SECTION 15
INSTRUMENTS AND INSTRUMENT SYSTEMS

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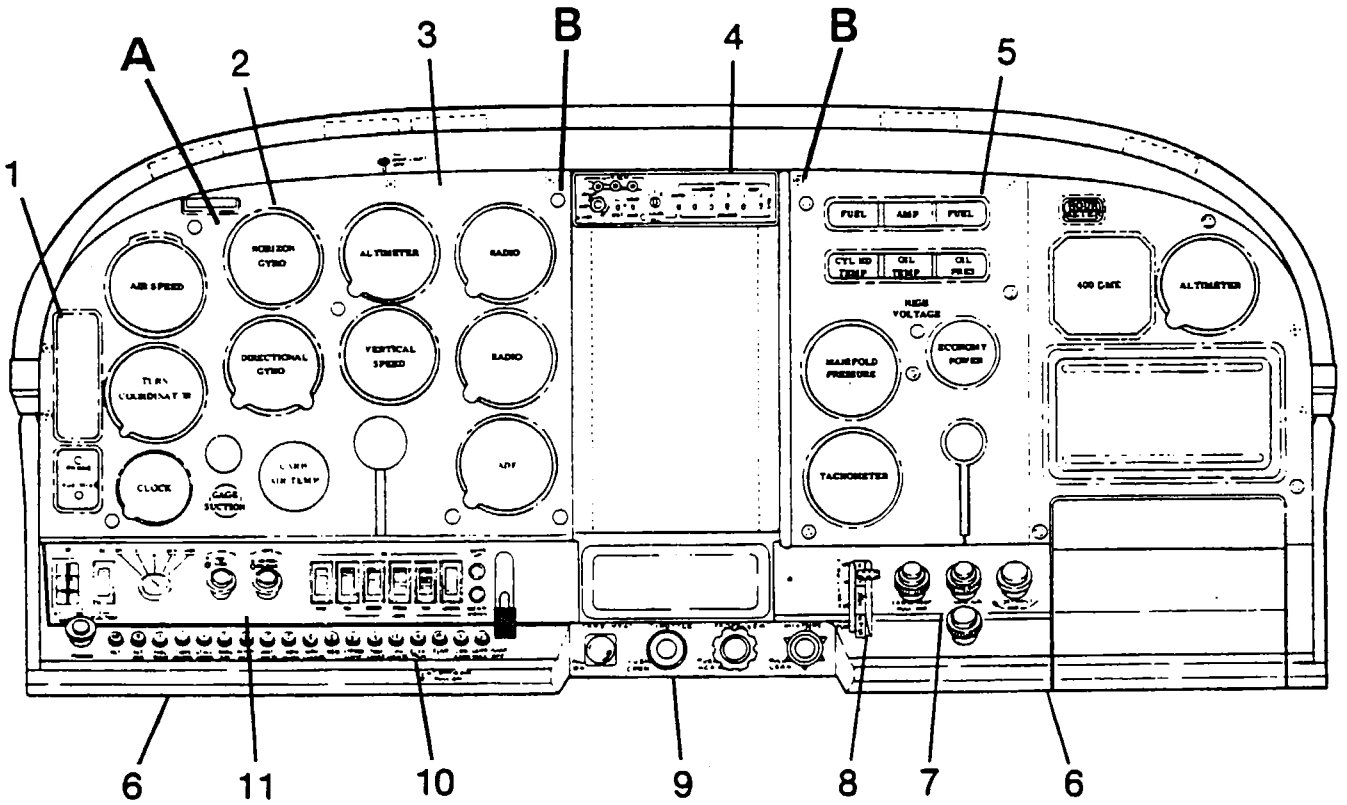
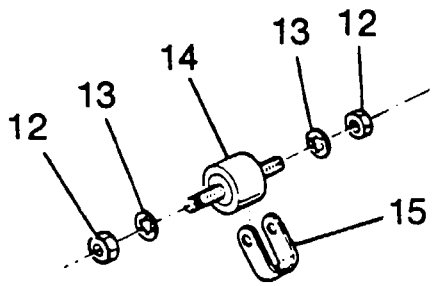
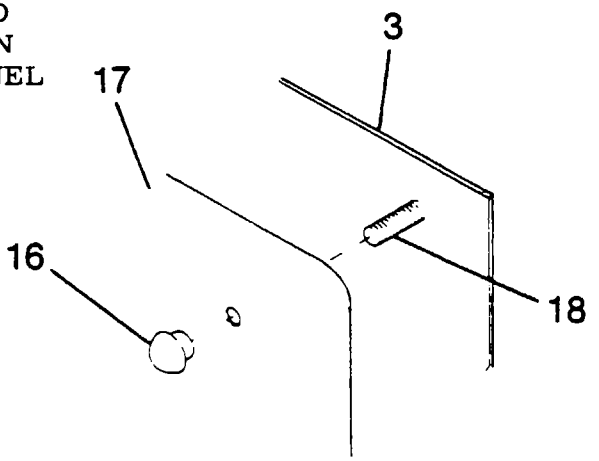


NOTE POSITION OF GROUND STRAP AND SEQUENCE OF ATTACHING PARTS WHEN REMOVING OR INSTALLING SHOCK PANEL



Detail **A**



Detail **B**

1. Marker Beacon Controls
2. Shock Mounted Panel
3. Removeable Panel
4. Radio and Switch Panel
5. Fuel and Engine Instruments
6. Knee Pad
7. Heating and Ventilating Controls
8. Wing Flap Control
9. Engine Controls
10. Circuit Breaker Panel
11. Switch Panel
12. Nut
13. Washer
14. Shock Mount
15. Ground Strap
16. Threaded Button
17. Decorative Cover
18. Stud

Figure 15-1. Instrument Panel

15-1. INSTRUMENTS AND INSTRUMENT SYSTEMS.

15-2. GENERAL. This section describes typical instrument installations and their respective operating systems. Emphasis is placed on trouble shooting and corrective measures only. It does NOT deal with specific instrument repairs since this usually requires special equipment and data and should be handled by instrument specialists. Federal Aviation Regulations require malfunctioning instruments be sent to an approved instrument overhaul and repair station or returned to manufacturer for servicing. Our concern here is with preventive maintenance on various instrument systems and correction of system faults which result in instrument malfunctions. The descriptive material, maintenance and trouble shooting information in this section is intended to help the mechanic determine malfunctions and correct them, up to the defective instrument itself, at which point an instrument technician should be called in. Some instruments, such as fuel quantity and oil pressure gages, are so simple and inexpensive, repairs usually will be more costly than a new instrument. On the other hand, aneroid and gyro instruments usually are well worth repairing. The words "replace instrument" in the text, therefore, should be taken only in the sense of physical replacement in aircraft. Whether replacement is to be with a new instrument, an exchange one, or original instrument is to be repaired must be decided on basis of individual circumstances.

15-3. INSTRUMENT PANEL. (See figure 15-1.)

15-4. DESCRIPTION. The instrument panel assembly consists of a stationary panel, a removable flight instrument panel and a shock-mounted panel. The stationary panel, containing fuel and engine instruments is secured to the engine mount stringers and a forward fuselage bulkhead. The removeable panel, containing flight instruments such as airspeed, vertical speed and altimeter is secured to the stationary panel with screws. The shock-mounted panel, containing major flight instruments such as the horizontal and directional gyros is secured to the removable panel with rubber shock-mounted assemblies. Most of the instruments are screw mounted on the panel.

15-5. REMOVAL AND INSTALLATION.

a. Flight Instrument Panel.
   1. Unscrew threaded buttons and remove decorative cover. Disconnect post light wiring if installed.
   2. Tag and disconnect plumbing and wiring. Cap plumbing.
   3. Remove screws securing flight instrument panel to stationary panel and pull straight back to remove.
   4. To install, place panel in position and install screws.
   5. Install flight instruments in panel.
   6. Uncap plumbing and connect plumbing also wiring. Do not over-tighten connections. Refer to note in paragraph 15-9.

b. Shock-Mounted Panel.

NOTE

Due to the difficulty encountered when removing the shock-mounted panel with the gyros installed, it is recommended that the directional gyro be disconnected and removed prior to removal of the shock-mounted panel.

1. Unscrew threaded buttons and remove decorative cover. Disconnect post light wiring if installed.
2. Tag, disconnect and cap gyro plumbing.
3. Remove directional gyro mounting screws and remove gyro from panel.
4. Remove shock-mount nuts and washers then work panel out from behind flight instrument panel. The horizon gyro may also be removed from panel if desired.
5. To install shock-mounted panel, place panel over shock mount studs. Be sure the ground strap is installed in the proper position, if removed, then install nuts and washers.
6. Install gyros, uncap and install plumbing. Refer to note in paragraph 15-9.
7. Install decorative cover.

15-6. SHOCK-MOUNTS. Service life of shock-mounted instruments is directly related to adequate shock-mounting of the panel. If removal of shock-mounted panel is necessary, check mounts for deterioration and replace as necessary.

15-7. INSTRUMENTS. (See figure 15-1.)

15-8. REMOVAL. Most instruments are secured to the panel with screws inserted through the panel face, under the decorative cover. To remove an instrument, remove decorative cover, disconnect wiring or plumbing to instrument, remove mounting screws and take instrument out from behind, or in some cases, from front of panel. Instrument clusters are installed as units and are secured by a screw at each end. A cluster must be removed from panel to replace an individual gage. In all cases when an instrument is removed, disconnected lines or wires should be protected. Cap open lines and cover pressure connections on instrument to prevent thread damage and entrance of foreign matter. Wire terminals should be insulated or tied up to prevent accidental grounding or short-circuiting.

15-9. INSTALLATION. Generally, installation procedure is the reverse of removal procedure. Ensure mounting screw nuts are tightened firmly, but do not over-tighten, particularly on instruments having plastic cases. The same rule applies to connecting plumbing and wiring.

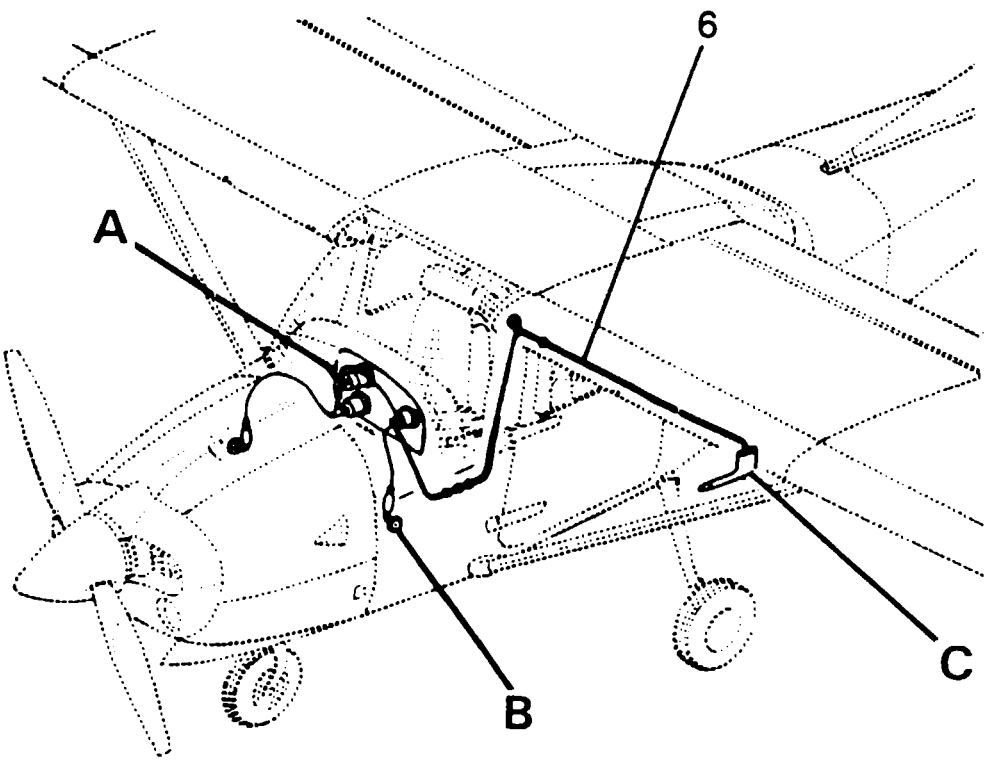
NOTE

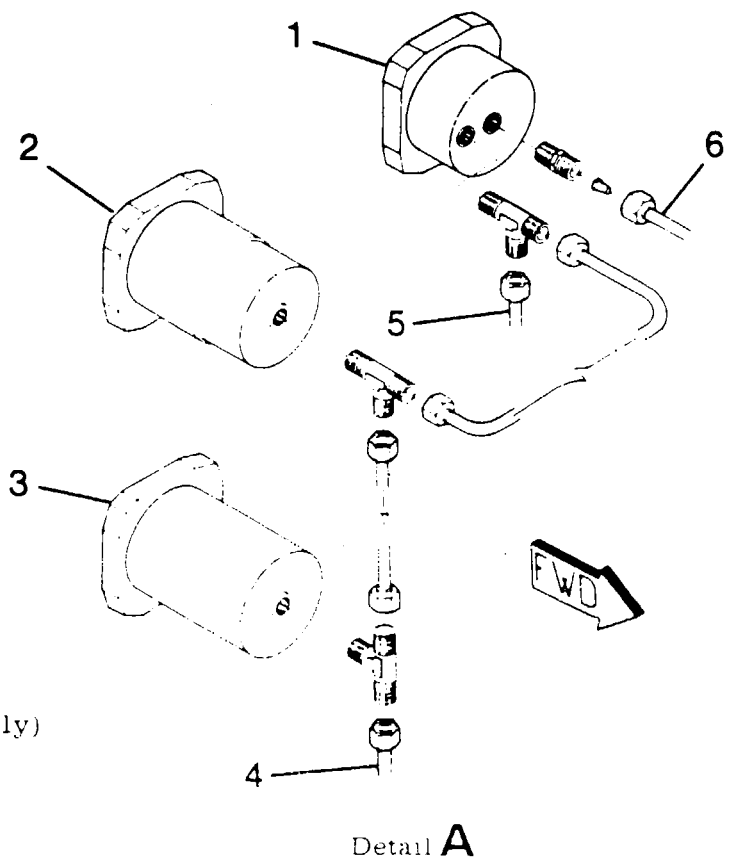
All instruments (gages and indicators), requiring a thread seal or lubricant, shall be installed using teflon tape on male fittings only. This tape is available through the Cessna Supply Division.

