bellcrank and remove ball joint from end of cable.
- (6) Slide the two protective seals from control cable.
- (7) Remove retainer nut and washer securing control cable to bracket and slide cable from bracket.
- (8) Remove remaining retainer nut that secures control cable to bracket and, from wing nacelle, pull cable through firewall.
- (9) Disconnect control cable from control handle by removing cotter pin, nut, washer, and bolt. Remove rod end and locknut from cable.
- (10) Remove three screws and washers securing clamp on control quadrant.
- (11) Slide the two protective seals from control cable.
- (12) Remove ties securing control cable to other cables in the cockpit area.
- (13) From access openings in underside of wing, loosen the three clamps so that cable can be pulled from the cockpit to wing nacelle access.

B. Propeller Pitch Control Cable Assembly Installation

NOTE: If new control is being installed, remove the protective seals, nuts, and washers from control cable.

- (1) From wing nacelle access opening, route control cable through the three clamps in wing forward section to the back side of control quadrant. Route other end of cable through firewall of wing nacelle.

- (2) Install one retainer nut on control cable that secures cable to bracket at rear of carburetor and route cable through bracket. Install washer and remaining retainer nut securing cable to bracket.
- (3) Install the protective seals on each end of control cable (larger seal first).
- (4) Position control cable in clamp on back side of control quadrant and secure clamp with three screws and washers.
- (5) Tighten the three clamps securing the control cable in wing forward section, making sure that all cables and lines in clamps are properly seated.
- (6) Install suitable ties to secure control cable to control cable bundle in cockpit.
- (7) Install locknut and rod end on end of control cable at back side of control quadrant and connect rod end to control handle using bolt, washer, nut, and cotter pin. Ensure that control handle mates within 0.06 (1/16) inch alignment with control handle of other engine.
- (8) Rig propeller control system per Paragraph C.

C. Rigging Instructions

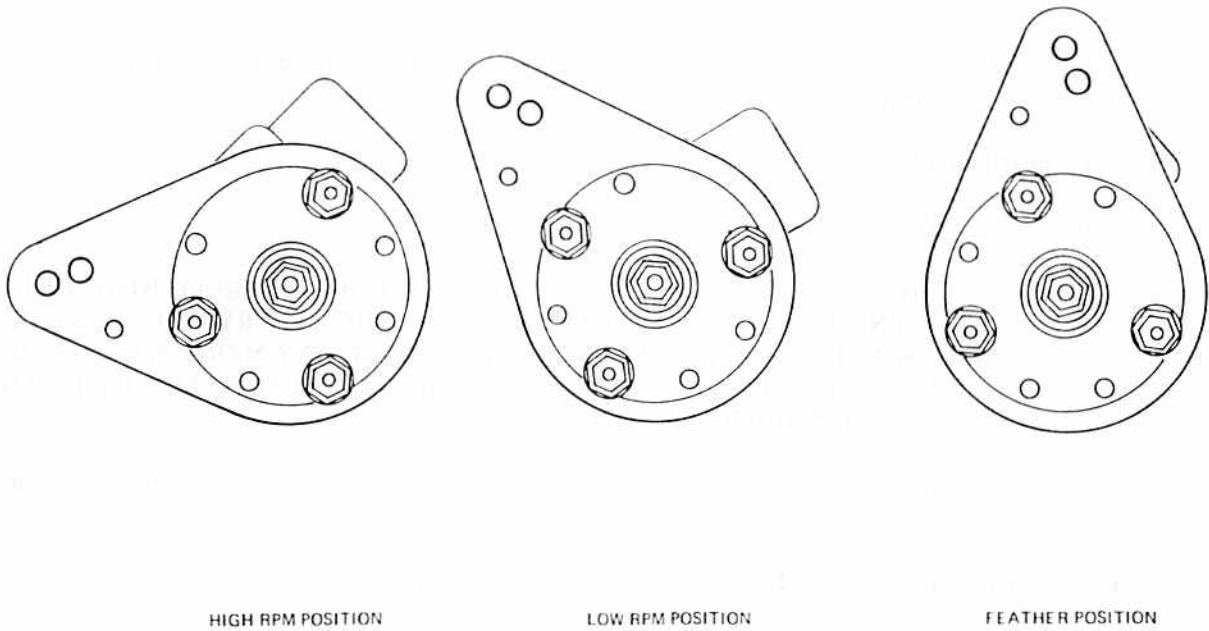
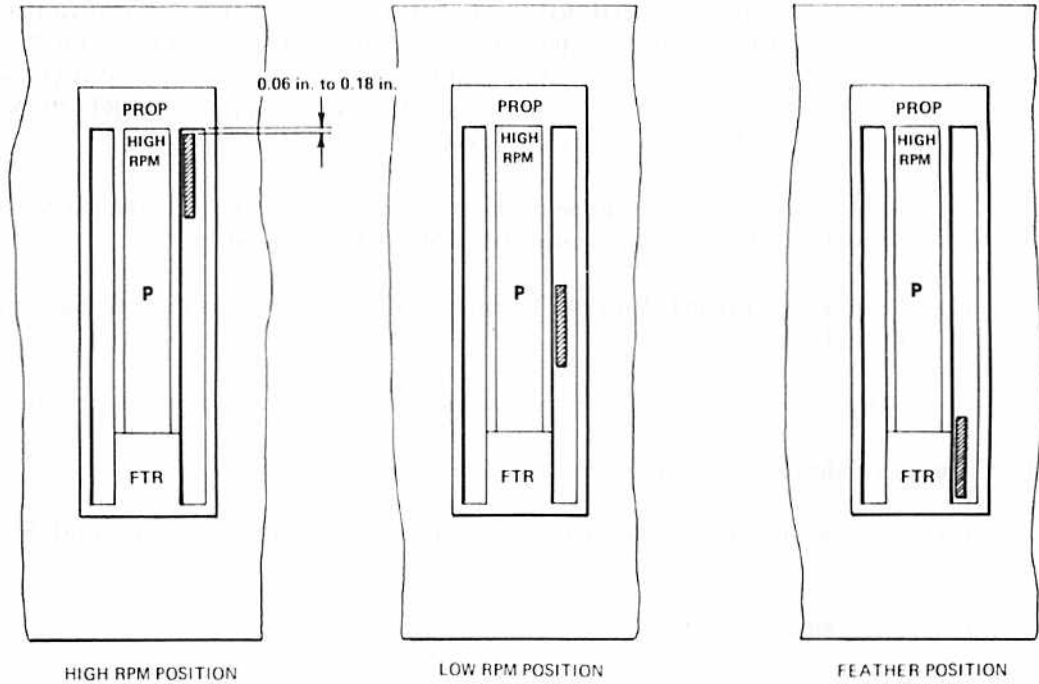
- (1) Make sure the linkage from the propeller pitch control to the ball joint at the end of the cable are installed properly and secured. Disconnect the ball joint at the governor control bellcrank.

NOTE: The governor control bellcrank is spring loaded and should come to rest at the HIGH RPM position when released. (See Figure 201.) Replace governor if bellcrank will not assume this position.

- (2) Place PROP lever in the HIGH RPM position (0.12 to 0.18 inch from forward end of slot).

NOTE: Threads must be visible through inspection hole in ball joint after adjustment is made. Nuts at air box bracket may be adjusted to provide additional length if required.

- (3) Loosen lock nut on ball joint and adjust length as required to install ball joint in proper hole in governor control bellcrank. Secure with washer and nut. Tighten lock nut.
- (4) Move PROP lever from HIGH RPM to FTR position and back several times, checking for a minimum 0.12-inch pinch at both ends of travel. If required, adjust cable attach nuts as required to provide pinch.
- (5) Position PROP lever at HIGH RPM position. Using a protractor, measure the angle of travel of the governor control bellcrank as the PROP lever is moved to the LOW RPM position. Angle of travel should not exceed 56 degrees \pm 1 degree.



Propeller Control System Rigging
Figure 201

61G72-3

D. Propeller Unfeathering Accumulator Removal (See Figure 202.)

WARNING: THE UNFEATHERING ACCUMULATOR SYSTEM IS CHARGED WITH NITROGEN AT 90 TO 100 PSI. BLEED ALL PRESSURE AT SERVICING VALVE BENEATH ACCUMULATOR BEFORE PERFORMING ANY MAINTENANCE. FAILURE TO COMPLY MAY RESULT IN NITROGEN AND PARTS BEING EXPELLED WITH CONSIDERABLE FORCE.

- (1) Remove top and bottom engine cowling. (Refer to Chapter 71.) At bottom of accumulator (7) on firewall, remove cap (1) from valve (2) and bleed off all nitrogen pressure.
- (2) Remove hose (3) and elbow (4). Remove screws (5) and washers (6) securing accumulator (7) to firewall.

NOTE: Refer to applicable manufacturer's publications for accumulator maintenance.

E. Propeller Unfeathering Accumulator Installation (See Figure 202.)

- (1) Install accumulator (7) on firewall and secure with washers (6) and screws (5). Secure bolts with lock wire.
- (2) Install elbow (4) and hose (3).
- (3) Charge accumulator to approximately 10 psi and check for leaks. Charge accumulator to 90 to 100 psi.

NOTE: Always install cap (1) and tighten securely to avoid contamination. Failure to comply may result in leakage.

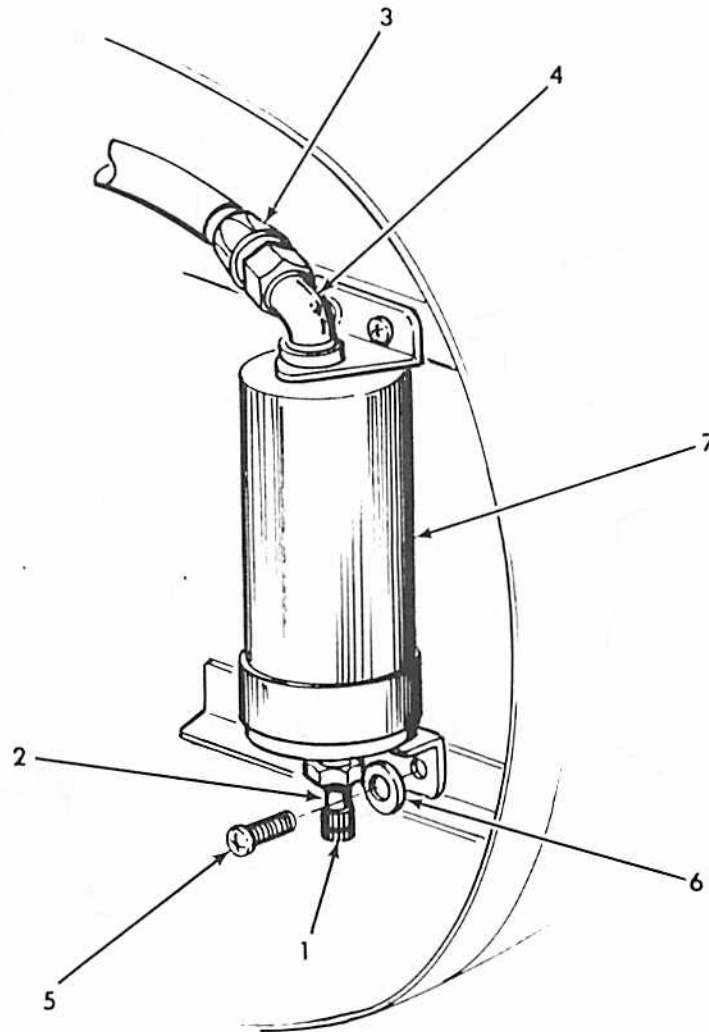
- (4) Install cap (1) on valve (2).

F. Unfeathering Valve Removal (See Figure 203.)

WARNING: THE UNFEATHERING ACCUMULATOR SYSTEM IS CHARGED WITH NITROGEN AT 90 to 100 PSI. BLEED ALL PRESSURE AT SERVICING VALVE BENEATH ACCUMULATOR BEFORE PERFORMING ANY MAINTENANCE. FAILURE TO COMPLY MAY RESULT IN NITROGEN AND PARTS BEING EXPELLED WITH CONSIDERABLE FORCE.

- (1) Remove top and bottom engine cowling. At bottom of accumulator (7, Figure 202) on firewall, remove cap (1) from valve (2) and bleed off all nitrogen pressure.
- (2) Remove hose (1, Figure 203) and elbow (2). Remove hose (3).
- (3) Remove cotter pin (4) and washer (5). Separate connector (6) from governor (13).
- (4) Remove cotter pin (7), washer (8), clevis pin (9), and connector (6).
- (5) Remove bolts (10), washers (11), and unfeathering valve (12).

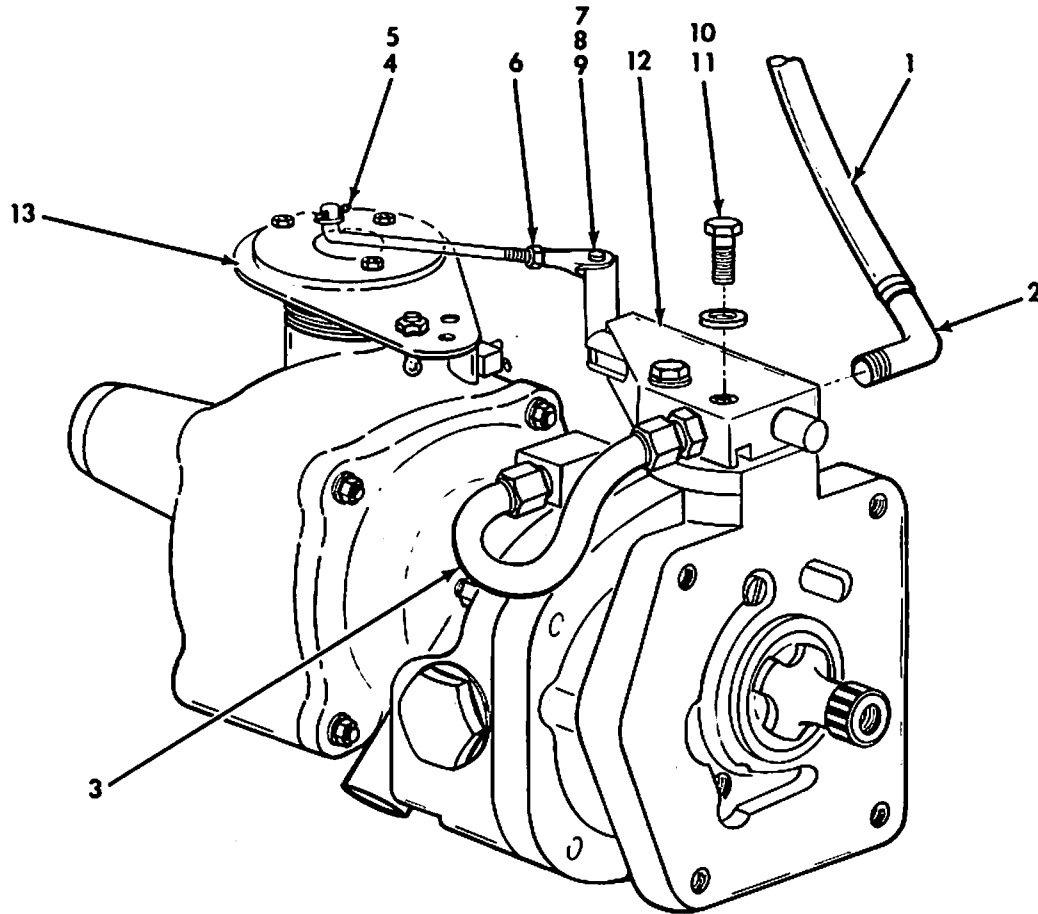
NOTE: Refer to applicable Hartzell publications for unfeathering valve maintenance.



1. Cap
2. Valve
3. Hose
4. Elbow
5. Screw
6. Washer
7. Accumulator

Unfeathering Accumulator
Figure 202

61G72-4



1. Hose
2. Elbow
3. Hose
4. Cotter Pin
5. Washer
6. Connector
7. Cotter Pin
8. Washer
9. Clevis Pin
10. Bolt
11. Washer
12. Unfeathering Valve
13. Governor

Unfeathering Valve
Figure 203

61G72-5

G. Unfeathering Valve Installation (See Figure 203.)

- (1) Install unfeathering valve (12) and secure with washers (11) and bolts (10).
- (2) Install connector (6) to actuator of feathering valve (12). Install connector (6) to governor (13). Secure with clevis pin (9), washers (8 and 5), and cotter pins (7 and 4).
- (3) Install hose (3). Install elbow (2) and hose (1).
- (4) Charge accumulator to approximately 10 psi and check for leaks. Charge accumulator to 90 to 100 psi.

NOTE: Always install cap on accumulator and tighten securely. Failure to comply will allow valve to become contaminated, which may result in leakage.

- (5) Install cap on accumulator valve.

H. Propeller Governor Removal (See Figure 204.)

WARNING: THE UNFEATHERING ACCUMULATOR SYSTEM IS CHARGED WITH NITROGEN AT 90 to 100 PSI. BLEED ALL PRESSURE AT SERVICING VALVE BENEATH ACCUMULATOR BEFORE PERFORMING ANY MAINTENANCE. FAILURE TO COMPLY MAY RESULT IN NITROGEN AND PARTS BEING EXPELLED WITH CONSIDERABLE FORCE.

- (1) Remove nut (1) and washer (2). Separate ball joint (3) from bellcrank (4).
- (2) If the aircraft is equipped with an unfeathering accumulator, bleed off all pressure. Remove cotter pin (4, Figure 203) and washer (5). Remove cotter pin (7), washer (8), clevis pin (9), and connector (6).
- (3) Remove nuts (5, Figure 204), washers (6), and propeller governor (7).

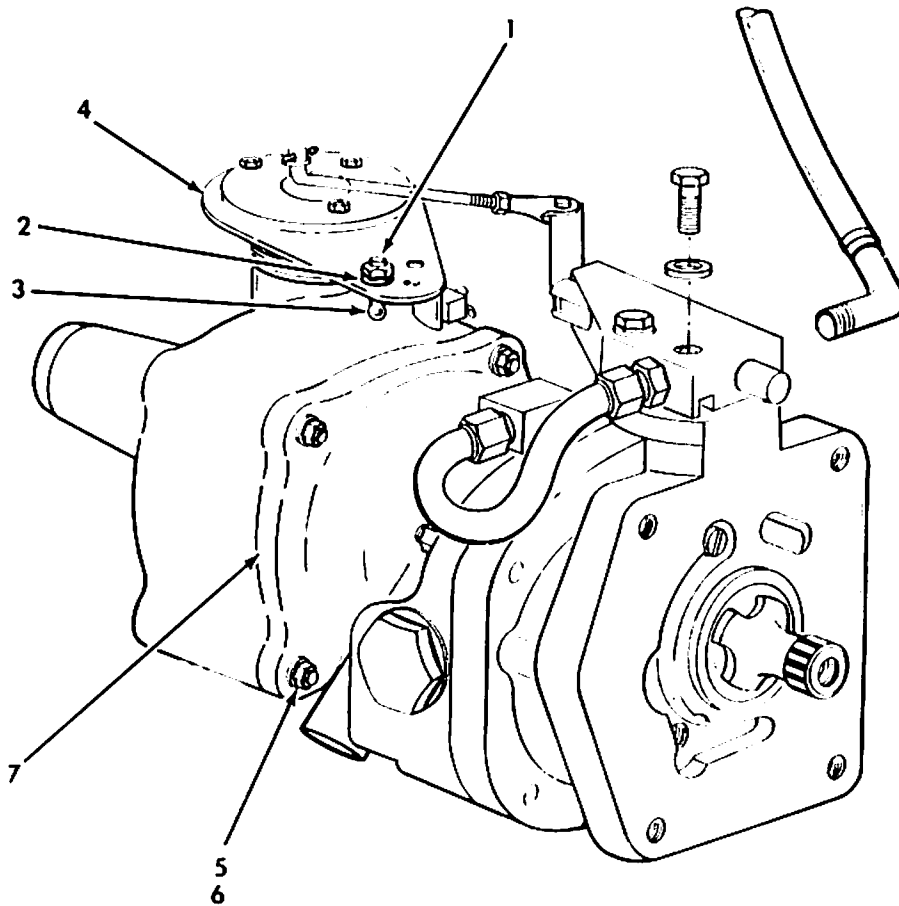
NOTE: Refer to applicable Hartzell publications for propeller governor maintenance instructions.

I. Propeller Governor Installation (See Figure 204.)

- (1) Install propeller governor (7) on accessory housing and secure with washers (6) and nuts (5).
- (2) If the aircraft is equipped with an unfeathering accumulator, install connector (6, Figure 203) to actuator of feathering valve (12). Install connector (6) to governor (13). Secure with clevis pin (9), washers (8 and 5), and cotter pins (7 and 4).
- (3) Charge accumulator to approximately 10 psi and check for leaks. Charge accumulator to 90 to 100 psi.

NOTE: Always install cap and tighten securely to avoid contamination. Failure to comply may result in leakage.

- (4) Rig propeller control system in accordance with Paragraph C. (Rigging Instructions).



- 1. Nut
- 2. Washer
- 3. Ball Joint
- 4. Bellcrank
- 5. Nut
- 6. Washer
- 7. Propeller Governor

Propeller Governor
Figure 204

61G/2.6

CHAPTER 71

POWER PLANT

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POWER PLANT – DESCRIPTION/OPERATION

1. **General**

The GA-7/Cougar is powered by two 160 H.P. Lycoming, four-cylinder, horizontally opposed, air-cooled engines.

The power plant is enclosed within a nacelle consisting of an upper and a lower cowl assembly which fairs in with the wing assembly.

The engine is attached to the engine mount assembly at four places using vibration isolator type shock mounts. After complete engine buildup, the power plant is attached to the wing at the four engine mount support locations.

The engine is cooled by ram air pressure that is forced over and around the cylinders by the use of baffles. The air is then exhausted to the atmosphere through an exit located in the bottom of the lower cowl assembly.

2. **Engine Data**

Engine	0-320-D1D
Rated horsepower	160
Rated speed rpm	2700
Bore, inches	5.125
Stroke, inches	3.875
Displacement, cubic inches	319.8
Compression ratio	8.5:1
Firing order	1-3-2-4
Spark plug gap . . . . .	.0107 to 0.021
Valve rocker clearance (hydraulic tappets collapsed) . . . . .	.0028 to 0.080
Propeller drive ratio	1:1
Propeller drive rotation (viewed from rear)	Clockwise

NOTE: See latest revision of Lycoming Service Instruction Number 1042 for gap on specific plug being used.

3. **Engine Operation**

Refer to Avco Lycoming Operator's Manual, Avco Lycoming Service Instructions, and the Aircraft Pilot's Operating Handbook for proper operation of engines.

POWER PLANT – TROUBLESHOOTING

1. Troubleshooting the Power Plant

TROUBLE	PROBABLE CAUSE	REMEDY
Engine fails to start.	Lack of fuel.	Open fuel selector valve. Service fuel tanks. Push mixture control to full rich position.
	Flooded or overprimed.	Open the throttle and unload engine by cranking.
	Underprimed.	Prime with two to three strokes.
	Incorrect throttle setting.	Set throttle to closed position.
	Defective spark plugs.	Clean and regap, or replace.
	Dead or weak battery.	Recharge or replace.
	Defective ignition wire.	Check with electric tester, and replace any defective wires.
	Water in carburetor.	Drain carburetor and lines.
	Internal failure.	Check oil sump for metal particles. If found, complete overhaul is indicated.
Engine not idling properly.	Incorrect carburetor idle adjustment.	Adjust throttle stop to obtain correct idle.
	Idle mixture.	Adjust mixture.
	Open primer.	Lock primer in closed position.
	Leak in the induction system.	Tighten all connections and replace defective parts.
	Uneven cylinder compression.	Check condition of rings and valve seats and then check cylinder compression.
	Insufficient fuel pressure.	Check fuel pumps and filters.
	Faulty ignition system.	Check ignition leads, plugs, and magnetos.
Low power and uneven running.	Mixture too rich.	Readjustment of carburetor by authorized personnel.
	Mixture too lean.	Readjustment of carburetor by authorized personnel.

TROUBLE	PROBABLE CAUSE	REMEDY
Low power and uneven running. (Continued)	Leaks in induction system.	Tighten all connections and replace defective parts.
	Defective spark plugs.	Clean and regap or replace spark plugs.
	Magnetos not properly timed.	Check for proper timing and synchronization.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
	Improper grade of fuel.	Empty tank and fill with proper grade fuel.
Failure of engine to develop full power.	Throttle not properly adjusted.	Adjust throttle lever.
	Leak in the induction system.	Tighten all connections and replace defective parts.
	Dirty air filter.	Clean or replace filter.
	Restriction in air scoop.	Remove restriction.
	Improper grade of fuel.	Empty tank and fill with proper grade fuel.
Rough running engine.	Faulty ignition system.	Check ignition leads, plugs, and magnetos.
	Lead deposit on spark plugs.	Clean and regap or replace spark plugs.
	Unbalanced propeller.	Remove propeller and check for balance.
	Worn mounting bushings.	Install new mounting bushings.
	Uneven compression.	Check compression.
Low oil pressure.	Magneto not properly timed.	Check magneto timing. (Refer to Chapter 74.)
	Insufficient oil.	Check oil supply and fill as recommended.
	Defective pressure gauge.	Replace gauge.
	Dirty oil strainer.	Remove and clean oil strainer.
	Air or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in pressure or suction lines.	Check gasket between accessory housing and crankcase.

TROUBLE	PROBABLE CAUSE	REMEDY
Low oil pressure. (Continued)	Stoppage in oil pump intake passage.	Check line for obstruction and clean strainer.
	High oil temperature	See "High oil temperature" in "Trouble" column.
High oil temperature.	Insufficient oil supply.	Check oil supply and fill as recommended.
	Insufficient cooling air.	Check cowl inlet and outlet for obstructions. Check baffles.
	Low grade of oil.	Replace with oil conforming to specifications. (Refer to Chapter 12.)
	Clogged oil cooler, lines, or strainers.	Remove and clean oil cooler, lines, and strainers.
	Defective gauge.	Replace gauge. (See Chapter 79.)
	Defective probe.	Replace probe.
	Excessive blowby.	Usually caused by worn or stuck rings. Complete overhaul required.
Excessive oil consumption.	Bearing failure.	Examine sump for metal particles. If found, complete overhaul required.
	Worn piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
	Low grade of oil.	Replace with proper grade of oil.
	External leakage.	Check engine carefully for leaking gaskets and O-rings.
	Failure of rings to seat (new nitrided cylinders).	Use mineral base oil, climb to cruise altitude at full power and operate above 75 percent cruise power setting until oil consumption stabilizes.
Engine does not stop.	Mixture control not correctly adjusted.	Adjust mixture control.
	Faulty ignition system.	Check ground wires.
Cold weather difficulties.	Cold oil.	Heat oil.

