

## SECTION 15

### INSTRUMENTS AND INSTRUMENT SYSTEMS

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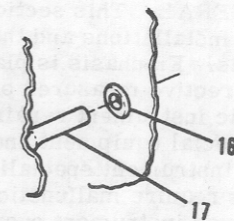
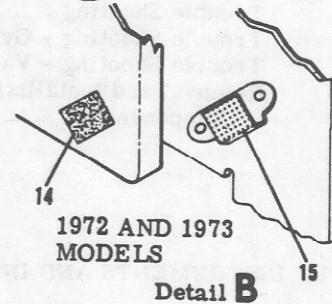
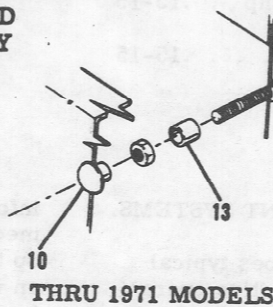
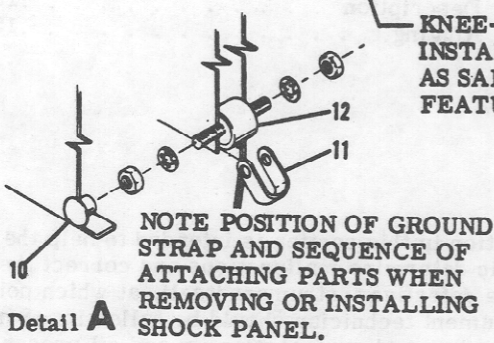
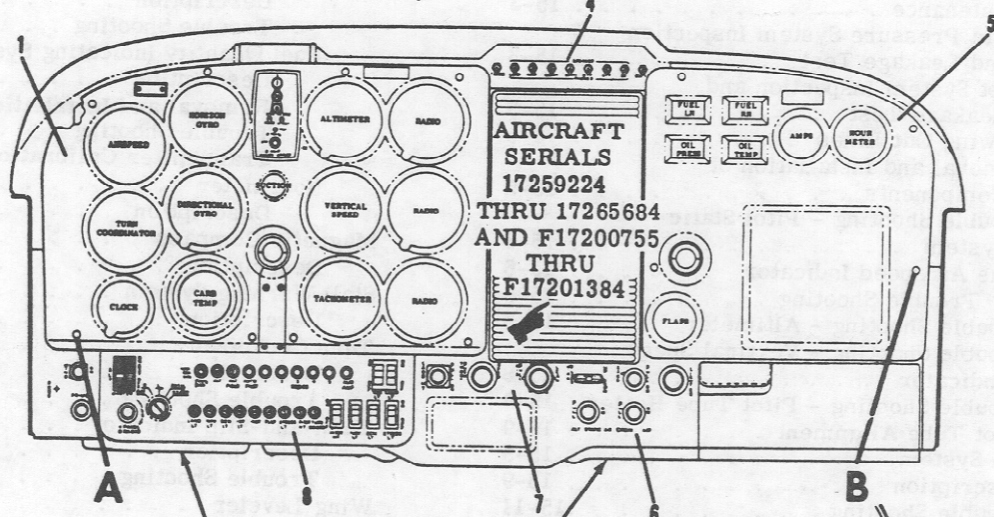
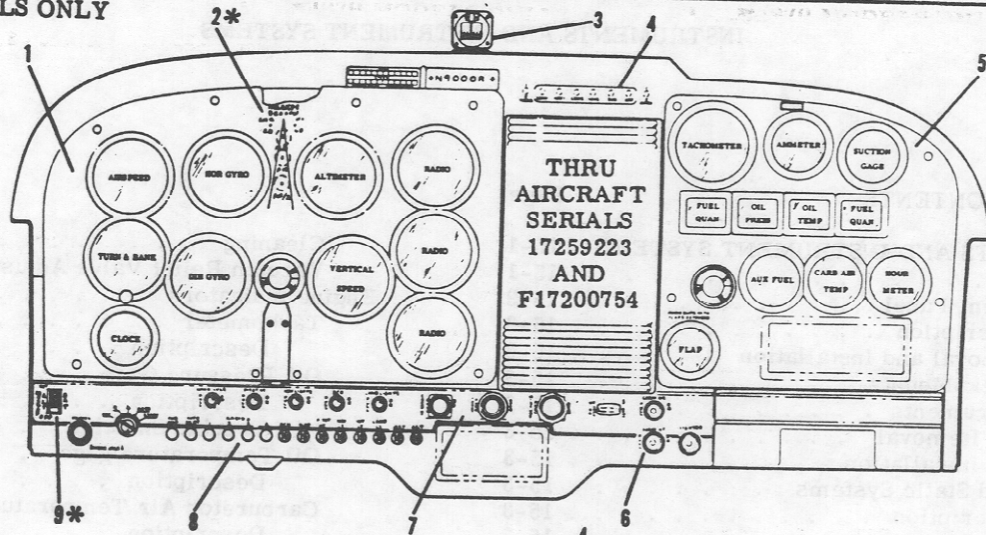
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#### 15-1. INSTRUMENTS AND INSTRUMENT SYSTEMS.

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.

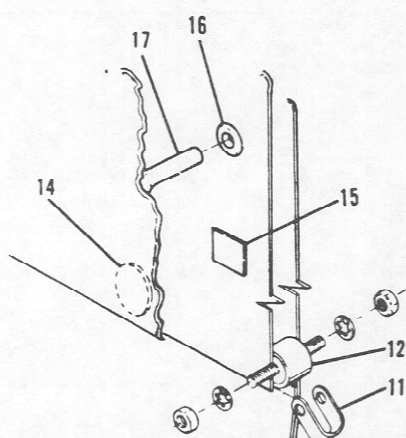
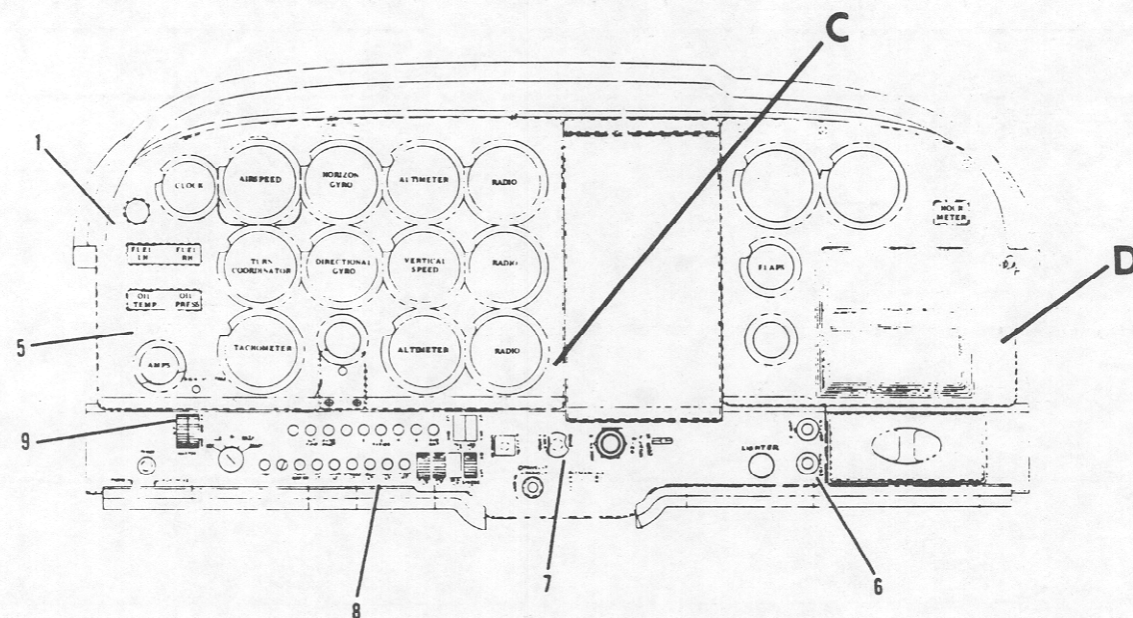
**\*1970 MODELS ONLY**