When replacing an electrical gage in an instrument cluster assembly, avoid bending pointer or dial plate. Distortion of dial or back plate could change the calibration of gages.

15-10. PITOT AND STATIC SYSTEMS.

15-11. DESCRIPTION. The pitot system conveys ram air pressure to the airspeed indicator. The static system vents vertical speed indicator, altimeter and airspeed indicator to atmospheric pressure through plastic tubing connected to static ports. A static line sump is installed at each source button to collect condensation in static system. A pitot tube heater may be installed. The heating element is controlled by a switch at the instrument panel and





Detail A

1. Airspeed Indicator
2. Altimeter
3. Vertical Speed Indicator
4. Static Line (To Right Sump)
5. Static Line (To Left Sump)
6. Pitot Line (To Pitot Tube)
7. Mounting Screw
8. Decorative Cover
9. Retainer
10. True Airspeed Ring
11. Instrument Panel
12. Spacer
13. Sump
14. Static Port
15. Fuselage Skin
16. Heater Element (Heated Pitot Only)
17. Mast Body
18. Connector

Figure 15-2. Pitot-Static Systems (Sheet 1 of 2)

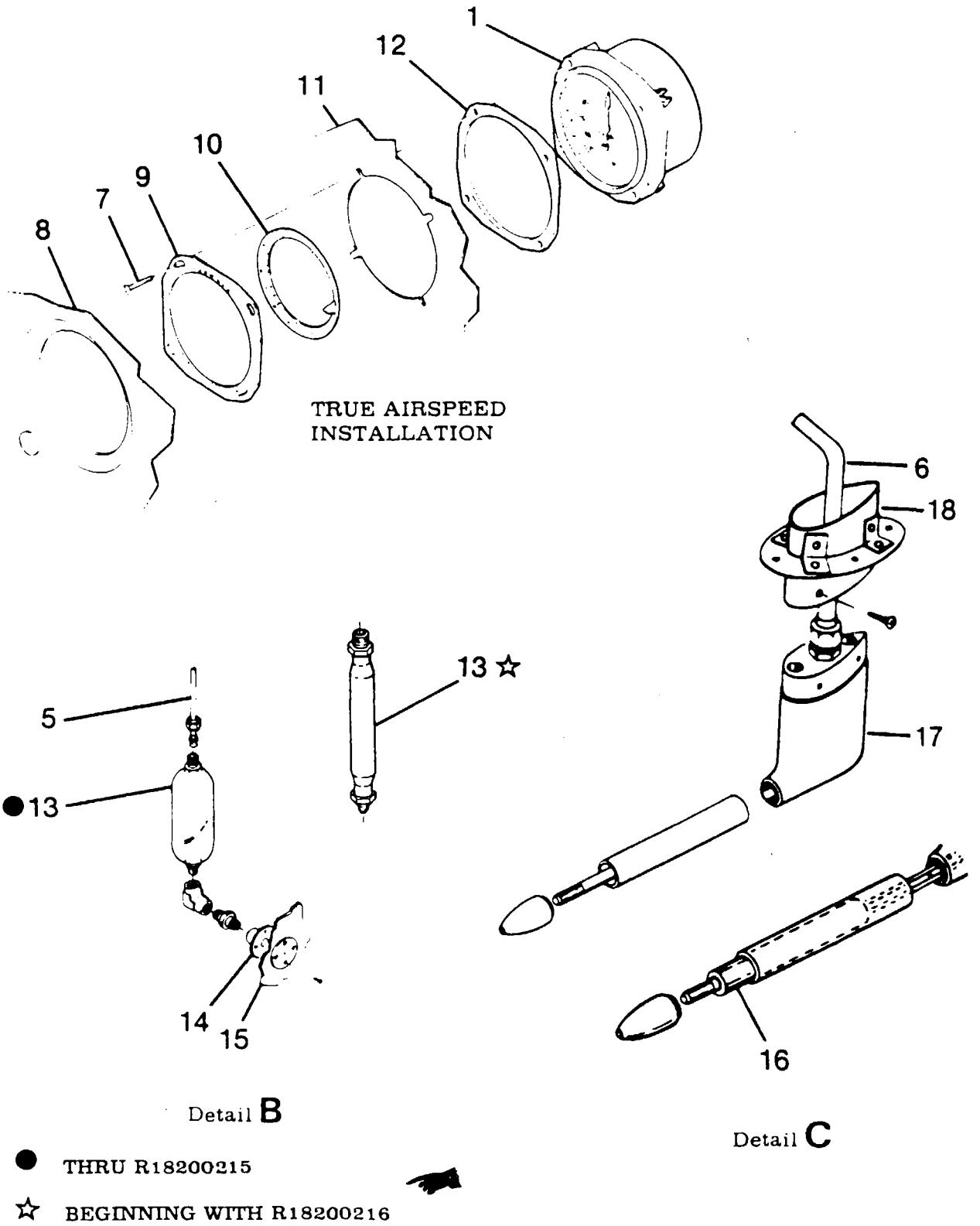
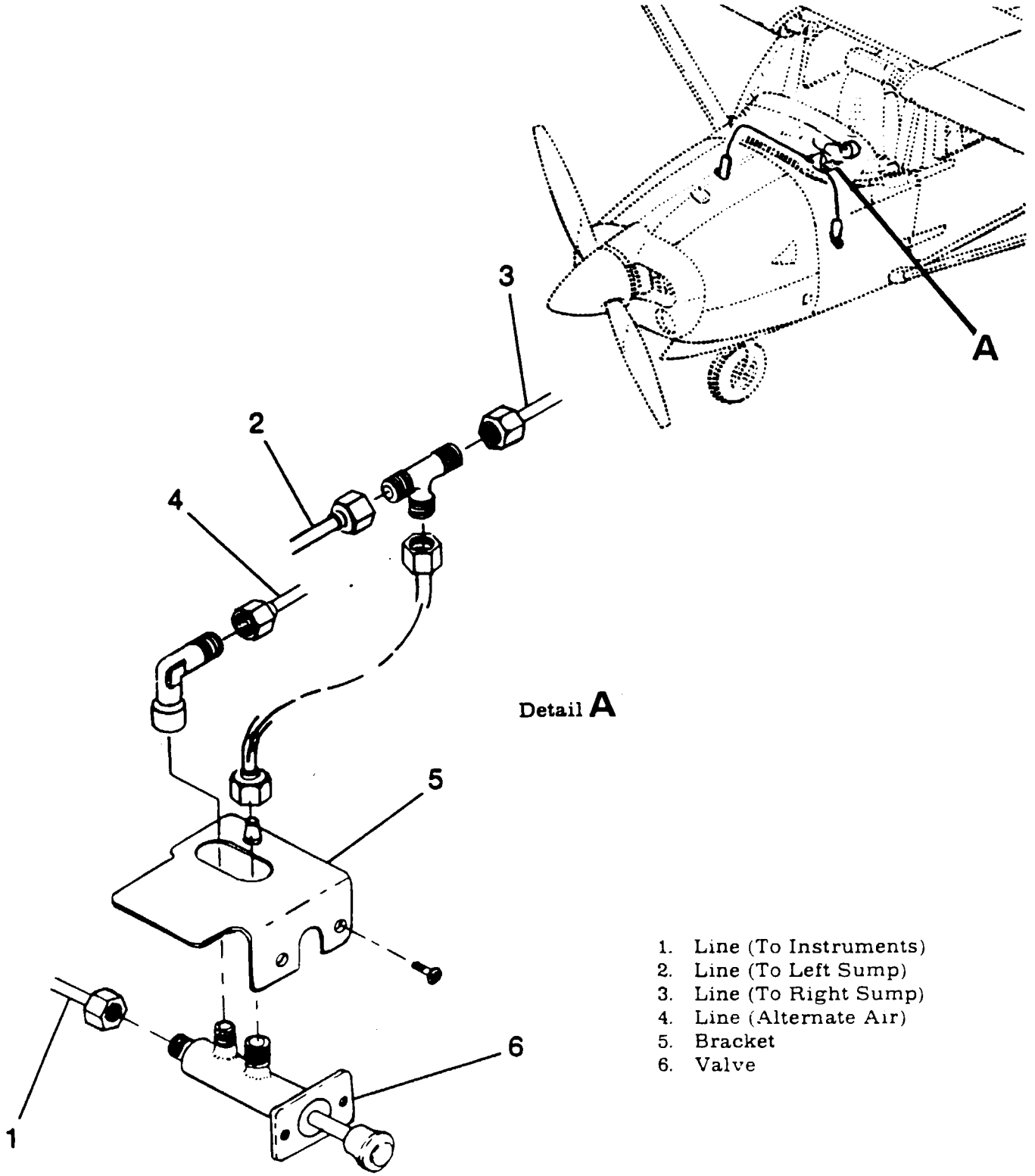


Figure 15-2. Pitot-Static Systems (Sheet 2 of 2)



1. Line (To Instruments)
2. Line (To Left Sump)
3. Line (To Right Sump)
4. Line (Alternate Air)
5. Bracket
6. Valve

Figure 15-3. Alternate Static Air System

powered by the electrical system. A static pressure alternate source valve may be installed in the static system for use when the external static source is malfunctioning. This valve also permits draining condensate from the static lines. Refer to PILOT'S OPERATING HANDBOOK for flight operation using alternate static source pressure. The encoding altimeter supplies an altimeter reading to the optional 300 or 400 transponder for signal transmission. The standby altimeter is connected to the static system by a tube to the vertical speed indicator. The static tube installation will vary when an alternate static source is installed.

15-12. MAINTENANCE. Proper maintenance of pitot and static system is essential for proper operation of altimeter, vertical speed and airspeed indicators. Leaks, moisture and obstructions in pitot system will result in false airspeed indications, while static system malfunctions will affect readings of all three instruments. Under instrument flight conditions, these instrument errors could be hazardous. Cleanliness and security are the principal rules for system maintenance. The pitot tube and static ports MUST be kept clean and unobstructed.

15-13. STATIC PRESSURE SYSTEM INSPECTION AND LEAKAGE TEST. The following procedure outlines inspection and testing of static pressure system, assuming altimeter has been tested and inspected in accordance with current Federal Aviation Regulations.

a. Ensure static system is free from entrapped moisture and restrictions.
b. Ensure no alterations or deformations of airframe surface have been made which would affect the relationship between air pressure in static pressure system and true ambient static air pressure for any flight configuration.
c. Seal one static source port with pressure sensitive tape. This seal must be air tight.
d. Close static pressure alternate source valve, if installed.
e. Attach a source of suction to the remaining static pressure source opening. Figure 15-5 shows one method of obtaining suction.
f. Slowly apply suction until altimeter indicates a 1000-foot increase in altitude.

CAUTION

When applying or releasing suction, do not exceed range of vertical speed indicator or airspeed indicator.

g. Cut off suction source to maintain a "closed" system for one minute. Leakage shall not exceed 100 feet of altitude loss as indicated on altimeter.
h. If leakage rate is within tolerance, slowly release suction source and remove tape from static port.

NOTE

If leakage rate exceeds the maximum allowable, first tighten all connections, then repeat leakage test. If leakage rate still exceeds the maximum allowable, use following procedure.

i. Disconnect static pressure lines from airspeed indicator and vertical speed indicator. Use suitable fittings to connect lines together so altimeter is the only instrument still connected into static pressure system.

j. Repeat leakage test to check whether static pressure system or the bypassed instruments are cause of leakage. If instruments are at fault, they must be repaired by an "appropriately rated rapair station" or replaced. If static pressure system is at fault, use following procedure to locate leakage.
k. Attach a source of positive pressure to static source opening. Figure 15-4 shows one method of obtaining positive pressure.

CAUTION

Do not apply positive pressure with airspeed indicator or vertical speed indicator connected to static pressure system.

l. Slowly apply positive pressure until altimeter indicates a 500-foot decrease in altitude and maintain this altimeter indication while checking for leaks. Coat line connections and static source flange with LEAK-TEC or a solution of mild soap and water, watching for bubbles to locate leaks.
m. Tighten leaking connections. Repair or replace parts found defective.
n. Reconnect airspeed and vertical speed indicators into static pressure system and repeat leakage test per steps "c" thru "h".

15-14. PITOT SYSTEM INSPECTION AND LEAKAGE TEST. To check pitot system for leaks, place a piece of tape over small hole in lower aft end of pitot tube, fasten a piece of rubber or plastic tubing over pitot tube, close opposite end of tubing and slowly roll up tube until airspeed indicator registers in cruise range. Secure tube and after a few minutes recheck airspeed indicator. Any leakage will have reduced the pressure in system, resulting in a lower airspeed indication. Slowly unroll tubing before removing it, so pressure is reduced gradually. Otherwise instrument may be damaged. If test reveals a leak in system, check all connections for tightness.

15-15. BLOWING OUT LINES. Although the pitot system is designed to drain down to pitot tube opening, condensation may collect at other points in system and produce a partial obstruction. To clear the line, disconnect it at airspeed indicator. Using low pressure air, blow from indicator end of line toward the pitot tube.