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TROUBLE	PROBABLE CAUSE	REMEDY
Cold weather difficulties. (Continued)	Weak battery.	Recharge or replace.
	High oil pressure.	In extreme cold weather, readings up to approximately 100 psi do not necessarily indicate malfunctioning.
	Overpriming.	Open throttle, put mixture control in idle cutoff position. Crank engine until it starts. Immediately return mixture control to full rich position and close throttle as required.

POWER PLANT – MAINTENANCE PRACTICES

1. General

Prior to performing maintenance on the power plant, ensure that all safety precautions (such as switches in OFF position, fire extinguishers available, and NO SMOKING rules) are enforced. The complete power plant should be inspected for cleanliness and general condition. More detailed and up-to-date maintenance information can be obtained from the Avco Lycoming Operator's Manual, Service Letters, Bulletins, and Service Instructions.

2. Cleaning Power Plant

WARNING: USE SOLVENTS IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

CAUTION: USE EXTREME CARE TO PREVENT SOLVENT ENTERING THE MAGNETOS, ALTERNATORS, STARTERS, VACUUM PUMP, AND OPENINGS IN THE ENGINE. KEEP THE AMOUNT OF SOLVENT CONTACTING WIRING TO A MINIMUM.

Cleaning of the power plant can be accomplished with a suitable solvent and drying thoroughly (Stoddard solvent or equivalent).

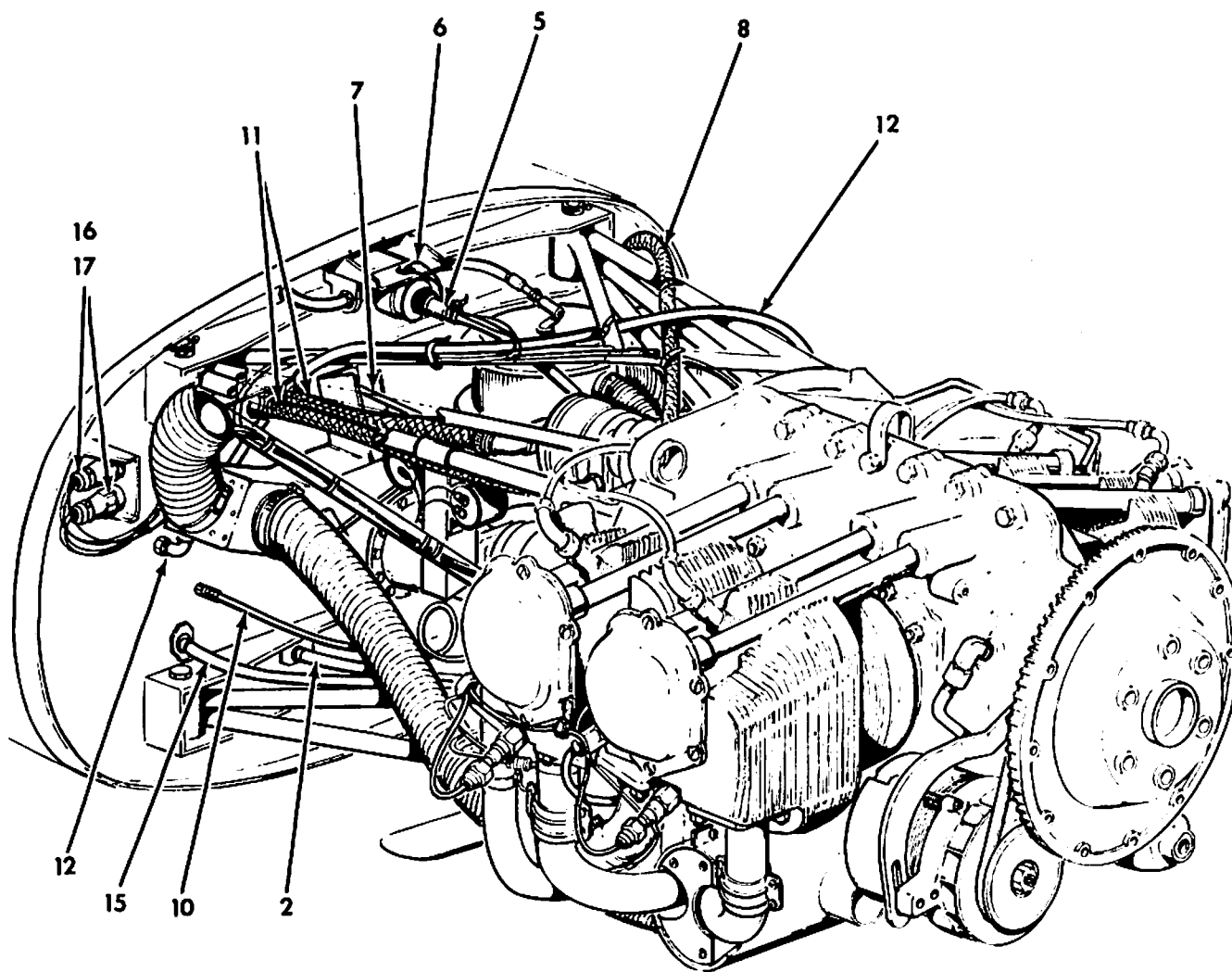
3. Removal/Installation of Power Plant

A. Remove Power Plant (See Figure 201.)

WARNING: PRIOR TO REMOVAL OF THE ENGINE, ENSURE THAT ALL ELECTRICAL SWITCHES ARE IN OFF POSITION AND THAT BATTERY IS DISCONNECTED FROM ELECTRICAL SYSTEM.

CAUTION: PRIOR TO REMOVAL OF THE ENGINE, PLACE A SUPPORT UNDER THE TAIL OF THE AIRCRAFT TO PREVENT DAMAGE TO THE EMPENNAGE. TAG OR LABEL ALL WIRING AND CABLES PRIOR TO REMOVAL OF THE ENGINE FOR REFERENCE ON INSTALLATION.

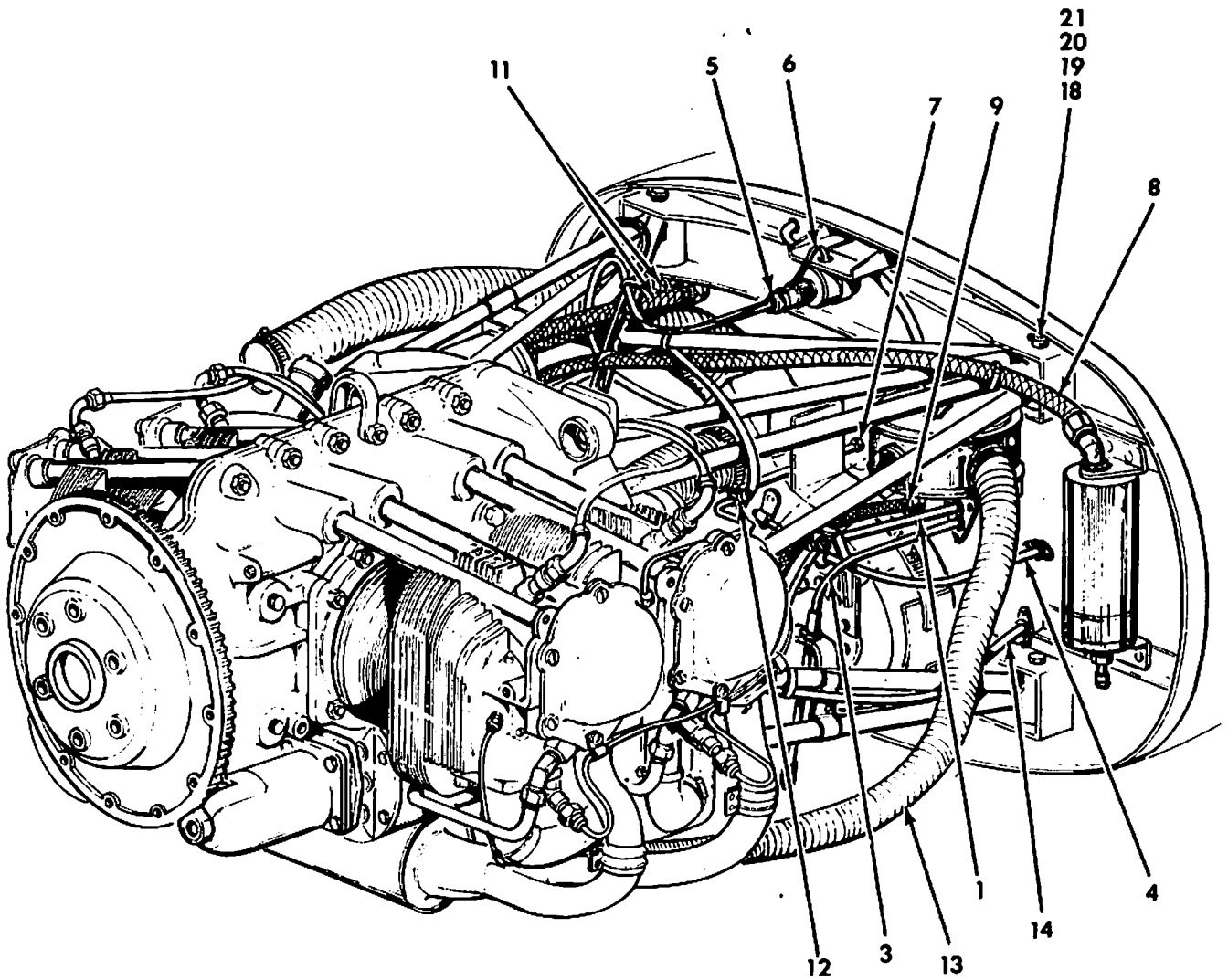
- (1) Position electrical switches to the OFF position and disconnect battery.
- (2) Remove upper and lower cowl assemblies. (Refer to 71-1-1.)
- (3) Remove spinner and propeller. (Refer to Chapter 61, observing all WARNINGS and CAUTIONS.)
- (4) Disconnect throttle control (1) from carburetor and separate from power plant. (Refer to Chapter 73.)
- (5) Disconnect mixture control (2) from carburetor and separate from power plant. (Refer to Chapter 73.)
- (6) Separate cowl flap control (3) from power plant. (Refer to 71-1-1.)
- (7) Disconnect carburetor heat control (4) from airbox assembly.



**Power Plant Removal/Installation
Figure 201 (Sheet 1 of 2)**

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- | | |
|--------------------------------|----------------------------|
| 1. Throttle Control | 12. Manifold Pressure Line |
| 2. Mixture Control | 13. Heat Duct |
| 3. Cowl Flap Control | 14. Power Cable |
| 4. Carburetor Heat Control | 15. Ground Cable |
| 5. Tachometer Drive Cable | 16. Connector |
| 6. Tachometer Generator Wiring | 17. Connector |
| 7. Propeller Control | 18. Bolt |
| 8. Pressure Hose | 19. Washer |
| 9. Fuel Supply Hose | 20. Nut |
| 10. Fuel Prime Line | 21. Cotter Pin |
| 11. Gyro Pressure Pump Hose | |

Power Plant Removal/Installation
Figure 201 (Sheet 2 of 2)

71G72-1-2

- (8) Disconnect tachometer generator drive cable (5) from tachometer generator.
- (9) Disconnect tachometer generator wires (6) at splices.
- (10) Disconnect propeller control (7) from propeller governor. (Refer to Chapter 61.)
- (11) Disconnect pressure hose (8) from propeller accumulator. (Refer to Chapter 61, observing all WARNINGS and CAUTIONS.)
- (12) Ensure that fuel selector is in the OFF position and that fuel primer is in locked position. Disconnect fuel supply hose (9) at firewall. (Refer to Chapter 28, observing all WARNINGS and CAUTIONS.)
- (13) Disconnect fuel primer line (10) at firewall. (Refer to Chapter 28, observing all WARNINGS and CAUTIONS.)
- (14) Disconnect two hoses (11) from gyro pressure pump. (Refer to Chapter 34.)
- (15) Disconnect manifold pressure line (12) at firewall. (Refer to Chapter 77.)
- (16) Disconnect heater system duct (13).
- (17) Disconnect power cable (14) from starter and separate from power plant.
- (18) Disconnect ground cable (15) from engine and separate from power plant.
- (19) Disconnect the two electrical connectors (16 and 17) at firewall.
- (20) Plug or cap all hoses and lines which have been separated prior to engine removal.
- (21) Attach a suitable lifting device to engine hoist point and remove bolt (18), washers (19), nut (20), and cotter pin (21) from the four attach points on wing. Remove power plant from aircraft.

NOTE: If required, use a suitable punch to drive bolts (18) from mountings.

B. Install Power Plant (See Figure 201.)

- (1) Apply a brush coat of zinc chromate primer coating (MIL-P-8585), or equivalent, to top and bottom mounting area just prior to installing power plant.
- (2) Position power plant to align with the four mounts on wing while primer coating on mounts is wet and install bolt (18), washer (19), and nut (20) at each location. Tighten nuts until firmly seated and if required, continue tightening nut until first slot aligns with hole in bolt. Install cotter pin (21). Remove lifting device.
- (3) Connect two electrical connectors (16 and 17) at firewall.
- (4) Connect ground cable (15) to engine and secure. (Refer to Chapter 24.)
- (5) Connect power cable (14) to starter and secure. (Refer to Chapter 24.)

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- (6) Connect heater system duct (13).
- (7) Connect manifold pressure line (12) at firewall. (Refer to Chapter 77.)
- (8) Connect two hoses (11) to gyro pressure pump. (Refer to Chapter 34.)
- (9) Connect fuel primer line (10) at firewall. (Refer to Chapter 28.)
- (10) Connect fuel supply hose (9) at firewall. (Refer to Chapter 28.)
- (11) Connect pressure hose (8) to propeller accumulator. (Refer to Chapter 61.)
- (12) Connect propeller control (7) to propeller governor. (Refer to Chapter 61.)
- (13) Connect tachometer generator wires (6).
- (14) Connect tachometer generator drive cable (5) to tachometer generator.
- (15) Connect carburetor heat control (4) to air box assembly.
- (16) Secure cowl flap control (3) to power plant. (Refer to 71-1-1.)
- (17) Connect mixture control (2) to carburetor and secure to power plant. (Refer to Chapter 73.)
- (18) Connect throttle control (1) to carburetor and secure to power plant. (Refer to Chapter 73.)
- (19) Install propeller and spinner. (Refer to Chapter 61.)
- (20) Install upper and lower cowl assemblies. (Refer to 71-1-1.)
- (21) Ensure that all electrical switches are in OFF position and connect battery.

POWER PLANT COWLING – DESCRIPTION/OPERATION**1. General**

The power plant is enclosed by a two-piece cowl assembly which makes up the forward nacelle. The upper cowl assembly is secured to the wing nacelle section and to the lower cowl assembly with quick-release fasteners. The upper cowl assembly incorporates an oil filler access door. The lower cowl assembly is secured to the wing nacelle section with screws. The lower cowl assembly incorporates a cowl flap assembly which is controlled from the cockpit.

POWER PLANT COWLING – MAINTENANCE PRACTICES

1. Removal/Installation of Cowling

A. Remove Cowling (See Figure 201.)

- (1) Disconnect quick-release fasteners and lift off upper cowl assembly.
- (2) Disconnect cowl flap control from cowl flap by removing nut from ball joint.
- (3) Remove screws and remove lower cowl assembly.

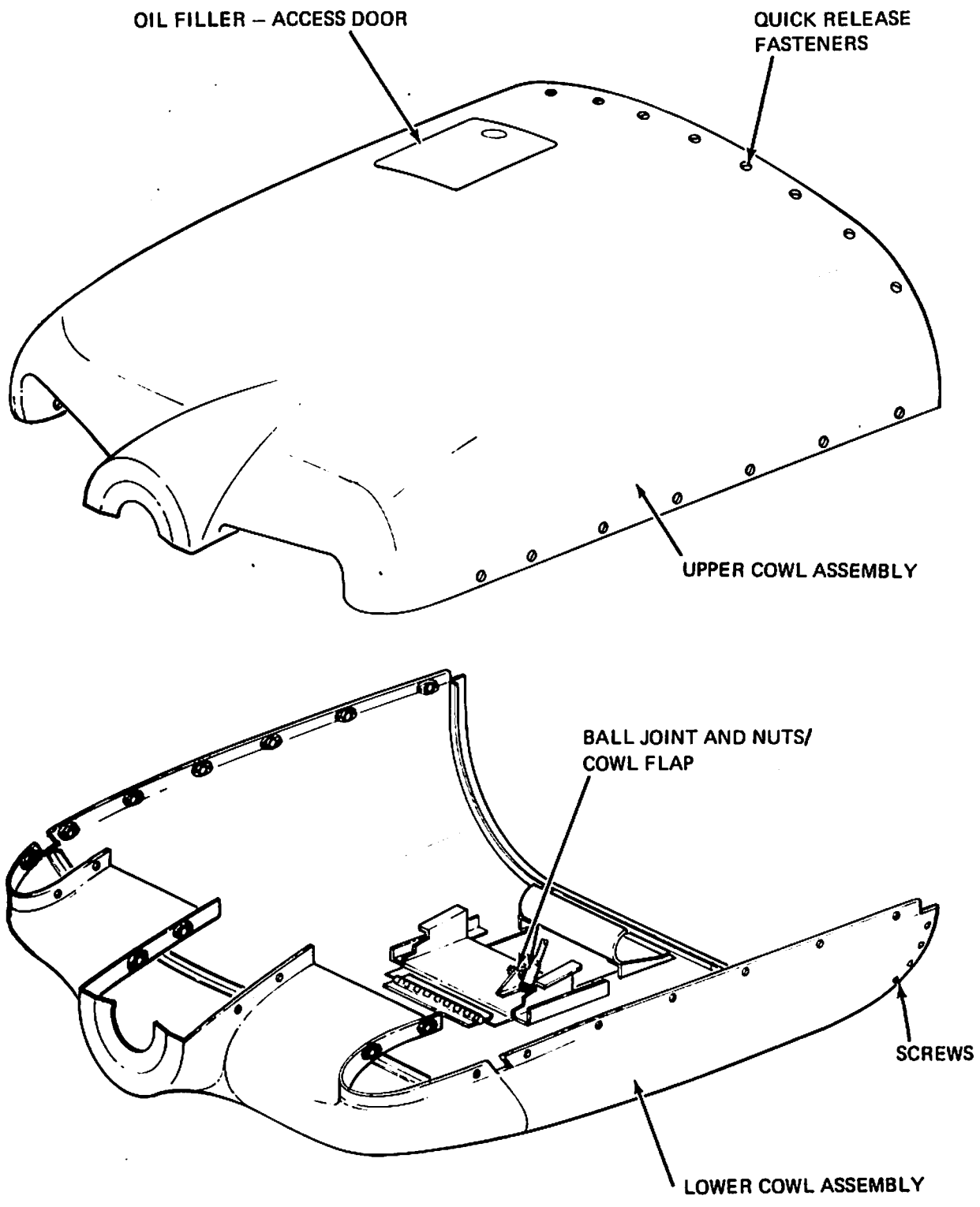
B. Cleaning, Inspection, and Repair of Cowling

**WARNING: USE SOLVENTS IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES.
KEEP AWAY FROM FLAMES.**

- (1) Clean cowling with a suitable cleaning solvent and wipe dry with a clean cloth.
- (2) Inspect cowling for cracks, dents, loose rivets, and missing or damaged fasteners. Inspect for damaged Fiberglas.
- (3) Repair all defects to prevent further damage. Replace missing or damaged fasteners.

C. Install Cowling (See Figure 201.)

- (1) Position lower cowl assembly and secure with screws.
- (2) Connect cowl flap control to cowl flap.
- (3) Position upper cowl assembly and secure quick-release fasteners.



Engine Cowling Removal/Installation
Figure 201

71G72-2

**ENGINE MOUNT – DESCRIPTION/OPERATION****1. General**

The engine mount is composed of sections of tubing, formed and welded together. The purpose of the engine mount is to support the engine and attach the engine to the airframe. The engine is attached to the mount at four places, using vibration isolator type shock mount assemblies, bolts, and self-locking type nuts. The engine mount is attached to the airframe at four places, using bolts, washers, and nuts safetied with cotter pins.

ENGINE MOUNT – MAINTENANCE PRACTICES

1. Removal/Installation of Engine Mount

A. Remove Engine Mount (See Figure 201.)

- (1) Remove power plant. (Refer to 71-0.)
- (2) Disconnect all wiring, ties, and clamps attached to engine mount (1).

CAUTION: TAG OR LABEL ALL WIRING PRIOR TO REMOVAL FOR REFERENCE ON INSTALLATION.

- (3) Disconnect wiring from transmitters located on transmitter bracket assembly.
- (4) Remove screws, washers, and nuts and separate bracket assembly.
- (5) Remove nuts (2), washers (3), and bolts (4) securing engine mount to engine and remove engine mount.

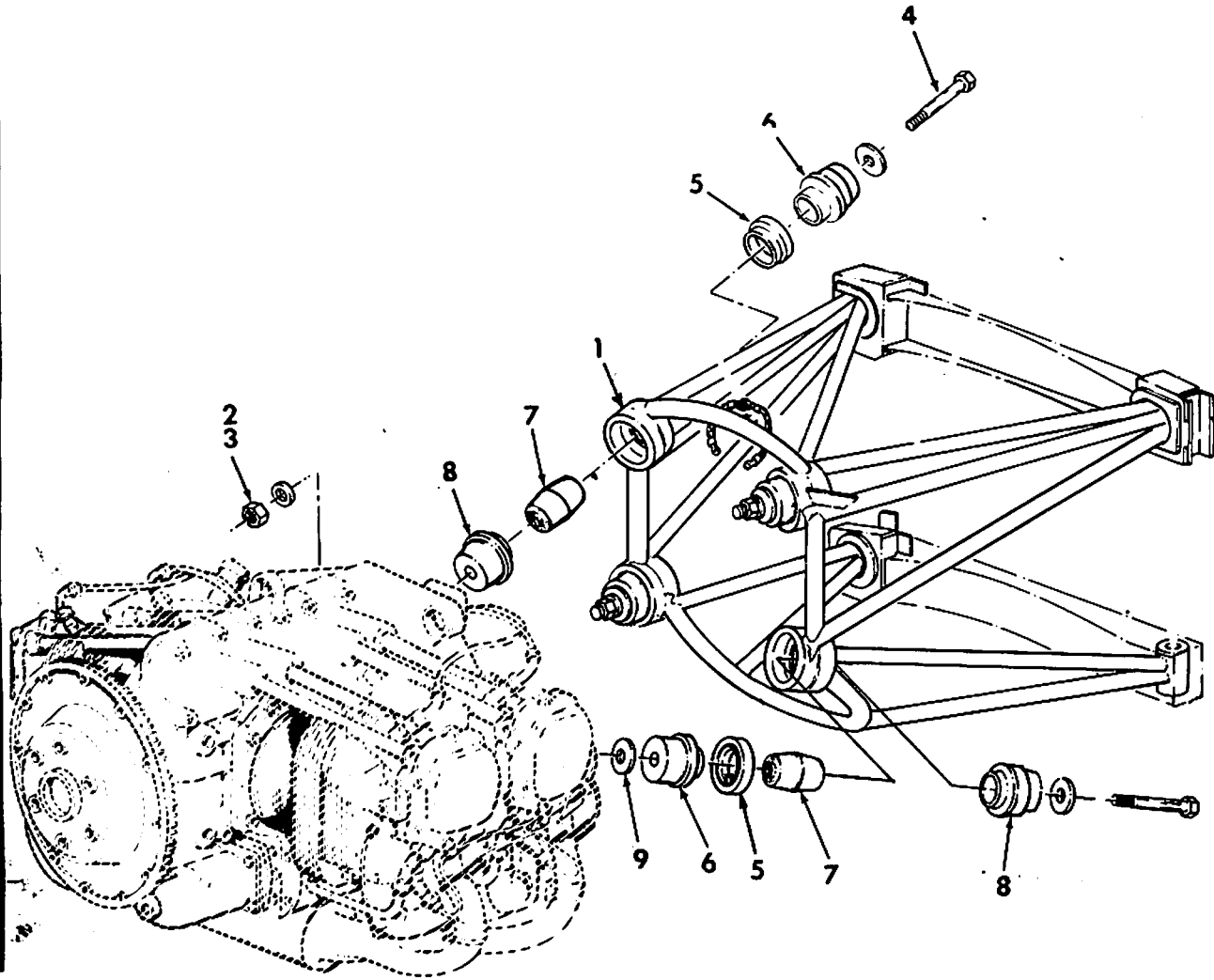
B. Cleaning, Inspection, and Repair of Engine Mount

WARNING: USE SOLVENTS IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (1) Clean engine mount with a suitable cleaning solvent and wipe dry with a clean cloth.
- (2) Inspect engine mount (1) for cracks, broken welds, and obvious damage.
- (3) Inspect components of shock mount assemblies for cracks, distortion, and wear.
- (4) Repair engine mount in strict accordance with AC 43.13-1A of the Federal Aviation Regulations.
- (5) If damage exists to shock mount assemblies, replace with mounting kits (P/N J-9613-49).

C. Install Engine Mount (See Figure 201.)

- (1) Position spacer (5) and shouldered mount (6) in forward side of the two lower mount rings of engine mount and install gel-filled insert (7). Position smooth mount (8) in aft side of mount rings. From aft side, slide bolt (4) through center of shock mount assembly to help hold components in position.
- (2) Position spacer (5) and shouldered mount (6) in aft side of the two upper mount rings of engine mount and install gel-filled insert (7). Position smooth mount (8) in forward side of mount rings. From aft side, slide bolt (4) with washers (3) through center of shock mount assembly to help hold components in position.
- (3) Slide shock mount washer (9) over forward end of each of the two lower bolts (4).



- | | |
|-----------------|-----------------------|
| 1. Engine Mount | 6. Shouldered Mount |
| 2. Nut | 7. Gel-filled Insert |
| 3. Washer | 8. Smooth Mount |
| 4. Bolt | 9. Shock Mount Washer |
| 5. Spacer | |

Engine Mount Removal/Installation
Figure 201

71G72-3

- (4) Mate engine mount with engine.

CAUTION: FULL THREAD ENGAGEMENT SHALL BE MAINTAINED BETWEEN MOUNTING BOLT AND NUT AT ALL FOUR MOUNTING LOCATIONS. IF NECESSARY, THE NEXT LONGER BOLT MAY BE USED TO OBTAIN FULL THREAD ENGAGEMENT. ONE ADDITIONAL MOUNTING WASHER MAY BE USED AT EACH MOUNTING LOCATION SO NUT WILL NOT BOTTOM-OUT ON BOLT WHEN TORQUE IS APPLIED TO NUT.

- (5) Secure engine mount by installing washers (3) and nuts (2). Torque nuts to 450 to 500 inch-pounds.
- (6) Connect all wiring, ties, and clamps to engine mount (1) which were disconnected during removal.
- (7) Connect transmitter bracket to engine mount and connect wiring.
- (8) Install power plant. (Refer to 71-0.)