- |                                     |                  |
|-------------------------------------|------------------|
| 1. Shock-Mounted Panel              | 11. Ground Strap |
| 2. Marker Beacon Controls           | 12. Shock-Mount  |
| 3. Magnetic Compass                 | 13. Spacer       |
| 4. Radio and Switch Panel           | 14. Pile         |
| 5. Fuel and Engine Instruments      | 15. Hook         |
| 6. Heating and Ventilating Controls | 16. Grommet      |
| 7. Engine Controls                  | 17. Pin          |
| 8. Switch and Circuit Breaker Panel |                  |
| 9. Split-Master Switch              |                  |
| 10. Button                          |                  |

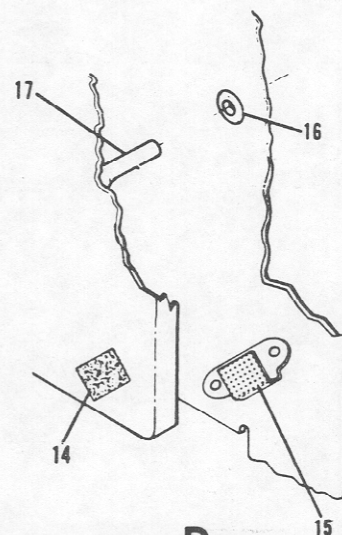
Figure 15-1. Typical Instrument Panel (Sheet 1 of 2)





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

Detail C



Detail D

BEGINNING WITH SERIALS 17265685 AND F17201385

- 5. Fuel and Engine Instruments
- 6. Heating and Ventilating Controls
- 7. Engine Controls
- 8. Switch and Circuit Breaker Panel
- 9. Split-Master Switch
- 10. Button

- 11. Ground Strap
- 12. Shock-Mount
- 13. Spacer
- 14. Pile
- 15. Hook
- 16. Grommet
- 17. Pin

Figure 15-1. Typical Instrument Panel (Sheet 2 of 2)

### 15-3. INSTRUMENT PANEL. (Refer to figure 15-1.)

15-4. DESCRIPTION. The instrument panel assembly consists of a stationary and shock-mounted panel. The stationary panel contains instruments which are NOT sensitive to vibration. The shock-mounted panel contains major flight instruments such as horizontal and directional gyros which are affected by vibration. Most of the instruments are screw-mounted on the panel backs.

15-5. REMOVAL AND INSTALLATION. The stationary panel is secured to engine mount stringers and a forward fuselage bulkhead and ordinarily is not considered removable. The shock-mounted panel is secured to stationary panel with rubber shock-mounted assemblies. To remove shock-mounted panel proceed as follows:

- a. Remove left control wheel and tube assembly by removing bolt at universal joint. (1969 Models only.)
- b. Thru 1971 Models unscrew threaded buttons securing decorative covers, 1972 and 1973 Models Velcro Fasteners are used. Beginning with 1974 Models a pin and grommet arrangement is used.
- c. Remove nuts from shock-mounts, tag and disconnect instrument wiring and plumbing and pull panel straight back.
- d. Reverse preceding steps for installation. Ensure ground strap is properly installed.

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

### 15-7. INSTRUMENTS. (Refer to figure 15-1.)

15-8. REMOVAL. Most instruments are secured to panel with screws inserted through panel face. 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.

#### NOTE

Thru 1975 models, the clusters are located directly above the glove box. Removal of cluster will be simpler if glove box is removed first.

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 Cessna Service Parts Center.

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

### 15-10. PITOT AND STATIC SYSTEMS. (Refer to figure 15-2.)

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 a static port. A static line sump is installed at source button to collect condensation in static system. A pitot tube heater may be installed. The heating element is controlled by a switch at instrument panel and powered by the electrical system. An alternate static source valve may be installed in the static system for use when the external static source is malfunctioning. Refer to the Owner's Manual for flight operation using the alternate static source. Beginning with serial 17263459, an encoding altimeter may be installed which is also connected to static system pressure. The encoding altimeter supplies coded altitude signals to the aircraft's transponder for transmission to ground based interrogating radar. The encoding altimeter installation requires the use of a fully operational secondary altimeter as backup. Figure 15-2, sheet 2 may be used as a guide for removal and installation of the encoding altimeter.

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 air-frame 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. Close static pressure alternate source control, if installed.



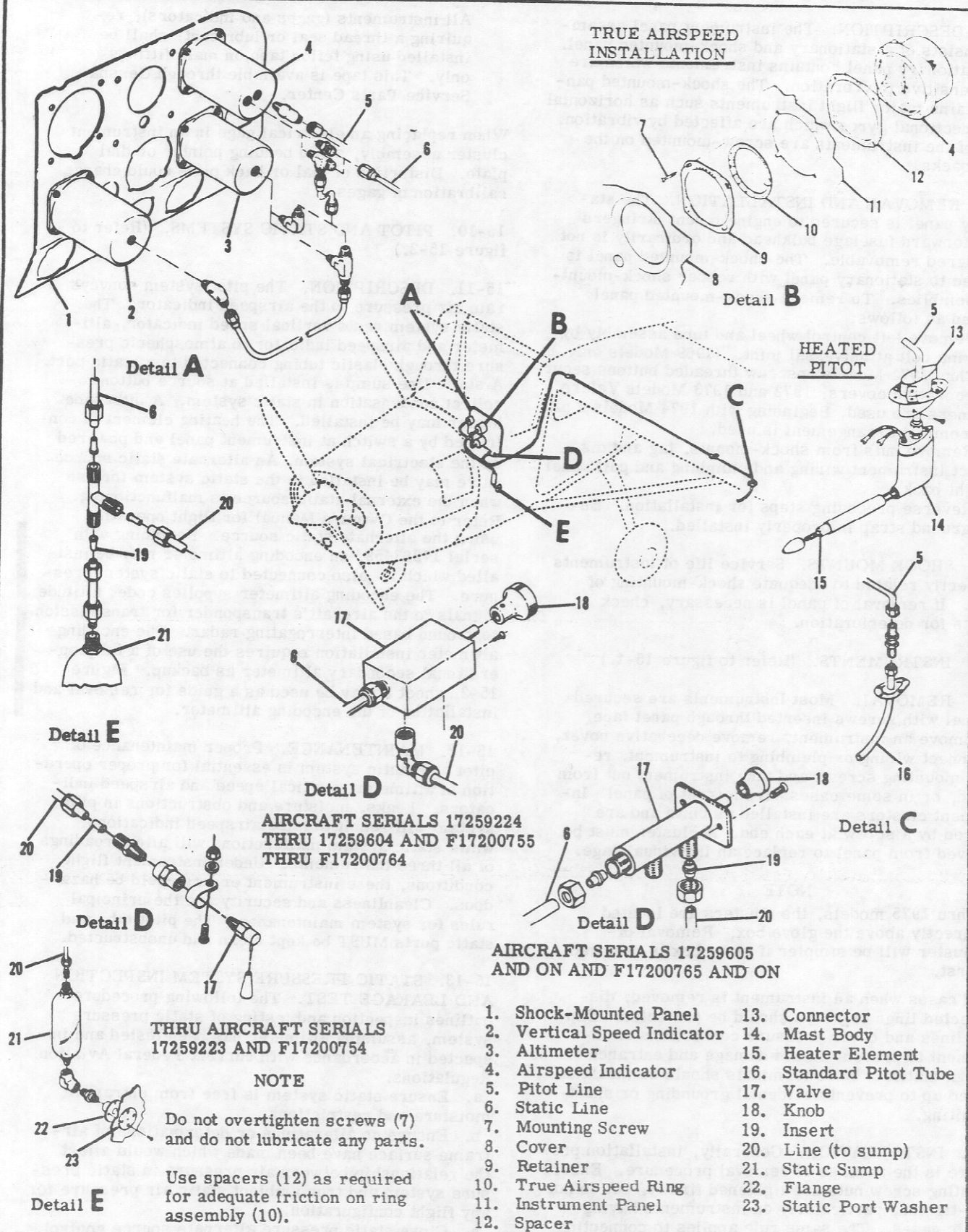
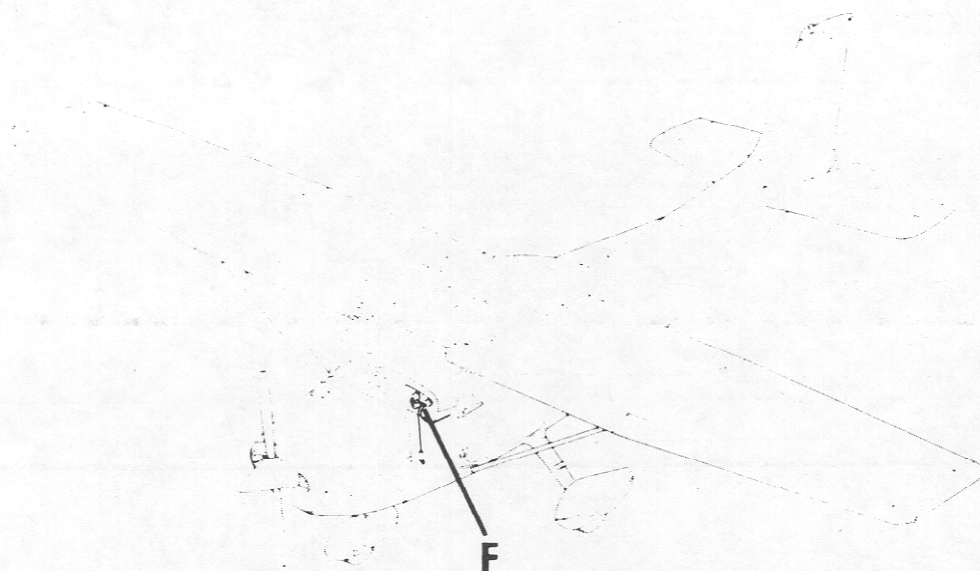
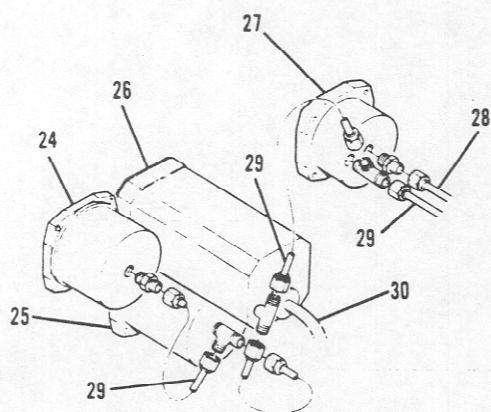