CAUTION

Never blow through pitot or static lines toward the instruments.

Like the pitot lines, static pressure lines must be kept clear and connections tight. Static source sumps collect moisture and keeps system clear. However, when necessary, disconnect static line at first instrument to which it is connected, then blow line to clear with low pressure air.

NOTE

On aircraft equipped with alternate static source, use the same procedure, opening alternate static source valve momentarily to clear line, then close valve and clear remainder of system.

Check all static pressure line connections for tightness. If hose or hose connections are used, check for general condition and clamps for security. Replace hoses which have cracked, hardened or show other signs of deterioration.

15-16. REMOVAL AND INSTALLATION OF COMPONENTS. (See figure 15-2.) To remove pitot mast, remove four mounting screws on side of connector (18) and pull mast out of connector far enough to disconnect pitot line (6). Electrical connections to heater assembly (if installed) may be disconnected through wing access opening just inboard of mast. Pitot and static lines are removed in the usual manner, after removing wing access plates, lower wing fairing strip and upholstery as required. Installation of tubing will be simpler if a guide wire is drawn in as tubing is removed from wing. The tubing may be removed intact by drawing it out through cabin and right door. When replacing components of pitot and static pressure systems, use anti-seize compound sparingly on male threads on both metal and plastic connections. Avoid excess compound which might enter lines. Tighten connections firmly, but avoid overtightening and distorting fittings. If twisting of plastic tubing is encountered when tightening fittings, VV-P-236 (USP Petrolatum), may be applied sparingly between tubing and fittings.

15-17. TROUBLE SHOOTING -- PITOT-STATIC SYSTEM.

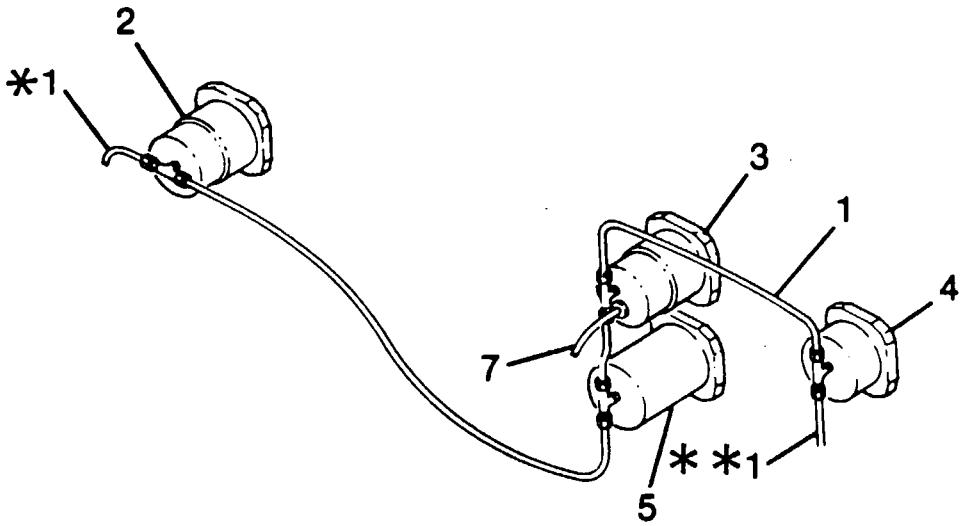
TROUBLE	PROBABLE CAUSE	REMEDY
LOW OR SLUGGISH AIR-SPEED INDICATION. (Normal altimeter and vertical speed.)	Pitot tube deformed, leak or obstruction in pitot line.	Straighten tube, repair or replace damaged line.
INCORRECT OR SLUGGISH RESPONSE. (All three instruments.)	Leaks or obstruction in static line.	Repair or replace line.
	Alternate static source valve open.	Close for normal operation.

15-18. TRUE AIRSPEED INDICATOR. A true airspeed indicator may be installed. This indicator is equipped with a conversion ring which is rotated until pressure altitude is aligned with outside air temperature, then airspeed indicated on the instrument is read as true airspeed on the adjustable ring. See figure 15-2 for removal and installation. Upon installation, before tightening mounting screws (7), calibrate the instrument as follows: Rotate ring (10) until 105 knots on adjustable ring aligns with 105 knots on indicator. Holding this setting, move retainer (9) until 60°F aligns with zero pressure altitude, then tighten mounting screws (7) and replace decorative cover.

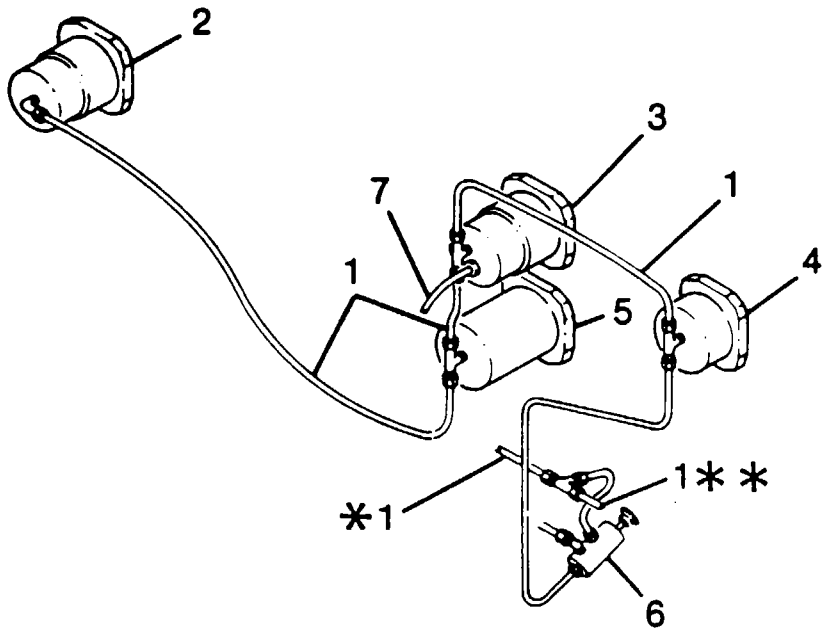
NOTE

Do not overtighten screws (7) and do not lubricate any parts.

Use spacers (12) as required for adequate friction on ring assembly (10).



WITHOUT ALTERNATE STATIC SOURCE INSTALLED



WITH ALTERNATE STATIC SOUCE INSTALLED

NOTE

*TO R/H STATIC SOURCE
* *TO L/H STATIC SOURCE

1. Static Line
2. Standby Altimeter
3. Encoding Altimeter
4. Airspeed Indicator
5. Vertical Speed Indicator
6. Alternate Static Source Valve
7. Line (To Transponder)

Figure 15-4. Encoding Altimeter Installation

15-19. TROUBLE SHOOTING -- AIRSPEED INDICATOR.

NOTE

Refer to paragraph 15-15 before blowing out pitot or static lines.

TROUBLE	PROBABLE CAUSE	REMEDY
HAND FAILS TO RESPOND.	Pitot pressure connection not properly connected to pressure line from pitot tube.	Repair or replace damaged line, tighten connections.
	Pitot or static lines clogged.	Blow out lines.
INCORRECT INDICATION OR HAND OSCILLATES.	Leak in pitot or static lines.	Repair or replace damaged lines, tighten connections.
	Defective mechanism.	Replace instrument.
	Leaking diaphragm.	Replace instrument.
	Alternate static source valve open.	Close for normal operation.
HAND VIBRATES.	Excessive vibration caused by loose mounting screws.	Tighten mounting screws.
	Excessive tubing vibration.	Tighten clamps and connections, replace tubing with flexible hose.

15-20. TROUBLE SHOOTING -- ALTIMETER.

NOTE

Refer to paragraph 15-15 before blowing out pitot or static lines.

TROUBLE	PROBABLE CAUSE	REMEDY
INSTRUMENT FAILS TO OPERATE.	Static line plugged.	Blow out lines.
	Defective mechanism.	Replace instrument.
INCORRECT INDICATION.	Hands not carefully set.	Reset hands with knob.
	Leaking diaphragm.	Replace instrument.
	Pointers out of calibration.	Replace instrument.

15-20. TROUBLE SHOOTING -- ALTIMETER (Cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
HAND OSCILLATES.	Static pressure irregular.	Blow out lines, tighten connections.
	Leak in airspeed or vertical speed indicator installations.	Blow out lines, tighten connections.

15-21. TROUBLE SHOOTING -- VERTICAL SPEED INDICATOR.

NOTE

Refer to paragraph 15-15 before blowing out pitot or static lines.

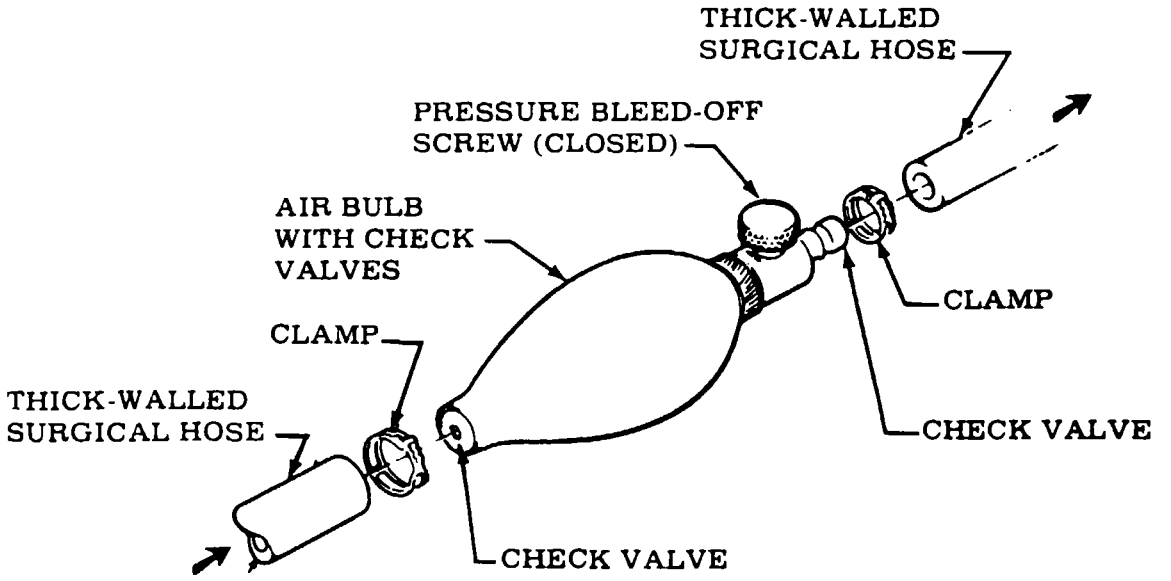
TROUBLE	PROBABLE CAUSE	REMEDY
INSTRUMENT FAILS TO OPERATE.	Static line plugged.	Blow out lines.
	Static line broken.	Repair or replace damaged line, tighten connections.
INCORRECT INDICATION.	Partially plugged static line.	Blow out lines.
	Ruptured diaphragm.	Replace instrument.
	Pointer off zero.	Reset pointer to zero.
POINTER OSCILLATES.	Partially plugged static line.	Blow out lines.
	Leak in static line.	Repair or replace damaged lines, tighten connections.
	Leak in instrument case.	Replace instrument.

15-22. TROUBLE SHOOTING -- PITOT TUBE HEATER.

NOTE

Refer to paragraph 15-15 before blowing out pitot or static lines.

TROUBLE	PROBABLE CAUSE	REMEDY
TUBE DOES NOT HEAT OR CLEAR ICE.	Switch turned "OFF".	Turn switch "ON"
	Open circuit breaker.	Reset breaker.
	Break in wiring.	Repair wiring.
	Heating element burned out.	Replace element.



TO APPLY SUCTION:

1. Squeeze air bulb to expel as much air as possible.
2. Hold suction hose firmly against static pressure source opening.
3. Slowly release air bulb to obtain desired suction, then pinch hose shut tightly to trap suction in system.
4. After leak test, release suction slowly by intermittently allowing a small amount of air to enter static system. To do this, tilt end of suction hose away from opening, then immediately tilt it back against opening. Wait until vertical speed indicator approaches zero, then repeat. Continue to admit this small amount of air intermittently until all suction is released, then remove test equipment.

TO APPLY PRESSURE:

CAUTION

Do not apply positive pressure with airspeed indicator or vertical speed indicator connected into static system.

1. Hold pressure hose firmly against static pressure source opening.
2. Slowly squeeze air bulb to apply desired pressure to static system. Desired pressure may be maintained by repeatedly squeezing bulb to replace any air escaping through leaks.
3. Release pressure by slowly opening pressure bleed-off screw, then remove test equipment.

Figure 15-5. Static System Test Equipment

15-23. VACUUM SYSTEM.

15-24. DESCRIPTION. A dry vacuum system is installed on the aircraft. The system utilizes a sealed bearing, engine-driven vacuum pump. A discharge tube is connected to the pump to expel the air from the pump overboard. A suction relief valve is used to control system pressure and is connected between the pump inlet and the instruments. In the cabin. the vacuum line is routed from the gyro instruments to the relief valve at the firewall. A central air filtering system is utilized. The reading of the suction gage indicates net difference in suction before and after air passes through a gyro. This differential pressure will gradually decrease as the central air filter becomes dirty, causing a lower reading on the suction gage.

15-25. TROUBLE SHOOTING -- VACUUM SYSTEM.

NOTE

Refer to paragraph 15-15 before blowing out pitot or static lines.