CAUTION: ADDITIONAL SHOCK MOUNT WASHERS MAY BE USED AS REQUIRED FOR PERMISSIBLE MISMATCH OF 0.200 INCH MAXIMUM REFERENCE BETWEEN PROPELLER SPINNER AND ENGINE COWLING. TOTAL QUANTITY OF TWO SHOCK MOUNT WASHERS SHALL NOT BE EXCEEDED AT ANY ONE MOUNTING LOCATION.

- (9) Check for a maximum mismatch of 0.200 inch between propeller spinner and engine cowling. If mismatch is not within tolerance, add additional shock mount washers as follows:
- (a) Remove engine cowling.
- (b) Attach a suitable lifting device to engine hoist point. Raise engine to relieve stress from shock mounts.
- (c) At determined location to install additional washers to obtain permissible mismatch, remove nut (2) and washer (3) and slide bolt (4) back far enough to install additional washers. Reinstall nut (2) and washer (3) and torque nut to 450 to 500 inch-pounds.

NOTE: If washers are to be added at more than one location, only remove one nut (2) at a time. After washer has been added at one location, go to next location.

- (d) Remove lifting device from engine.
- (e) Install engine cowling and recheck mismatch.

2. Engine Mount Inspection**A. Upper Engine Mount Attach Point Inspection (See Figure 202.)**

- (1) Remove upper cowling.
- (2) Using a non-metallic scraper, remove sealant material from top, front and inside of upper engine mount attach points at the firewall. (See Figure 202.)

NOTE: It is not necessary to remove sealant from the entire attach point. Clean only the areas indicated in Figure 202.

NOTE: To ensure adequate engine mount tube inspection remove any sealant that may extend 0.25 beyond edge of attach point. (See Figure 202).

WARNING: METHYL ETHYL KETONE IS TOXIC AND FLAMMABLE. USE IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (3) Using a suitable solvent (methyl ethyl ketone or equivalent) remove any remaining sealant residue and/or zinc chromate primer from areas to be inspected.
- (4) Inspect attach points in areas shown in Figure 202 for cracks originating from the bolt holes.

B. Upper and Lower Engine Mount Bolt Inspection (See Figure 202.)

- (1) Using a non-metallic scraper, remove sealant material from bolt head and nut areas of the bolts that secure the engine mount to the attach points.
- (2) Inspect bolts and nuts for condition, looseness or mounting and proper safetying.

C. Engine Mount Attach Point & Boot Resealing (See Figure 202.)

WARNING: METHYL ETHYL KETONE IS TOXIC AND FLAMMABLE. USE IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

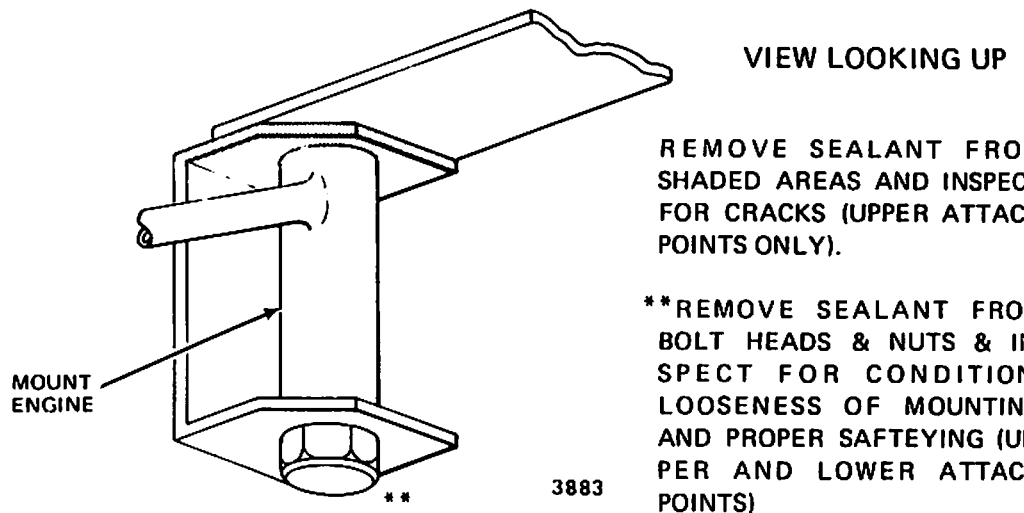
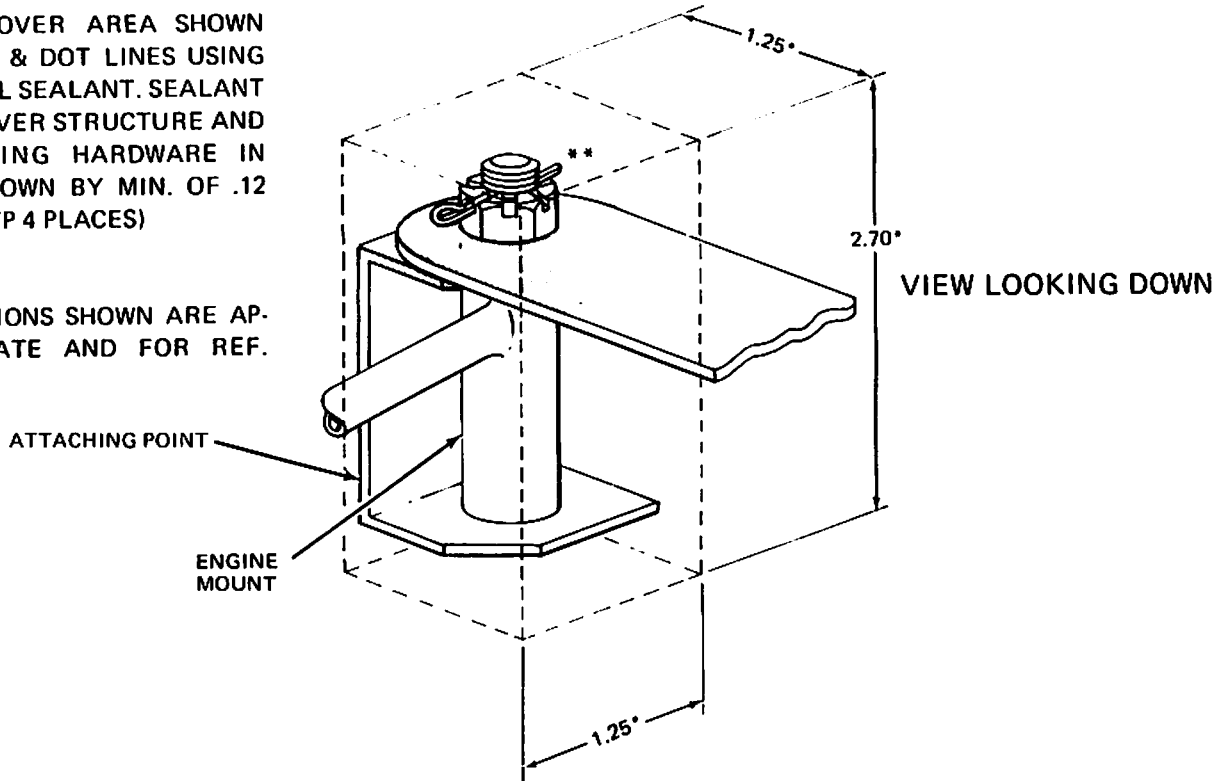
- (1) Clean exposed metal areas with methyl ethyl ketone or equivalent and apply firewall sealant (Coast Pro Seal 700 or equivalent) to the attach points, bolt heads and nuts.

NOTE: Reapplication of zinc chromate primer to previously primed aluminum parts is not required.

NOTE: Sealant must cover aluminum structure in area shown in Figure 202 by a minimum of 0.12 inch.

NOTE: COVER AREA SHOWN BY DASH & DOT LINES USING FIREWALL SEALANT. SEALANT MUST COVER STRUCTURE AND ATTACHING HARDWARE IN AREA SHOWN BY MIN. OF .12 INCH. (TYP 4 PLACES)

*DIMENSIONS SHOWN ARE APPROXIMATE AND FOR REF. ONLY.



REMOVE SEALANT FROM SHADED AREAS AND INSPECT FOR CRACKS (UPPER ATTACH POINTS ONLY).

**REMOVE SEALANT FROM BOLT HEADS & NUTS & INSPECT FOR CONDITION, LOOSENESS OF MOUNTING AND PROPER SAFETYING (UPPER AND LOWER ATTACH POINTS)

**Engine Mount Inspection
Figure 202**

AIR INDUCTION SYSTEM – DESCRIPTION/OPERATION

1. **General** (See Figure 201.)

The air induction system consists of an air box assembly mounted to the carburetor just aft of the engine. The air box is controlled from the cockpit to allow heated or unheated filtered ram air to be transferred to the carburetor. Outside unheated air is transferred to the air box assembly from the right-hand aft baffle assembly by means of an air duct. Heated air is transferred to the carburetor from the heater-muffler exhaust system. A replaceable air filter is located in the air box assembly.

AIR INDUCTION SYSTEM – MAINTENANCE PRACTICES

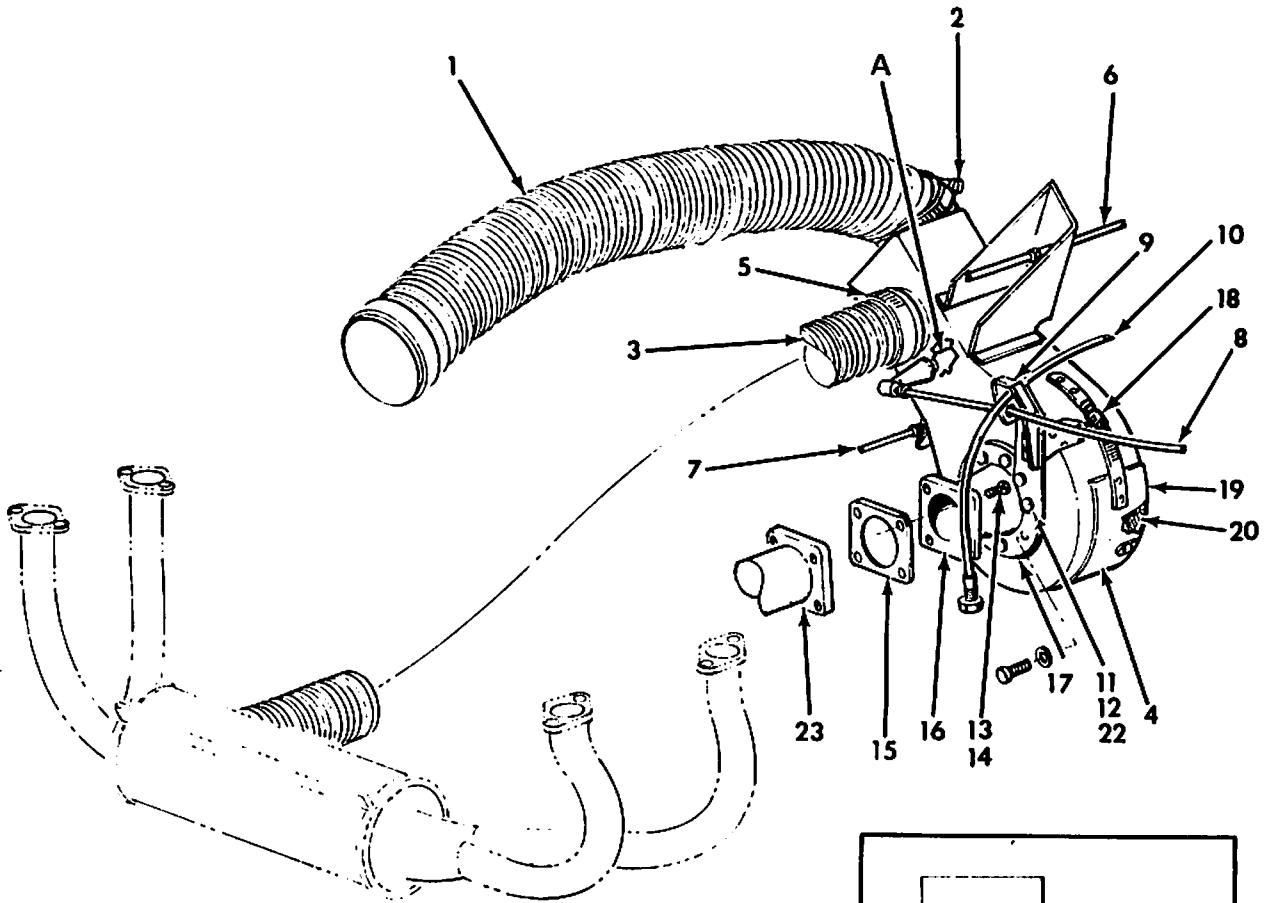
1. Removal/Installation of Air Induction System

A. Remove Air Induction System (See Figure 201.)

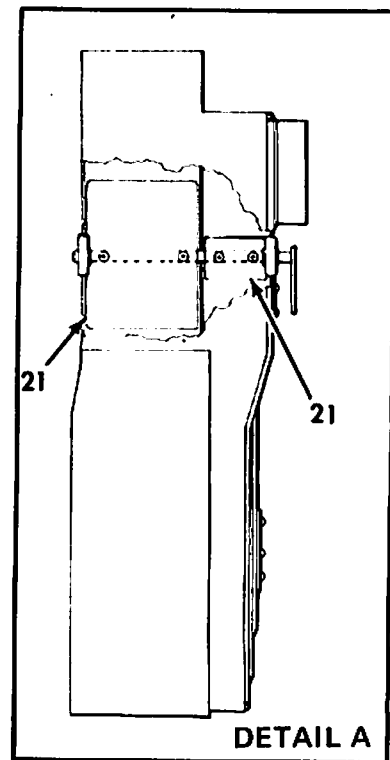
- (1) Remove air duct (1) by removing two clamps (2).
- (2) Disconnect heated air duct (3) from air box assembly (4) by removing clamp (5).
- (3) Disconnect propeller control (6) from propeller governor and remove propeller control from air box assembly bracket. (Refer to Chapter 61.)
- (4) Disconnect throttle control (7) from carburetor and remove throttle control from air box assembly bracket. (Refer to Chapter 73.)
- (5) Disconnect carburetor heat control (8) from air box assembly. (Refer to Chapter 30.)
- (6) Remove bracket (9) securing mixture control (10) and carburetor heat control (8) to air box assembly by removing two bolts (11) and two washers (12).
- (7) Remove safety wire, four screws (13), four washers (14), and gasket (15) from carburetor and carburetor adapter (16) and remove adapter and air box assembly.
- (8) Remove the remaining six bolts (11) and washers (12) and separate carburetor adapter (16) and seal (17) from air box assembly.
- (9) Loosen door clamp (18) securing air box assembly door (19) and remove filter assembly (20).

B. Cleaning, Inspection, and Repair of Air Induction System (See Figure 201.)

- (1) Clean air box assembly (4) and air duct (1) using compressed air.
- (2) Inspect air box assembly for damaged or worn valves, loose or missing rivets, worn or damaged door clamp (18), missing or damaged nutplates (22) and obvious damage.
- (3) Inspect air duct (1) for deterioration and damage.
- (4) Inspect filter assembly (20) for damage and for foreign material.
- (5) Replace damaged or worn valves (21).
- (6) Replace loose or missing rivets in air box assembly.
- (7) Replace missing or damaged nutplates (22).
- (8) Replace damaged air duct (1).
- (9) Replace filter assembly (20) if damaged or 50 percent covered with foreign material.



- | | |
|----------------------------|---------------------|
| 1. Air Duct | 13. Screw |
| 2. Clamp | 14. Washer |
| 3. Heated Air Duct | 15. Gasket |
| 4. Air Box Assembly | 16. Adapter |
| 5. Clamp | 17. Seal |
| 6. Propeller Control | 18. Door Clamp |
| 7. Throttle Control | 19. Door |
| 8. Carburetor Heat Control | 20. Filter Assembly |
| 9. Bracket | 21. Valves |
| 10. Mixture Control | 22. Nutplates |
| 11. Bolt | 23. Carburetor |
| 12. Washer | |



**Air Induction System Removal/Installation
Figure 201**

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C. Install Air Induction System (See Figure 201.)

- (1) Install filter assembly (20) and secure air box assembly door (19) by tightening door clamp (18).**
- (2) Position seal (17) and carburetor adapter (16) to air box assembly and install six bolts (11) and washers (12). Do not install two bolts and washers securing bracket for controls.**
- (3) Position gasket (15) and air box assembly to carburetor (23) and install four screws (13) and four washers (14). Safety screws with safety wire.**
- (4) Position bracket (9) securing mixture control (10) and carburetor heat control (8) to air box assembly and secure bracket using remaining two bolts (11) and washers (12).**
- (5) Connect carburetor heat control (8) to air box assembly. (Refer to Chapter 73.)**
- (6) Route throttle control (7) through air box assembly bracket and connect to carburetor. (Refer to Chapter 73.)**
- (7) Route propeller control (6) through air box assembly bracket and connect to propeller governor. (Refer to Chapter 61.)**
- (8) Connect heated air duct (3) to air box assembly using clamp (5).**
- (9) Connect air duct (1) to air box assembly and to right-hand aft baffle using clamps (2).**

**ENGINE Baffles – DESCRIPTION/OPERATION****1. General**

The engine baffles are made from sheet aluminum with rubber-asbestos composition seal at points of contact with the engine cowling. The baffles are attached to the engine and direct the cooling air around the engine to provide optimum engine cooling. The complete baffles are composed of several segments. This provides for easy removal and replacement of any single segment.

ENGINE Baffles – MAINTENANCE PRACTICES

1. Removal/Installation of Engine Baffles

A. Remove Engine Baffles (See Figure 201.)

- (1) Remove upper and lower cowl assemblies. (Refer to 71-1-1.)

NOTE: If all baffle assemblies are not to be removed, disconnect only the items necessary to remove a specific baffle assembly.

- (2) Disconnect upper spark plug leads from spark plugs and pull ends through rear baffle assemblies.
- (3) Disconnect manifold pressure line at each side of the left rear baffle assembly. If left rear baffle assembly is to be replaced, remove bulkhead connector.
- (4) Disconnect air duct from aft side of right-hand rear baffle assembly.
- (5) Disconnect clamp securing electrical wires to front center baffle assembly.
- (6) Disconnect springs on underside of engine securing front and rear baffle assemblies to intercylinder baffle assemblies (part of basic engine).
- (7) Remove screws and bolts as necessary to remove individual baffle assemblies.

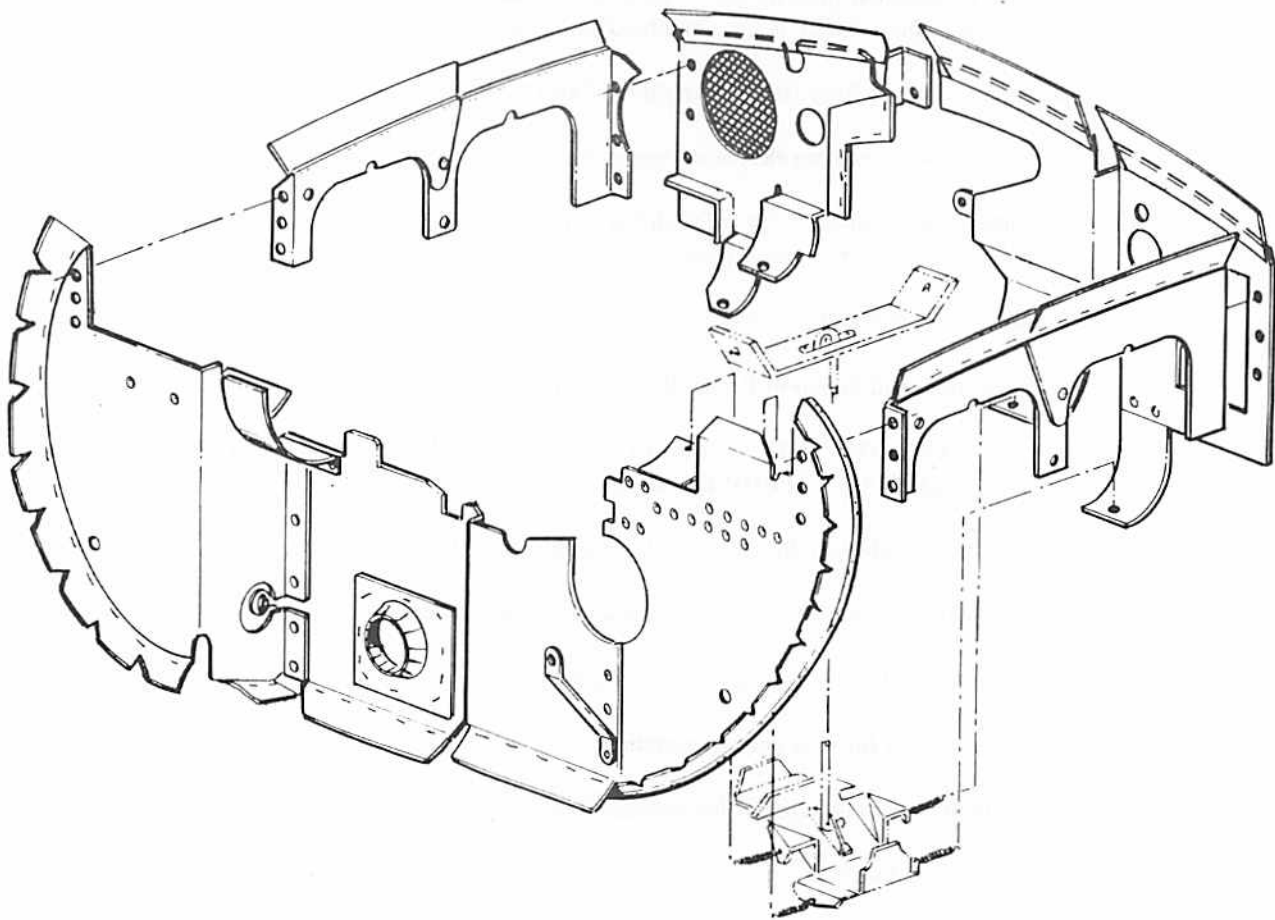
B. Cleaning, Inspection, and Repair of Engine Baffle Assemblies

WARNING: USE SOLVENTS IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- (1) Clean baffle assemblies with a suitable cleaning solvent and wipe dry with a clean cloth.
- (2) Inspect baffle assemblies for cracks and loose or missing rivets.
- (3) Inspect seals for deterioration, damage, and security.
- (4) Inspect grommets for wear and deterioration.
- (5) Repair all defects to prevent further damage. Replace loose and missing rivets.
- (6) Replace damaged seals or replace metal stitching if seals are loose.
- (7) Replace grommets if worn or damaged.

C. Install Engine Baffle Assemblies

- (1) Install baffle assemblies, using screws and bolts.
- (2) Connect springs on underside of engine securing front and rear baffle assemblies to intercylinder baffle assemblies.



Engine Baffle Assemblies Removal/Installation
Figure 201

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- (3) Connect clamp securing electrical wires to front center baffle assembly.
- (4) Connect air duct to aft side of right-hand rear baffle assembly.
- (5) If removed, install bulkhead connector on left rear baffle assembly. Connect manifold pressure line to each side of bulkhead connector.
- (6) Pull spark plug leads through rear baffle assemblies and connect to spark plugs.
- (7) Install upper and lower cowl assemblies. (Refer to 71-1-1.)

ENGINE DRAINS – DESCRIPTION/OPERATION

1. General

All drain lines are routed overboard through openings in the bottom of the lower cowl assembly.

The engine breather line is a flexible line attached to the breather vent port in the top of the engine. The breather prevents an excessive pressure buildup inside the crankcase. The flexible line is extended by a piece of aluminum tubing attached to the flexible line with a spring clamp.

The fuel pump line is a clear plastic line attached to the fuel pump vent by a spring clamp.

The air box assembly drain line is a clear plastic line connected to the low end of the air box assembly. The drain line is used to exit accumulated moisture.

CHAPTER 73

ENGINE FUEL AND CONTROL

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GRUMMAN AMERICAN AVIATION
GA-7/COUGAR
MAINTENANCE MANUAL

ENGINE FUEL AND CONTROL – DESCRIPTION/OPERATION

1. **General**

The engine fuel and control system consists of the units and components which deliver metered fuel to the engine. These items include the carburetor, fuel priming system, fuel controls, and fuel pressure indicating system.



CARBURETOR – DESCRIPTION/OPERATION

1. General

Each of the engines is equipped with a single-barrel, float-type carburetor, which incorporates an idle cutoff mechanism and a manual mixture control. The carburetor is mounted horizontally on the rear of the engine.

CARBURETOR – MAINTENANCE PRACTICES

1. Removal/Installation of Carburetor

A. Remove Carburetor (See Figure 201.)

- (1) Place fuel selector valve in the OFF position.
- (2) Remove upper and lower cowl assemblies. (Refer to Chapter 71.)

WARNING: WHEN FUEL PRESSURE LINES ARE DISCONNECTED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO SPILLAGE.

- (3) Disconnect fuel pressure line from carburetor. Plug pressure line.
- (4) Disconnect throttle control and mixture control from carburetor.
- (5) Remove bolts and washers securing bracket and carburetor adapter to air box assembly.
- (6) Remove safety wire, four screws, and washers securing adapter to carburetor and remove adapter, gasket, and seal.
- (7) Remove four nuts and washers securing carburetor to engine and remove carburetor and gasket.

B. Install Carburetor (See Figure 201.)

NOTE: Ensure that all mating surfaces of the carburetor, engine, carburetor adapter, and air box assembly are smooth and clean and that all traces of old seal and gaskets have been removed.