Figure 15-2. Pitot-Static Systems (Sheet 1 of 2)

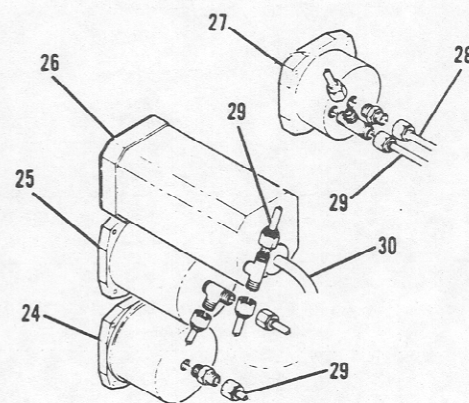


### ENCODING ALTIMETER INSTALLATION



Detail **F**

SERIALS 17263459 THRU 17265684



Detail **F**

BEGINNING WITH SERIALS 17265685

- 24. Backup Altimeter
- 25. Vertical Speed Indicator
- 26. Encoding Altimeter
- 27. Airspeed Indicator
- 28. Pitot Line
- 29. Static Line
- 30. Cable (To Transponder)

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



d. Attach a source of suction to static pressure source opening. Figure 15-3 shows one method of obtaining suction.

e. 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.

f. 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.

g. If leakage rate is within tolerance, slowly release suction source.

### NOTE

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

h. 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.

i. 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 repair station" or replaced. If static pressure system is at fault, use following procedure to locate leakage.

j. Attach a source of positive pressure to static source opening. Figure 15-3 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.

k. 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 solution of mild soap and water, watching for bubbles to locate leaks.

l. Tighten leaking connections. Repair or replace parts found defective.

m. Reconnect airspeed and vertical speed indicators into static pressure system and repeat leakage test per steps "c" thru "g".

**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 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 line, disconnect at airspeed indicator. Using low pressure air, blow from indicator end of line toward pitot tube.

### CAUTION

Never blow through pitot or static lines toward instruments.

Like pitot lines, static pressure lines must be kept clear and connections tight. All models have a static source sump which collects moisture and keeps system clear. However, when necessary, disconnect static line at first instrument to which it is connected, then blow line clear with low-pressure air. Check all static pressure line connections for tightness. If hose or hose connections are used, check for general condition and clamps for security. Replace hose which have cracked, hardened or show other signs of deterioration.

**15-16. REMOVAL AND INSTALLATION OF COMPONENTS.** (Refer to figure 15-2.) To remove pitot mast remove four mounting screws on side of connector (13) and pull mast out of connector far enough to disconnect pitot line (5). Electrical connections to heater assembly (if installed) may be disconnected through wing access opening just in-board 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. 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 AIRSPEED INDICATION. (Normal altimeter and vertical speed.) | Pitot tube obstructed, leak or obstruction in pitot line. | Test pitot tube and line for leaks or obstructions. Blow out tube and line, repair or replace damaged line. |
| INCORRECT OR SLUGGISH RESPONSE. (all three instruments.)                    | Leaks or obstruction in static line.                      | Test line for leaks and obstructions. Repair or replace line, blow out obstructed line.                     |

15-18. TRUE AIRSPEED INDICATOR. A true airspeed indicator may be installed. This indicator, equipped with a conversion ring, may be 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. Refer to figure 15-2 for removal and installation. Upon installation, before tightening mounting screws (7), calibrate instrument as follows: Rotate ring (10) until 120 mph on the adjustable ring aligns with 120 mph on the in-

dicator. Holding this setting, move retainer (9) until 60°F aligns with zero pressure altitude, then tighten mounting screws (7) and replace decorative cover (8).

## NOTE

Beginning with 1976 models, true airspeed indicators are graduated in knots. Therefore, use 105 knots in the above calibration procedure instead of 120 miles per hour.

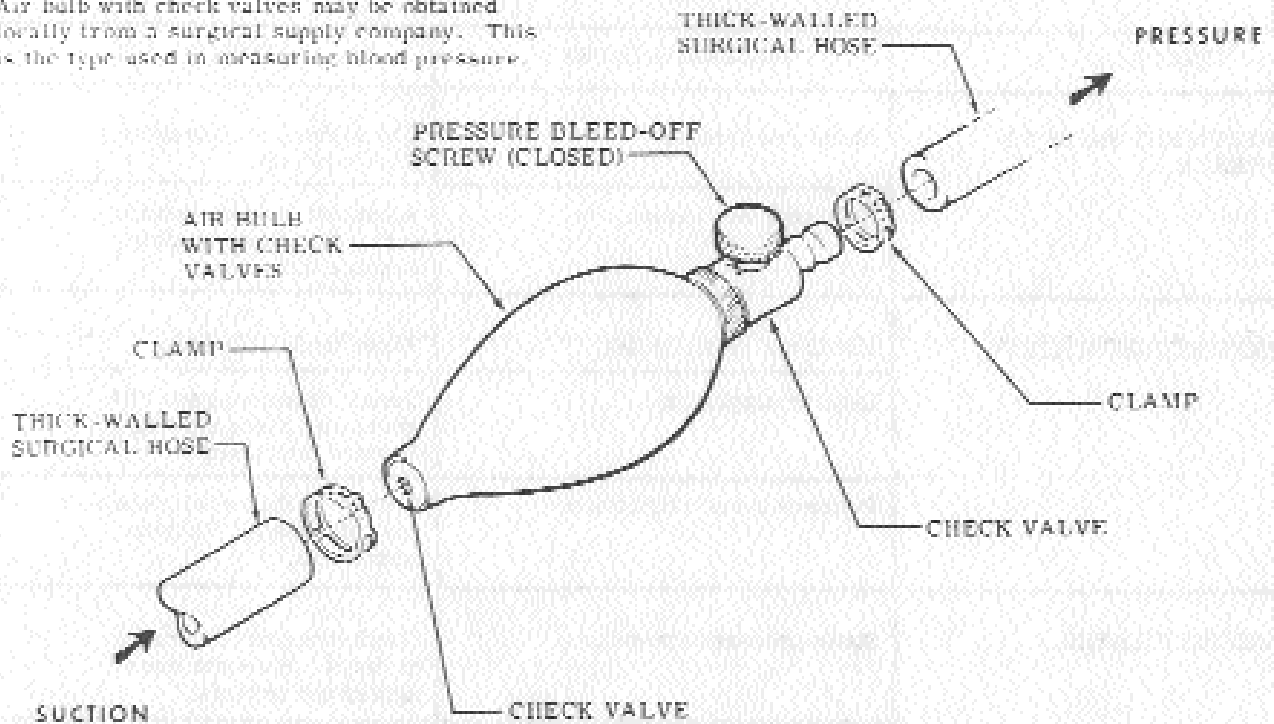
# 15-19. TROUBLE SHOOTING--AIRSPEED INDICATOR.