TROUBLE	PROBABLE CAUSE	REMEDY
HIGH SUCTION GAGE READINGS. (Gyros function normally.)	**Suction relief valve filter clogged. Relief valve malfunction.**	**Replace filter. Reset relief valve. Replace gage.**
LOW SUCTION GAGE READINGS.	**Leaks or restriction between instruments and relief valve, relief valve out of adjustment, defective pump.**	**Repair or replace lines, adjust or replace relief valve, repair or replace pump.**
	Central air filter dirty.	**Replace filter.**
SUCTION GAGE FLUCTUATES.	**Defective gage or sticking relief valve.**	**Replace gage. Clean sticking valve with Stoddard solvent. Blow dry and test. If valve sticks after cleaning, replace it.**

15-26. TROUBLE SHOOTING -- GYROS.

TROUBLE	PROBABLE CAUSE	REMEDY
HORIZON BAR FAILS TO RESPOND.	Central air filter dirty.	Replace filter.
	Suction relief valve improperly adjusted.	Adjust or replace relief valve.
	Faulty suction gage.	Replace suction gage.
	Vacuum pump failure.	Replace pump.
	Vacuum line kinked or leaking.	Repair or replace damaged lines, tighten connections.
HORIZON BAR DOES NOT SETTLE.	Defective mechanism.	Replace instrument.
	Insufficient vacuum.	Adjust or replace relief valve.
	Excessive vibration.	Replace defective shock panel mounts.
HORIZON BAR OSCILLATES OR VIBRATES EXCESSIVELY.	Central air filter dirty.	Replace filter.
	Suction relief valve improperly adjusted.	Adjust or replace relief valve.
	Faulty suction gage.	Replace suction gage.
	Defective mechanism.	Replace instrument.
	Excessive vibration.	Replace defective shock panel mounts.
EXCESSIVE DRIFT IN EITHER DIRECTION.	Central air filter dirty.	Replace filter.
	Low vacuum, relief valve improperly adjusted.	Adjust or replace relief valve.
	Faulty suction gage.	Replace suction gage.
	Vacuum pump failure.	Replace pump.
	Vacuum line kinked or leaking.	Repair or replace damaged lines, tighten connections.
DIAL SPINS IN ONE DIRECTION CONTINUOUSLY.	Operating limits have been exceeded.	Replace instrument.
	Defective mechanism.	Replace instrument.

15-27. TROUBLE SHOOTING -- VACUUM PUMP.

TROUBLE	PROBABLE CAUSE	REMEDY
EXCESSIVE OIL IN DISCHARGE.	Damaged engine drive seal.	Replace gasket.
HIGH SUCTION.	Suction relief valve screen clogged.	Clean or replace screen.
LOW SUCTION.	Relief valve leaking.	Replace relief valve.
	Vacuum pump failure.	Replace vacuum pump.

15-28. MAINTENANCE PRACTICES.

NOTE

When replacing a vacuum system component, ensure all connections are made correctly to avoid damage to gyro system. When a component is removed, cap off and identify all open lines, hoses, and fittings to prevent dirt from entering system, and to ensure proper reinstallation. Upon component replacement, check all hoses carefully to be sure they are clean and free of debris, oil, solvent, collapsed inner liners, and external damage. Replace old, hard, cracked, or brittle hoses, particularly on pump inlet, to avoid possible pump damage. On vacuum pump, where hose clearance is tight, making it difficult to reinstall hoses, apply a light film of petrolatum to the fitting. Install hoses by pushing them straight on, and do not wiggle hoses from side to side as this could cause particles to be cut from inside of hose, allowing particles to enter system.

CAUTION

Do not use teflon tape, pipe dope, or thread lubricants of any type on fitting threads, and avoid over-tightening of connections. All filters in vacuum system must be changed when installing a new pump. Failure to do so will void pump warranty. DO NOT CONNECT A PUMP BACKWARDS since the manifold check valve provides no pressure relief, the pump will be destroyed within a matter of seconds after starting the engine.

15-28A. REMOVAL OF VACUUM PUMP.

a. Remove upper engine cowling in accordance with procedures in Section 11 or 11A.
b. Disconnect, cap off and identify hose on inlet side of vacuum pump.
c. Identify and disconnect hose on outlet side of vacuum pump.
d. Remove nuts, lockwashers, and flat washers securing vacuum pump to engine.
e. Remove vacuum pump from mounting studs on engine.

f. Remove fittings from pump and retain if they are reusable. Discard any twisted fittings and damaged nuts and lockwashers.

15-28B. MOUNTING PAD INSPECTION.

a. Check condition of the AND 20000 pad seal. If the seal shows any signs of oil leakage, replace the seal. Replace seal if there is any doubt as to its serviceability.

15-28C. INSTALLATION OF VACUUM PUMP.

a. Before installing a new vacuum pump purge all lines in the system to remove carbon particles or pump components that may have been deposited in the lines by a previous pump.
b. Consult the applicable Parts Catalog, the pump vendor's application list, or the PMA label on the pump box to verify that the pump is the correct model for the engine and/or system.

NOTE

Before installing vacuum pump on engine, ensure that mating surfaces are clean and free of any old gasket material.

c. Position vacuum pump in a jaw-protected vise, with drive coupling downward.

CAUTION

Pump housing should never be placed directly in a vise, since clamping across center housing will cause an interal failure of carbon rotor. Protect pump mounting flange with soft metal or wood. NEVER INSTALL a pump that has been dropped.

NOTE

Do not use teflon tape, pipe dope, or thread lubricants of any type, and avoid over-tightening of connections.

d. Install elbow in pump; hand-tighten only.

NOTE

Use only a box wrench to tighten fittings to desired position. Do not make more than one and one half (1-1.2) turns beyond hand-tighten position.

e. Position new mounting pad gasket on mounting studs on engine.
f. Position vacuum pump on mounting studs.
g. Secure pump to engine with flat washers, new lockwashers, and nuts.

CAUTION

Always replace lockwashers with new ones when installing a new vacuum pump. Tighten all four mounting nuts 50-70 in. lbs.

h. Connect hose to inlet side of vacuum pump.
i. Install upper engine cowling in accordance with the procedures in Section 11 or 11A.

15-29. CLEANING. Low pressure, dry compressed air should be used in cleaning vacuum system components. Remove and discard suction relief valve filter; suction relief valve should be washed with Stoddard solvent then dried with low-pressure air. Install new filter. Refer to Section 2 for central air filter. Check hose for collapsed inner liners as well as external damage.

CAUTION

Never apply compressed air to lines or components installed in aircraft. The excessive pressures will damage gyros. If an obstructed line is to be blown out, disconnect at both ends and blow from instrument panel out.

15-29A. LOW-VACUUM WARNING LIGHT. A red low-vacuum warning light is installed on the instrument panel. The light is controlled by a vacuum switch which is teed into the line between the suction gage and the directional gyro. The switch contacts are normally closed. The light may be checked by turning ON the master switch. With the engine running, the light should illuminate when the vacuum drops below 3 ± .5 inches Hg.

15-30. VACUUM RELIEF VALVE ADJUSTMENT. A suction gage reading of 5.3 inches of mercury is desirable for gyro instruments. However, a range of 4.6 to 5.4 inches of mercury is acceptable. To adjust relief valve, remove central air filter, run engine to 1900 RPM on ground and adjust relief valve to 5.3 ± .1 inches of mercury.

CAUTION

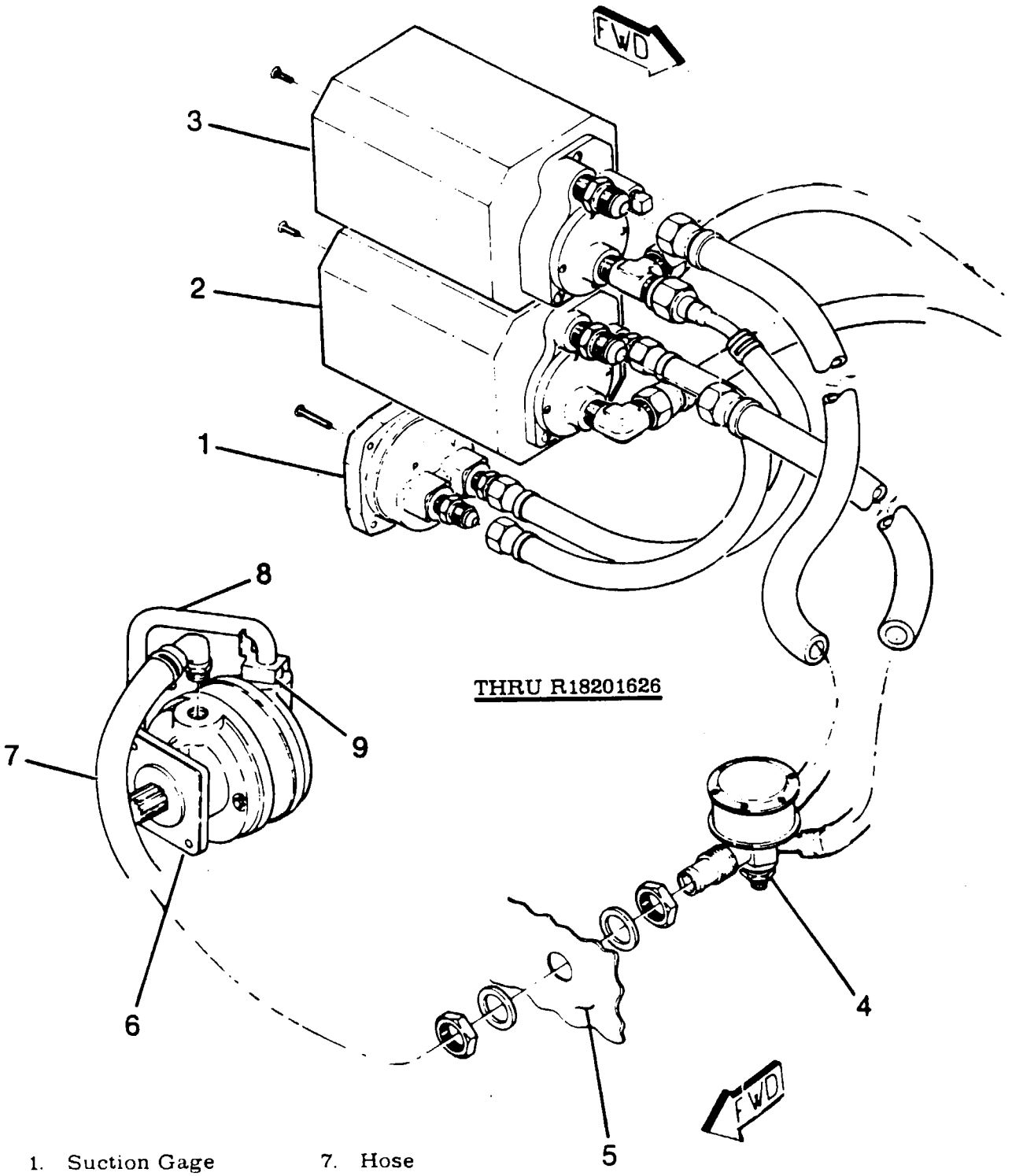
Do not exceed maximum engine temperature.

NOTE

If vacuum drops noticeably after replacing central air filter, remove and replace existing filter with a new filter.

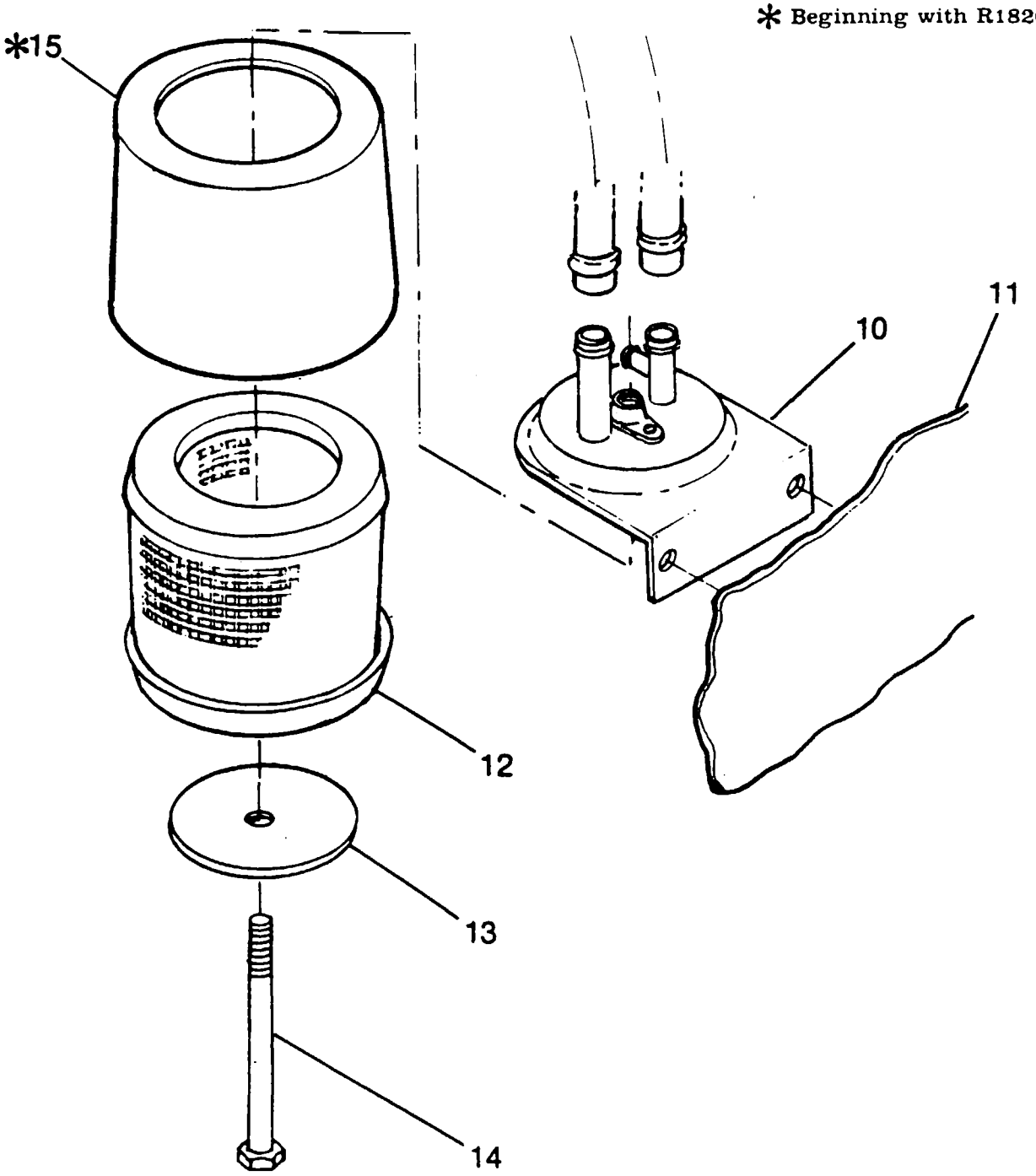
15-30A. STANDBY VACUUM SYSTEM.

