SECTION 14

INSTRUMENTS AND INSTRUMENT SYSTEMS

TABLE OF CONTENTS

14-1. INSTRUMENTS AND INSTRUMENT SYSTEMS.

14-2. GENERAL. This section describes typical instrument installations and their respective operating systems. Emphasis is placed on troubleshooting and corrective measures only. It does NOT deal with specific instrument repairs since this usually requires special equipment and data and must 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. This Service Manual provides preventive maintenance information on various instrument systems and repair of systems that do not operate. The descriptive material, maintenance and trouble shooting information in this section is intended to help the mechanic determine why an instrument system does not operate in a satisfactory manner. 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. Aneroid and gyro instruments are usually worth repairing. The words “replace instrument” in the text, therefore, must be taken only in the sense of physical replacement in the aircraft. If replacement is to be with a new instrument, an exchange one, or the original instrument is to be repaired must be decided on basis of individual circumstances.

14-3. INSTRUMENT PANEL.

14-4. DESCRIPTION. The instrument panel assembly consists of a stationary panel, a removable flight instrument panel and a shock-mounted panel. The stationary panel is part of the fuselage structure and not ordinarily removable. The stationary panel contains fuel and engine instruments. The removable panel contains flight instruments such as airspeed, vertical speed and altimeter. The shock-mounted panel contains major flight instruments such as the horizontal and directional gyros. Decorative covers are installed on the panel with screw on buttons thru 1971 models, beginning with 1972 models Velcro fasteners are used.

14-5, REMOVAL AND INSTALLATION. Two methods can be used to remove the shock-mounted or removable panel. Disconnect wiring and plumbing as necessary, tag wiring and cap plumbing. Instruments can be removed from the panel singular or the panel can be removed as an assembly. A removable door/two removable doors beginning with 1973 models, forward of the windshield provide access to the area behind the instrument panel.

14-6. SHOCK-MOUNTS.

14-7. DESCRIPTION. Service life of instruments is directly related to proper shock mounting of the panel. Thru 1972 models the shock mounted panel is secured to the stationary panel with seven shock mounts, two non-adjacent mounts could possibly have been cut through the middle, at the factory, to lessen vibration. If additional instruments are installed in the field, these two cut shock mounts must be replaced with standard shock mounts if excessive vibration occurs due to the increase weight. Conversely, if the weight of the panel is decreased by permanent removal of equipment, two non-adjacent shock mounts can be cut through the middle to lessen vibration caused by the decreased weight of the panel. Beginning with 1973 models the shock-mounted panel contains only two instruments and is installed with four shock mounts. Shock mounts must be checked periodically for deterioration and replaced as necessary.

14-8. INSTRUMENTS.

REMOVAL AND INSTALLATION. Thru 1972 models 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 the instrument, tag wiring and secure wiring to prevent accidental short-circuiting, cap plumbing, remove mounting screws and take instrument out from behind the panel. Beginning with 1973 models the instruments are removed in the same manner with the exception that the instrument case flange is on the forward side of the panel and instruments can be removed through the front of the panel. Generally, installation procedure is the reverse of removal procedure. Ensure mounting screws are tightened firmly, but do not over-tighten, particularly on instruments having plastic cases. The same rule applies to connecting plumbing or wiring.

NOTE: All instruments (gages and indicators), requiring a thread seal or lubricant, must be installed using Teflon tape on male fittings only. This tape is available through the 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 the calibration of gage.

14-10. PITOT AND STATIC SYSTEMS.

14-11. DESCRIPTION. Thru aircraft serials 337-01462 and F33700055 a dual static source, located in the left tail boom, furnishes atmospheric pressure for the altimeter, airspeed indicator, and vertical speed indicator. The airspeed indicator is furnished ram air pressure from a mast-type pitot tube located on the underside of the left wing leading edge. Beginning with aircraft serials 33701463 and F33700056 the dual static source is located on the forward fuselage and the pitot tube is installed in the left wing strut fairing. A pitot tube heater may be installed on either tube to prevent icing. An alternate static source may be installed for use when the standard system malfunctions. This source is to be used only in emergencies.

14-12. MAINTENANCE. Proper maintenance of pitot and static system is essential for proper operation of altimeter, vertical speed and sirspeed 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.