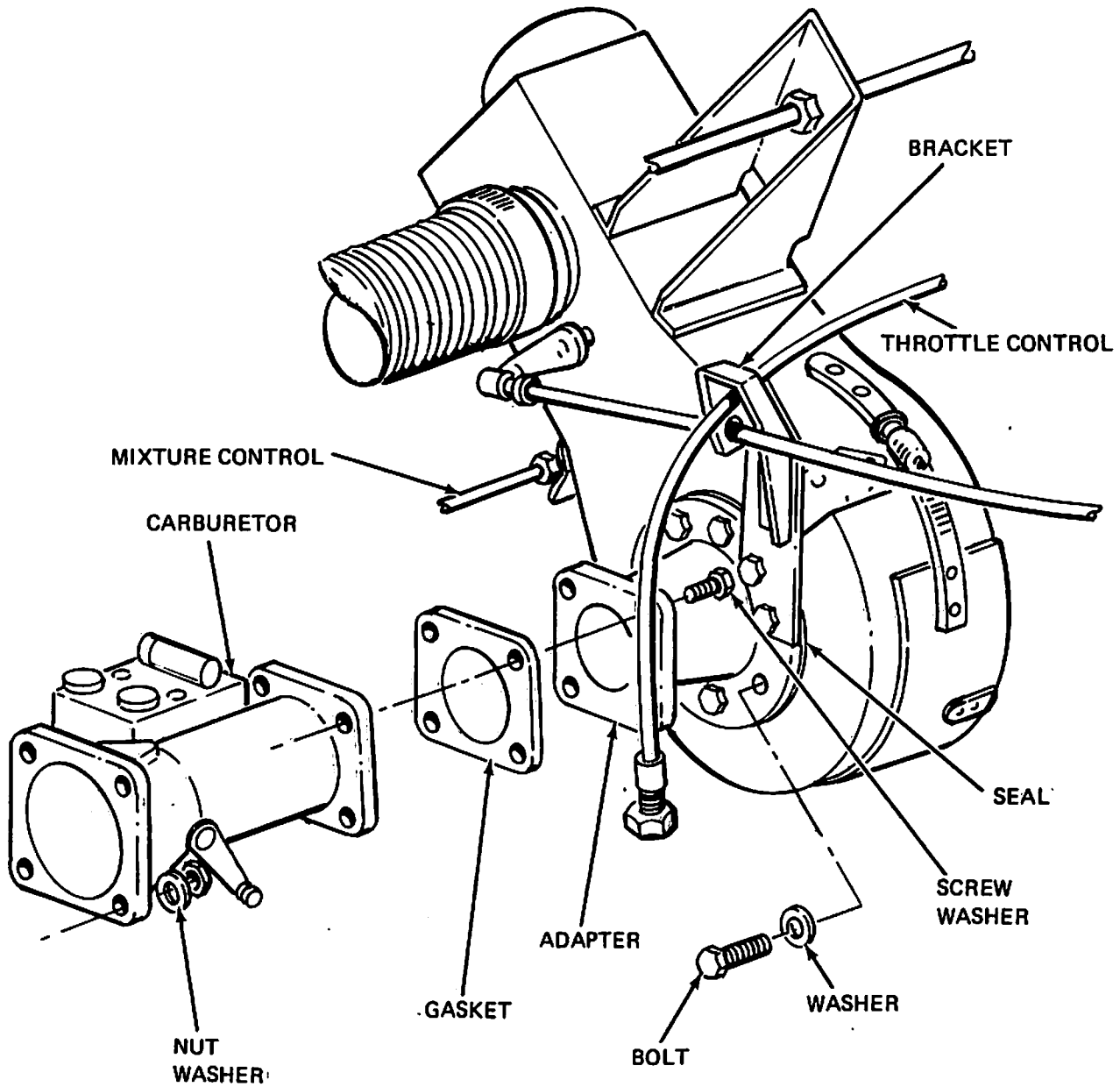
- (1) Position new gasket and carburetor on engine and secure with washers and nuts.
- (2) Position new gasket and carburetor adapter on carburetor and install four screws and washers securing adapter to carburetor. Safety-wire the screws with safety wire.
- (3) Position new seal between carburetor adapter and air box assembly and position control bracket. Install eight bolts and washers securing adapter and control bracket to air box assembly.
- (4) Connect throttle control and mixture control to carburetor.

WARNING: WHEN FUEL PRESSURE LINES ARE UNPLUGGED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO SPILLAGE.

- (5) Unplug pressure line and connect to carburetor.

C. Adjust Carburetor (Idle Speed and Mixture Adjustment)

Refer to 73-2-1 for idle speed and mixture adjustment.



**Carburetor Removal/Installation
Figure 201**

73G72-1

FUEL PRIMER SYSTEM – DESCRIPTION/OPERATION

1. General

Each engine is equipped with a four-cylinder primer system. Fuel is injected directly into the cylinder intake system of each engine by a primer solenoid valve located in each wing nacelle. Both primer solenoid valves are controlled by the same primer switch which is located on the lower left instrument panel. Fuel is transferred from the primer solenoid valve through a copper primer line which connects to the engine primer lines at the rear of the engine.

FUEL PRIMER SYSTEM – TROUBLESHOOTING**1. Troubleshooting the Fuel Primer System**

TROUBLE	PROBABLE CAUSE	REMEDY
Both engines fail to prime.	Tripped circuit breaker.	Reset circuit breaker.
	Defective primer switch.	Replace defective switch.
	Defective wiring to switch – no voltage.	Check wiring for security – check wiring with ohmmeter and repair as necessary.
One engine fails to prime.	Defective wiring to primer solenoid valve.	Check wiring with ohmmeter and repair as necessary.
	Defective primer solenoid valve.	Replace defective valve.
	Clogged or damaged primer lines.	Clean or replace primer lines.

FUEL PRIMER SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of Fuel Primer System

A. Remove Primer Switch

CAUTION: ENSURE THAT MASTER SWITCH IS IN OFF POSITION PRIOR TO REMOVAL OF PRIMER SWITCH.

- (1) Remove knurl nut from primer switch on front of instrument panel. Slide switch from instrument panel.

CAUTION: TAG OR LABEL ALL WIRING PRIOR TO REMOVAL FOR REFERENCE ON INSTALLATION.

- (2) Remove wiring from primer switch.

B. Install Primer Switch

CAUTION: ENSURE THAT MASTER SWITCH IS IN OFF POSITION DURING INSTALLATION OF PRIMER SWITCH.

- (1) Connect wiring to primer switch.
- (2) Position primer switch on instrument panel and secure with knurl nut.

C. Remove Primer Solenoid Valve

CAUTION: ENSURE THAT MASTER SWITCH IS IN OFF POSITION PRIOR TO REMOVAL OF PRIMER SOLENOID VALVE.

- (1) Disconnect solenoid valve wiring at splices just below valve.

WARNING: WHEN FUEL LINES ARE DISCONNECTED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO SPILLAGE.

- (2) Disconnect primer line from bottom of solenoid valve. Plug primer line.
- (3) Remove screw securing clamp at top of solenoid valve.
- (4) Remove solenoid valve from tee in fuel line. Plug fuel line.

D. Install Primer Solenoid

WARNING: WHEN FUEL LINES ARE UNPLUGGED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO SPILLAGE.

- (1) Remove plug from fuel line tee and install solenoid valve on tee.
- (2) Install clamp at top of solenoid valve and secure with screw.

- (3) Remove plug from primer line and connect primer line to solenoid valve.
- (4) Connect solenoid valve wiring.

E. Removal/Installation of Fuel Primer Lines (See Figure 201.)

Since the fuel primer lines are composed of standard aircraft tubing and fittings, removal and installation is merely the use of standard maintenance practices observing all **WARNINGS** and **CAUTIONS**.

F. Cleaning of Fuel Primer Lines

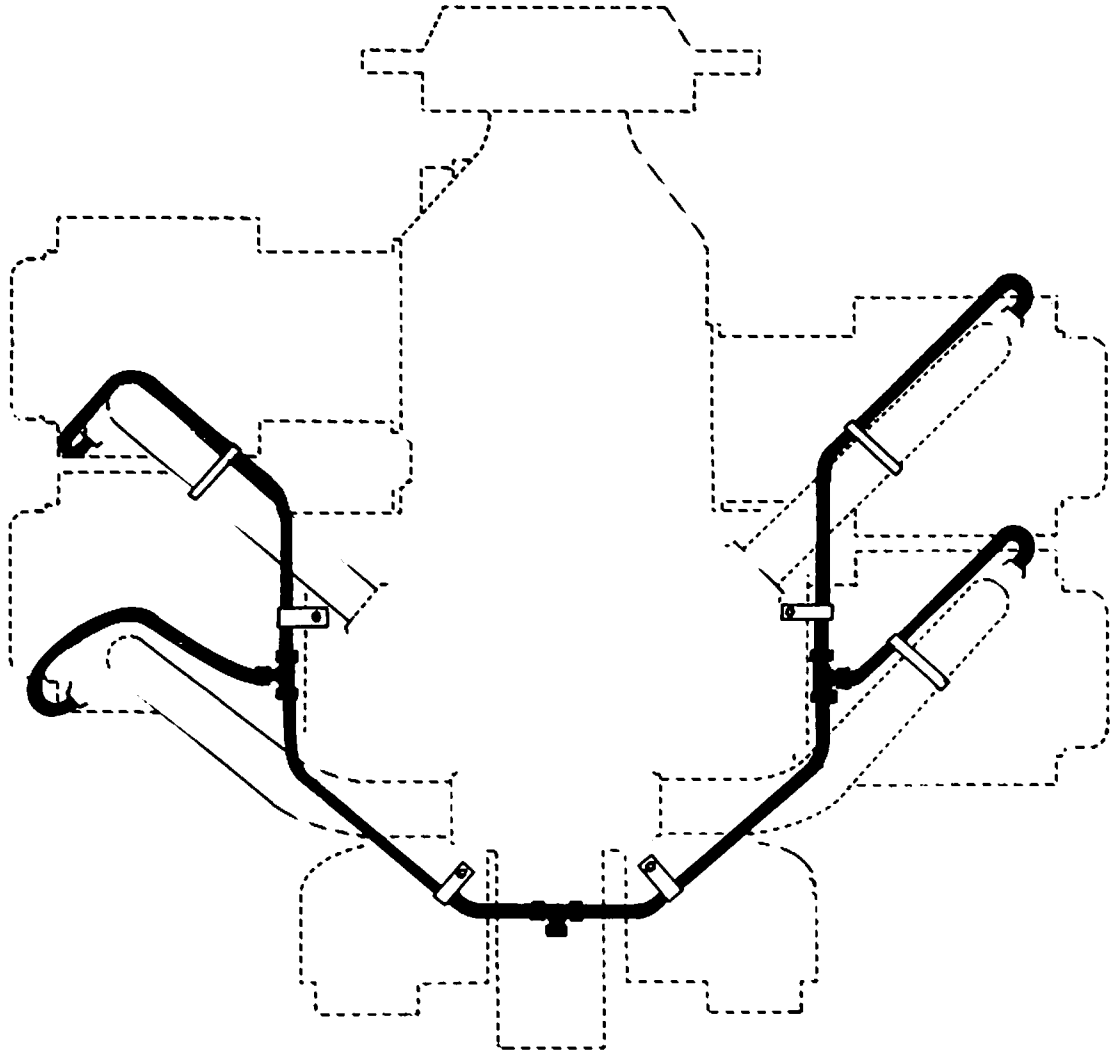
WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

Prior to installation, clean primer lines by passing Stoddard solvent or equivalent through them and then air dry.

G. Operational Check of Fuel Primer System

WARNING: WHEN FUEL LINES ARE DISCONNECTED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO SPILLAGE.

- (1) Disconnect fuel primer line from engine primer line tee at rear of engine, ensuring that a suitable container is on hand to catch fuel spillage.
- (2) Operate fuel primer system as follows:
 - (a) Station someone to observe fuel flow from primer line and to catch fuel flow.
 - (b) Ensure that throttle control is in OFF position.
 - (c) Position master switch to the ON position.
 - (d) Position electric fuel pump switch to the ON position.
 - (e) Position fuel primer switch to the prime position.
 - (f) Ensure that fuel flows from primer line.
 - (g) Return all switches to the OFF position.
- (3) Connect primer line to engine primer line tee at rear of engine.



Fuel Primer Lines Removal/Installation
Figure 201

73G72-2



FUEL CONTROLS – DESCRIPTION/OPERATION

1. General

The fuel controls consist of a throttle control and a mixture control for each of the engines. The throttle control handles and the mixture control handles are located on the control quadrant in the cockpit. Each control handle is connected to the carburetor by means of a flexible control cable assembly.

The throttle control regulates the power output of the engine by controlling the amount of the fuel/air mixture that moves into the engine cylinders. The engine manifold pressure is controlled by the throttle setting.

The mixture control meters the amount of fuel that passes through the carburetor main jet and is used to regulate fuel economy at a given power setting and cruising altitude.

FUEL CONTROLS – MAINTENANCE PRACTICES

1. Removal/Installation of Fuel Controls

NOTE: The throttle control and the mixture control for each engine is basically removed and installed in the same manner. Therefore, removal and installation procedures are given for only one of the controls.

A. Remove Control Cable Assembly

- (1) Remove seat and interior furnishings as required to gain access to the control routing from back side of control quadrant to where control cable assembly enters the wing. (Refer to Chapter 25.)
- (2) Remove the two forward access panels from underside of wing between the fuselage and the wing nacelle.
- (3) Remove access panel from underside of wing nacelle.
- (4) Remove upper and lower engine cowl assemblies. (Refer to Chapter 71.)
- (5) Disconnect control cable from carburetor and remove fitting from end of cable.
- (6) Slide the two protective seals from control cable.
- (7) Remove retainer nut and washer securing control cable to bracket and slide cable from bracket.
- (8) Remove remaining retainer nut that secures control cable to bracket; from wing nacelle, pull cable through firewall.
- (9) Disconnect control cable from control handle by removing cotter pin, washers, and clevis pin. Remove rod end and locknut from cable.
- (10) Remove three screws and washers securing clamp on control quadrant.
- (11) Slide the two protective seals from control cable.
- (12) Remove ties securing control cable to other cables in the cockpit area.
- (13) From access openings in underside of wing, loosen the three clamps so that control cable can be pulled from the cockpit to wing nacelle access.

B. Install Control Cable Assembly

NOTE: If new control cable is being installed, remove the protective seals, nuts, and washers from control cable.

- (1) From wing nacelle access opening, route control cable through the three clamps in wing forward section to the back side of control quadrant. Route other end of cable through firewall of wing nacelle.

- (2) Install one retainer nut on control cable that secures cable to bracket at rear of carburetor and route cable through bracket. Install washer and remaining retainer nut securing cable to bracket.
- (3) Install the protective seals on each end of control cable (larger seal first).
- (4) Position control cable in clamp on back side of control quadrant and secure clamp with three screws and washers.
- (5) Tighten the three clamps securing the control cable in wing forward section, making sure that all cables and lines in clamps are properly seated.
- (6) Install suitable ties to secure control cable to control cable bundle in cockpit.
- (7) Install locknut and rod end on end of control cable at back side of control quadrant and connect rod end to control handle using clevis pin, washer, and cotter pin. Ensure that control handle mates within 0.06 (1/16) inch alignment with control handle of other engine.
- (8) Install locknut and fitting on carburetor end of control fitting.
- (9) Advance control handle forward on control quadrant to within 0.12 (1/8) inch minimum from end of slot.
- (10) Position lever arm on carburetor as follows:
 - (a) Position throttle lever arm against the full open stop.
 - (b) Position mixture lever arm to the full rich position.
- (11) With control handle in position outlined in Step (9) and lever arm in position outlined in Step (10), adjust fitting on end of control cable to align with hole in lever arm and connect control cable to carburetor.

CAUTION: ENSURE THAT THREAD ON CONTROL CABLE COVERS INSPECTION HOLE IN END FITTING. IF INSPECTION HOLE IS NOT COVERED, ADJUST RETAINER NUTS AT BRACKET TO OBTAIN MORE THREAD ENGAGEMENT.
- (12) Check thread engagement to ensure that inspection hole in end fitting is covered. Adjust retaining nut at bracket as required.
- (13) Secure locknut at control cable end fitting.
- (14) Move control handle through full travel and check for 0.12 (1/8) inch "pinch" at both ends of travel.
- (15) Operate engine and check the throttle control and/or mixture control for proper operation. (Refer to Pilot's Operating Handbook.)
- (16) Shut down engine. Correct any adjustments.

- (17) Install lower and upper cowling. (Refer to Chapter 71.)
 - (18) Install access panels to underside of wing and wing nacelle.
 - (19) Install interior furnishings and seat that was removed for access to control cable routing in cockpit.
2. Adjustment of Carburetor (Idle Speed and Mixture Adjustment)
- A. Adjust Carburetor
- (1) Remove upper cowl assembly. (Refer to Chapter 71.)
 - (2) Perform a normal engine warmup until oil temperature has stabilized (75°F minimum). (Refer to Pilot's Operating Handbook.)
 - (3) With engine operating at 1800 rpm, check for normal magneto rpm drop (175 rpm maximum drop with no more than 50 rpm difference between magnetos).
 - (4) Set the throttle stop idle speed adjustment screw on carburetor so that the engine idles at 600 to 650 rpm.
 - (5) With a smooth and steady motion, pull mixture control towards the idle cutoff position and observe the tachometer for any change in rpm. Return the mixture control to the full rich position prior to engine cutting out. An increase of more than 50 rpm while "leaning out" indicates an excessively rich idle mixture. An immediate decrease in rpm indicates the idle mixture is too lean.
 - (6) If the procedure in Step (5) indicates the fuel mixture is too rich or too lean, turn the idle mixture screw in the carburetor to obtain the necessary correction, and repeat Step (5).
 - (7) Each time the idle adjustment is changed, run the engine up to 2000 rpm before proceeding with the next rpm check.
 - (8) Check engine idle speed and if necessary, make final adjustments to obtain correct idle speed.
 - (9) Shut down engine.
 - (10) Install upper cowl assembly. (Refer to Chapter 71.)



FUEL PRESSURE INDICATING SYSTEM – DESCRIPTION/OPERATION

1. General

The fuel pressure indicating system consists of a fuel pressure gauge, fuel pressure transducer, associated wiring, and pressure line for each engine.

The fuel pressure gauges are mounted in the instrument cluster assembly on the instrument panel. (Refer to Chapter 28.)

The fuel pressure transducer is located at the rear of the engine and is connected to the engine driven fuel pump by a flexible fuel pressure line. The fuel pressure transducer sends electrical current to the fuel pressure gauge.

FUEL PRESSURE INDICATING SYSTEM – MAINTENANCE PRACTICES**1. Removal/Installation of Fuel Pressure Gauge**

Refer to Chapter 28 for removal and installation of fuel pressure gauge.

2. Removal/Installation of Fuel Pressure Transducer**A. Remove Fuel Pressure Transducer**

NOTE: Prior to removal of fuel pressure transducer, determine if transducer is defective. (Refer to troubleshooting in Chapter 28.)

- (1) Remove upper cowl assembly. (Refer to Chapter 71.)

CAUTION: TAG OR LABEL ALL WIRING PRIOR TO REMOVAL FOR REFERENCE ON INSTALLATION.

- (2) Tag and disconnect wires from fuel pressure transducer.

WARNING: WHEN FLEXIBLE FUEL LINES ARE DISCONNECTED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO FUEL SPILLAGE.

- (3) Disconnect fuel pressure line from fuel pressure transducer.

- (4) Remove fuel pressure transducer and braided strap by removing screw and washer from clamp.

B. Install Fuel Pressure Transducer

- (1) Position fuel pressure transducer and braided strap and secure using screw and washer through clamp. Ensure clamp is tight for positive ground.

WARNING: WHEN FLEXIBLE FUEL LINES ARE UNCAPPED, SOME FUEL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT FIRE HAZARD DUE TO FUEL SPILLAGE.

- (2) Remove plug from fuel pressure line and connect to fuel pressure transducer.

- (3) Connect wires to fuel pressure transducer.

- (4) Operate engine and observe fuel pressure gauge for normal indication. (Refer to Pilot's Operating Handbook.)

- (5) Shut down engine.

- (6) Install upper cowl assembly. (Refer to Chapter 71.)

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IGNITION SYSTEM – DESCRIPTION/OPERATION

1. General

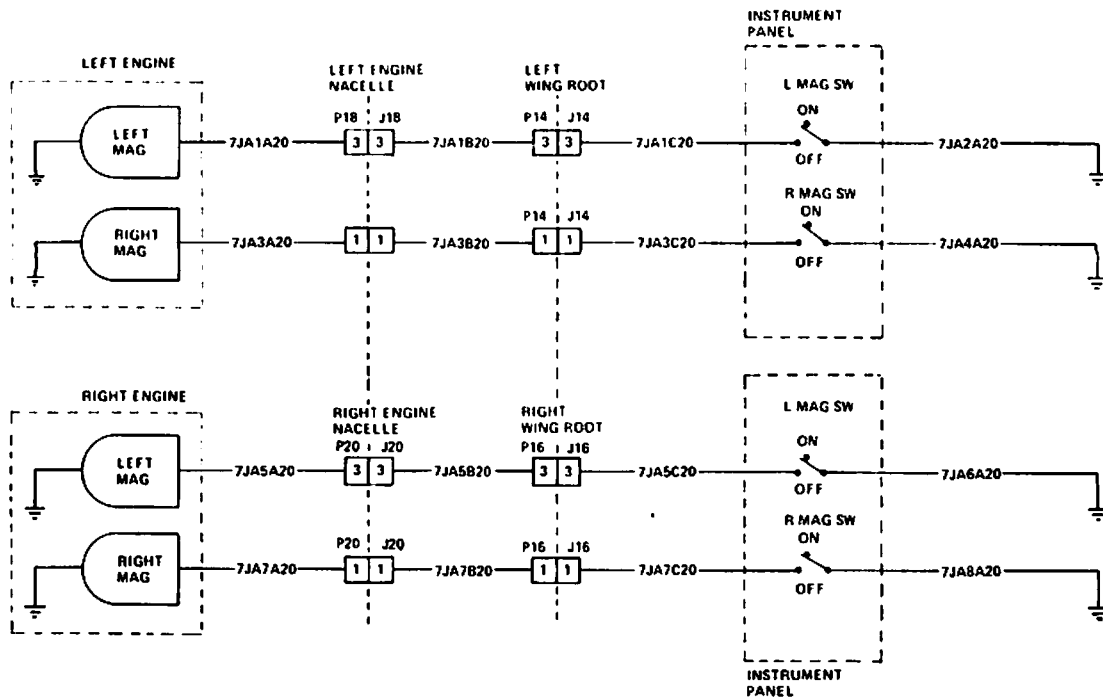
The ignition system components generate, control, and distribute an electrical current to ignite the fuel-air mixture in the cylinders. The engine dual-ignition system consists of the magnetos, shielded harness, spark plugs, and individual magneto switches. The magnetos are a sealed, lightweight type requiring no internal adjustments. Timing the magneto to the engine is the only adjustment required. Each lead of the ignition harness can be removed separately. The magneto switches are located on the lower left-hand side of the instrument panel.

MAGNETO – DESCRIPTION/OPERATION

I. General (See Figure 1.)

The magnetos supply the electrical current to the spark plugs which in turn ignite the fuel-air mixture in the cylinders. The magnetos are a sealed, lightweight type requiring no internal adjustments. Timing the magneto to the engine is the only adjustment required.

The GA-7/Cougar engines are designed to start on the left magneto. The left magneto (only) has impulse coupling.



74G72-1

**Magneto – Wiring Diagram
Figure 1**

MAGNETO – MAINTENANCE PRACTICES

1. Removal/Installation of Magneto

A. Removal of Magneto

WARNING: DURING ALL MAGNETO MAINTENANCE, TAKE PROPER PRECAUTIONS TO MAKE SURE THE ENGINE CANNOT FIRE OR START WHEN THE PROPELLER IS MOVED.

- (1) Remove engine cowling.
- (2) Disconnect the magneto ground wire ("P" lead) and shielding terminal.
- (3) Remove the distributor cap assembly.
- (4) Remove the mounting lugs and withdraw the magneto.

NOTE: Make a note of the approximate angle the magneto makes with the engine centerline as an aid in its subsequent installation.

B. Installation of Magneto

- (1) Rotate the propeller in the normal direction of rotation until No. 1 cylinder enters its compression cycle.

NOTE: To determine if the No. 1 cylinder is in the compression cycle, remove the top plug from the No. 1 cylinder and place thumb over the port. As the piston approaches the end of the compression stroke, a positive pressure will try to force the thumb off the port.

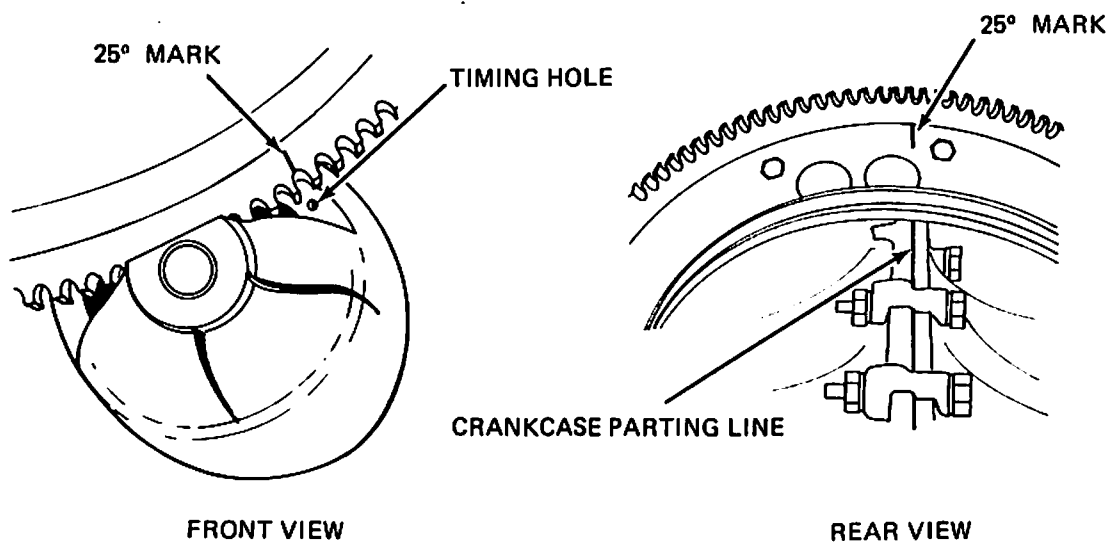
- (2) Continue turning the propeller in the normal direction of rotation until the 25 degree advance timing mark on the forward face of the flywheel becomes aligned with the small hole drilled in the head of the starter casing. Alternate method is to align the 25 degree advance mark on the back of the flywheel with the crankcase parting line. At this point, the engine is ready to receive the magnetos. (See Figure 201.)

NOTE: Starter ring gear may be marked at 20 degrees and 25 degrees. Consult engine data plate for correct timing mark for your installation.

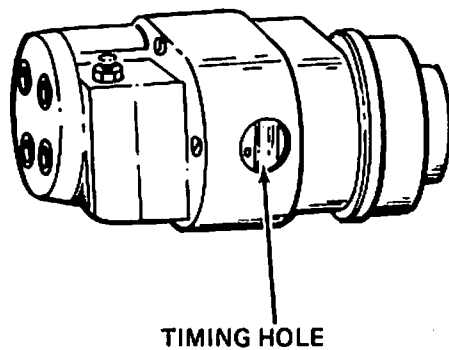
- (3) Remove the plug from the bottom of the magneto. (See Figure 202.)

NOTE: In order to rotate the magneto incorporating an impulse coupling, depress the pawl on the impulse coupling with the finger.

- (4) Rotate the magneto shaft until a spark occurs from No. 1 lead (hold screwdriver close to No. 1 lead while turning the shaft). As soon as the spark occurs, slowly reverse direction until the timing hole in the rotor is centered in the plug opening. (See Figure 202.)



**Advance Timing Alignment
Figure 201**



**Magneto Timing Hole
Figure 202**

74G72-2

NOTE: Failure to spark check the No. 1 position leaves the possibility of the magneto being 180 degrees out of phase. The timing hole appears in the plug opening twice for every complete firing cycle.

- (5) Insert a pin (0.093 inch diameter) into the timing hole in order to keep the rotor in the timed position.
- (6) Position the magneto into the crankcase at the approximate angle noted on removal. Be sure gasket is installed behind the magneto mounting flange.
- (7) Install the attach clip over the magneto mounting flange and tighten the nut finger-tight.