15-30B. DESCRIPTION. A standby vacuum system may be installed in the airplane. The system consists of an electric motor drive vacuum pump, a vacuum relief valve, a manifold valve and associated hoses. The vacuum pump and motor assembly are mounted on the aft side of the firewall. A circuit breaker switch on the instrument panel controls and protects the system.



1. Suction Gage
2. Directional Gyro
3. Gyro Horizon
4. Suction Relief Valve
5. Firewall
6. Vacuum Pump
7. Hose
8. Overboard Line
9. Tube Locator
10. Bracket
11. Cabin Skin
12. Filter
13. Washer
14. Bolt

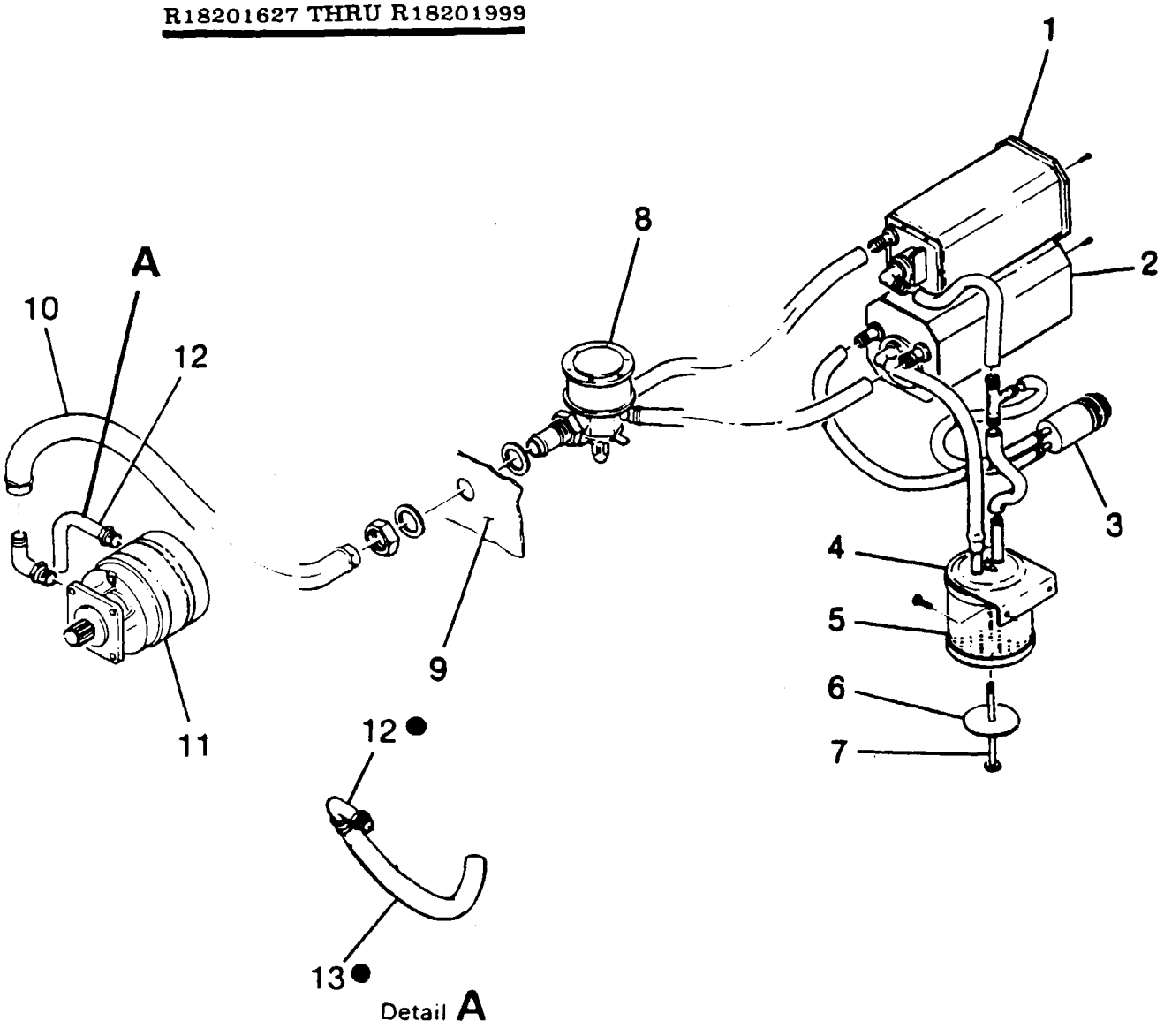
Figure 15-6. Vacuum System Installation (Sheet 1 of 4)



15. Cover

Figure 15-6. Vacuum System Installation (Sheet 2 of 4)

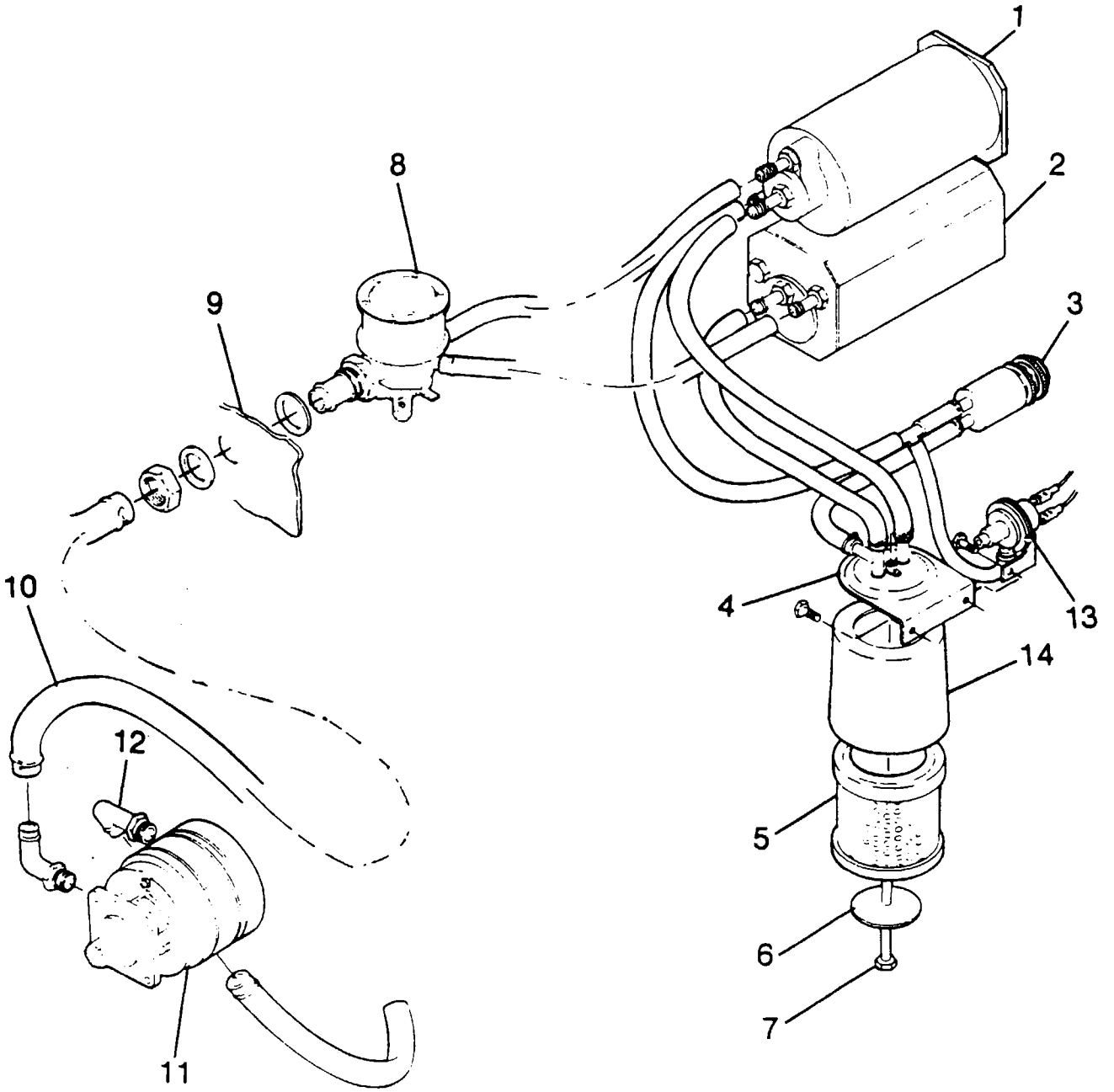
R18201627 THRU R18201999



1. Gyro Horizon
2. Directional Gyro
3. Suction Gage
4. Bracket
5. Filter
6. Washer
7. Bolt
8. Suction Relief Valve
9. Firewall
10. Hose
11. Vacuum Pump
12. Overboard Line
13. Hose

● BEGINNING WITH R18201929

Figure 15-6. Vacuum System Installation (Sheet 3 of 4)



BEGINNING WITH R18202000

1. Gyro Horizon
2. Directional Gyro
3. Suction Gage
4. Bracket
5. Filter
6. Washer
7. Bolt
8. Suction Relief Valve
9. Firewall
10. Hose
11. Vacuum PUmp
12. Overboard Line
13. Vacuum Switch
14. Cover

Figure 15-6. Vacuum System Installation (Sheet 4 of 4)

15-30C. TROUBLE SHOOTING - STANDBY VACUUM SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
NO SUCTION GAGE READING.	Circuit breaker switch has opened.	Reset circuit breaker switch. If switch reopens, check wire from switch to bus bar for short. Repair or replace wire.
	Defective motor.	Check voltage input wire and ground wire. Repair or replace wires.
	Defective pump.	Check pump operation. Replace pump.
LOW SUCTION GAGE READING.	Leak or restriction between pump and suction gage.	Check hoses and connections for leaks and obstructions. Install new clamps at connections. clear or replace hoses.
	Relief valve not properly adjusted.	Adjust relief valve.
	Defective pump.	Check pump. Replace pump.
	Central air filter dirty.	Replace central air filter.

15-30D. REMOVAL. (See figure 15-6A.)

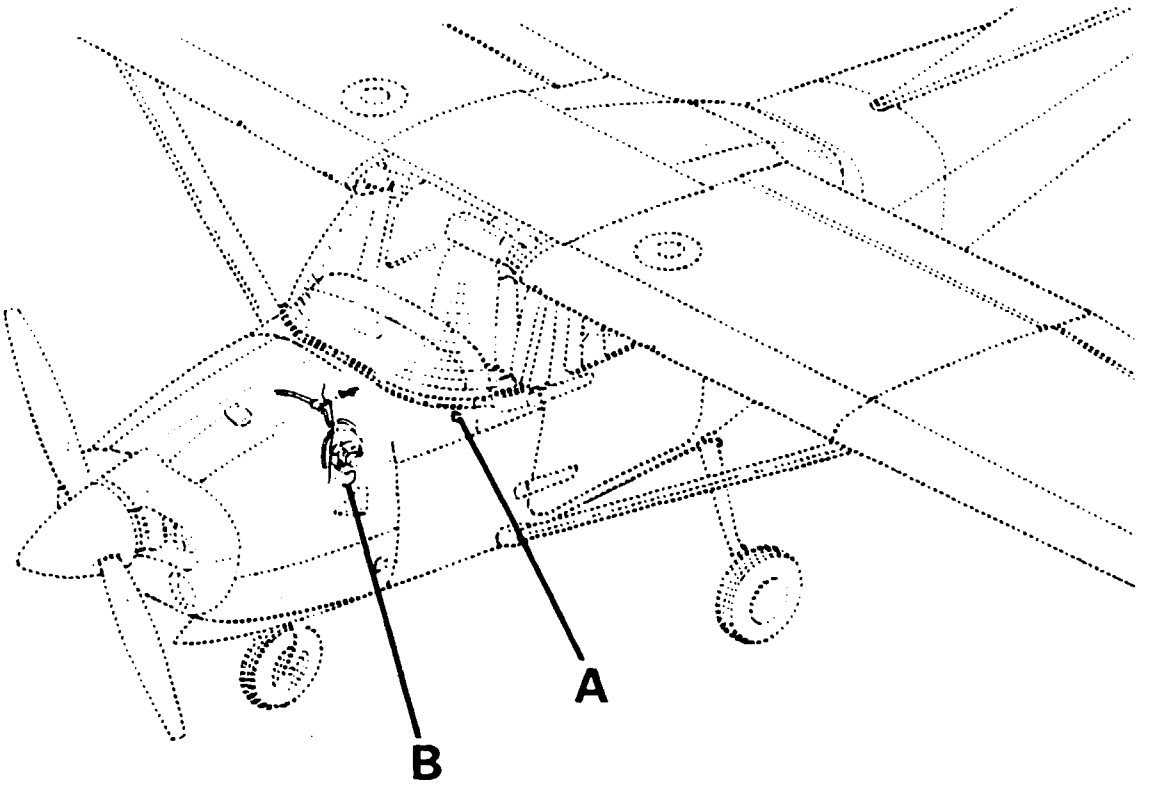
a. Make sure circuit breaker switch (1) and battery switch are off.
b. Remove clamps securing hoses (15) and (16) to vacuum pump (20).
c. Cap hoses and pump fittings so dirt cannot enter system.
d. Disconnect ground wire (18) and voltage input wire (17).
e. Remove safety-wire from bolts (23).
f. Remove bolts (23) and washers (24) and remove motor and pump assembly.
g. If motor (26) is to be removed from assembly, remove nuts (21) and washers (22).