14-13. STATIC PRESSURE SYSTEM INSPECTION AND LEAKAGE TEST.

a. THRU AIRCRAFT SERIALS 33701462 AND F337-00055. 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.

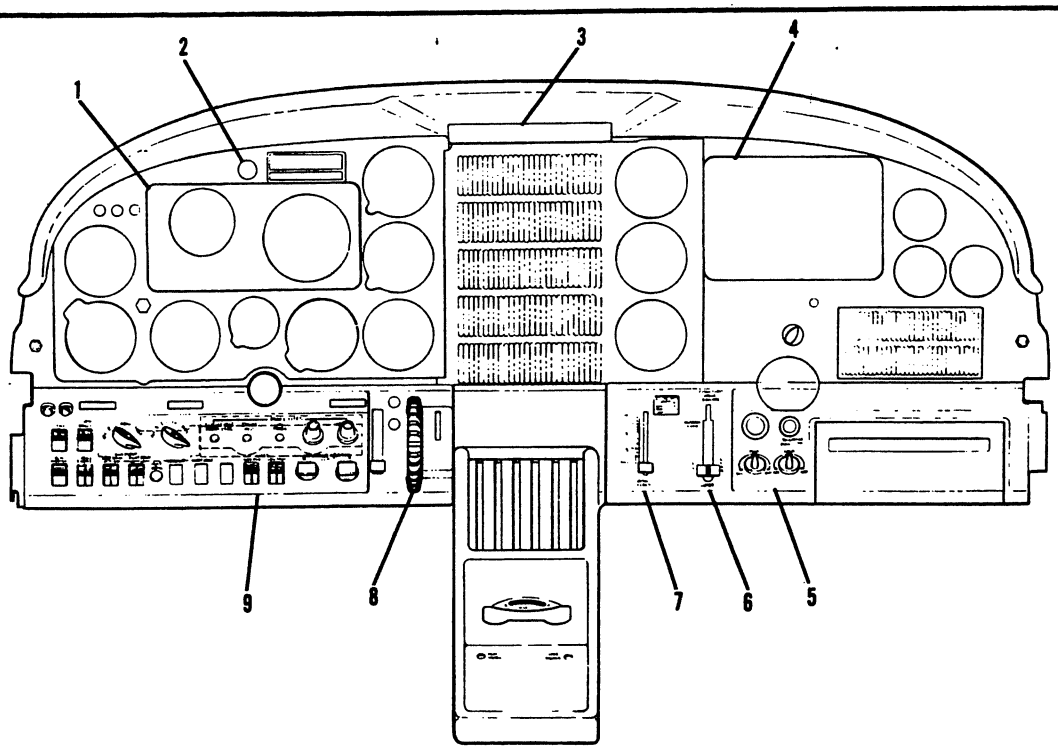
1. Ensure static system is free from entrapped moisture and restrictions.
2. Ensure no alterations or deformations of airframe surface have been made which would affect the relationship between air pressure in static pressure system and true ambient static air pressure for any flight configuration.
3. Seal off one static pressure source opening with plastic tape. This MUST be an air-tight seal.
4. Close static pressure alternate source valve, if installed.
5. Attach a source of suction to remaining static pressure source opening. Figure 14-5 shows one method of obtaining suction.
6. Slowly apply suction until altimeter indicates a 1000-foot increase in altitude.