NOTE: Install the magneto with the impulse coupling on the left side.

- (8) Install the second magneto in the same manner as described in steps (3) through (7).

CAUTION: DO NOT ROTATE THE PROPELLER WITH THE PIN STILL INSTALLED IN THE MAGNETO TIMING HOLE.

- (9) Final timing should be accomplished with a timing light. Using a battery-powered timing light, attach the positive leads to the magneto ground terminal, and the negative leads to any unpainted portion of the engine.
- (10) Remove the pins from the magnetos.
- (11) Rotate the magneto in its mounting flange until the light comes on. Slowly turn the magneto in the opposite direction until the light goes off. Bring the magneto back slowly until the light just comes on.

NOTE: Some timing lights operate in the reverse manner as described above. The lights come on when the breaker points open. Check timing light instructions.

- (12) Repeat this process for the other magneto.
- (13) Upon timing both magnetos, check to ascertain that both magnetos will fire simultaneously.

NOTE: To check the simultaneous firing of both magnetos, back off on the propeller a few degrees (timing light should go out). Bring the propeller back slowly in the direction of normal rotation until the 20 degree or 25 degree (depending on installation) advanced timing mark aligns with the hole in the starter casing. At this point, both lights should go on simultaneously. When timing the magneto to the engine, a maximum tolerance of ± 2 degrees is allowable.

- (14) Tighten the magneto mounting nut and torque to 150 inch-pounds and install magneto ground wire and shielding terminal.

- (15) When the magneto shows an excessive rpm loss or has reached a total of 900 hours, whichever comes first, the magneto should be returned to the magneto manufacturer for exchange. No attempt should be made to repair the magneto in the field since disassembly of the magneto will void its warranty.

NOTE: If the drive shaft nut has been removed from the magneto incorporating the impulse coupling, care should be exercised when reassembling, not to overtighten. The recommended torque is 156 inch-pounds. Torque may be increased to line up hole with slot in nut.

- (16) Replace engine cowling.

IGNITION DISTRIBUTION – DESCRIPTION/OPERATION

1. **General**

The ignition distribution is a dual system. The output of each magneto is applied to all four cylinders. The ignition distribution system consists of the leads, from the magnetos, and the spark plugs. Each lead is shielded and can be removed separately.

IGNITION DISTRIBUTION – MAINTENANCE PRACTICES

1. Inspection of Ignition Distribution System Components

- A. Check magneto harness for security of mounting clamps, tight connections, and frayed shielding.

WARNING: USE SOLVENTS IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

- B. Examine spark plug lead shielding, compression springs, and ceramics for corrosion and deposits. If this condition exists, clean the leads and ceramics with a clean cloth moistened with methyl ethyl ketone.

NOTE: If lead has been disassembled, see Figure 201 for correct arrangement at reassembly.

- C. Remove and check spark plugs for proper gap and evidence of fouling. Clean and regap plugs if necessary. (See latest revision of Lycoming Service Instruction No. 1042.) Plugs should be rotated upper-to-lower every 100 hours of plug service, or sooner if lead fouling occurs.
- D. Check magnetos to engine timing. If necessary, time the magnetos to the engine. The magneto-to-engine timing check should be made every 100 hours.

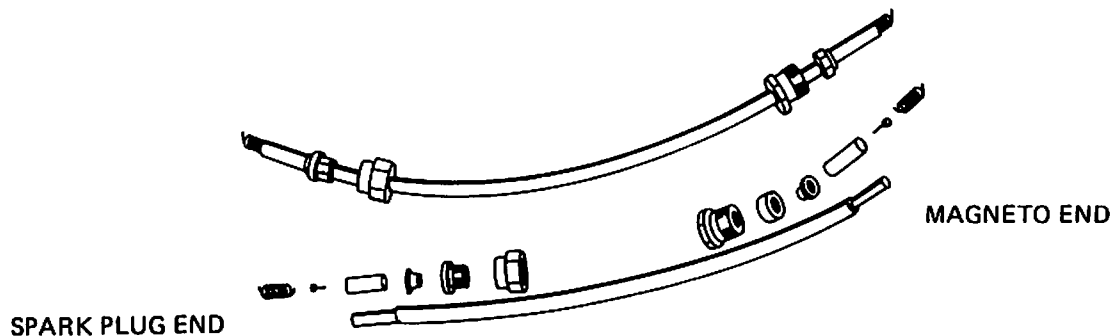
2. Removal/Installation of Ignition Distribution System Components

- A. Remove Ignition Harness.

- (1) Remove engine cowling.
- (2) Tag or identify each lead for reference at installation.
- (3) Disconnect harness leads at spark plugs.
- (4) Remove clamps securing the harness to the cylinder head.
- (5) Remove harness ties to engine mount.
- (6) Remove plastic ties as necessary to separate harness leads.
- (7) Remove attaching screws from magneto caps.
- (8) Remove the magneto caps and harness as an assembly.

- B. Install Ignition Harness.

- (1) Route ignition harness leads as shown in Figure 202. (For alternate ignition lead routing, see Lycoming Service Instruction No. 1294.)
- (2) Install ignition harness leads and magneto caps on magnetos.
- (3) Connect ignition harness leads to spark plugs. Tighten nut finger-tight plus one-fourth turn.



74G72-3

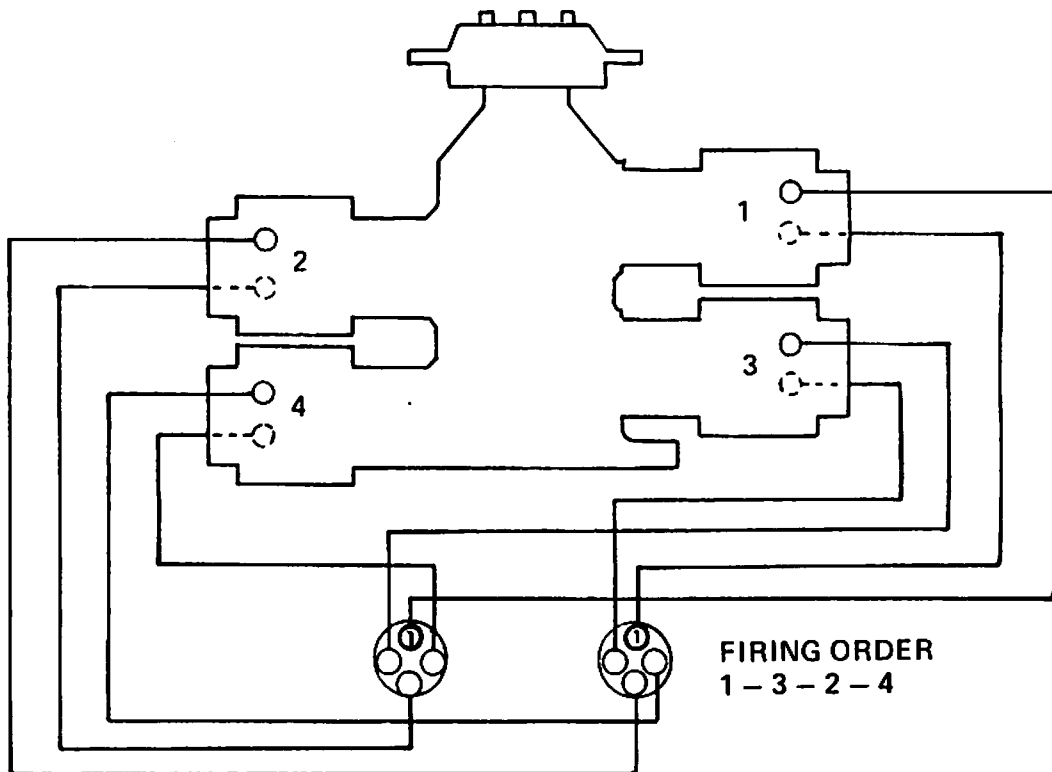
NOTE: Refer to Slick Electro pamphlet (Form No. 1009-5M-8-68) for assembly instructions and tool requirements. Slick Electro Inc., 530 Blackhawk Park Avenue, Rockford, Ill. 61101.

Magneto Lead Disassembly/Assembly
Figure 201

- (4) Install plastic ties on harness as necessary.
 - (5) Install clamps securing ignition leads to cylinder heads as necessary.
 - (6) Secure ignition harness to engine mount as necessary.
 - (7) Remove identification tags installed prior to removal.
 - (8) Replace engine cowling.
- C. Remove Spark Plugs.
- (1) Remove engine cowling.
 - (2) Disconnect ignition leads from spark plugs.
 - (3) Remove spark plugs.
- D. Install Spark Plugs.

NOTE: Ensure spark plugs are correctly gapped before installing.

- (1) Apply anti-seize compound on all but first two threads of the spark plug.



Ignition System Schematic
Figure 202

74G72-4

- (2) Install spark plugs and torque to 360 to 420 inch-pounds.
- (3) Attach ignition leads to spark plugs. Tighten nut finger-tight plus one-fourth turn.
- (4) Replace engine cowling.

CHAPTER 77

ENGINE INDICATING

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Removal/Installation of Exhaust Gas Temperature (EGT) Probe	202

ENGINE INDICATING SYSTEM – DESCRIPTION/OPERATION**1. General**

Because of the simplicity of the engines installed in the GA-7/Cougar aircraft, only a limited number of engine indicating instruments are required. Most of the engine indicating instruments are discussed in their specifically related system chapters. This chapter covers the tachometer, cylinder head temperature, manifold pressure, and exhaust gas temperature (EGT) indicating systems. The exhaust gas temperature (EGT) indicating is an optional item.

ENGINE INSTRUMENT MARKINGS	
Tachometer Green Arc (Normal Operating Range) Red Radial Line (Maximum)	2000 to 2700 RPM 2700 RPM
Manifold Pressure	Range 10 to 35 in. Hg.
Cylinder Head Temperature Green Bar Red Radial Line (Never Exceed) White Radial Line	200°F to 500°F 500°F 200°F and 300°F

TACHOMETER SYSTEM – DESCRIPTION/OPERATION

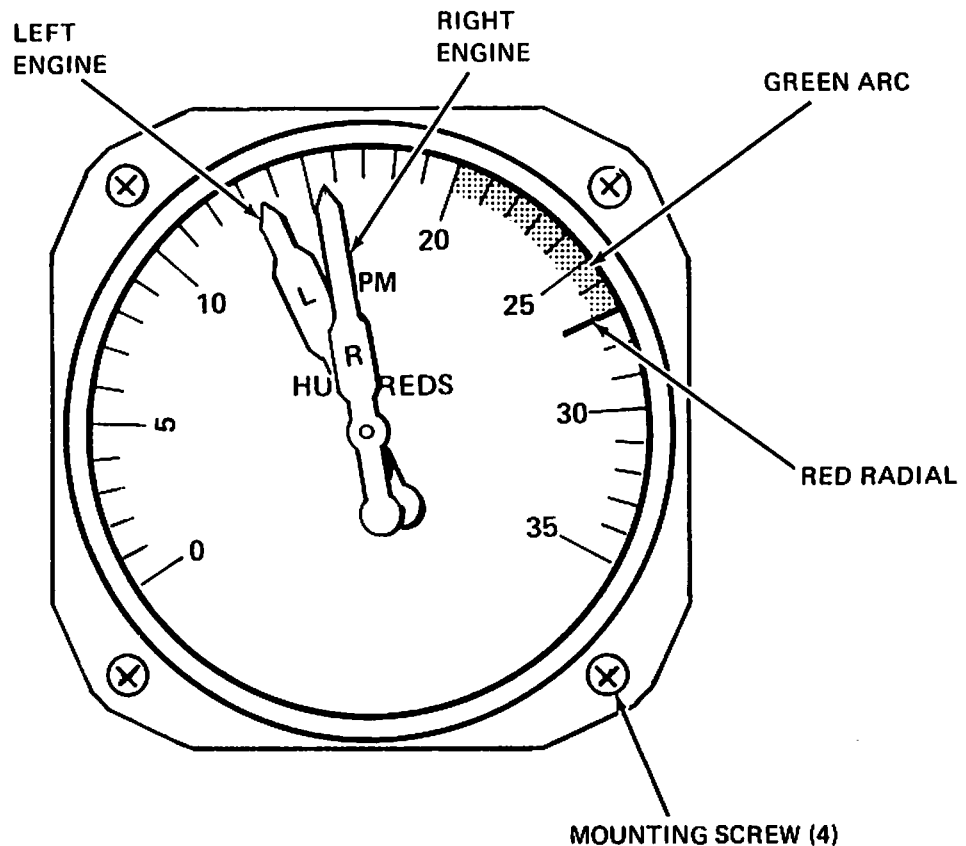
1. General (See Figures 1 and 2.)

The tachometer is an electrically operated indicator, mounted on the lower center of the instrument panel. The tachometer is a dual indicator which indicates the revolutions per minute (rpm) of each engine. The tachometer is electrically connected to a tach generator mounted on the firewall in each engine nacelle. The tach generators are connected to the engines by flexible cables. The tach generator rotates at the rate the crankshaft revolves in rpm and produces electrical impulses that are applied to the tachometer. The tachometer is calibrated in hundreds of rpm.

The tachometer provides the pilot with throttle control information necessary in making required power settings and adjustments for takeoff, climb, cruise, and descent. The tachometer is also used when making magneto checks and for maintenance checks of the engine.

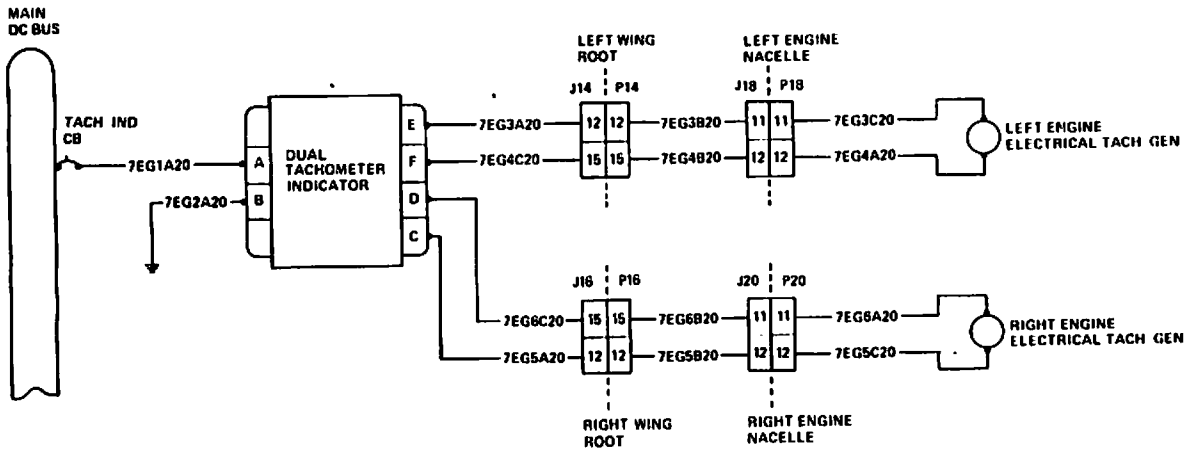
The tachometer dial is color coded for easy interpretation. The green arc on the face of the instrument indicates the normal, safe operating range of the engine. The red line is the maximum allowable rpm.

A drop in engine rpm could be an indication of carburetor ice buildup.



**Dual Tach Indicator
Figure 1**

77G72-1



**Electrical Tachometer – Wiring Diagram
Figure 2**

77G72-2

TACHOMETER SYSTEM – TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
<p>No rpm indication from either engine.</p>	Master switch open.	Close switch.
	Tachometer circuit breaker open or defective.	Close or replace circuit breaker.
	Tachometer defective.	Replace tachometer.
<p>No indication from right engine.</p>	Right engine tach generator defective.	Replace tach generator.
	Flexible cable from engine to tach generator defective.	Replace flexible cable.
	Defective electrical wiring.	Repair wiring.
	Tachometer defective.	Replace tachometer.
<p>No indication from left engine.</p>	Left engine tach generator defective.	Replace tach generator.
	Flexible cable from engine to tach generator defective.	Replace flexible cable.
	Defective electrical wiring.	Repair wiring.
	Tachometer defective.	Replace tachometer.

TACHOMETER SYSTEM - MAINTENANCE PRACTICES**1. Removal/Installation of Tachometer****A. Removal of Tachometer**

- (1) Disconnect tachometer electrical cable on rear of instrument.
- (2) Remove four mounting screws and remove tachometer from instrument panel.

B. Installation of Tachometer

- (1) Place tachometer in position on instrument panel and secure with four screws.
- (2) Connect electrical cable to rear of tachometer.

2. Removal/Installation of Tach Generator

4

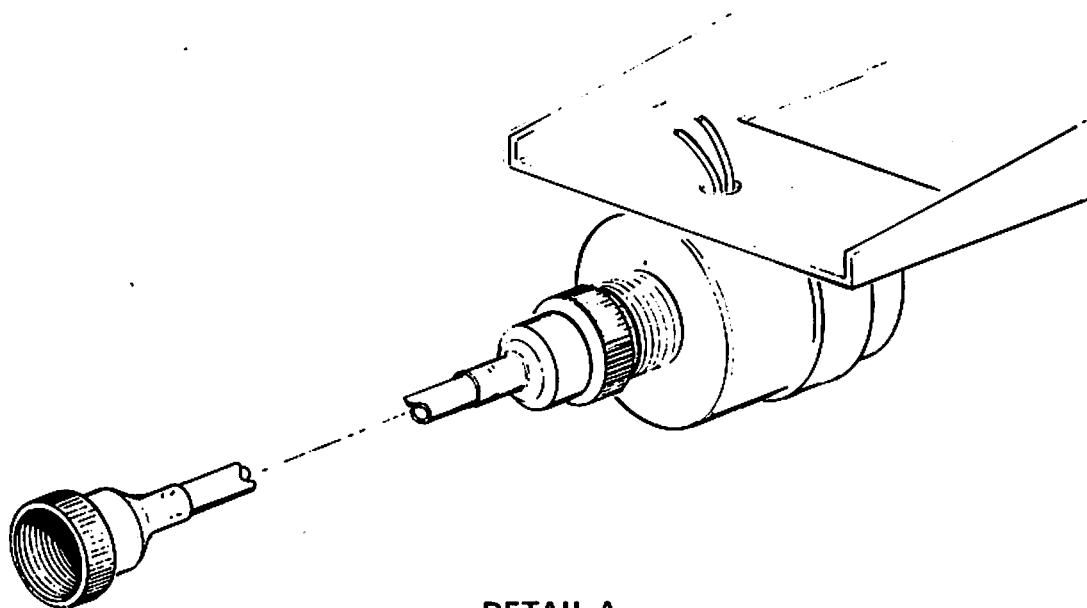
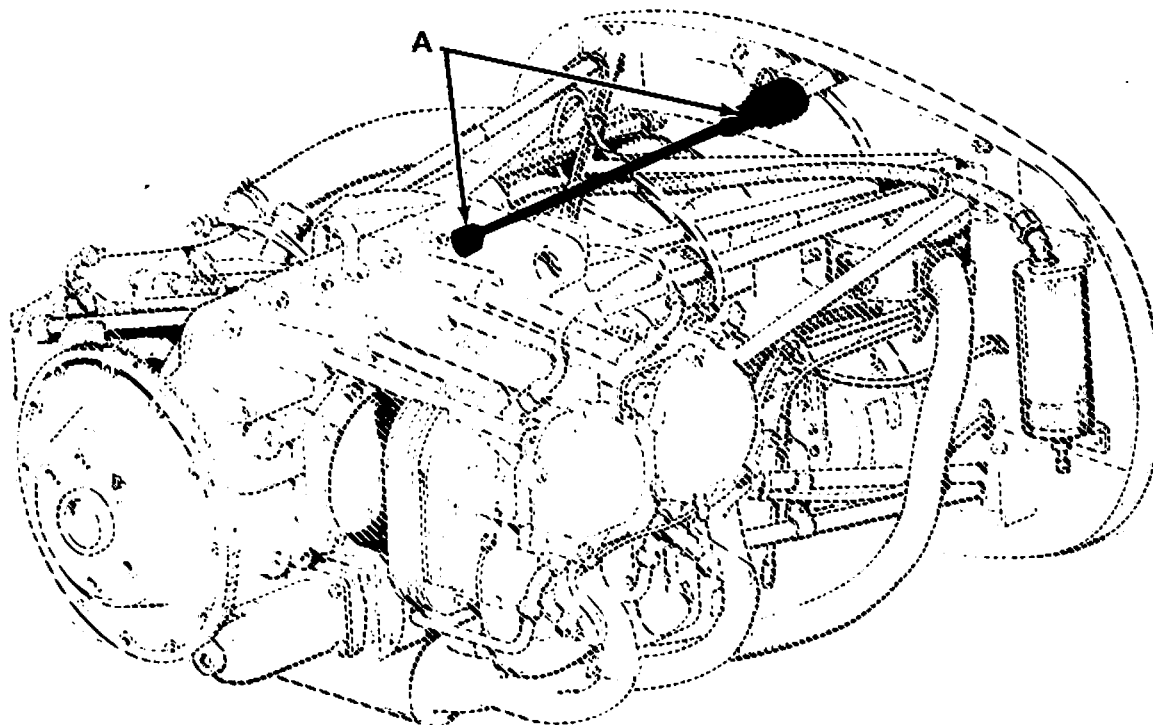
A. Removal of Tach Generator (See Figure 201.)

NOTE: A tach generator is mounted on the firewall of each engine nacelle.

- (1) Remove upper engine cowling.
- (2) Disconnect flexible cable from tach generator.
- (3) Disconnect tach generator electrical wires from engine nacelle plug.
- (4) Loosen the two screws from clamp around tach generator.
- (5) Remove tach generator.

B. Installation of Tach Generator (See Figure 201.)

- (1) Place tach generator inside clamp and connect flex cable. Tighten the two screws to secure the clamp.
- (2) Connect the electrical wires from the tach generator to the engine nacelle plug.
- (3) Connect the flexible cable between tach generator and engine.
- (4) Replace upper engine cowling.



DETAIL A

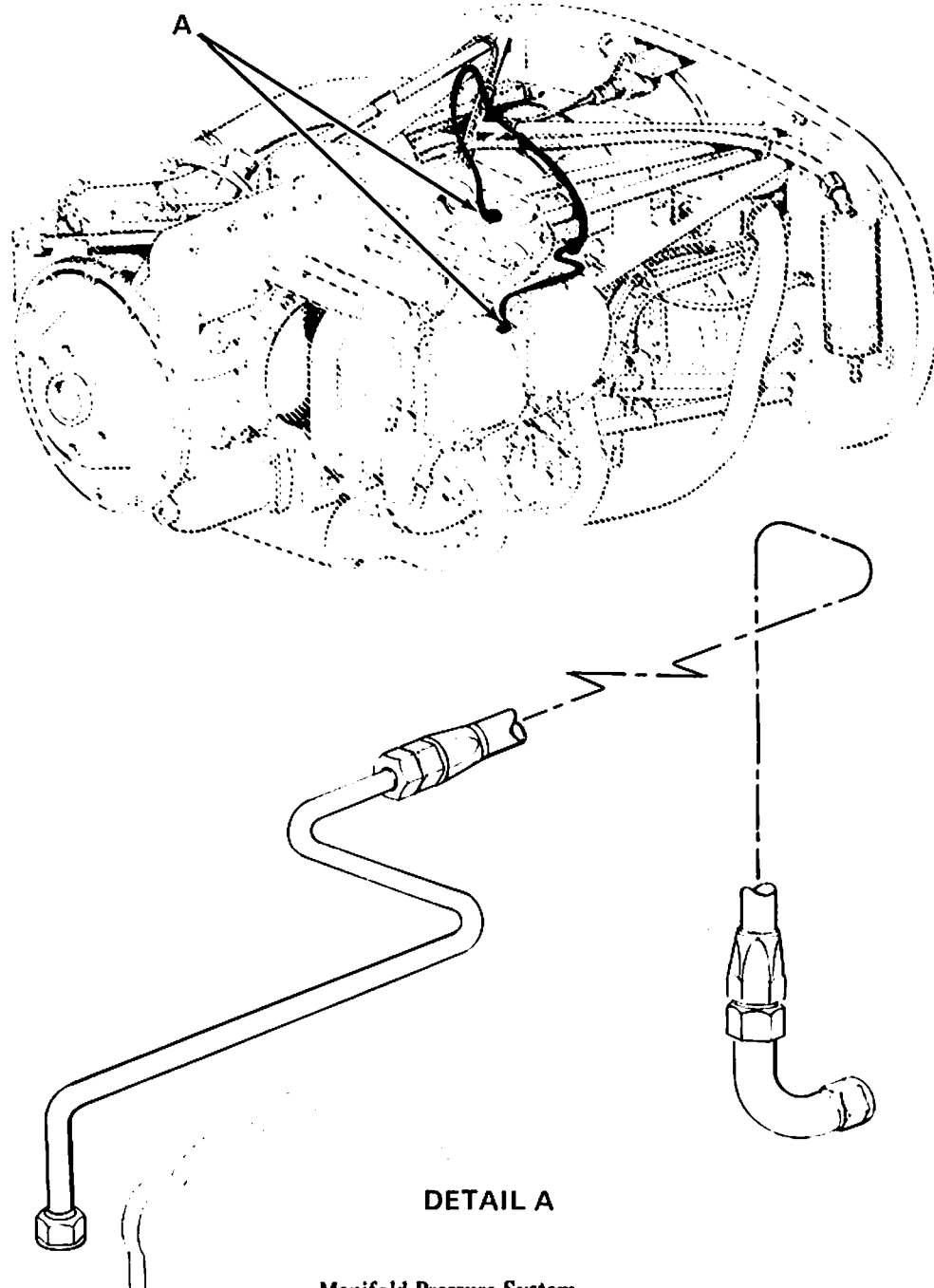
**Tach Generator and Flexible Cable – Removal/Installation
Figure 201**

77G72-3

MANIFOLD PRESSURE SYSTEM – DESCRIPTION/OPERATION

1. General (See Figure 1.)

The dual manifold pressure gauge is a vapor proof, absolute pressure type instrument calibrated from 10 to 35 inches of mercury. The manifold pressure is picked up from number four cylinder of each engine.



**Manifold Pressure System
Figure 1**

77G72-4

MANIFOLD PRESSURE SYSTEM – TROUBLESHOOTING**1. Troubleshooting the Manifold Pressure System**

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instrument.
Excessive error when engine is running.	Line leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Defective instrument.	Replace instrument.
Dull or discolored markings.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines at instrument and blow out.

MANIFOLD PRESSURE SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of Manifold Pressure Gauge

A. Removal of Manifold Pressure Gauge

NOTE: In the following procedure, tag each hose to aid in reinstallation.

- (1) Disconnect the two pressure lines from the rear of the manifold pressure gauge. Cover the ends of the hoses to prevent foreign matter from entering the hoses.
- (2) Remove the four screws securing the manifold pressure gauge to the instrument panel.
- (3) Remove manifold pressure gauge.