| TROUBLE                                  | PROBABLE CAUSE                                                                     | REMEDY                                                                                                             |
|------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| HAND FAILS TO RESPOND.                   | Pitot pressure connection not properly connected to pressure line from pitot tube. | Test line and connection for leaks. Repair or replace damaged line, tighten connections.                           |
|                                          | Pitot or static lines clogged.                                                     | Check line for obstructions. Blow out lines.                                                                       |
| INCORRECT INDICATION OR HAND OSCILLATES. | Leak in pitot or static lines.                                                     | Test lines and connections for leaks. Repair or replace damaged lines, tighten connections.                        |
|                                          | Defective mechanism or leaking diaphragm.                                          | Substitute known-good indicator and check reading. Replace instrument.                                             |
| HAND VIBRATES.                           | Excessive vibration.                                                               | Check panel shock mounts. Replace defective shock mounts.                                                          |
|                                          | Excessive tubing vibration.                                                        | Check clamps and line connections for security. Tighten clamps and connections, replace tubing with flexible hose. |



#### NOTE

Air bulb with check valves may be obtained locally from a surgical supply company. This is the type used in measuring blood pressure.



#### 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 15-3. Static Test Equipment

# 15-20. TROUBLE SHOOTING--ALTIMETER

| TROUBLE                      | PROBABLE CAUSE                                              | REMEDY                                                                                      |
|------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| INSTRUMENT FAILS TO OPERATE. | Static line plugged.                                        | Check line for obstructions. Blow out lines.                                                |
|                              | Defective mechanism.                                        | Substitute known-good altimeter and check reading. Replace instrument.                      |
| INCORRECT INDICATION.        | Hands not carefully set.                                    | Reset hands with knob.                                                                      |
|                              | Leaking diaphragm.                                          | Substitute known-good altimeter and check reading. Replace instrument.                      |
|                              | Pointers out of calibration.                                | Compare reading with known-good altimeter. Replace instrument.                              |
| HAND OSCILLATES.             | Static pressure irregular.                                  | Check lines for obstruction or leaks. Blow out lines, tighten connections.                  |
|                              | Leak in airspeed or vertical speed indicator installations. | Check other instruments and system plumbing for leaks. Blow out lines, tighten connections. |

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

| TROUBLE                      | PROBABLE CAUSE                 | REMEDY                                                                                                |
|------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------|
| INSTRUMENT FAILS TO OPERATE. | Static line plugged.           | Check line for obstructions. Blow out lines.                                                          |
|                              | Static line broken.            | Check line for damage, connections for security. Repair or replace damaged line, tighten connections. |
| INCORRECT INDICATION.        | Partially plugged static line. | Check line for obstructions. Blow out lines.                                                          |
|                              | Ruptured diaphragm.            | Substitute known-good indicator and check reading. Replace instrument.                                |
|                              | Pointer off zero.              | Reset pointer to zero. Reset pointer to zero.                                                         |
| POINTER OSCILLATES.          | Partially plugged static line. | Check line for obstructions. Blow out lines.                                                          |



15-21. TROUBLE SHOOTING---VERTICAL SPEED INDICATOR. (Cont)

| TROUBLE                     | PROBABLE CAUSE           | REMEDY                                                                                      |
|-----------------------------|--------------------------|---------------------------------------------------------------------------------------------|
| POINTER OSCILLATES. (cont). | Leak in static line.     | Test lines and connections for leaks. Repair or replace damaged lines. tighten connections. |
|                             | Leak in instrument case. | Substitute known-good indicator and check reading. Replace instrument.                      |
| HAND VIBRATES.              | Excessive vibration.     | Check shock mounts. Replace defective shock mounts.                                         |
|                             | Defective diaphragm.     | Substitute known-good indicator and check for vibration. Replace instrument.                |

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

| TROUBLE                          | PROBABLE CAUSE              | REMEDY                                                |
|----------------------------------|-----------------------------|-------------------------------------------------------|
| TUBE DOES NOT HEAT OR CLEAR ICE. | Switch turned "OFF."        | Turn switch "ON."                                     |
|                                  | Popped circuit breaker.     | Check visually. Reset breaker.                        |
|                                  | Break in wiring.            | Test for open circuit. Repair wiring.                 |
|                                  | Heating element burned out. | Check resistance of heating element. Replace element. |

15-23. PITOT TUBE ALIGNMENT. (Refer to figure 15-2.) For correct airspeed indication pitot tube (18) must be properly aligned. Open end of tube must be perpendicular to longitudinal axis of aircraft. A template like the one shown in figure 15-4 will prove the most convenient means of checking alignment. Prior to using template, check that pitot tube parallels row of rivets just outboard of tube. A straightedge may be placed along row of rivets to check the alignment. The template fits over the wing leading edge and should conform to the illustration. The illustration has been drawn carefully to actual size and may be traced directly on a piece of carbon paper between the printed page and the template material, the contours can be traced.

15-24. VACUUM SYSTEM. (Refer to figure 15-5.)

15-25. DESCRIPTION. Suction to operate the gyros is provided by an engine-driven vacuum pump, gear-driven through a spline-type coupling. The Model F172, through aircraft serial F17200805, utilized a wet system in which the air discharges into an oil separator after lubricating the pump, then is expelled overboard. The Model 172 and the F172 beginning with aircraft serial F17200805, utilizes a dry-type pump which requires no oil separator. A suction relief valve, to control system pressure, is connected between the pump inlet and the instruments. In the cabin, the vacuum line is routed from gyro instruments to the relief valve at the firewall. A central air filtering system is utilized. Beginning with aircraft 17262867 and F17201240 a disposable type air filter 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.