15-30E. INSTALLATION. (See figure 15-6A.)

a. If motor was removed from assembly, position motor (26) and install washers (22) and nuts (21).
b. Position pump and motor assembly on duct assembly and install washers (24) and bolts (23).
c. Safety-wire bolts (23).
d. Place hoses (15) and (16) over pump fittings and install clamps.
e. Connect voltage input wire (17) and ground wire (18).
f. Turn on battery switch and circuit breaker switch (1), then check suction gage to see that system is operating properly. Turn off switches.

CAUTION

Check that voltage input wire (17) is not pushed down into motor as it could become entangled with the armature, locking it.



1. Circuit Breaker Switch
2. Instrument Panel

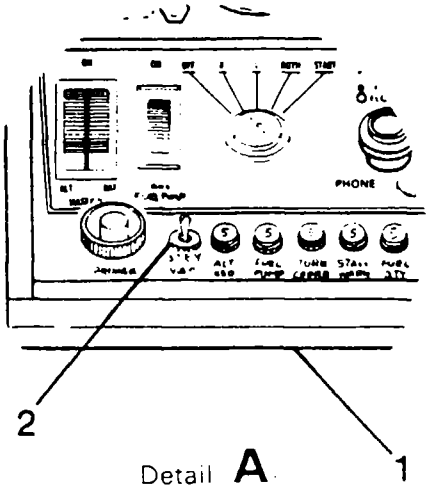
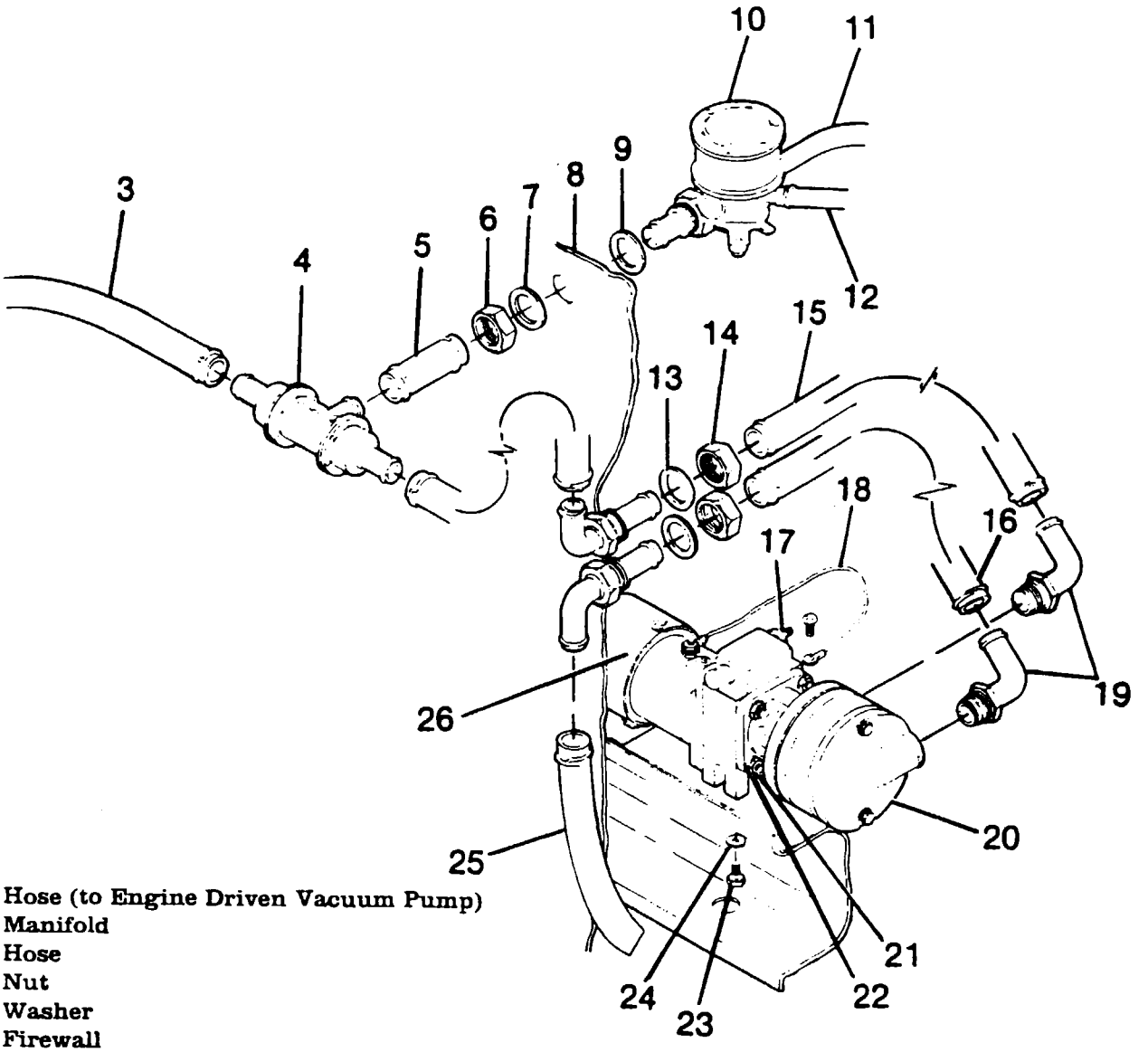


Figure 15-6A. Standby Vacuum System (Sheet 1 of 2)



Detail **B**

3. Hose (to Engine Driven Vacuum Pump)
4. Manifold
5. Hose
6. Nut
7. Washer
8. Firewall
9. Washer
10. Relief Valve
11. Hose (to Directional Gyro)
12. Hose (to Gyro Horizon)
13. Washer
14. Nut
15. Hose (to Manifold
16. Hose
17. Voltage Input Wire
18. Ground Wire
19. Fittings
20. Vacuum Pump
21. Nut
22. Washer
23. Bolt
24. Washer
25. Vent Hose
26. Motor

Figure 15-6A. Standby Vacuum System (Sheet 2 of 2)

15-31. ENGINE INDICATORS.

15-32. TACHOMETER.

15-33. DESCRIPTION. The tachometer is a mechanical indicator driven at half crankshaft speed by a flexible shaft. Most tachometer difficulties will be found in the drive-shaft. To function properly, the shaft housing must be free of kinks, dents and sharp bends. There should be no bend on a radius shorter than six inches and no bend within three inches of either terminal. If a tachometer is noisy or the pointer oscillates, check cable housing for kinks, sharp bends and damage. Disconnect cable at tachometer and pull it out of housing. Check cable for worn spots, breaks and kinks.

NOTE

Before replacing a tachometer cable in housing, coat lower two thirds with AC Type ST-640 speedometer cable grease or Lubriplate No. 110. Insert cable in housing as far as possible, then slowly rotate to make sure it is seated in the engine fitting. Insert cable in tachometer, making sure it is seated in drive shaft, then reconnect housing and torque to 50 pound-inches (at instrument).

15-34. MANIFOLD PRESSURE GAGE. THRU R1821433, and TR1821430.

15-35. DESCRIPTION. The manifold pressure gage is a barometric instrument which indicates absolute pressure in the intake manifold in inches of mercury.

15-36. FUEL PRESSURE GAGE. THRU R18201430 and R18201432.

15-37. DESCRIPTION. The 1.25 inch diameter fuel pressure gage is a pressure instrument calibrated in PSI indicating approximate fuel pressure to the engine. Pressure for operating the indicator is obtained through a hose from the fuel manifold valve.

15-38. MANIFOLD PRESSURE/FUEL PRESSURE GAGE. R18201434 & ON. and TR18201431. TR18201433 & ON.

15-39. DESCRIPTION. The manifold pressure and fuel pressure gage are in one instrument case. However, each instrument operates independently. The manifold pressure gage is a barometric instrument which indicates absolute pressure in the intake manifold in inches of mercury. The fuel pressure gage is a pressure instrument calibrated in PSI indicating approximate fuel pressure to the engine. Pressure for operating the indicator is obtained through a hose from the fuel manifold valve. The manifold pressure and fuel pressure gage on the Model R182 is equipped with a dampening screw located on the back of the gage.

15-39A. DAMPENING ADJUSTMENT (R182). Evacuate the instrument to 10 IN HG. absolute, release the vacuum abruptly and check time required for needle to pass from 10 IN HG. to 25 IN HG. Set the dampening screw so time required for needle to pass from 10 IN HG. to 25 IN HG checks 2.0 ± 1.0 seconds.

15-40. TROUBLE SHOOTING -- MANIFOLD PRESSURE GAGE.

TROUBLE	PROBABLE CAUSE	REMEDY
EXCESSIVE ERROR AT EXISTING BAROMETRIC PRESSURE.	Pointer shifted.	Replace instrument.
	Leak in vacuum bellows.	Replace instrument.
	Loose pointer.	Replace instrument.
	Leak in pressure line.	Test line and connections for leaks. Repair or replace damaged line, tighten connections.
	Condensate or fuel in line.	Check line for obstructions. Blow out line.
JERKY MOVEMENT OF POINTER.	Excessive internal friction.	Replace instrument.
	Rocker shaft screws tight.	Replace instrument.
	Link springs too tight.	Replace instrument.
	Dirty pivot bearings.	Replace instrument.
	Defective mechanism.	Replace instrument.
	Leak in pressure line.	Test line and connections for leaks. Repair or replace damaged line, tighten connections.
SLUGGISH OPERATION OF POINTER.	Foreign matter in line.	Check line for obstructions. Blow out line.
	Damping needle dirty.	Replace instrument.
	Leak in pressure line.	Test line and connections for leaks. Repair or replace damaged line, tighten connections.
EXCESSIVE POINTER VIBRATION.	Tight rocker pivot bearings.	Replace instrument.
	Excessive vibration.	Check panel shock-mounts. Replace defective shock-mounts.
IMPROPER CALIBRATION.	Faulty mechanism.	Replace instrument.
NO POINTER MOVEMENT.	Faulty mechanism.	Replace instrument.
	Broken pressure line.	Check line and connections for breaks. Repair or replace damaged line.

15-41. TROUBLE SHOOTING -- FUEL PRESSURE GAGE.

TROUBLE	PROBABLE CAUSE	REMEDY
DOES NOT REGISTER.	Pressure line clogged.	Check line for obstructions. Blow out line.
	Pressure line broken.	Check line for damage or leaks. Repair or replace damaged line.
	Fractured bellows or damaged mechanism.	Replace instrument.
	Clogged snubber orifice.	Replace instrument.
	Pointer loose on shaft.	Replace instrument.
POINTER FAILS TO RETURN TO ZERO.	Foreign matter in line.	Check line for obstructions. Blow out line.
	Clogged snubber orifice.	Replace instrument.
	Damaged bellows or mechanism.	Replace instrument.
INCORRECT OR ERRATIC READING.	Damaged or dirty mechanism.	Replace instrument.
	Pointer bent, rubbing on dial or glass.	Replace instrument.
	Leak or partial obstruction in pressure or vent line.	Check line for obstructions or leaks. Blow out dirty line. repair or tighten loose connections.

15-42. CYLINDER HEAD TEMPERATURE GAGE.

15-43. DESCRIPTION. The temperature sending unit regulates electrical power through the cylinder head temperature gage. The gage and sending unit require little or no maintenance other than cleaning, making sure lead is properly supported and all connections are clean, tight and properly insulated. The Rochester and Stewart Warner gages are connected the same, but the Rochester gage does not have a calibration pot and cannot be adjusted. Refer to Table 2, page 15-30B when trouble shooting the cylinder head temperature gage.

NOTE

A Cylinder Head Temperature Gage Calibration Unit (SK182-43) is available for Stewart Warner gages and may be ordered through the Cessna Service Parts Center. Rochester gages are not adjustable.

15-44. TROUBLE SHOOTING -- CYLINDER HEAD TEMPERATURE GAGE.

TROUBLE	PROBABLE CAUSE	REMEDY
GAGE INOPERATIVE.	No current to circuit.	Repair electrical circuit.
	Defective gage, bulb or circuit.	Repair or replace defective items.
GAGE FLUCTUATES RAPIDLY.	Loose or broken wire permitting alternate make and break or gage circuit.	Repair or replace defective wire.
GAGE READS TOO HIGH ON SCALE.	High voltage.	Check "A" terminal.
	Gage off calibration.	Replace gage.
GAGE READS TOO LOW ON SCALE.	Low voltage.	Check voltage supply and "D" terminal.
	Gage off calibration.	Replace gage.
GAGE READS OFF SCALE AT HIGH END.	Break in bulb.	Replace bulb.
	Break in bulb lead.	Replace bulb.
	Internal break in gage.	Replace gage.
OBVIOUSLY INCORRECT READING.	Defective gage mechanism.	Replace gage.
	Incorrect calibration.	Calibrate system.