B. Installation of Manifold Pressure Gauge

- (1) Place manifold pressure gauge in position on instrument panel and secure with four screws.

NOTE: In the following procedure, ensure the right and left engine hoses are connected to their respective inputs.

- (2) Connect the two pressure lines to the rear of the gauge.

2. Removal/Installation of Manifold Pressure Lines

The manifold pressure gauge is connected by both rubber and metal tubing to each engine. The rubber tubing is fastened to its connections by spring clamps. When installing or replacing the metal tubing, seal the connections with MIL-T-5544 Graphite-Petroleum or equivalent sealant. Apply to male threads only and always omit the first two threads.

ENGINE TEMPERATURE INDICATING SYSTEM – DESCRIPTION/OPERATION

1. General

Two of the instruments used to indicate engine operating temperatures are the cylinder head and exhaust gas temperature (EGT) indicators. The EGT indicator is located on lower left center of the instrument panel. The cylinder head temperature indicators are located in the instrument cluster on the right side of the instrument panel.

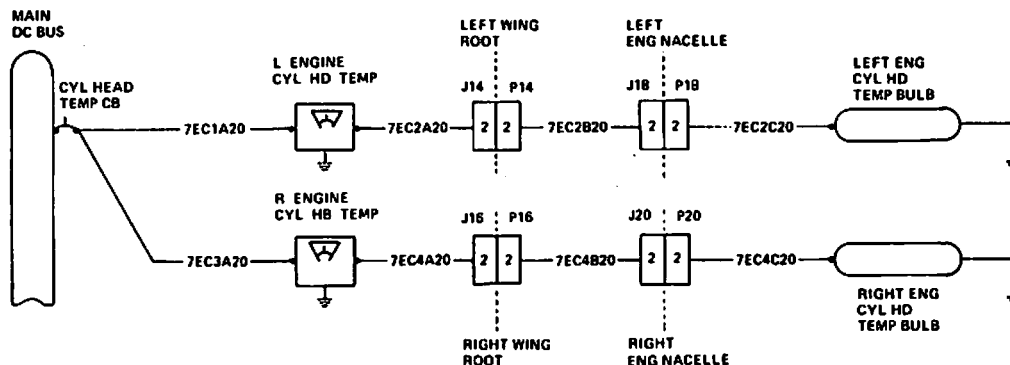
The use of these indicators aid the pilot in setting the most economical fuel-air mixture for cruising flight at a power setting of 75 percent or less.

2. Cylinder Head Temperature Indicator (See Figure 1.)

There are two cylinder head temperature indicators, one for each engine. This instrument measures the cylinder head temperature using a sensor located in a cylinder head. The cylinder head used is the hottest head in normal operation. The engines in the GA-7/Cougar use cylinder number three. This indicator is electrical and is wired through a circuit breaker mounted on the instrument panel.

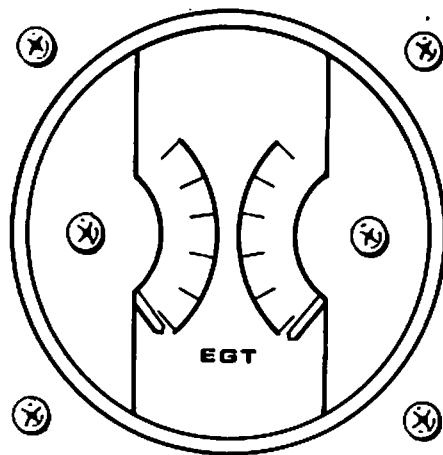
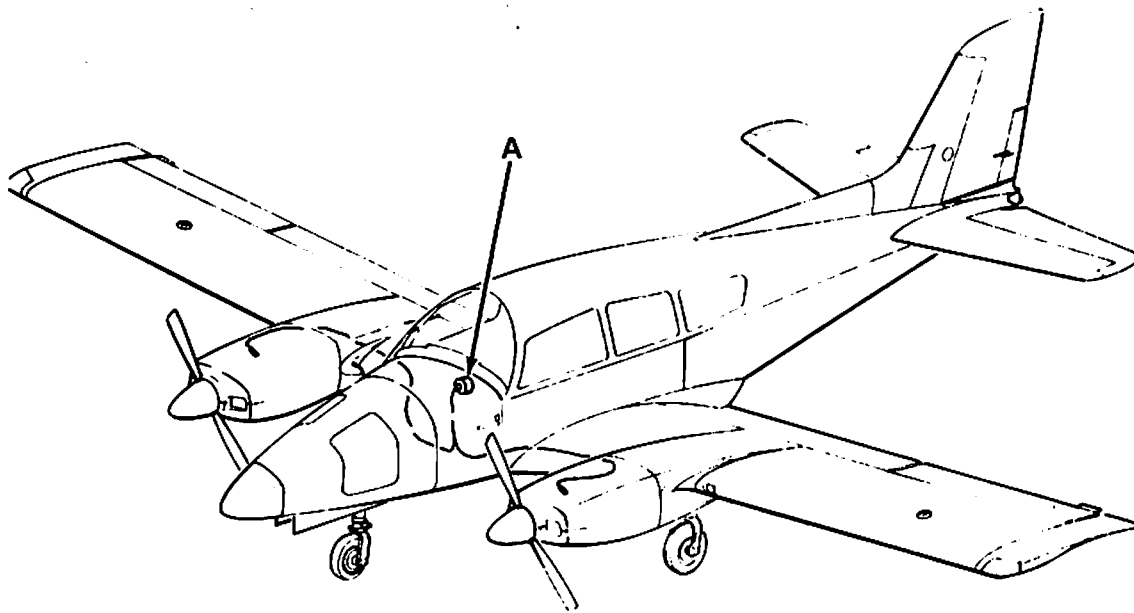
3. Exhaust Gas Temperature (EGT) Indicator (Optional) (See Figure 2.)

This indicator, which is commonly referred to as EGT, is used to aid the pilot in setting the economical fuel-air mixture for cruising flight at a power setting of 75 percent or less. It is a sensing device that monitors the temperature of exhaust gases leaving the engine cylinders. The temperature sensor is placed in the exhaust pipe of cylinder number three.



Cylinder Head Temperature – Wiring Diagram
Figure 1

77G72-5



DETAIL A

**Exhaust Gas Temperature (EGT) System
Figure 2**

77G72-6

ENGINE TEMPERATURE INDICATING SYSTEM – TROUBLESHOOTING

1. Troubleshooting Cylinder Head Temperature Indicator System

TROUBLE	PROBABLE CAUSE	REMEDY
Both instruments show no indication.	Master switch open.	Close master switch.
	Cylinder head temperature circuit breaker open or defective.	Close or replace circuit breaker.
	Defective instruments.	Replace instruments.
Right engine indicator shows no indication. (Engine is operating.)	Defective temperature sensor.	Replace sensor.
	Defective indicator.	Replace indicator.
	Defective wiring (open) between sensor and indicator.	Repair wiring.
Right engine indicator goes all the way to upper limit. (Engine not hot.)	Defective wiring (grounded) between sensor and indicator.	Repair wiring.
	Defective sensor.	Replace sensor.
Left engine indicator shows no indication. (Engine is operating.)	Defective temperature sensor.	Replace sensor.
	Defective indicator.	Replace indicator.
	Defective wiring (open) between sensor and indicator.	Repair wiring.
Left engine indicator goes all the way to upper limit. (Engine not hot.)	Defective wiring (grounded) between sensor and indicator.	Repair wiring.
	Defective sensor.	Replace sensor.

2. Troubleshooting Exhaust Gas Temperature (EGT) Indicator System

TROUBLE	PROBABLE CAUSE	REMEDY
No EGT indication from either engine.	Defective indicator.	Replace indicator.
No EGT indication from right engine.	Defective temperature probe.	Replace probe.
	Defective wiring.	Repair wiring.
	Defective indicator.	Replace indicator.

TROUBLE	PROBABLE CAUSE	REMEDY
No EGT indication from left engine.	Defective temperature probe.	Replace probe.
	Defective wiring.	Repair wiring.
	Defective indicator.	Replace indicator.

ENGINE TEMPERATURE INDICATING SYSTEM – MAINTENANCE PRACTICES

1. Removal/Installation of Cylinder Head Temperature Indicator (See Figure 201.)

A. Removal of Cylinder Head Temperature Indicator

- (1) Ensure the master switch is OFF.

NOTE: In the following procedure, tag each lead to aid in reinstallation.

- (2) At right side of the instrument panel, behind the right instrument cluster, disconnect electrical leads from the back of each indicator in the right instrument cluster.
- (3) At front of the instrument, remove four screws holding the instrument cluster to the instrument panel. Retain screws for reuse.
- (4) From front of the instrument panel, push instrument cluster slightly backward and downward to clear instrument panel. This will free faceplate of instrument cluster.
- (5) Lower instrument cluster from behind instrument panel.
- (6) While holding front of cylinder head temperature indicator that is to be removed, remove locknuts and insulating washers that secure cylinder head temperature indicator to instrument cluster case. Retain nuts and washers for reuse.
- (7) Disengage and remove indicator from instrument cluster case.

B. Installation of Cylinder Head Temperature Indicator

- (1) Place cylinder head temperature indicator in instrument cluster case so studs protrude through holes in the case.
- (2) Properly align face of cylinder head temperature indicator in instrument cluster and secure with nuts and washers previously removed.
- (3) Place instrument cluster faceplate in position on instrument cluster and place instrument cluster in position behind instrument panel.
- (4) Secure instrument cluster to instrument panel with four screws previously removed.
- (5) Connect electrical leads to connections on the back of each indicator on the right instrument cluster.

2. Removal/Installation of Cylinder Head Temperature Probe (See Figure 202.)

A. Removal of Cylinder Head Temperature Probe

- (1) Remove upper and lower engine cowling.
- (2) Locate cylinder head temperature probe on bottom of cylinder number three (beneath lower spark plug of number three cylinder).
- (3) Remove lead from probe.

(4) Remove probe from engine.

B. Installation of Cylinder Head Temperature Probe

- (1) Install probe in opening beneath lower spark plug of number three cylinder. Torque to standard value. (See Chapter 91.)
- (2) Attach lead to probe.
- (3) Replace lower and upper engine cowling.

3. Removal/Installation of Exhaust Gas Temperature (EGT) Indicator

A. Removal of Exhaust Gas Temperature (EGT) Indicator

- (1) Disconnect the two leads from the rear of the EGT indicator.
- (2) Remove the four screws and nuts securing the instrument to the instrument panel. Retain for future use.

B. Installation of Exhaust Gas Temperature (EGT) Indicator

- (1) Place EGT indicator in position on instrument panel and secure with the four screws and nuts previously removed.
- (2) Connect the two leads to the rear of the indicator.

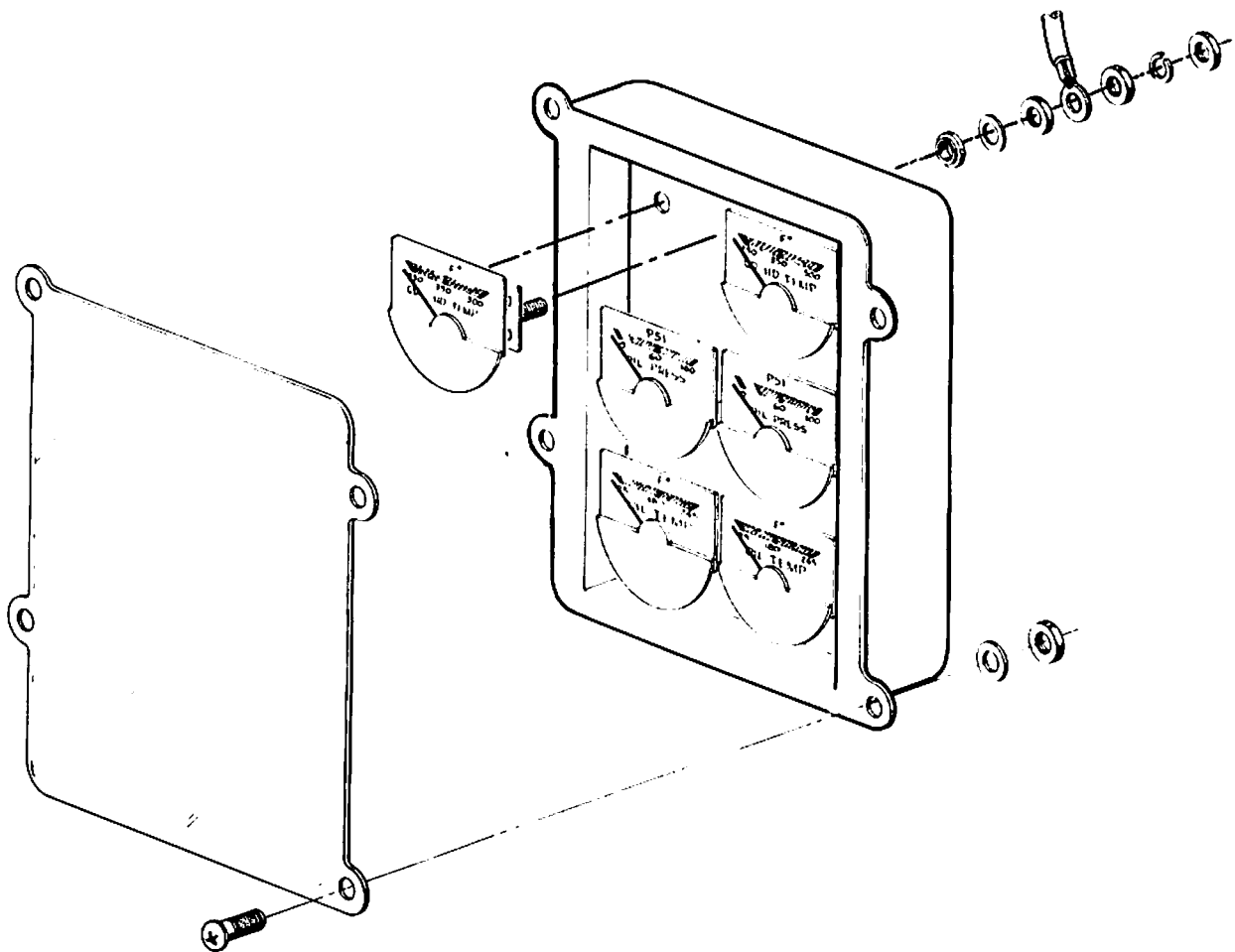
4. Removal/Installation of Exhaust Gas Temperature (EGT) Probe (See Figure 203.)

A. Removal of EGT Probe

- (1) Remove the upper and lower engine cowling.
- (2) Locate the EGT probe attached to the exhaust pipe of cylinder number three.
- (3) Disconnect the wires attached to the EGT probe.
- (4) Remove safety wire from band screw.
- (5) Loosen and remove the clamp/probe assembly from around exhaust pipe.

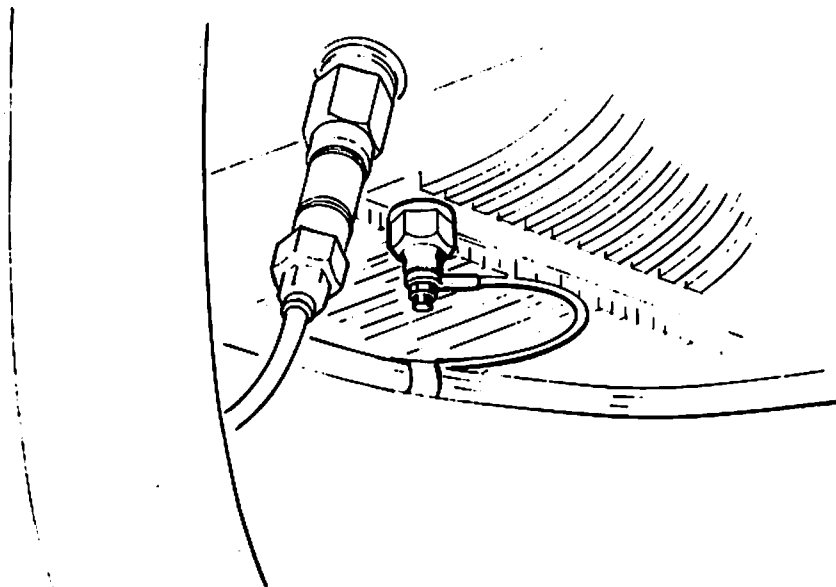
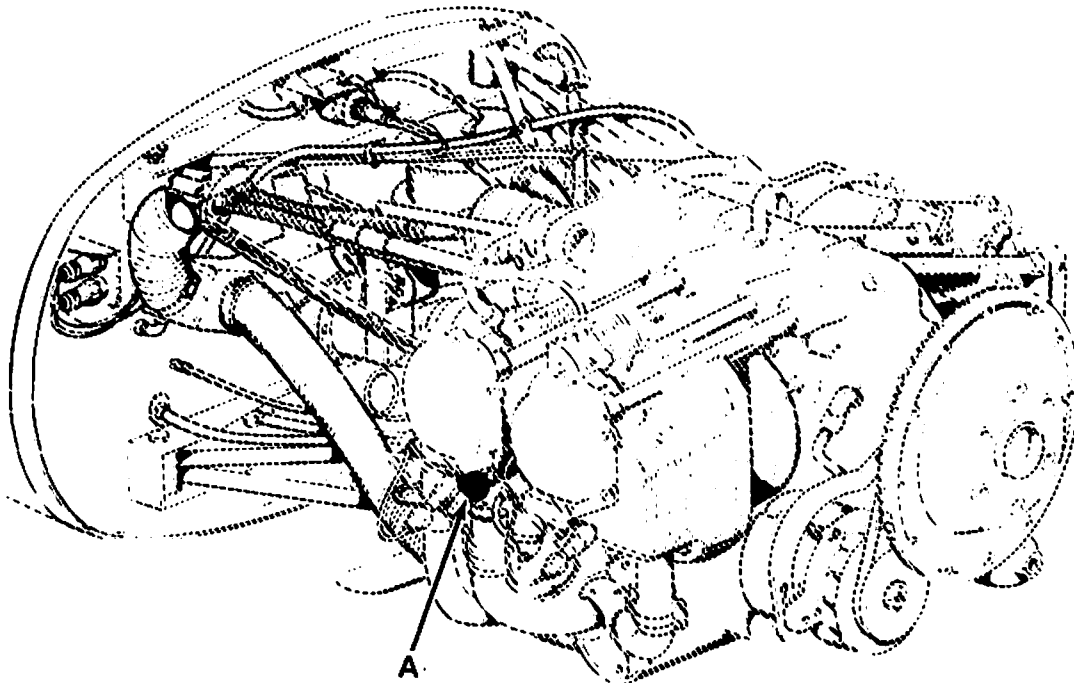
B. Installation of EGT Probe

- (1) Insert EGT probe into hole in exhaust pipe of number three cylinder and position clamp around exhaust pipe.
- (2) Tighten clamp band screw to secure clamp/probe assembly to exhaust pipe. (Torque screw to 45 inch-pounds.)
- (3) Attach safety wire to bank screw.
- (4) Attach wires to EGT probe.
- (5) Replace lower and upper engine cowling.



**Cylinder Head Temperature Indicator – Removal/Installation
Figure 201**

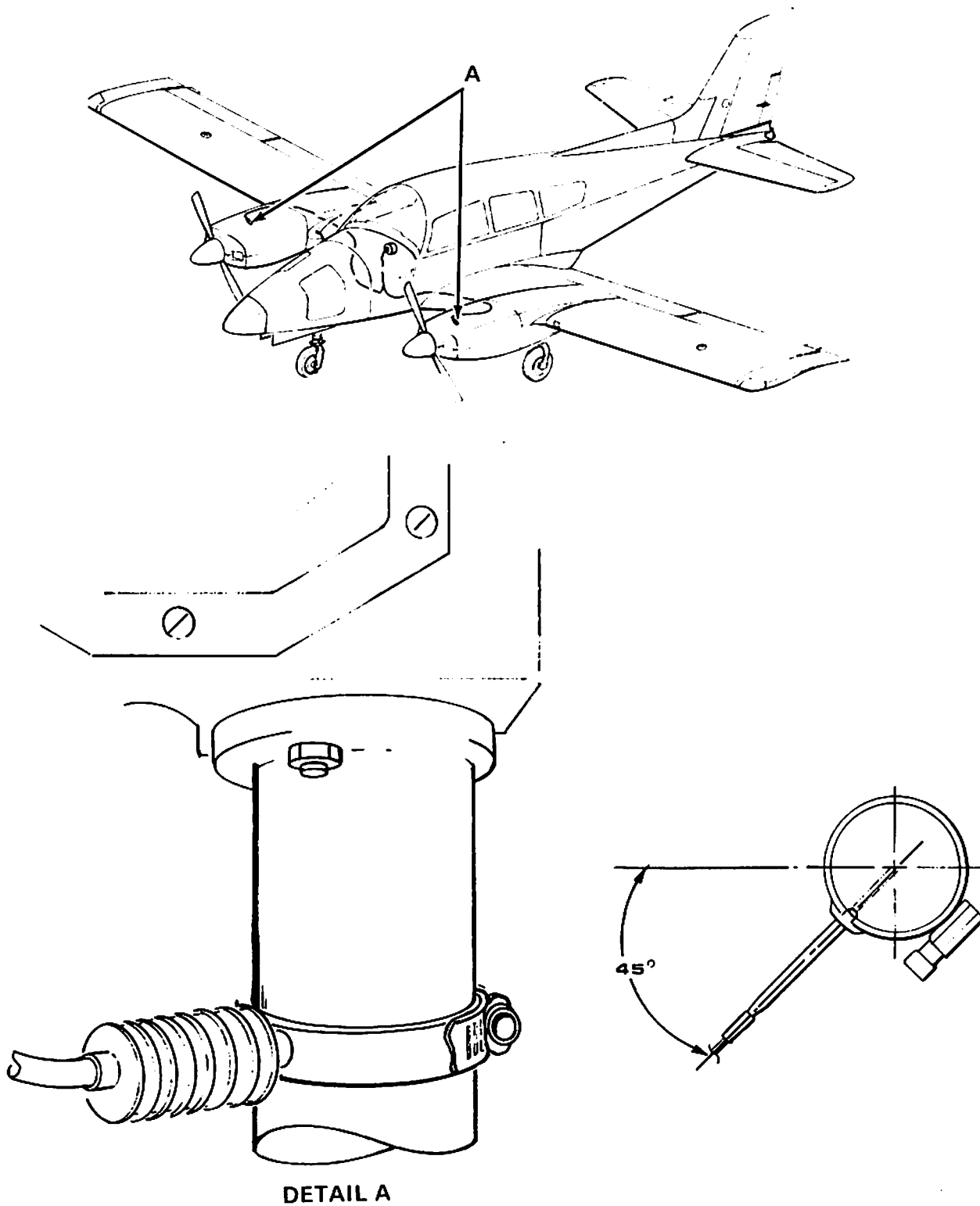
77G72-7



DETAIL A

**Cylinder Head Temperature Probe – Removal/Installation
Figure 202**

77G72-8



**Exhaust Gas Temperature Probe – Removal/Installation
Figure 203**

77G72-9

CHAPTER 78

EXHAUST

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ENGINE EXHAUST SYSTEM – DESCRIPTION/OPERATION

1. General

The engine exhaust system consists of an integral muffler and exhaust pipe, clamp assemblies, risers, and gaskets. The muffler is enclosed by a metal shroud which has provisions for attaching two flexible duct type tubes. One tube transfers heated air to the cabin for cabin heating. The second tube transfers heated air to the carburetor for carburetor heat as required. An inlet port is also incorporated into the shroud which mates with the forward baffle to receive ram air from an opening in the cowl assemblies. An exhaust gas temperature probe is attached to the riser of No. 3 exhaust port.

ENGINE EXHAUST SYSTEM – MAINTENANCE PRACTICES**1. Removal/Installation of Engine Exhaust System (See Figure 201.)****A. Remove Engine Exhaust System**

- (1) Remove upper and lower cowl assemblies. (Refer to Chapter 71.)
- (2) Loosen clamps (1) and disconnect cabin heat tube (2) and carburetor heat tube (3) from shroud (4).
- (3) Remove bolts (5) and nuts (6) securing supports (7) to forward baffles.
- (4) Remove exhaust gas temperature probe (8) from riser at No. 3 exhaust port. (Refer to Chapter 77.)
- (5) Remove nuts (9) and washers (10) and remove exhaust assembly and gaskets (11) from engine.
- (6) Remove end plate (12) from exhaust assembly by removing screws (13).
- (7) Remove screws (14) and clip nuts (15) securing shroud (4). Spread shroud and slide from muffler (16).

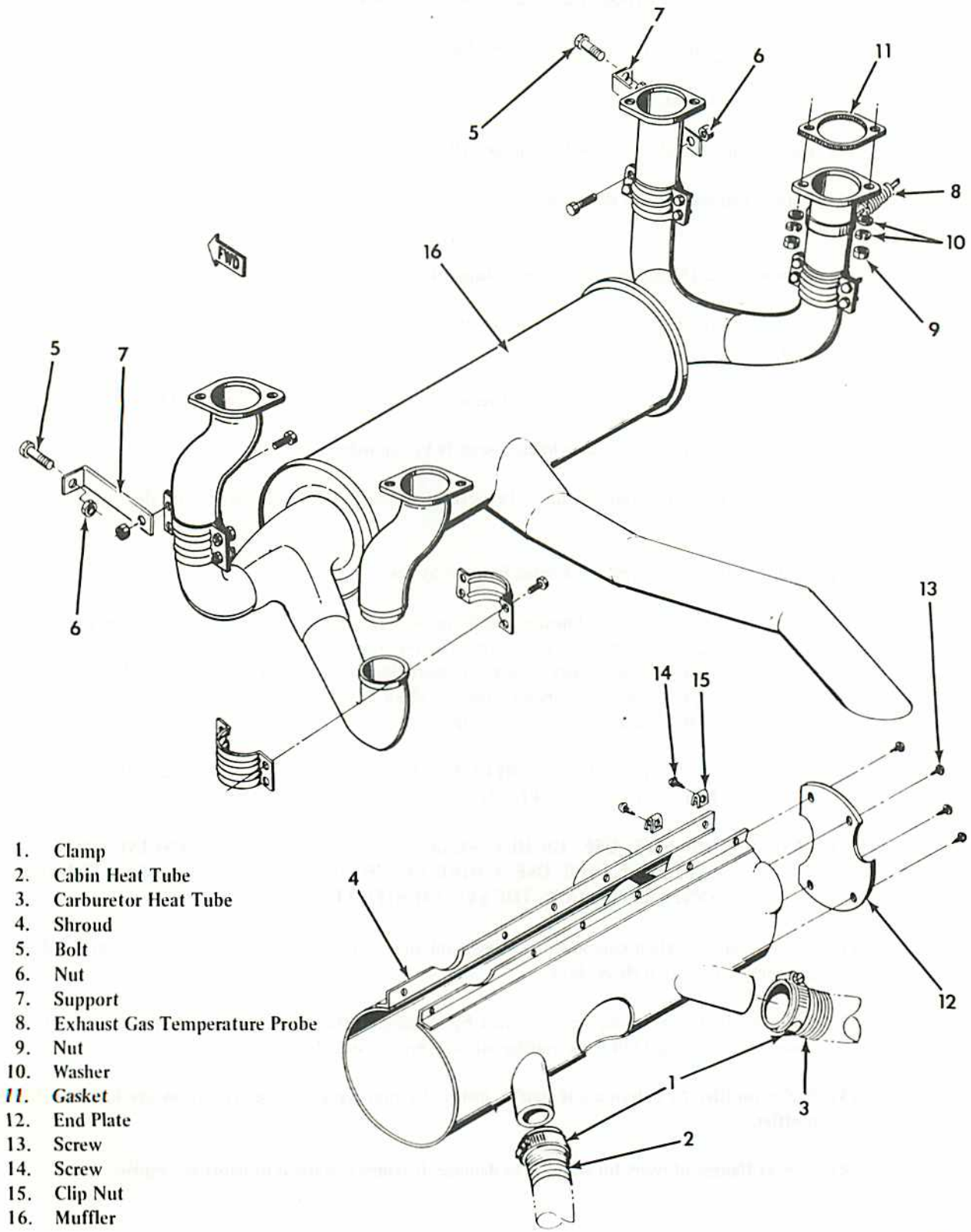
B. Cleaning, Inspection, and Repair of Engine Exhaust System

Exhaust systems are subject to burning, cracking, and general deterioration from alternate thermal stresses and vibration. Consequently, it is extremely important that the system be inspected every 100 hours or at any time exhaust fumes or carbon monoxide are detected in the cabin. To inspect the exhaust system properly, the components must be clean and free from oil, grease, or dirt. Stoddard solvent may be used to clean exhaust system components.