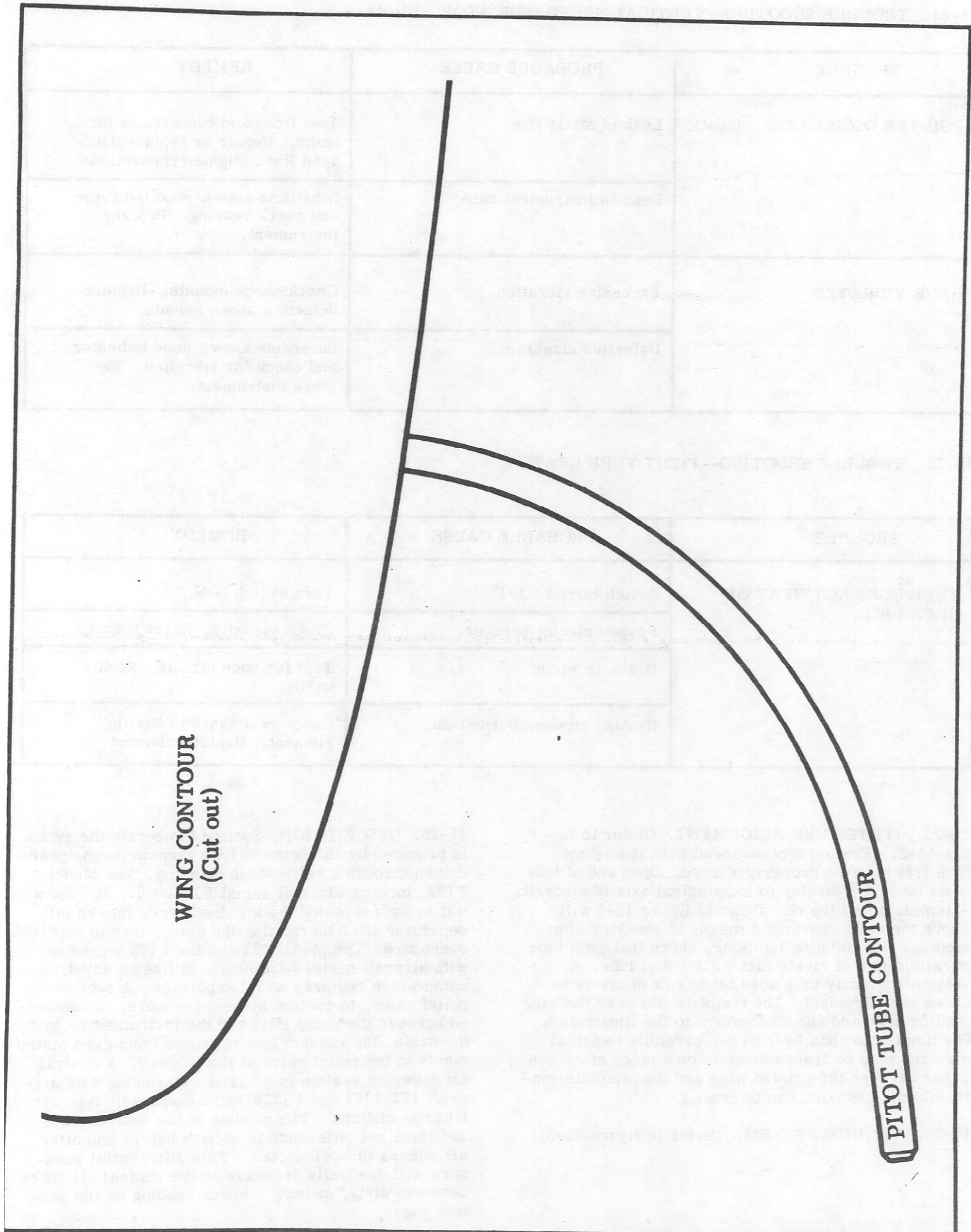


Figure 15-4. Pitot Tube Alignment Template

15-26. TROUBLE SHOOTING--VACUUM SYSTEM

| TROUBLE                                                         | PROBABLE CAUSE                                                                                             | REMEDY                                                                                                                                                    |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| HIGH SUCTION GAGE READINGS.                                     | Gyros function normally-relief valve screen clogged, relief valve malfunction.                             | Check screen, than valve. Compare gage readings with new gage. Clean screen, reset valve. Replace gage.                                                   |
| NORMAL SUCTION GAGE READING, SLUGGISH OR ERRATIC GYRO RESPONSE. | Instrument air filters clogged.                                                                            | Check operation with filters removed. Replace filters.                                                                                                    |
| LOW SUCTION GAGE READINGS.                                      | Leaks or restriction between instruments and relief valve, relief valve out of adjustment, defective pump. | Check lines for leaks, disconnect and test pump. Repair or replace lines, adjust or replace relief valve. repair or replace pump.                         |
|                                                                 | Central air filter dirty.                                                                                  | Check operation with filter removed. Clean or replace filter.                                                                                             |
| SUCTION GAGE FLUCTUATES.                                        | Defective gage or sticking relief valve.                                                                   | Check suction with test gage. Replace gage. Clean sticking valve with Stoddard solvent. Blow dry and test. If valve sticks after cleaning, replace valve. |

15-27. TROUBLE SHOOTING--GYROS.

| TROUBLE                       | PROBABLE CAUSE                            | REMEDY                                                                                  |
|-------------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------|
| HORIZON BAR FAILS TO RESPOND. | Central filter dirty.                     | Check filter. Clean or replace filter.                                                  |
|                               | Suction relief valve improperly adjusted. | Adjust or replace relief valve.                                                         |
|                               | Faulty suction gage.                      | Substitute known-good suction gage and check gyro response. Replace suction gage.       |
|                               | Vacuum pump failure.                      | Check pump. Replace pump.                                                               |
|                               | Vacuum line kinked or leaking.            | Check lines for damage and leaks. Repair or replace damaged lines. tighten connections. |
| HORIZON BAR DOES NOT SETTLE.  | Defective mechanism.                      | Substitute known-good gyro and check indication. Replace instrument.                    |
|                               | Insufficient vacuum.                      | Adjust or replace relief valve.                                                         |
|                               | Excessive vibration.                      | Check panel shock-mounts. Replace defective shock-mounts.                               |



## 15-27. TROUBLE SHOOTING--GYROS. (Cont).

| TROUBLE                                         | PROBABLE CAUSE                                | REMEDY                                                                                  |
|-------------------------------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------------|
| HORIZON BAR OSCILLATES OR VIBRATES EXCESSIVELY. | Central filter dirty.                         | Check filter. Clean or replace filter.                                                  |
|                                                 | Suction relief valve improperly adjusted.     | Adjust or replace relief valve.                                                         |
|                                                 | Faulty suction gage.                          | Substitute known-good suction gage and check gyro indication. Replace suction gage.     |
|                                                 | Defective mechanism.                          | Substitute known-good gyro and check indication. Replace instrument.                    |
|                                                 | Excessive vibration.                          | Check panel shock-mounts. Replace defective shock-mounts.                               |
| EXCESSIVE DRIFT IN EITHER DIRECTION.            | Central air filter dirty.                     | Check filter. Clean or replace filter.                                                  |
|                                                 | Low vacuum, relief valve improperly adjusted. | Adjust or replace relief valve.                                                         |
|                                                 | Faulty suction gage.                          | Substitute known-good suction gage and check gyro indication. Replace suction gage.     |
|                                                 | Vacuum pump failure.                          | Check pump. Replace pump.                                                               |
|                                                 | Vacuum line kinked or leaking.                | Check lines for damage and leaks. Repair or replace damaged lines, tighten connections. |
| DIAL SPINS IN ONE DIRECTION CONTINUOUSLY.       | Operating limits have been exceeded.          | Replace instrument.                                                                     |
|                                                 | Defective mechanism.                          | Substitute known-good gyro and check indication. Replace instrument.                    |