15-45. OIL PRESSURE GAGE.

15-46. DESCRIPTION. The Bourdon tube-type oil pressure gage is a direct-reading instrument, operated by a pressure pickup line connected to the engine main oil gallery. The oil pressure line from the instrument to the engine should be filled with kerosene, especially during cold weather operation, to attain an immediate oil indication.

15-47. TROUBLE SHOOTING -- OIL PRESSURE GAGE

TROUBLE	PROBABLE CAUSE	REMEDY
GAGE DOES NOT REGISTER.	Pressure line clogged.	Clean line.
	Pressure line broken.	Repair or replace damaged line.
	Fractured Bourdon tube.	Replace instrument.
	Gage pointer loose on staff.	Replace instrument.
	Damaged gage movement.	Replace instrument.
GAGE POINTER FAILS TO RETURN TO ZERO.	Foreign matter in line.	Clean line.
	Foreign matter in Bourdon tube.	Replace instrument.
	Bourdon tube stretched.	Replace instrument.
GAGE DOES NOT REGISTER PROPERLY.	Faulty mechanism.	Replace instrument.
GAGE HAS ERRATIC OPERATION.	Worn or bent movement.	Replace instrument.
	Foreign matter in Bourdon tube.	Replace instrument.
	Dirty or corroded movement.	Replace instrument.
	Pointer bent and rubbing on dial, dial screw or glass.	Replace instrument.
	Leak in pressure line.	Repair or replace damaged line.

15-48. OIL TEMPERATURE GAGE.

15-49. DESCRIPTION. On some airplanes, the oil temperature gage is a Bourdon tube type pressure instrument connected by armored capillary tubing to a temperature bulb in the engine. The temperature bulb, capillary tube and gage are filled with fluid and sealed. Expansion and contraction of fluid in the bulb with temperature changes operates the gage. Checking capillary tube for damage and fittings for security is the only maintenance required. Since the tubes inside diameter is small, small dents and kinks, which would be acceptable in larger tubing, may partially or completely close off the capillary, making the gage inoperative. Some airplanes are equipped with gages that are electrically actuated and are not adjustable. Refer to Table 1, page 15-30A when trouble shooting the oil temperature gage.

15-50. CARBURETOR AIR TEMPERATURE GAGE.

15-51. DESCRIPTION. The carburetor air temperature gage is of the resistance-bridge type. Changes in electrical resistance of the element are indicated by the gage, calibrated for temperature. The system requires power from the airplane electrical system and operates only when the master switch is on. Although both instrument and sensing bulb are grounded, two leads are used to avoid possibility of instrument error, induced by poor electrical bonds in the airframe.

15-52. TROUBLE SHOOTING -- CARBURETOR AIR TEMPERATURE GAGE.

TROUBLE	PROBABLE CAUSE	REMEDY
GAGE POINTER STAYS OFF LOW END OF SCALE.	Popped circuit breaker.	Reset breaker.
	Master switch "OFF" or switch defective	Replace defective switch.
	Broken or grounded leads between gage and sensing unit.	Repair or replace defective wiring.
	Defective gage or sensing unit.	Replace gage or sensing unit.

15-52. TROUBLE SHOOTING -- CARBURETOR AIR TEMPRATURE GAGE (Cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
GAGE POINTER GOES OFF HIGH END OF SCALE.	Broken or grounded lead.	Repair or replace defective wiring.
	Defective gage or sensing unit.	Replace gage or sensing unit.
GAGE OPERATES INTER-MITTENTLY.	Defective master switch, broken or grounded lead.	Replace switch, repair or replace defective wiring.
	Defective gage or sensing unit.	Replace gage or sensing unit.
EXCESSIVE POINTER OSCILLATION.	Loose or broken lead.	Repair or replace defective wiring.
	Defective gage or sensing unit.	Replace gage or sensing unit.
	Excessive panel vibration.	Tighten panel mounting screws.
OBVIOUSLY INCORRECT TEMPERATURE READING.	Defective gage or sensing unit.	Replace gage or sensing unit.
POINTER FAILS TO GO OFF SCALE WITH CURRENT OFF.	Defective master switch.	Replace switch.
	Defective gage.	Replace gage.

15-53. FUEL QUANTITY INDICATING SYSTEM.

15-54. DESCRIPTION. The magnetic type fuel quantity indicators are used in conjunction with a float-operated variable-resistance transmitter in each fuel cell. The full position of float produces a minimum resistance through the transmitter, permitting maximum current flow through the fuel quantity indicator and maximum pointer deflection. As fuel level is lowered, resistance in the transmitter is increased, producing a decreased current flow through the fuel quantity indicator and a smaller pointer deflection.

15-55. REMOVAL AND INSTALLATION OF TRANSMITTER. (Refer to Section 12.)

a. Drain fuel from cell/bay. (Observe the precautions in Section 12.)
b. Remove wing root fairing.
c. Disconnect electrical lead and ground strap from transmitter.
d. Remove screws attaching transmitter and carefully work transmitter from cell. DO NOT BEND FLOAT ARM.
e. Reverse preceding steps for installation, using new gaskets around opening and under screw heads.

NOTE

Torque retaining screws so gasket seats evenly and inspect float position to ensure bottom of float approx..20 from bottom of fuel tank.

15-56. TROUBLE SHOOTING -- FUEL QUANTITY INDICATING SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
FAILURE TO INDICATE.	No power to indicator or transmitter. (Pointer stays below E.)	Check and reset breaker. repair or replace defective wiring.
	Grounded wire. (Pointer stays above F.)	Repair or replace defective wire.
	Low voltage.	Correct voltage.
	Defective indicator.	Replace indicator.
SYSTEM OFF CALIBRATION.	Defective indicator.	Replace indicator.
	Defective transmitter. Low or high voltage.	Recalibrate or replace. Correct voltage.
STICKY OR SLUGGISH INDICATOR OPERATION.	Defective indicator.	Replace indicator.
	Low voltage.	Correct voltage.
ERRATIC READINGS.	Loose or broken wiring on indicator or transmitter.	Repair or replace defective wire.
	Defective indicator or transmitter.	Replace indicator or transmitter.
	Defective master switch.	Replace switch.

15-57. TRANSMITTER ADJUSTMENT.
(Refer to page 15-30A).

15-57. TRANSMITTER ADJUSTMENT.

WARNING

Using the following fuel transmitter calibration procedure on components other than the originally installed (Stewart Warner) components will result in a faulty fuel quantity reading.

15-57A. STEWART WARNER GAGE TRANSMITTER CALIBRATION. Chances of transmitter calibration changing in normal service is remote; however, it is possible that float arm or float arm stops may become bent if transmitter is removed from cell. Transmitter calibration is obtained by adjusting float travel. Float travel is limited by float arm stops.

WARNING

Use extreme caution while working with electrical components of the fuel system. The possibility of electrical sparks around an "empty" fuel cell creates a hazardous situation.

Before installing transmitter, attach electrical wires and place master switch in "ON" position. Allow float arm to rest against lower float arm stop and read indicator. The pointer should be on E (empty) position. Adjust the float arm against lower stop so pointer indicator is on E. Raise float until arm is against upper stop and adjust upper stop to permit indicator pointer to be on F (full). Install transmitter in accordance with paragraph 15-55.

15-57B. ROCHESTER GAGE TRANSMITTER. Do not attempt to adjust float arm or stop. No adjustment is allowed.

Table 1

NOTE

Select the oil temperature sending unit part number from the left column and the temperature from the column headings. Read the ohms value under the appropriate temperature column.

Part Number	Type	72°F	120°F	165°F	220°F	250°F
S1630-1	Oil Temp				46.4	
S1630-1	Oil Temp		620.0			52.4
S1630-1	Oil Temp		620.0			52.4
S1630-1	Oil Temp			192.0		
S2335-1	Oil Temp	990.0				34.0

Table 2

NOTE

Select the cylinder head temperature sending unit part number from the left column and the temperature from the column headings. Read the ohms value under the appropriate temperature column.

Part Number	Type	200°F	220°F	450°F	475°F
S1372-1	CHT		310.0	34.8	
S1372-2	CHT		310.0	34.8	
S1372-3	CHT			113.0	
S1372-4	CHT			113.0	
S2334-3	CHT	745.0			38.0
S2334-4	CHT	745.0			38.0

15-57C. FUEL QUANTITY INDICATING SYSTEM OPERATIONAL TEST.

WARNING: REMOVE ALL IGNITION SOURCES FROM THE AIRPLANE AND VAPOR HAZARD AREA. SOME TYPICAL EXAMPLES OF IGNITION SOURCES ARE STATIC ELECTRICITY, ELECTRICAL POWERED EQUIPMENT (TOOLS OR ELECTRONIC TEST EQUIPMENT - BOTH INSTALLED ON THE AIRPLANE AND GROUND SUPPORT EQUIPMENT), SMOKING AND SPARKS FROM METAL TOOLS.

WARNING: OBSERVE ALL STANDARD FUEL SYSTEM FIRE AND SAFETY PRACTICES.

1. Disconnect all electrical power from the airplane. Attach maintenance warning tags to the battery connector and external power receptacle stating:

   DO NOT CONNECT ELECTRICAL POWER, MAINTENANCE IN PROGRESS.

2. Electrically ground the airplane.

3. Level the airplane and drain all fuel from wing fuel tanks. Refer to Section 2, Ground Handling, Servicing, Cleaning, Lubrication, And Inspection as required.

4. Gain access to each fuel transmitter float arm and actuate the arm through the transmitter's full range of travel.

   A. Ensure the transmitter float arm moves freely and consistently through this range of travel. Replace any transmitter that does not move freely or consistently.

WARNING: USE EXTREME CAUTION WHILE WORKING WITH ELECTRICAL COMPONENTS OF THE FUEL SYSTEM. THE POSSIBILITY OF ELECTRICAL SPARKS AROUND AN "EMPTY" FUEL CELL CREATES A HAZARDOUS SITUATION.

   B. While the transmitter float arm is being actuated, apply airplane battery electrical power as required to ensure that the fuel quantity indicator follows the movement of the transmitter float arm. If this does not occur, troubleshoot, repair and/or replace components as required until the results are achieved as stated.

      NOTE: Stewart Warner fuel quantity indicating systems can be adjusted. Refer to paragraph 15-57A for instructions for adjusting Stewart Warner fuel indicating systems. Rochester fuel quantity indicating system components are not adjustable, only component replacement or standard electrical wiring system maintenance practices are permitted.

5. With the fuel selector valve in the "OFF" position, add unusable fuel quantity to each fuel tank.

6. Apply electrical power as required to verify the fuel quantity indicator indicates "EMPTY".

   A. If "EMPTY" is not indicated, adjust, troubleshoot, repair and/or replace fuel-indicating components as required until the "EMPTY" indication is achieved.

      NOTE: Stewart Warner fuel quantity indicating systems can be adjusted. Refer to paragraph 15-57A for instructions for adjusting Stewart Warner fuel indicating systems. Rochester fuel quantity indicating system components are not adjustable, only component replacement or standard electrical wiring system maintenance practices are permitted.

7. Fill tanks to capacity, apply electrical power as required and verify fuel quantity indicator indicates "FULL".

   A. If "FULL" is not indicated, adjust, troubleshoot, repair and/or replace fuel indicating components as required until the "FULL" indication is achieved.

      NOTE: Stewart Warner fuel quantity indicating systems can be adjusted. Refer to paragraph 15-57A for instructions for adjusting Stewart Warner fuel indicating systems. Rochester fuel quantity indicating system components are not adjustable, only component replacement or standard electrical wiring system maintenance practices are permitted.

8. Install any items and/or equipment removed to accomplish the Fuel Quantity Indicating System Operational Test, remove maintenance warning tags and connect the airplane battery.

15-58. HOURMETER. (See figure 15-7.)

15-59. DESCRIPTION. The hourmeter is an electrically operated instrument, actuated by a pressure switch in the oil pressure gage line. Electrical power is supplied through a one-amp fuse from the electrical clock circuit, and therefore will operate independent of the master switch. A diode incorporated into the meter prevents interruption of avionics operation. This type hourmeter is identified by a white + above the positive terminal.

NOTE

When installing the hourmeter, the positive (red) wire must be connected to the white + terminal. Connecting wires incorrectly will damage the meter.

15-60. ECONOMY MIXTURE INDICATOR.

15-61. DESCRIPTION. The economy mixture indicator is an exhaust gas temperature (EGT) sensing device which is used to aid the pilot in selecting the most desirable fuel-air mixture for cruising flight at less than 75% power. Exhaust gas temperature (EGT) varies with ratio of fuel-to-air mixture entering the engine cylinders. Refer to the PILOT'S OPERATING HANDBOOK for operating procedure of the system.

15-62. TROUBLE SHOOTING -- ECONOMY MIXTURE INDICATOR.

TROUBLE	PROBABLE CAUSE	REMEDY
GAGE INOPERATIVE.	Defective gage, probe or circuit.	Repair or replace defective part.
INCORRECT READING.	Indicator needs calibrating.	Calibrate indicator in accordance with paragraph 15-61.
FLUCTUATING READING.	Loose, frayed or broken lead, permitting alternate make and break of current.	Tighten connections and repair or replace defective leads.

15-63. CALIBRATION. When a new EGT gage or probe is installed accomplish the following steps:

a. Before flight remove the decorative cover on right hand instrument panel and temporarily install the EGT indicator with one screw.

b. Test fly the airplane and establish 75% power in level flight. Carefully lean the fuel mixture to achieve peak EGT. Remove the EGT indicator from the panel and adjust the screw on the back of the instrument beneath the plastic cap with a small blade screwdriver to place the EGT indicator hand over the 4/5 scale increment of the indicator scale. Turning the screw clockwise increases the reading and counter-clockwise decreases the reading. The adjusting screw has an adjustment range of approximately 600°F or 2 increments in either direction. Stops are provided on the adjust screw which control the above and should not be forced past stops as it will affect calibration of the Unit Scale.