WARNING: USE SOLVENTS IN A WELL VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAMES.

WARNING: DO NOT USE HIGHLY FLAMMABLE SOLVENTS ON ENGINE EXHAUST SYSTEM. NEVER USE A WIRE BRUSH OR ABRASIVE TO CLEAN EXHAUST SYSTEMS OR MARK THE SYSTEM WITH LEAD PENCILS.

- (1) Clean exhaust system components, using a suitable cleaning solvent. Allow components to drain and then wipe with a clean cloth.
- (2) Check muffler interior for scale and rust by tapping muffler lightly with a rubber mallet. If large flakes of scale or rust fall from muffler interior, replace muffler.
- (3) Shake muffler to determine if baffles inside the muffler are loose. If baffles are loose, replace muffler.
- (4) Inspect flanges of risers for warpage or damage. If flange is warped or damaged, replace riser.



- 1. Clamp
- 2. Cabin Heat Tube
- 3. Carburetor Heat Tube
- 4. Shroud
- 5. Bolt
- 6. Nut
- 7. Support
- 8. Exhaust Gas Temperature Probe
- 9. Nut
- 10. Washer
- 11. Gasket
- 12. End Plate
- 13. Screw
- 14. Screw
- 15. Clip Nut
- 16. Muffer

**Engine Exhaust System Removal/Installation
Figure 201**

78G72-1

- (5) Inspect welds and areas surrounding the welds for cracks and holes. Deposits of exhaust gas in the weld area indicate a leaking condition.
- (6) Repair cracks and holes in muffler in accordance with AC 43.13-1A, Chapter 14.
- (7) Perform exhaust assembly air leak test as follows:

CAUTION: THE INSIDE OF THE VACUUM CLEANER AND CLEANER HOSE SHOULD BE FREE OF ANY CONTAMINATION THAT MIGHT BE BLOWN INTO THE EXHAUST ASSEMBLY.

- (a) Plug all openings in exhaust assembly and attach the pressure side of an industrial vacuum cleaner (capable of producing a pressure rise of at least 2 inches Hg above atmospheric pressure) to the exhaust pipe opening. Use a rubber plug or other suitable means of effecting a suitable seal.
 - (b) With vacuum cleaner operating, the complete exhaust assembly can be checked for leaks by applying a soapy water solution to all areas and watching for air bubbles.
- (8) If leaks are found around clamp assemblies securing risers to muffler, remove clamp assemblies and swage out the risers for a tight fit.
 - (9) If leaks are found in the muffler, repair muffler in accordance with AC 43.13-1A, Chapter 14.
 - (10) After leaks found during the air leak test have been repaired, repeat the air leak test outlined in Step (7).

C. Install Engine Exhaust System (See Figure 201.)

- (1) Position shroud (4) over muffler (16) and secure with screws (14) and clip nuts (15).
- (2) Install end plate (12) to exhaust assembly, using screws (13).

CAUTION: ENSURE THAT ENGINE EXHAUST FLANGE MATING SURFACES ARE CLEAN AND SMOOTH.

- (3) Clean engine exhaust flange mating surfaces.
- (4) Position new gaskets (11) and exhaust assembly and secure with nuts (9) and washers (10). Torque nuts to 110 to 130 inch-pounds.
- (5) Install exhaust gas temperature probe (8) to riser at No. 3 exhaust port. (Refer to Chapter 77.)
- (6) Install bolts (5) and nuts (6) securing supports (7) to forward baffles.
- (7) Connect carburetor heat tube (3) and cabin heat tube (2) to shroud (4) and tighten clamps (1).
- (8) Install lower and upper cowl assemblies. (Refer to Chapter 71.)

CHAPTER 79**ENGINE OIL SYSTEM****TABLE OF CONTENTS**

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ENGINE OIL SYSTEM – DESCRIPTION/OPERATION

1. General

The engine oil system is of the pressure wet sump type with an oil cooler. The oil sump capacity is 8 U.S. quarts. Minimum safe quantity in oil sump is 2 U.S. quarts. This chapter covers only those units and components of the oil system that are externally mounted to the engine. For additional information on the engine oil system, refer to Avco Lycoming Operator's Manual and Avco Lycoming Service Instructions.

The oil cooler is a five-module size cooler mounted on the aft side of the left rear baffle assembly. The oil cooler is connected to the engine accessory housing by flexible lines. Air to the oil cooler is picked up directly from the left rear baffle assembly.

The oil pressure gauge is mounted in the instrument panel. The oil pressure gauge is wired to the oil pressure transducer located at the rear of the engine. A flexible line connects the oil pressure transducer with the engine.

The oil temperature gauge is mounted in the instrument cluster assembly on the instrument panel. The oil temperature gauge is wired to the oil temperature sensor located in the accessory case.

An oil pressure relief valve, located behind the oil filler neck in the engine, maintains oil pressure at normal operating condition from 60 to 90 psi (25 psi at idle speed). The oil pressure relief valve is not adjustable; however, the oil pressure can be adjusted by the addition or removal of washers. For information changing the values of the pressure relief valve, refer to Avco Lycoming Operator's Manual and Avco Lycoming Service Instructions.

The optional oil filter, if installed, is located at the rear of the engine. The oil filter is the screw-in – disposable, type. For filter servicing, refer to Chapter 12.

A breather line is attached to the engine breather vent and is routed overboard. The breather vent prevents excessive pressure buildup in the engine crankcase.

ENGINE OIL SYSTEM – TROUBLESHOOTING

1. Oil Cooler Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
High temperature indication.	Obstructions in oil cooler air passages.	Inspect oil cooler core for dirt or obstructions and clean as necessary.
Low or no oil pressure indication.	Loose fittings or leaking oil cooler.	Inspect oil cooler and fittings. Replace oil cooler if leaking internally. Tighten fittings if leaking.

2. Oil Pressure Gauge Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
No indication.	Insufficient oil.	Check oil supply and fill as recommended.
		Starting at engine, inspect oil cooler, all fittings, and lines for leaks. Repair or replace as necessary.
	Defective gauge. *See Note.	Replace gauge.
	Tripped circuit breaker.	Reset circuit breaker. If circuit breaker continues to trip, check wiring.
	Pressure relief valve stuck.	Repair or replace valve.
	Gauge not grounded.	Check gauge ground connection and perform necessary repairs.
	Obstruction in pressure line.	Starting at engine, remove all fittings and lines. Inspect and clean as required and reinstall.
High or low indication, or no indication.	Defective gauge. *See Note.	Replace gauge.
	Oil pressure relief valve out of adjustment.	Check engine pressure with a calibrated gauge and correct pressure setting as required.
	Loose fittings, defective lines, or leaking oil cooler.	Inspect oil cooler, fittings, and lines for leaks. Repair or replace as necessary.

TROUBLE	PROBABLE CAUSE	REMEDY
	Defective wiring.	Check system with ohm-meter and perform necessary repairs.
*Note	Defective gauge.	Temporarily substitute a 137.0-ohm resistance for the oil pressure transducer. If gauge does not indicate 100 psi, replace gauge.
	Defective transducer.	Temporarily substitute a 137.0-ohm resistance for the oil pressure transducer. If oil pressure gauge indicates 100 psi, replace transducer.

3. Oil Temperature Gauge Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
No indication.	Defective gauge. *See Note.	Replace gauge.
	Tripped circuit breaker.	Reset circuit breaker. If circuit breaker continues to trip, check wiring.
	Gauge not grounded.	Check gauge ground connection and perform necessary repairs.
High or low indications, or no indication.	Defective wiring.	Check systems with ohmmeter and perform necessary repairs.
	Defective gauge. *See Note.	Replace gauge.
Low indication.	Low aircraft supply voltage.	Check aircraft supply voltage. Adjust, repair, or replace as necessary.
*Note	Defective gauge.	Temporarily substitute a 36.0-ohm resistance for the oil temperature sensor. If gauge does not indicate 245° (red line), replace gauge.

TROUBLE	PROBABLE CAUSE	REMEDY
	Defective Sensor.	Temporarily substitute a 36.0-ohm resistance for the oil temperature sensor. If oil temperature gauge indicates 245° (red line), replace sensor.

ENGINE OIL SYSTEM – MAINTENANCE PRACTICES1. General

Periodic maintenance of the engine oil system should include an oil change, filter change, and removal and inspection of the oil suction and oil pressure screens. Refer to Chapter 12 for servicing of the engine oil system.

NOTE: During the initial 50 hours operation of a new or overhauled engine, use straight mineral oil (nondetergent). Detergent or additive oils should only be used after consulting Lycoming Service Instruction No. 1014.

The following are recommended oil viscosities to be used in the engine oil system. Refer to the latest revision of Avco Lycoming Service Instruction No. 1014 for more complete details.

Average Ambient Air Temperature	Straight Mineral Grade	Ashless Dispersant
Above 60°F (16°C)	SAE 50	SAE 40 or SAE 50
30° (-1°C) to 90°F (32°C)	SAE 40	SAE 40
0° (-18°C) to 70°F (21°C)	SAE 30	SAE 40 or SAE 20W-30
Below 10°F (-12°C)	SAE 20	SAE 20W-30

2. Removal/Installation of Engine Oil System Externally Mounted Components

NOTE: For additional information on the engine oil system not covered in this manual, refer to Avco Lycoming Operator's Manual and Avco Lycoming Service Instructions.

A. Remove Oil Cooler (See Figure 201.)

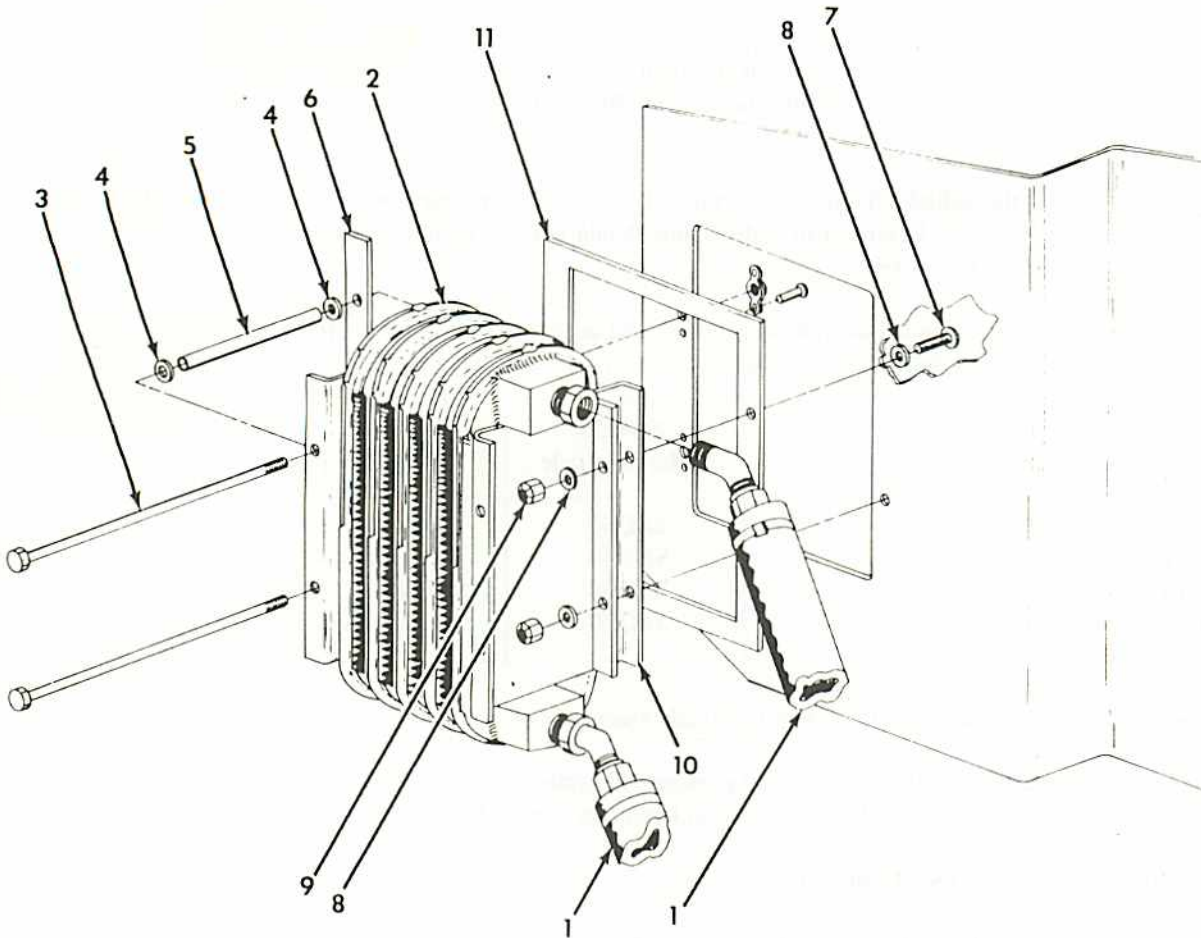
- (1) Remove upper and lower cowl assemblies. (Refer to Chapter 71.)

WARNING: BEFORE ATTEMPTING OIL COOLER REMOVAL, ENSURE THAT OIL COOLER IS COOL TO THE TOUCH. WHEN FLEXIBLE LINES ARE DISCONNECTED, SOME OIL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT HAZARD DUE TO SPILLAGE.

- (2) Place suitable container under oil cooler and disconnect flexible lines (1) from oil cooler (2). Cap flexible line to prevent oil system contamination.
- (3) Remove safety wire from two bolts (3) and remove bolts, washers (4), and spacers (5) and doubler (6).
- (4) Remove two screws (7), washers (8), nuts (9), and doubler (10). Remove oil cooler (2) and gasket (11) from baffle assembly.

B. Cleaning, Inspection, and Repair of Oil Cooler

- (1) Clean oil cooler using solvent, P-S-661 or equivalent. After oil cooler has been cleaned, let dry.
- (2) Inspect oil cooler for cracks, damage, and evidence of leaking. Replace damaged oil cooler.



- 1. Flexible Lines
- 2. Oil Cooler
- 3. Bolt
- 4. Washer
- 5. Spacer
- 6. Doubler
- 7. Screw
- 8. Washer
- 9. Nut
- 10. Doubler
- 11. Gasket

**Oil Cooler Removal/Installation
Figure 201**

79G72-1

CAUTION: DO NOT APPLY MORE THAN 100 PSI AIR PRESSURE MAXIMUM TO OIL COOLER WHEN PERFORMING SUBMERGE LEAK TEST.

- (3) Perform submerge leak test to oil cooler as follows:
 - (a) Plug outlet opening in oil cooler and connect an approved air supply not to exceed 100 psi to inlet opening.
 - (b) Submerge oil cooler in water and observe for air leaks. If air leaks exist, oil cooler should be replaced.
- (4) Inspect fittings on oil cooler for cracks, damaged and worn threads, and corrosion. Replace damaged or worn fittings.

C. Install Oil Cooler (See Figure 201.)

- (1) If new oil cooler is to be installed, remove fittings from old oil cooler and install on new cooler.
- (2) Position gasket (11) and oil cooler on aft side of left-hand rear baffle assembly and install doubler (10), screws (7), washers (8), and nuts (9).
- (3) Install doubler (6), spacers (5), bolts (3), and washers (4). Safety-wire the bolts.

CAUTION: WHEN FLEXIBLE LINES ARE UNCAPPED, SOME OIL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT HAZARD DUE TO SPILLAGE.

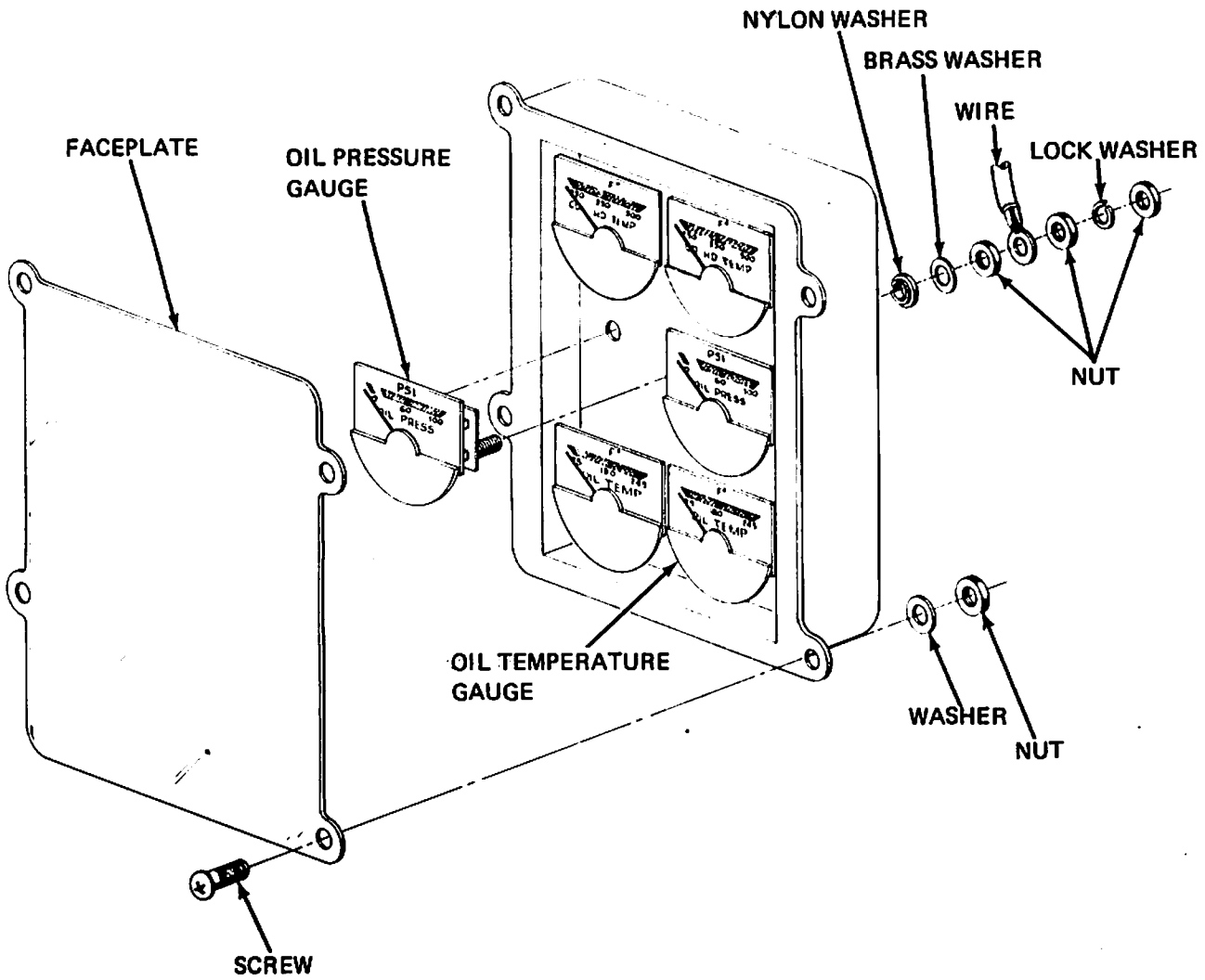
- (4) Uncap flexible lines and connect to oil cooler. Torque flexible line fittings 70 to 80 inch-pounds
- (5) Check engine oil quantity for proper operating level.
- (6) Operate engine for 3 minutes while observing oil pressure and oil temperature gauges for normal indications. (Refer to Pilot's Operating Handbook.)
- (7) Shut down engine and check oil cooler, flexible lines, and all connections for signs of leakage. Correct any leaks.
- (8) Install lower and upper cowl assemblies. (Refer to Chapter 71.)

D. Remove Oil Pressure and Oil Temperature Gauges (See Figure 202.)

CAUTION: ENSURE THAT MASTER SWITCH IS IN OFF POSITION PRIOR TO REMOVAL OF ANY GAUGE.

NOTE: Prior to removal of any oil pressure gauge or oil temperature gauge, determine if any of the gauges are defective. (Refer to Troubleshooting Table.)

- (1) Remove the cluster assembly which houses the oil pressure gauges, oil temperature gauges, and cylinder head temperature gauges from the instrument panel by removing the four attaching screws, washers, and nuts.
- (2) Separate faceplate from cluster assembly.



**Oil Pressure and Oil Temperature Gauge Removal/Installation
Figure 202**

79G72-2

CAUTION: TAG OR LABEL ALL WIRING PRIOR TO REMOVAL FOR REFERENCE ON INSTALLATION.

- (3) Tag and disconnect wiring from the defective gauge to be removed.
- (4) Remove remaining nuts, brass washers, and nylon washers securing defective gauge from cluster assembly.

E. Calibration/Repair of Oil Pressure and Oil Temperature Gauges

No attempt should be made to calibrate or repair a defective gauge. If gauge is defective, replace with new gauge.

F. Install Oil Pressure and Oil Temperature Gauges. (See Figure 202.)

CAUTION: ENSURE THAT MASTER SWITCH IS IN OFF POSITION PRIOR TO INSTALLATION OF ANY GAUGE.

- (1) Position new gauge in cluster assembly and secure using nylon washers, brass washers, and nuts.
- (2) Connect wiring to gauge using lockwashers and nuts.
- (3) Position faceplate on cluster assembly and mate cluster assembly with back side of instrument panel.
- (4) Install attaching screws, washers, and nuts securing cluster assembly to instrument panel.
- (5) Operate engine for approximately 3 minutes if ambient temperature is above 32°F (10 minutes if ambient temperature is below 32°F). Observe oil pressure gauge and oil temperature gauge for normal indications. (Refer to Pilot's Operating Handbook.)
- (6) Shut down engine.

G. Remove Oil Pressure Transducer

NOTE: Prior to removal of oil pressure transducer, determine if transducer is defective. (Refer to Troubleshooting Table.)

- (1) Disconnect wire from oil pressure transducer.

CAUTION: WHEN FLEXIBLE LINES ARE DISCONNECTED, SOME OIL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT HAZARD DUE TO SPILLAGE.

- (2) Disconnect oil pressure flexible line from oil pressure transducer. Plug flexible line.
- (3) Remove oil pressure transducer and braided strap by removing screw and washer from clamp.

H. Install Oil Pressure Transducer

- (1) Position oil pressure transducer and braided strap and secure using screw and washer through clamp. Ensure clamp is tight for positive ground.

CAUTION: WHEN FLEXIBLE LINES ARE UNPLUGGED, SOME OIL SPILLAGE MAY OCCUR. TAKE PROPER PRECAUTIONS TO PREVENT HAZARD DUE TO SPILLAGE.

- (2) Remove plug from oil pressure flexible line and connect to oil pressure transducer.
- (3) Connect wire to oil pressure transducer.
- (4) Operate engine and observe oil pressure gauge for normal indication. (Refer to Pilot's Operating Handbook.)
- (5) Shut down engine.

I. Remove Oil Temperature Sensor

NOTE: Prior to removal of oil temperature sensor, determine if sensor is defective. (Refer to Troubleshooting Table.)

- (1) Disconnect wire from oil temperature sensor.
- (2) Cut safety wire and remove oil temperature sensor.

J. Install Oil Temperature Sensor

- (1) Install oil temperature sensor in accessory housing. Safety-wire the sensor.
- (2) Connect wire to oil temperature sensor.
- (3) Operate engine for approximately 3 minutes if ambient temperature is above 32°F (10 minutes if ambient temperature is below 32°F). Observe oil temperature gauge for normal indication. (Refer to Pilot's Operating Handbook.)
- (4) Shut down engine.

K. Inspect Oil System Flexible Lines

NOTE: Inspect flexible line at each inspection.

- (1) Inspect exterior of flexible lines for wetness, evidence of leakage, severe discoloration, rubbing or chafing, and color bleaching of the end fittings.

CAUTION: AVOID EXCESSIVE FLEXING AND SHARP BENDING WHEN INSPECTING FLEXIBLE LINES FOR STIFFNESS.

- (2) Inspect flexible lines for stiffness.

L. Replacement of Oil System Flexible Lines

- (1) Replace all flexible lines at each engine overhaul or every 5 years, whichever occurs first.
- (2) Replace all flexible lines that show evidence of leakage, severe discoloration, color bleaching of end fittings, and damage from rubbing or chafing.

- (3) During removal, do not attempt to straighten a flexible line that has taken a permanent set during extended use
- (4) During installation, avoid twisting flexible lines and provide as large a bend radius as possible.
- (5) Route all flexible lines as far as possible from areas of intense heat.
- (6) If flexible line is being reinstalled, be sure that line is returned to original position.
- (7) Refer to AC 43.13-1A, Chapter 10 for additional procedures for installing flexible lines.

- (1) During removal of the element to be replaced, the element should be supported by a permanent fixture during the operation.
- (2) During installation, avoid twisting the shaft and provide a firm support as possible.
- (3) Remove the element from the machine in a safe manner.
- (4) If the element is to be replaced, the element should be replaced in the original position.
- (5) After the element is replaced, the element should be tested in the original position.