CAUTION

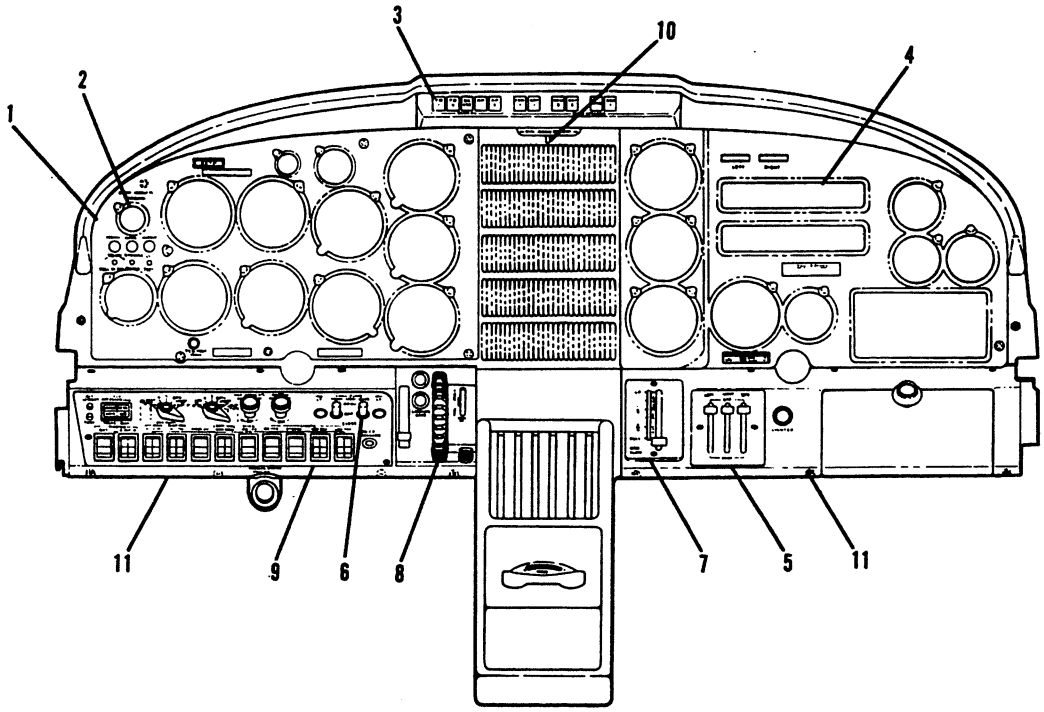
When applying or releasing suction, do not exceed range of vertical speed indicator or airspeed indicator.

7. Cut off suction source to maintain a "closed" system for one minute. Leakage shall not exceed

SHOP NOTES:

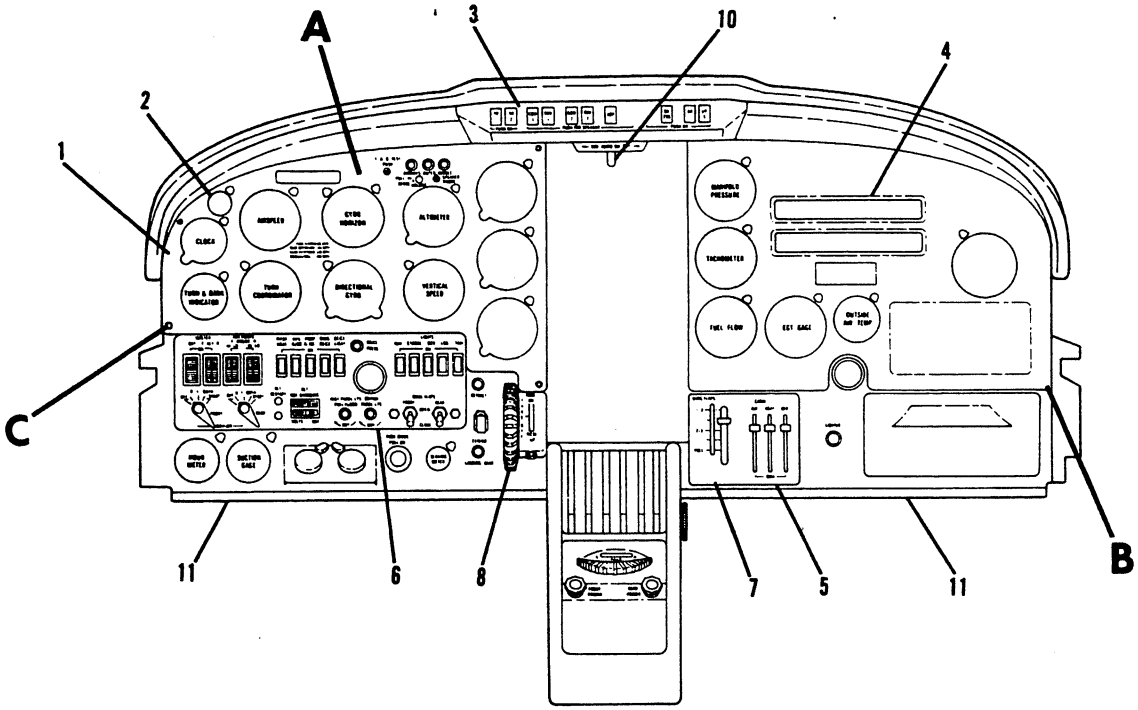


THRU AIRCRAFT SERIALS 33701398 AND F33700045

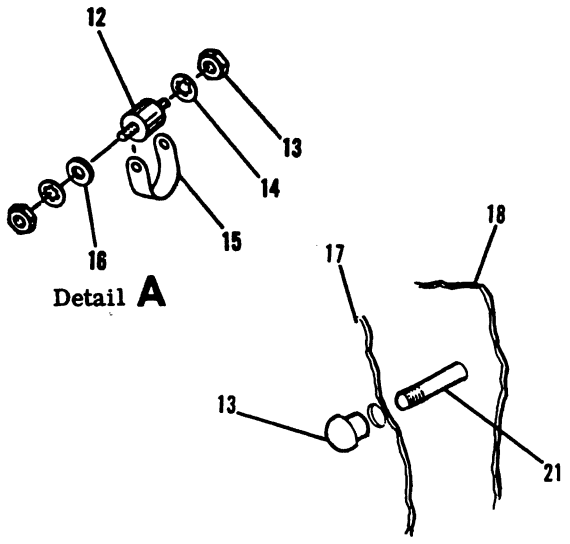


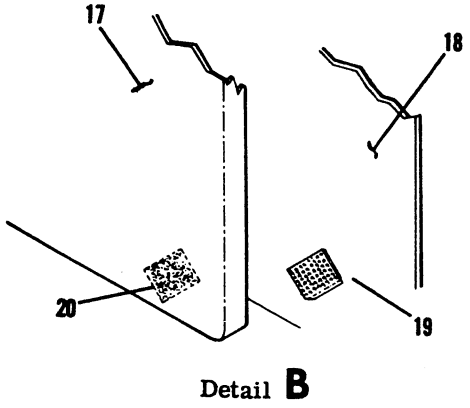
33701399 THRU 33701162 AND F33700046 THRU F33700055

14-1. Instrument Panel (Typical) (Sheet 1 of 2)



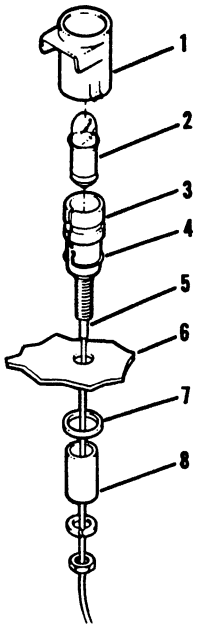
BEGINNING WITH 33701463 AND F33700056



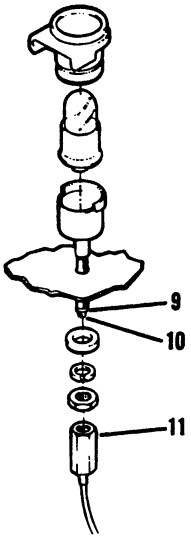


1. Shock Panel
2. Synchroscope
3. Radio Switch Panel
4. Fuel and Engine Instruments
5. Cabin Air Controls
6. Cowl Flap Controls
7. Flap Controls
8. Trim Control
9. Switch Panel
10. Radio Switch Lighting Rheostat
11. Knee Pad
12. Shock Mount
13. Nut
14. Lock Washer
15. Ground Strap
16. Washer
17. Decorative Cover
18. Panel
19. Velcro Fastener (Hook)
20. Velcro Fastener (Pile)
21. Threadsert

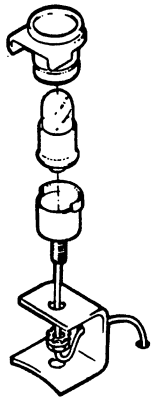
14-1. Instrument Panel (Typical) (Sheet 2 of 2)



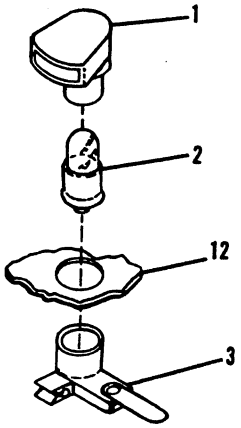
TYPE A



TYPE B



TYPE C



1. Shield
2. Bulb
3. Body
4. Bulb Retainer
5. Sleeve
6. Instrument Panel
7. Bushing
8. Spacer
9. Insulating Washer
10. Contact
11. Nylon Attach
12. Decorative Cover

POST LIGHT REMOVAL

DETACHABLE (TYPE B):	Unscrew nylon attach and remove as shown.
NON-DETACHABLE (TYPE A & C):	The lead must be severed before removal. Upon re-installation, a line splice is required (quick-disconnect, permanent splice, etc.). Use adequate insulation on the splice. Protect the end of the lead during removal to prevent accidental shorting.