## SHOP NOTES:

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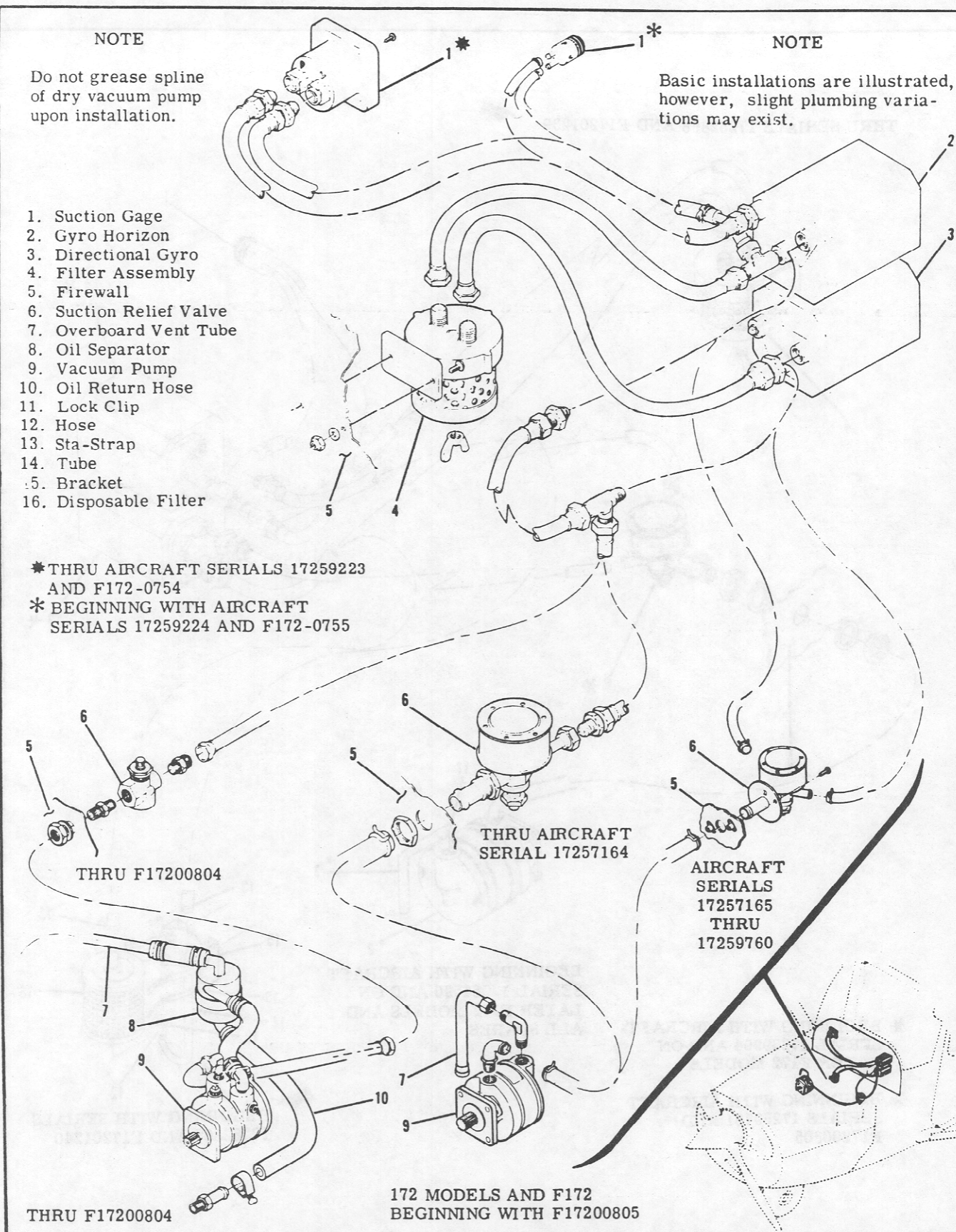


Figure 15-5. Vacuum System (Sheet 1 of 2)

THRU SERIALS 17262866 AND F17201239

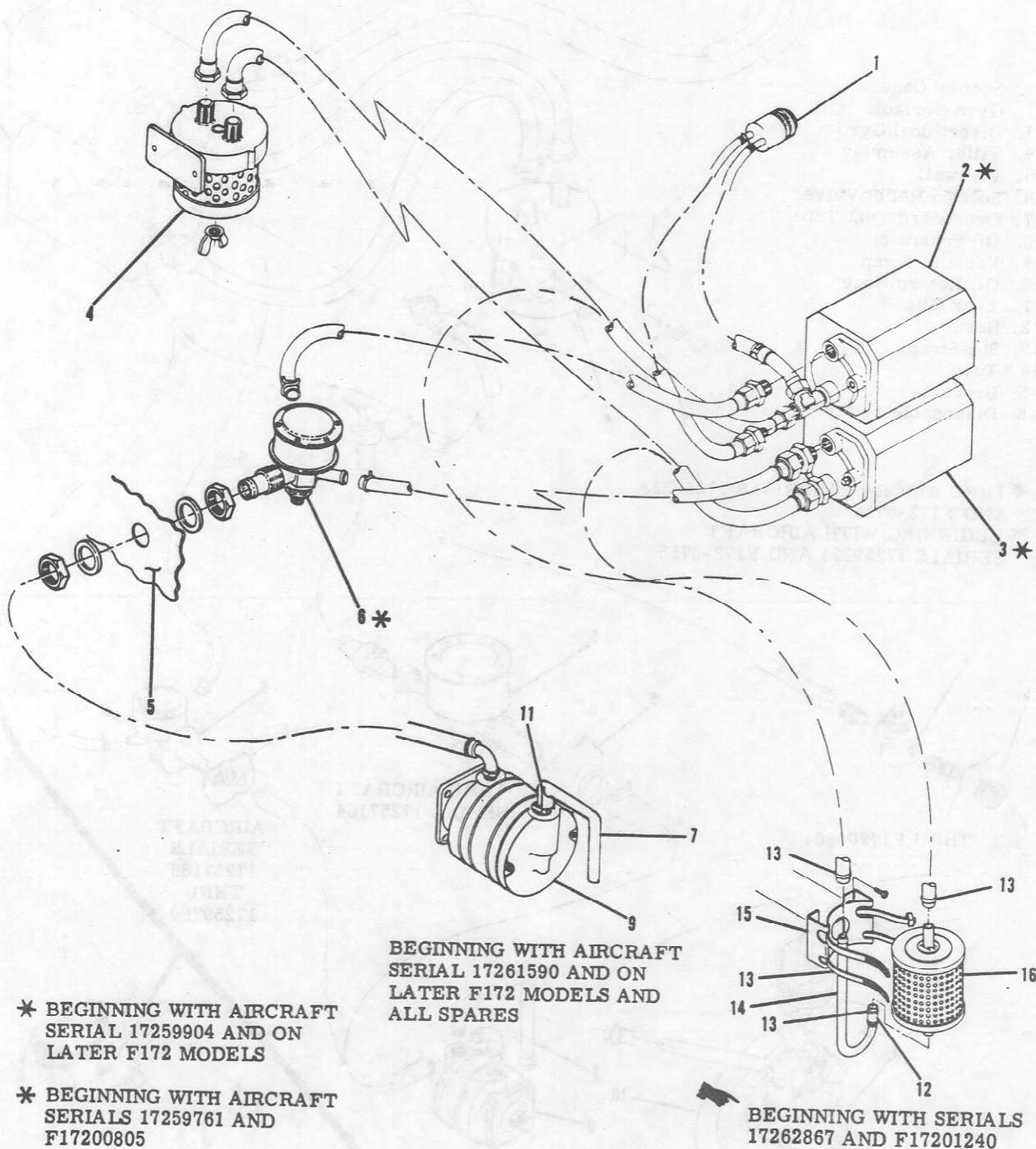


Figure 15-5. Vacuum System (Sheet 2 of 2)



# 15-28. TROUBLE SHOOTING--VACUUM PUMP.

| TROUBLE           | PROBABLE CAUSE                                                                                                         | REMEDY                                                                                                                                                                                                                                                                                            |
|-------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OIL IN DISCHARGE. | Damaged engine drive seal.                                                                                             | Replace gasket.                                                                                                                                                                                                                                                                                   |
|                   | Oil separator clogged, oil return line obstructed, excessive oil flow through pump.<br>(F172 Models through F17200804) | Check oil separator, return line; check that pump oil return rate does not exceed 120 cc/hour (approx. 8 drops/minute), at 50 psi oil pressure. Clean oil separator with Stoddard solvent, then blow dry. Blow out lines. If pump oil consumption is excessive, replace oil metering pin in pump. |
| HIGH SUCTION.     | Suction relief valve filter clogged.                                                                                   | Check filter for obstructions. Clean or replace filter.                                                                                                                                                                                                                                           |
| LOW SUCTION.      | Relief valve leaking.                                                                                                  | Replace relief valve.                                                                                                                                                                                                                                                                             |
|                   | Vacuum pump failure.                                                                                                   | Substitute known-good pump and check pump suction. Replace vacuum pump.                                                                                                                                                                                                                           |
| LOW PRESSURE.     | Safety valve leaking.                                                                                                  | Replace safety valve.                                                                                                                                                                                                                                                                             |
|                   | Vacuum pump failure.                                                                                                   | Substitute known-good pump and check pump pressure. Replace vacuum pump.                                                                                                                                                                                                                          |

15-29. REMOVAL AND INSTALLATION OF COMPONENTS. The various components of vacuum system are secured by conventional clamps, mounting screws and nuts. To remove a component, remove mounting screws and disconnect inlet and discharge lines. When replacing a vacuum system component, ensure connections are made correctly. Use no thread lube but teflon tape may be used on male threads. Avoid over tightening connections. Before reinstalling a vacuum pump, place mounting pad gasket in position over studs. On aircraft equipped with wet system only, coat pump drive splines lightly with a high-temperature grease such as Dow Silicone #30 (Dow-Corning Co., Midland, Mich.). After installing pump, before connecting plumbing, start engine and check for evidence of oil in air discharge. The allowable discharge is one to four ounces per hour for a wet system and no discharge is allowable in a dry-type system. Any oil in discharge of a dry system denotes a leaking drive seal.