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CHAPTER 80**STARTING****TABLE OF CONTENTS**

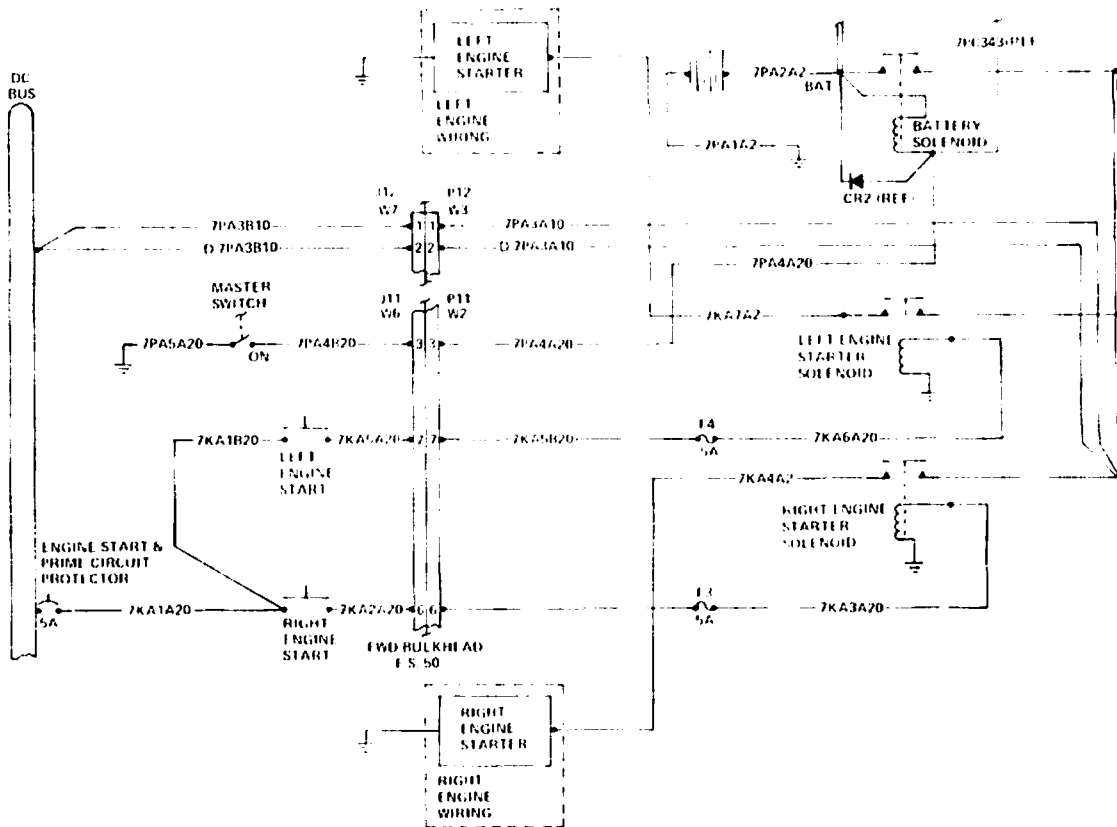
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STARTING – DESCRIPTION/OPERATION

1. General (See Figure 1.)

The starting system for each engine consists of the starter switch, starter solenoid, starter motor, a 5-amp circuit breaker, a 5-amp fuse located in the battery compartment, and associated wiring necessary to effect the required connections. The starter switch is a pushbutton type switch located on the lower left hand side of the instrument panel. The 5-amp circuit breaker that protects the starter circuit is located at the extreme right hand corner of the instrument panel. The starter solenoid is located in the forward baggage compartment and is connected directly to the starter switch.

The starter is mounted on the front of the engine and is secured with one mounting bolt and three mounting studs, nuts, and washers. When power is supplied to the starter, the starter drive gears engage the starter ring gear mounted on the front end of the crankshaft and turn the engine for starting. Power for starting is supplied from a 12-volt, 25-ampere hour, dry-charge type battery.



GA-7/Cougar Engine Starter Circuit
Figure 1

STARTING – TROUBLESHOOTING

1. Troubleshooting the Starter

TROUBLE	PROBABLE CAUSE	REMEDY
Starter will not operate.	Weak battery.	Recharge or replace.
	Blown fuse.	Replace fuse.
	Defective wiring.	Check wiring with ohmmeter and repair as required.
	Defective starter solenoid.	Replace solenoid.
		CAUTION: BE SURE THAT MASTER SWITCH IS OFF BEFORE ATTEMPTING THE FOLLOWING PROCEDURE. DAMAGE TO TEST EQUIPMENT COULD RESULT IF POWER IS ON.
	Defective starter switch.	With master switch off, conduct continuity test across starter switch. If circuit is open when button is depressed, replace switch.
	Defective starter motor.	Repair or replace.
Starter motor sluggish.	Weak battery.	Recharge or replace.
	Dirty contacts on starter switch or starter solenoid.	Replace.
	Defective starter.	Repair or replace.
	Dirty commutator.	Clean and turn down as required.
Starter noisy.	Worn starter drive gear.	Inspect starter drive gear and replace if necessary.
	Worn or broken teeth on crankshaft ring gear.	Inspect crankshaft and ring gear. Replace if necessary.

STARTING – MAINTENANCE PRACTICES

1. Removal/Installation of Starting System Components

A. Remove Starter (See Figure 201.)

NOTE: Ensure that master switch is in OFF position.

- (1) Remove cowl as necessary to gain access to starter. (Refer to Chapter 71.)
- (2) Disconnect starter cable.
- (3) Cut safety wire and remove bolt securing brace to alternator mount.
- (4) Remove mounting bolt and three nuts on starter mounting studs and remove starter.

B. Install Starter (See Figure 201.)

- (1) Position starter mounting studs and install nuts and mounting bolt. Torque to standard values shown in Chapter 91.
- (2) Position brace from alternator mount in place and install mounting bolt. Safety wire bolt.
- (3) Connect starter cable.
- (4) Install cowl.

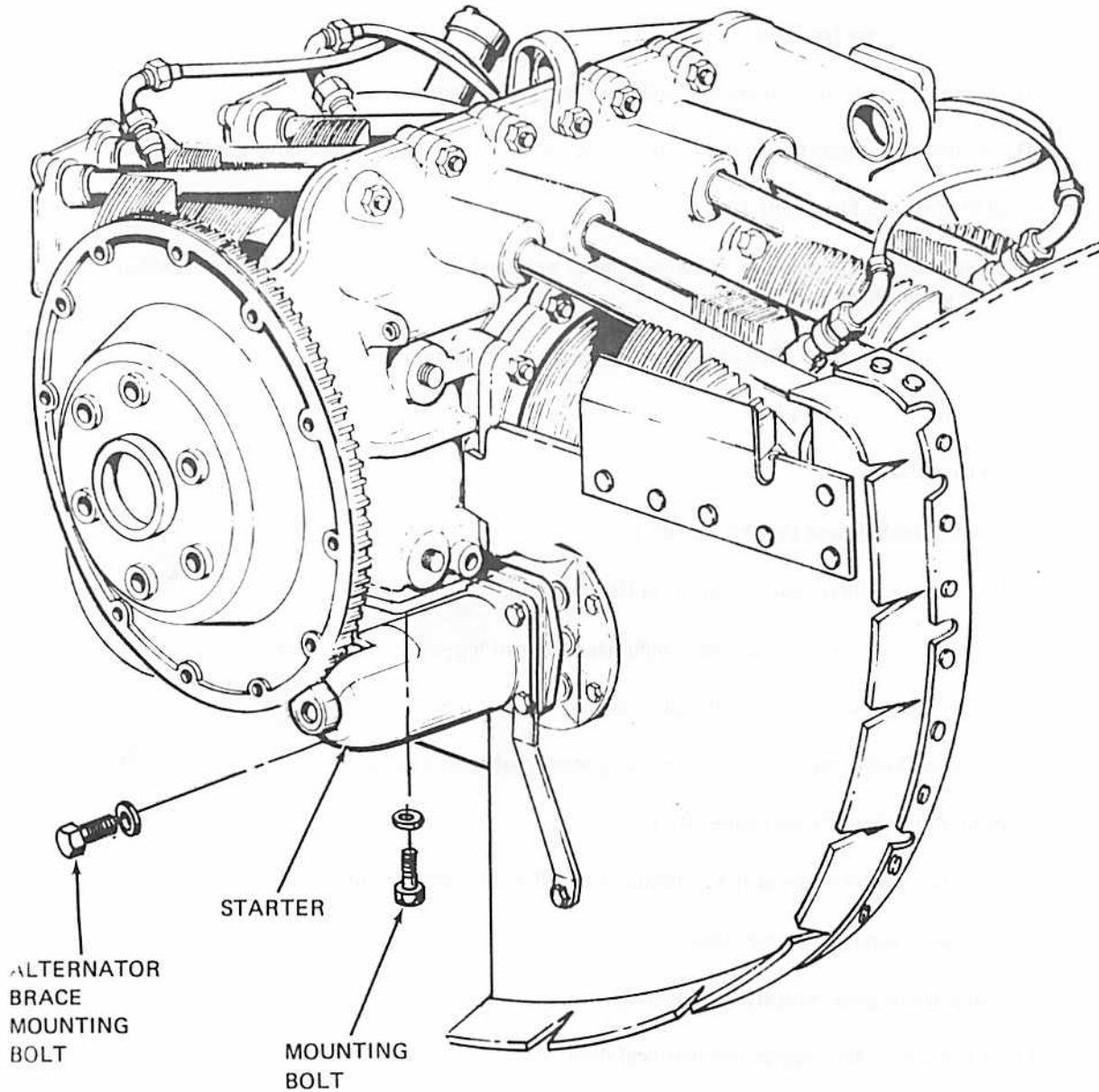
C. Remove Starter Solenoid (See Figure 202.)

NOTE: Ensure that master switch is in OFF position.

- (1) Gain access to starter solenoid in right hand forward baggage compartment.
- (2) Disconnect wiring from starter solenoid.
- (3) Remove bolts, nuts, and washers securing starter solenoid to bulkhead and remove solenoid.

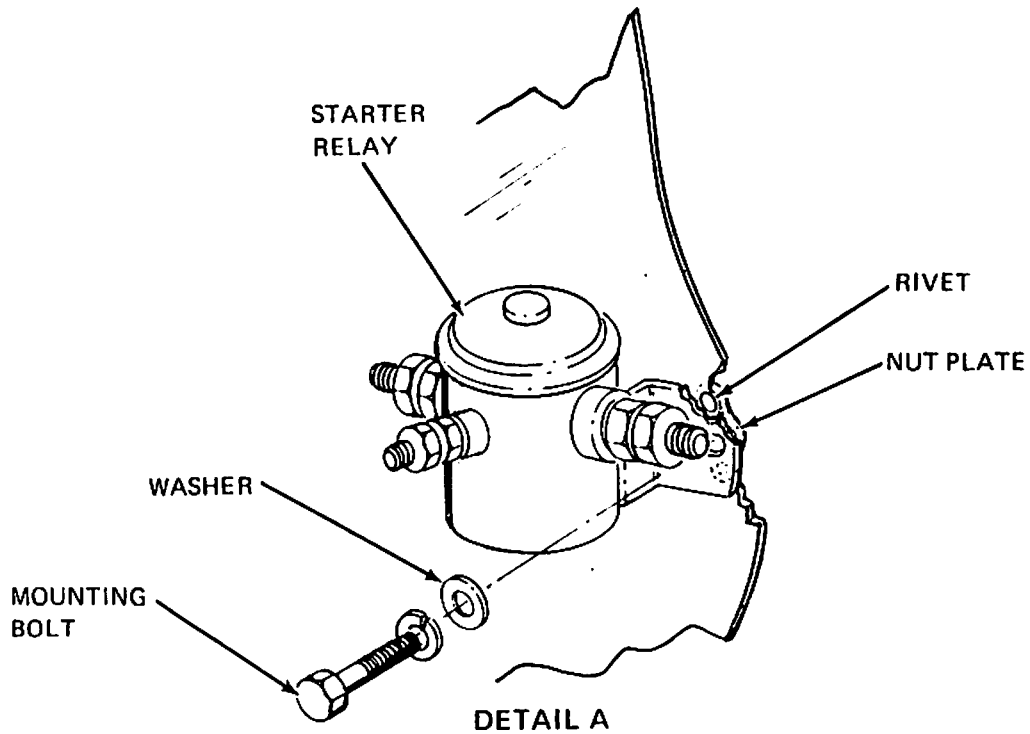
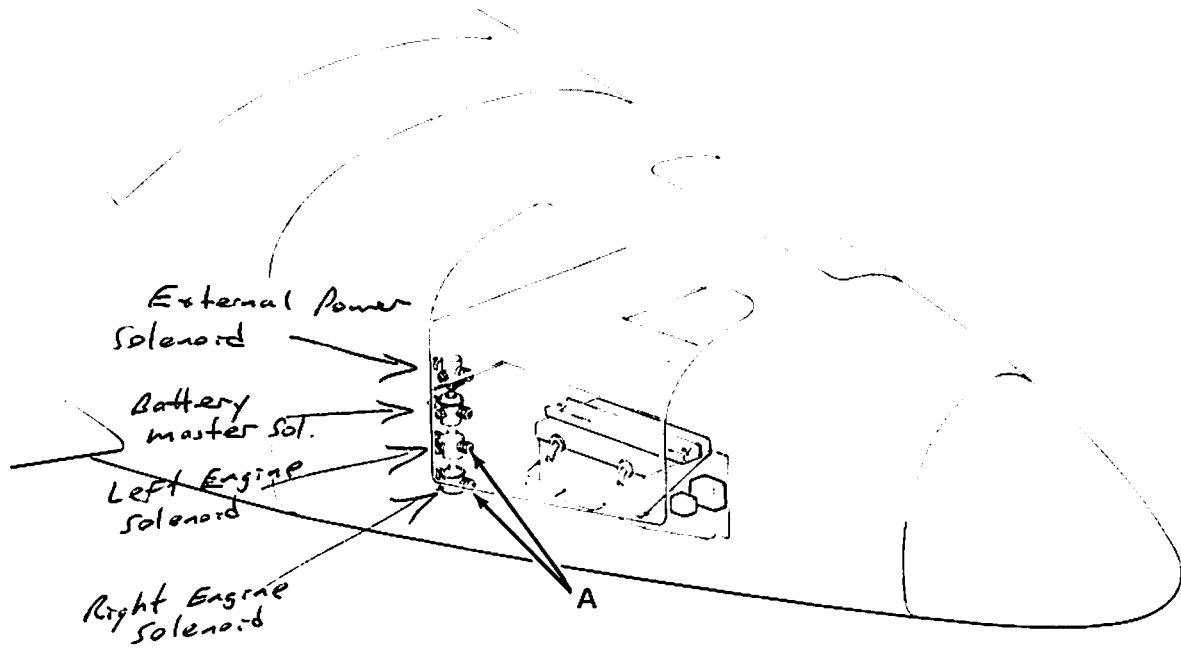
D. Install Starter Solenoid (See Figure 202.)

- (1) Position starter solenoid to bulkhead and install bolts, washers, and nuts.
- (2) Connect wiring to starter solenoid.
- (3) Replace baggage compartment flooring.
- (4) Close and secure baggage compartment door.



**GA-7 /Cougar Starter Removal/Installation
Figure 201**

80G72-2



GA-7/Cougar Starter Solenoid Removal/Installation
Figure 202

80G72-3



CHAPTER 91

CHARTS

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CHARTS**1. General**

This chapter contains several charts that include data to be utilized in various places throughout the manual. Special applications of torque on bolts and nuts or on flared tubing will be specified wherever they apply; but for standard applications this chapter will contain all the limits required.

2. Torque Values

The importance of correct torque application cannot be overemphasized. Undertorque can result in unnecessary wear of nuts and bolts as well as the parts they are holding together. When insufficient pressures are applied, uneven loads will be transmitted throughout the assembly which may result in excessive wear or premature failure due to fatigue. Overtorque can be equally damaging because of failure of a bolt or nut from overstressing the threaded areas.

A. Torque Values for Bolts and Nuts

There are a few simple, but very important, procedures that should be followed to ensure that the correct torque is applied:

- (1) Calibrate the torque wrench periodically to ensure accuracy; and recheck frequently.
- (2) Ascertain that the bolt and nut threads are clean and dry (unless otherwise specified by the manufacturer).
- (3) Run nut down to near contact with the washer or bearing surfaces and check "friction drag torque" required to turn the nut.
- (4) Add the friction drag torque to the desired torque recommended by the manufacturer, or obtain desired torque as shown in Tables 1 and 2. This is referred to as final torque which should register on the indicator or the setting for a snapover type of wrench.

NOTE: The torque values stated are inch-pounds, related only to oil-free cadmium plated threads. All torque values given throughout this manual are for oil-free threads unless otherwise noted. For more details on torquing, refer to FAA Manual AC 43.13-1.

B. Torque Values for Flare Fittings

When flared fittings are being installed, ascertain that the male threads are properly lubricated. Torque the fittings in accordance with Table 3.

3. Decimal Conversions

Decimal conversions from fractions are shown in Table 4. This table also gives millimeter equivalents of fractions and decimals.

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TABLE 1. TORQUE VALUES FOR COARSE THREAD SERIES BOLTS AND NUTS

COARSE THREAD SERIES							
BOLTS	NUTS		Nut-bolt size	Torque Limits (in.-lbs.)		Torque Limits (in.-lbs.)	
				Min.	Max.	Min.	Max.
Steel Tension	Steel Tension	Steel Shear		Min.	Max.	Min.	Max.
AN3 thru AN20	AN310	AN320	8 -32	12	15	7	9
AN42 thru AN49	AN315	AN364	10 -24	20	25	12	15
AN73 thru AN81	AN363	NAS1022	1/4 -20	40	50	25	30
AN173 thru AN186	AN365	MS17826	5/16 -18	80	90	48	55
MS20033 thru MS20046	NAS1021	MS20364	3/8 -16	160	185	95	110
MS20073	MS17825		7/16 -14	235	255	140	155
MS20074	MS21045		1/2 -13	400	480	240	290
AN509NK9	MS20365		9/16 -12	500	700	300	420
MS24694	MS20500		5/8 -11	700	900	420	540
AN525NK525	NAS679		3/4 -10	1,150	1,600	700	950
MS27039			7/8 - 9	2,200	3,000	1,300	1,800
			1 - 8	3,700	5,000	2,200	3,000
			1-1/8- 8	5,500	6,500	3,300	4,000
			1-1/4- 8	6,500	8,000	4,000	5,000

TABLE 2. TORQUE VALUES FOR FINE THREAD SERIES BOLTS AND NUTS

FINE THREAD SERIES														
BOLTS Steel Tension				BOLTS Steel Tension				BOLTS Aluminum						
AN3 thru AN20 AN42 thru AN49 AN73 thru AN81 AN173 thru AN186 MS20033 thru MS20046 MS20073 MS20074 ANS09NK9 MS24694 ANS25NK525 MS27039				MS20004 thru MS20024 NAS144 thru NAS158 NAS333 thru NAS 340 NAS583 thru NAS590 NAS624 thru NAS644 NAS1303 thru NAS1320 NAS172 NAS174 NAS515				AN3DD thru AN20DD AN173DD thru AN186DD AN409DD AN525D MS27039D						
													Steel shear bolt	
													NAS 464	
NUTS				NUTS				NUTS						
Steel Tension		Steel Shear		Steel Tension		Steel Shear		Alum. Tension		Alum. Shear				
AN310 AN315 AN363 AN365 NAS1021 MS17825 MS21045 MS20365 MS20500 NAS679		AN320 AN364 NAS1022 MS17826 MS20364		AN310 AN315 AN363 AN365 MS17825 MS20365 MS21045 NAS1021 NAS679 NAS1291		AN320 AN364 NAS1022 MS17826 MS20364		AN365D AN310D NAS1021D		AN320D AN364D NAS1022D				
Nut-bolt size	Torque Limits (in.-lbs)		Torque Limits (in.-lbs)		Torque Limits (in.-lbs)		Torque Limits (in.-lbs)		Torque Limits (in.-lbs)		Torque Limits (in.-lbs)			
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
8 -36	12	15	7	9					5	10	3	6		
10 -32	20	25	12	15	25	30	15	20	10	15	5	10		
1/4-28	50	70	30	40	80	100	50	60	30	45	15	30		
5/16-24	100	140	60	85	120	145	70	90	40	65	25	40		
3/8-24	160	190	95	110	200	250	120	150	75	110	45	70		
7/16-20	450	500	270	300	520	630	300	400	180	280	110	170		
1/2-20	480	690	290	110	770	950	450	550	280	410	160	260		
9/16-18	800	1,000	480	600	1,100	1,300	650	800	380	580	230	360		
5/8-18	1,100	1,300	660	780	1,250	1,550	750	950	550	670	270	420		
3/4-16	2,300	2,500	1,300	1,500	2,650	3,200	1,600	1,900	950	1,250	560	880		
7/8-14	2,500	3,000	1,500	1,800	3,550	4,350	2,100	2,690	1,250	1,900	750	1,200		
1-14	3,700	4,500	2,200	3,300	4,500	5,500	2,700	3,300	1,600	2,400	950	1,500		
1-1/8-12	5,000	7,000	3,000	4,200	6,000	7,300	3,600	4,400	2,100	3,200	1,250	2,000		
1-1/4-12	9,000	11,000	5,400	6,600	11,000	13,400	6,600	8,000	3,900	5,600	2,300	3,650		

TABLE 3. FLARE FITTING TORQUE CHART

TORQUE (INCH-POUND)						
TUBING OD (IN.)	ALUMINUM-ALLOY TUBING FLARE AND 10061 OR AND10078		STEEL TUBING FLARE AND10061		HOSE END FITTING AND HOSE ASSEMBLIES	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1/8	---	---	---	---	---	---
3/16	---	---	90	100	70	100
1/4	40	65	135	150	70	120
5/16	60	80	180	200	85	180
3/8	75	125	270	300	100	250
1/2	150	250	450	500	210	420
5/8	200	350	650	700	300	480
3/4	300	500	900	1000	500	850
1	500	700	1200	1400	700	1150
1-1/4	600	900	---	---	---	---
1-1/2	600	900	---	---	---	---
1-3/4	---	---	---	---	---	---
2	---	---	---	---	---	---

TABLE 4. DECIMAL CONVERSION CHART

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	MM EQUIV.	4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	MM EQUIV.
			$\frac{1}{32}$	$\frac{1}{64}$	.016	.02	.397				$\frac{17}{32}$	$\frac{33}{64}$	.516	.52	13.097
			$\frac{1}{32}$	$\frac{3}{64}$	.031	.03	.794				$\frac{17}{32}$	$\frac{35}{64}$	.531	.53	13.494
		$\frac{1}{16}$		$\frac{3}{64}$	.047	.05	1.191			$\frac{9}{16}$		$\frac{35}{64}$	.547	.55	13.891
		$\frac{1}{16}$		$\frac{5}{64}$	.062	.06	1.587			$\frac{9}{16}$		$\frac{37}{64}$	.562	.56	14.288
			$\frac{3}{32}$	$\frac{5}{64}$	.078	.08	1.984				$\frac{19}{32}$	$\frac{37}{64}$	.578	.58	14.684
			$\frac{3}{32}$	$\frac{7}{64}$	.094	.09	2.381				$\frac{19}{32}$	$\frac{39}{64}$	.594	.59	15.081
	$\frac{1}{8}$			$\frac{7}{64}$	.109	.11	2.778		$\frac{5}{8}$			$\frac{39}{64}$	.609	.61	15.478
	$\frac{1}{8}$			$\frac{9}{64}$	.125	.12	3.175		$\frac{5}{8}$			$\frac{41}{64}$	.625	.62	15.875
			$\frac{5}{32}$	$\frac{9}{64}$	.141	.14	3.572				$\frac{21}{32}$	$\frac{41}{64}$	.641	.64	16.272
			$\frac{5}{32}$	$\frac{11}{64}$	.156	.16	3.969				$\frac{21}{32}$	$\frac{43}{64}$	.656	.66	16.669
		$\frac{3}{16}$		$\frac{11}{64}$	.172	.17	4.366			$\frac{11}{16}$		$\frac{43}{64}$	.672	.67	17.065
		$\frac{3}{16}$		$\frac{13}{64}$	.188	.19	4.762			$\frac{11}{16}$		$\frac{45}{64}$	.688	.69	17.462
			$\frac{7}{32}$	$\frac{13}{64}$	.203	.20	5.159				$\frac{23}{32}$	$\frac{45}{64}$	.703	.70	17.859
			$\frac{7}{32}$	$\frac{15}{64}$	.219	.22	5.556				$\frac{23}{32}$	$\frac{47}{64}$	.719	.72	18.256
$\frac{1}{4}$				$\frac{15}{64}$	.234	.23	5.953		$\frac{3}{4}$			$\frac{47}{64}$	.734	.73	18.653
$\frac{1}{4}$				$\frac{17}{64}$	.250	.25	6.350		$\frac{3}{4}$			$\frac{49}{64}$	.750	.75	19.050
			$\frac{9}{32}$	$\frac{17}{64}$	.266	.27	6.747				$\frac{25}{32}$	$\frac{49}{64}$	.766	.77	19.447
			$\frac{9}{32}$	$\frac{19}{64}$	.281	.28	7.144				$\frac{25}{32}$	$\frac{51}{64}$	.781	.78	19.844
		$\frac{5}{16}$		$\frac{19}{64}$	.297	.30	7.540			$\frac{13}{16}$		$\frac{51}{64}$	.797	.80	20.241
		$\frac{5}{16}$		$\frac{21}{64}$	.312	.31	7.937			$\frac{13}{16}$		$\frac{53}{64}$	.812	.81	20.637
			$\frac{11}{32}$	$\frac{21}{64}$	.328	.33	8.334				$\frac{27}{32}$	$\frac{53}{64}$	.828	.83	21.034
			$\frac{11}{32}$	$\frac{23}{64}$	.344	.34	8.731				$\frac{27}{32}$	$\frac{55}{64}$	.844	.84	21.431
				$\frac{23}{64}$	.359	.36	9.128					$\frac{55}{64}$	.859	.86	21.828
	$\frac{3}{8}$			$\frac{23}{64}$	.375	.38	9.525		$\frac{7}{8}$			$\frac{57}{64}$	.875	.88	22.225
			$\frac{13}{32}$	$\frac{25}{64}$	.391	.39	9.922				$\frac{29}{32}$	$\frac{57}{64}$	.891	.89	22.622
			$\frac{13}{32}$	$\frac{27}{64}$	.406	.41	10.319				$\frac{29}{32}$	$\frac{59}{64}$	.906	.91	23.019
		$\frac{7}{16}$		$\frac{27}{64}$	.422	.42	10.716			$\frac{15}{16}$		$\frac{59}{64}$	.922	.92	23.416
		$\frac{7}{16}$		$\frac{29}{64}$	.438	.44	11.112			$\frac{15}{16}$		$\frac{61}{64}$	.938	.94	23.812
			$\frac{15}{32}$	$\frac{29}{64}$	.453	.45	11.509				$\frac{31}{32}$	$\frac{61}{64}$	.953	.95	24.209
			$\frac{15}{32}$	$\frac{31}{64}$	.469	.47	11.906				$\frac{31}{32}$	$\frac{63}{64}$	.969	.97	24.606
				$\frac{31}{64}$	.484	.48	12.303					$\frac{63}{64}$	.984	.98	25.003
					.500	.50	12.700						1.000	1.00	25.400