NOTE

The 4/5 scale increment setting provides the reference indicator point for relative temperature indications for normal cruise power settings within range of instrument scale.

c. After flight reinstall indicator and decorative cover.

The yellow adjustable hand on indicator is for use to mark a reference temperature setting.

15-64. REMOVAL AND INSTALLATION. Removal of the indicator is accomplished by removing the mounting screws and disconnecting the leads. Tag leads to facilitate installation. The thermocouple probe is secured to the exhaust stack with a clamp. When installing probe, tighten clamp to 45 pound-inches and safety as required. Refer to Section 11 for exhaust system installation.

15-65. MAGNETIC COMPASS. (See figure 15-7.)

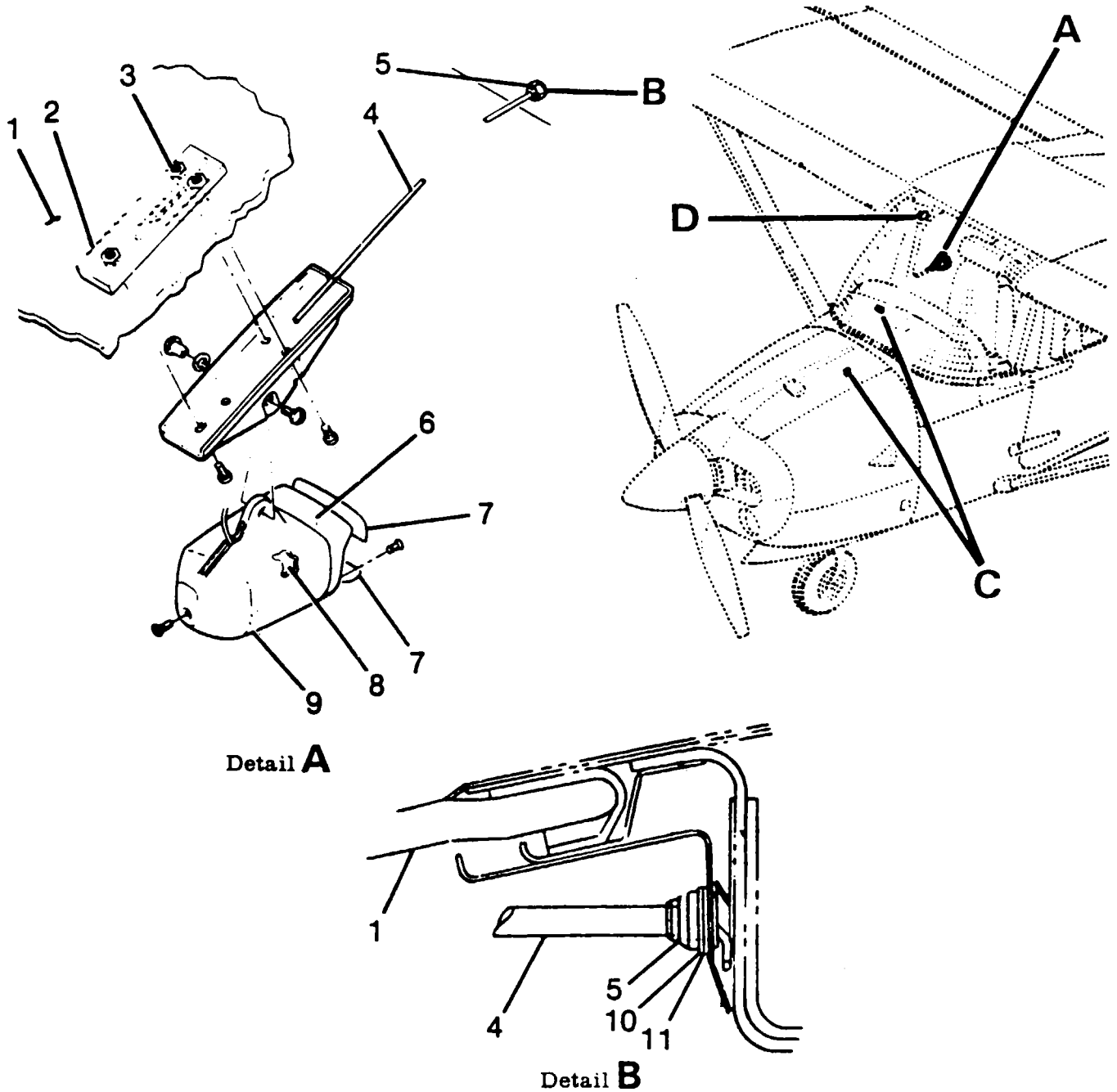
15-66. DESCRIPTION. The magnetic compass is liquid-filled, with expansion provisions to compensate for temperature changes. It is equipped with compensating magnets adjustable from the front of the case. The compass is internally lighted, controlled by the instrument lights rheostat switch. No maintenance is required on the compass except an occasional check on a compass rose and replacement of lamp. The compass mount is attached by three screws to a base plate which is bonded to windshield with methylene chloride. A tube containing the compass light wires is attached to the metal strip at the top of the windshield. Removal of the compass is accomplished by removing the screw at forward end of compass mount, unfastening the metal strip at the top of windshield and cutting the two wire splices. Removal of the compass mount is accomplished by removing three screws attaching mount to the base plate. Access to the inner screw is gained through a hole in the bottom of mount, through which a thin screwdriver may be inserted. When installing the compass, it will be necessary to splice the compass light wires.

15-67. STALL WARNING HORN AND TRANSMITTER.

15-68. DESCRIPTION. The stall warning horn is contained in the dual warning unit mounted on the right hand wing root rib. It is electrically operated and controlled by a stall warning transmitter mounted on the leading edge of the left wing. For further information on the warning horn and transmitter, refer to Section 16.

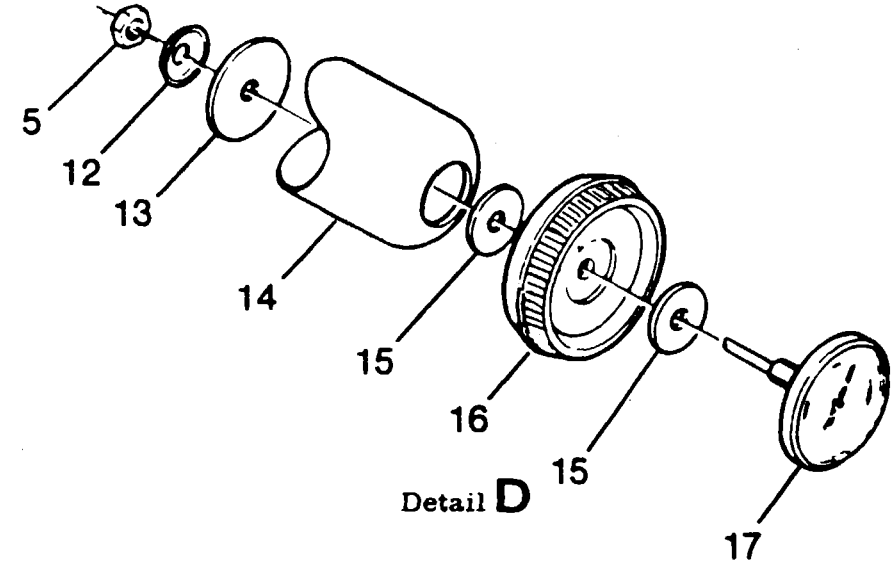
15-69. TURN COORDINATOR.

15-70. DESCRIPTION. The turn coordinator is an electrically operated, gyroscopic, roll-turn rate indicator. Its gyro simultaneously senses rate of motion roll and yaw axis which is projected on a single indicator. The gyro is a non-tumbling type requiring no caging mechanism and incorporates an ac brushless spin motor with a solid state inverter.



1. Windshield
2. Base Plate
3. Insert
4. Tube
5. Nut
6. Light
7. Compass Card
8. Compass
9. Mount
10. Washer
11. Lockwasher
12. Dished Washer
13. Plastic Washer
14. Air Vent Tube
15. Rubber Washer
16. Knob
17. O.A.T. Gage
18. Hourmeter
19. Positive Wire
20. Wire from Clock Circuit
21. Adapter
22. Pressure Switch
23. Negative Wire

Figure 15-7. Compass, O.A.T. Gage and Hourmeter Installation (Sheet 1 of 2).



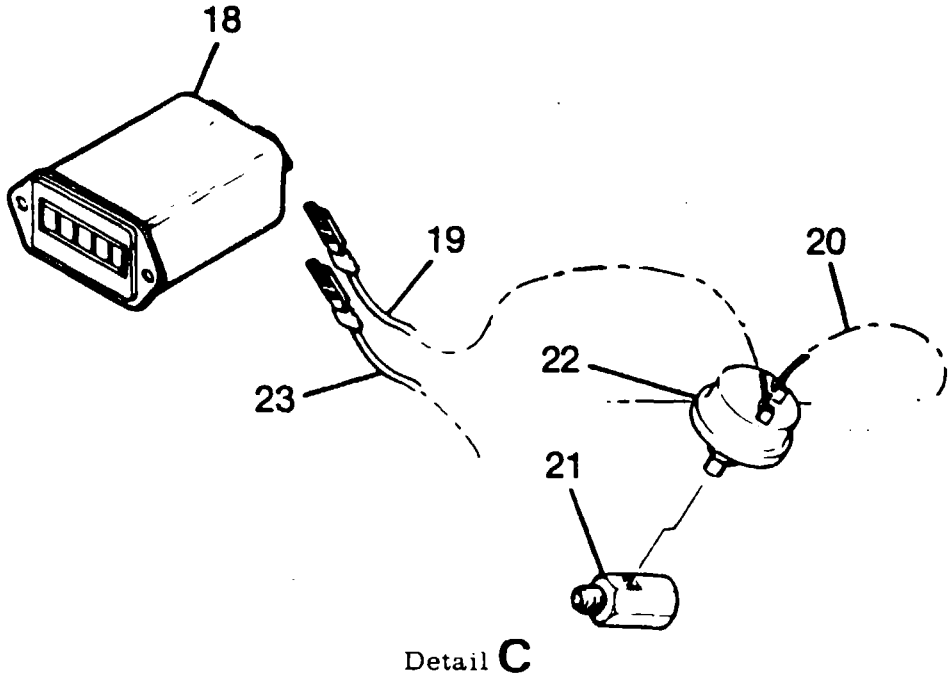


Figure 15-7. Compass. O.A.T. Gage and Hourmeter Installation (Sheet 2 of 2).

15-71. TROUBLE SHOOTING -- TURN COORDINATOR.

TROUBLE	PROBABLE CAUSE	REMEDY
INDICATOR DOES NOT RETURN TO CENTER.	Friction caused by contamination in the indicator dampening.	Replace instrument.
	Friction in gimbal assembly.	Replace instrument.
DOES NOT INDICATE A STANDARD RATE TURN (TOO SLOW).	Low voltage.	Correct voltage.
	Inverter frequency changed.	Replace instrument.
NOISY MOTOR.	Faulty bearings.	Replace instrument.
ROTOR DOES NOT START.	Faulty electrical connection.	Correct voltage or replace faulty wire.
	Inverter malfunctioning.	Replace instrument.
	Motor shorted.	Replace instrument.
	Bearings frozen.	Replace instrument.
IN COLD TEMPERATURES, HAND FAILS TO RESPOND OR IS SLUGGISH.	Oil in indicator becomes too thick.	Replace instrument.
	Insufficient bearing end play.	Replace instrument.
	Low voltage.	Correct voltage.
NOISY GYRO.	High voltage.	Correct voltage.
	Loose or defective rotor bearings.	Replace instrument.

15-72. TURN-AND-SLIP INDICATOR.

15-73. DESCRIPTION. The turn-and-slip indicator is operated by the aircraft electrical system and operates ONLY when the master switch is on. Its circuit is protected by an automatically-resetting circuit breaker.

15-74. TROUBLE SHOOTING. -- TURN-AND-SLIP INDICATOR.

TROUBLE	PROBABLE CAUSE	REMEDY
INDICATOR POINTER FAILS TO RESPOND.	Automatic resetting circuit breaker defective.	Replace circuit breaker.
	Master switch "OFF" or switch defective.	Replace defective switch.
	Broken or grounded lead to indicator.	Repair or replace defective wiring.
	Indicator not grounded.	Repair or replace defective wire.
	Defective mechanism.	Replace instrument.
HAND SLUGGISH IN RETURNING TO ZERO.	Defective mechanism.	Replace instrument.
	Low voltage.	Correct voltage.
POINTER DOES NOT INDICATE PROPER TURN.	Defective mechanism.	Replace instrument.
HAND DOES NOT SIT ON ZERO.	Gimbal and rotor out of balance.	Replace instrument.
	Hand incorrectly sits on rod.	Replace instrument.
	Sensitivity spring adjustment pulls hand off zero.	Replace instrument.
IN COLD TEMPERATURES, HAND FAILS TO RESPOND OR IS SLUGGISH.	Oil in indicator becomes too thick.	Replace instrument.
	Insufficient bearing end play.	Replace instrument.
		Low voltage.
NOISY GYRO.	High voltage.	Correct voltage.
	Loose or defective rotor bearings.	Replace instrument.

15-75. ELECTRIC CLOCK.

15-76. DESCRIPTION. The electric clock is connected to the battery through a one-ampere fuse mounted adjacent to the battery box. The electrical circuit is separate from the aircraft electrical system and will operate when the master switch is OFF.

15-77. OUTSIDE AIR TEMPERATURE GAGE. (See figure 15-7.)