15-30. CLEANING. In general, low-pressure, dry compressed air should be used in cleaning vacuum system components. Suction relief valve, exposed to engine oil and dirt, should be washed with Stoddard solvent, then dried with a low-pressure air blast. 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.

15-31. 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 the relief valve, remove control air filter, run engine to 2200 rpm on the ground and adjust relief valve to 5.3  $\pm$  .1 inches of mercury.

## CAUTION

Do not exceed maximum engine temperature.

Be sure filter element is clean before installing. If reading drops noticeably, install new filter element.

## 15-32. ENGINE INDICATORS.

### 15-33. TACHOMETER.

15-34. DESCRIPTION. The tachometer used on Cessna single-engine aircraft 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, 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 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 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).

### 15-35. OIL PRESSURE GAGE.

15-36. 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.

### 15-37. TROUBLE SHOOTING.

| TROUBLE                               | PROBABLE CAUSE                  | REMEDY                                                           |
|---------------------------------------|---------------------------------|------------------------------------------------------------------|
| GAGE DOES NOT REGISTER.               | Pressure line clogged.          | Check line for obstructions. Clean line.                         |
|                                       | Pressure line broken.           | Check line for leaks and damage. 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.         | Check line for obstructions. 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.                                              |

# 15-37. TROUBLE SHOOTING, (Cont).

| TROUBLE                             | PROBABLE CAUSE                                         | REMEDY                                                           |
|-------------------------------------|--------------------------------------------------------|------------------------------------------------------------------|
| GAGE HAS ERRATIC OPERATION, (Cont.) | Pointer bent and rubbing on dial, dial screw or glass. | Replace instrument.                                              |
|                                     | Leak in pressure line.                                 | Check line for leaks and damage. Repair or replace damaged line. |

# 15-38. OIL TEMPERATURE GAGE.

15-39. DESCRIPTION. The oil temperature gage is a Bourdon-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 gage. Checking capillary tube for damage and fittings for security is the only maintenance required. Since the tube's inside diameter is quite small, small dents and kinks which would be quite acceptable in larger tubing may partially or completely close off capillary, making gage inoperative.

# 15-42. TROUBLE SHOOTING.

| TROUBLE                                  | PROBABLE CAUSE                                          | REMEDY                                                                    |
|------------------------------------------|---------------------------------------------------------|---------------------------------------------------------------------------|
| GAGE POINTER STAYS OFF LOW END OF SCALE. | Circuit breaker out.                                    | Check visually. Reset breaker.                                            |
|                                          | Master switch OFF or switch defective.                  | Check switch ON. Replace defective switch.                                |
|                                          | Broken or grounded leads between gage and sensing unit. | Check circuit wiring. Repair or replace defective wiring.                 |
|                                          | Defective gage or sensing unit.                         | Substitute known-good gage or sensing unit. Replace gage or sensing unit. |
| GAGE POINTER GOES OFF HIGH END OF SCALE. | Broken or grounded lead.                                | Check circuit wiring. Repair or replace defective wiring.                 |
|                                          | Defective gage or sensing unit.                         | Substitute known-good gage or sensing unit. Replace gage or sensing unit. |
| GAGE OPERATES INTERMITTENTLY.            | Defective master switch, broken or grounded lead.       | Check circuit wiring. Replace switch, repair or replace defective wiring. |
|                                          | Defective gage or sensing unit.                         | Substitute known-good gage or sensing unit. Replace gage or sensing unit. |



## 15-42. TROUBLE SHOOTING. (Cont.)

| TROUBLE                                         | PROBABLE CAUSE                  | REMEDY                                                                    |
|-------------------------------------------------|---------------------------------|---------------------------------------------------------------------------|
| EXCESSIVE POINTER OSCILLATION. (Cont.)          | Loose or broken lead.           | Check circuit wiring. Repair or replace defective wiring.                 |
|                                                 | Defective gage or sensing unit. | Substitute known-good gage or sensing unit. Replace gage or sensing unit. |
|                                                 | Excessive panel vibration.      | Check panel shock-mounts. Replace defective shock-mounts.                 |
| OBVIOUSLY INCORRECT TEMPERATURE READING.        | Defective gage or sensing unit. | Substitute known-good 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.                 | Substitute known-good gage. Replace gage.                                 |

## 15-43. FUEL QUANTITY SYSTEM.

15-44. DESCRIPTION. The magnetic type fuel quantity indicators are used in conjunction with a float-operated variable-resistance transmitter in each fuel tank. The full position of float produces a minimum resistance through transmitter, permitting maximum current flow through the fuel quantity indicator and maximum pointer deflection. As fuel level is lowered, resistance in transmitter is increased, producing a decreased current flow through fuel quantity indicator and a smaller pointer deflection.

### 15-44A. REMOVAL AND INSTALLATION.

a. Drain fuel from tank. (Observe precautions in Section 12.

b. Remove access plate above fuel tank for access to transmitter.

c. Disconnect electrical lead and ground strap from transmitter.

d. Remove screws attaching transmitter and carefully work transmitter from tank. DO NOT BEND FLOAT ARM.

e. Install transmitter by reversing preceding steps, using new gasket around opening in fuel tank and under screw heads.

f. Service fuel tanks. Check for leaks and correct quantity indicator.

### NOTE

Ensure transmitter is properly grounded in accordance with Section 12.

## SHOP NOTES:

# 15-45. TROUBLE SHOOTING.

| TROUBLE                                 | PROBABLE CAUSE                                                 | REMEDY                                                                                                 |
|-----------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| FAILURE TO INDICATE.                    | No power to indicator or transmitter. (Pointer stays below E.) | Check circuit breaker and inspect for open circuit. Reset breaker, repair or replace defective wiring. |
|                                         | Grounded wire. (Pointer stays above F.)                        | Check for partial ground between transmitter and gage. Repair or replace defective wire.               |
|                                         | Low voltage.                                                   | Check voltage at indicator. Correct voltage.                                                           |
|                                         | Defective indicator.                                           | Substitute known-good indicator. Replace indicator.                                                    |
| OFF CALIBRATION.                        | Defective indicator.                                           | Substitute known-good indicator. Replace indicator.                                                    |
|                                         | Defective transmitter.                                         | Substitute known-good transmitter. Recalibrate or replace.                                             |
|                                         | Low or high voltage.                                           | Check voltage at indicator. Correct voltage.                                                           |
| STICKY OR SLUGGISH INDICATOR OPERATION. | Defective indicator.                                           | Substitute known-good indicator. Replace indicator.                                                    |
|                                         | Low voltage.                                                   | Check voltage at indicator. Correct voltage.                                                           |
| ERRATIC READINGS.                       | Loose or broken wiring on indicator or transmitter.            | Inspect circuit wiring. Repair or replace defective wire.                                              |
|                                         | Defective indicator or transmitter.                            | Substitute known-good component. Replace indicator or transmitter.                                     |
|                                         | Defective master switch.                                       | Replace switch.                                                                                        |

15-46. TRANSMITTER CALIBRATION. Possibility 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 the tank. Transmitter calibration is obtained by adjusting float travel. Float travel is limited by the 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 tank creates a hazardous situation.

Before installing transmitter, attach electrical wires and place master switch in ON position. Allow the float arm to rest against lower float arm stop and read indicator. The pointer should be on E (empty) position. Adjust lower stop with float arm against stop so that pointer indicator is on E (empty). Raise float arm until it is against upper stop and adjust stop to permit indicator pointer to be on F (full). Install transmitter in accordance with Section 12.

## 15-47. HOURMETER.

15-48. DESCRIPTION. The hourmeter is electrically operated and is actuated by a pressure switch in the oil pressure system. Electrical power is



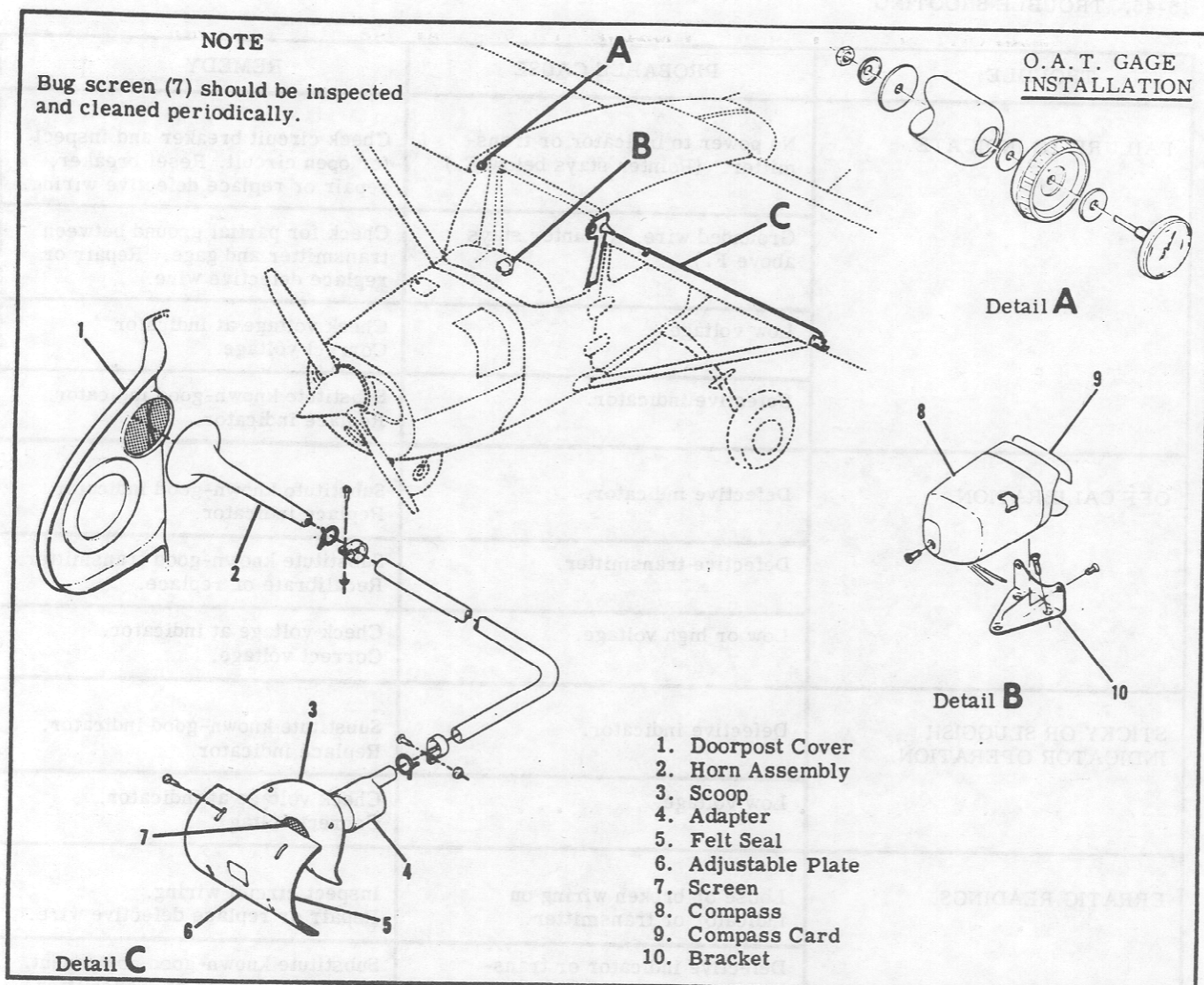


Figure 15-6. Stall Warning System and Compass Installation

supplied through a one-amp fuse from the electrical clock circuit and therefore, will operate independent of the master switch. If no clock is installed, a line direct from the battery contactor provides power independent of the master switch through a one-amp fuse located adjacent to the battery box. An indicator on the dial face rotates when the meter is actuated. If the meter is inoperative and clock is operating, the meter or its wiring is faulty and must be replaced.

15-49. MAGNETIC COMPASS. (Refer to figure 15-6.)

15-50. DESCRIPTION. The magnetic compass is liquid-filled, with expansion provisions to compensate for temperature changes. It is equipped with compensating magnets adjustable from front of case. The compass is internally lighted, controlled by the panel lights rheostat. No maintenance is required on compass except on occasional check on a compass rose for adjustment of compensation and replacement of lamp.

15-51. STALL WARNING SYSTEM. (Refer to figure 15-6.)

15-52. DESCRIPTION. The system is composed of an adjustable plate on left wing leading edge, connected to a reed type horn by means of plastic tubing. The horn is actuated approximately 5 to 10 miles per hour above stalling speed as a negative air pressure area at wing leading edge causes a reverse flow of air through horn. By moving adjustable plate (6) up, actuation of horn will occur at a higher speed and moving plate down causes actuation to occur at a slower speed. Center adjustable plate opening in wing leading edge upon installation, then flight test aircraft, observing horn actuation during stall. Re-adjust plate to obtain desired results if necessary. Approximately  $\frac{3}{32}$  inch adjustment of plate will change speed at which horn actuation occurs by 5 miles per hour. To test horn operation, cover opening in plate (6) with a clean cloth, such as a handkerchief and apply a slight suction by mouth to draw air through horn.



15-53. TURN COORDINATOR.

15-54. DESCRIPTION. The turn coordinator is an electrically operated, gyroscopic, roll-rate turn indicator. Its gyro simultaneously senses rate of

motion roll and yaw axes which is projected on a single indicator. The gyro is a non-tumbling type requiring no caging mechanism and incorporates an a.c. brushless spin motor with a solid state inverter.

15-55. TROUBLE SHOOTING.

| TROUBLE                                                     | PROBABLE CAUSE                                             | REMEDY                                                                |
|-------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------|
| INDICATOR DOES NOT RETURN TO CENTER.                        | Friction caused by contamination in the indicator damping. | Replace instrument.                                                   |
|                                                             | Friction in gimbal assembly.                               | Replace instrument.                                                   |
| DOES NOT INDICATE A STANDARD RATE TURN (TOO SLOW).          | Low voltage.                                               | Measure voltage at instrument. Correct voltage.                       |
|                                                             | Inverter frequency changed.                                | Replace instrument.                                                   |
| NOISY MOTOR.                                                | Faulty bearings.                                           | Replace instrument.                                                   |
| ROTOR DOES NOT START.                                       | Faulty electrical connection.                              | Check continuity and voltage. 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.                                               | Check voltage at instrument. Correct voltage.                         |
| NOISY GYRO.                                                 | High voltage.                                              | Check voltage to instrument. Correct voltage.                         |
|                                                             | Loose or defective rotor bearings.                         | Replace instrument.                                                   |

15-56. TURN-AND-SLIP INDICATOR.

is an electrically operated instrument powered by the aircraft electrical system, therefore, operating only when the master switch is ON.

15-57. DESCRIPTION. The turn-and-slip indicator

15-58. TROUBLE SHOOTING.

| TROUBLE                                                     | PROBABLE CAUSE                                     | REMEDY                                                                                                          |
|-------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| INDICATOR POINTER FAILS TO RESPOND.                         | Internal fuse blown.                               | Check wiring for continuity, check voltage at indicator. Replace fuse, if fuse still blows, replace instrument. |
|                                                             | Master switch "OFF" or switch defective.           | Check switch "ON." Replace defective switch.                                                                    |
|                                                             | Broken or grounded lead to indicator.              | Check circuit wiring. Repair or replace defective wiring.                                                       |
|                                                             | Indicator not grounded.                            | Check ground wire. Repair or replace defective wire.                                                            |
|                                                             | Defective mechanism.                               | Replace instrument.                                                                                             |
| HAND SLUGGISH IN RETURNING TO ZERO.                         | Defective mechanism.                               | Replace instrument.                                                                                             |
|                                                             | Low voltage.                                       | Check voltage at indicator. 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.                                       | Check voltage at indicator. Correct voltage.                                                                    |
| NOISY GYRO.                                                 | High voltage.                                      | Check voltage at indicator. Correct voltage.                                                                    |
|                                                             | Loose or defective rotor bearings.                 | Replace instrument.                                                                                             |