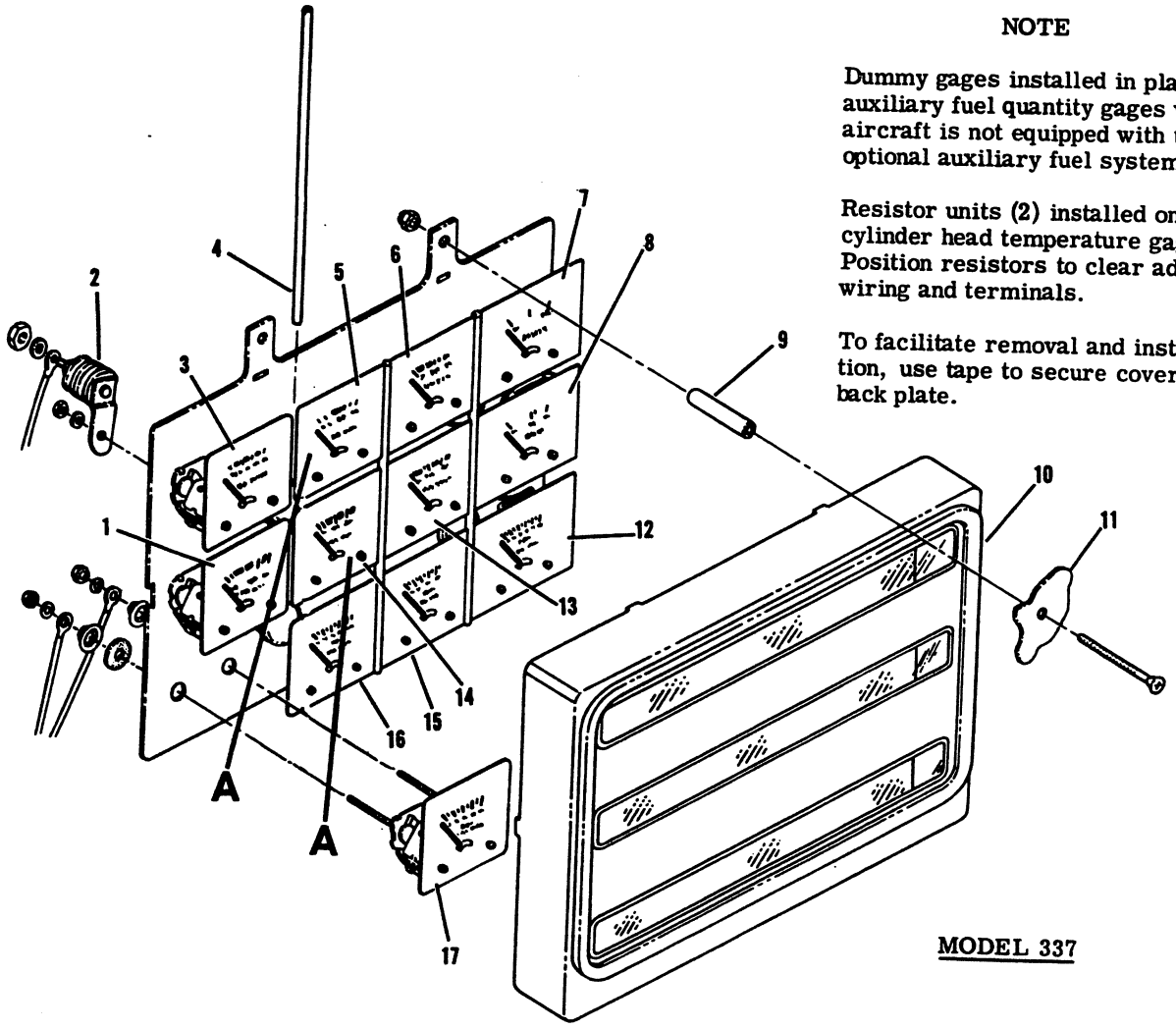
Figure 14-2. Instrument Panel Post Lights

NOTE

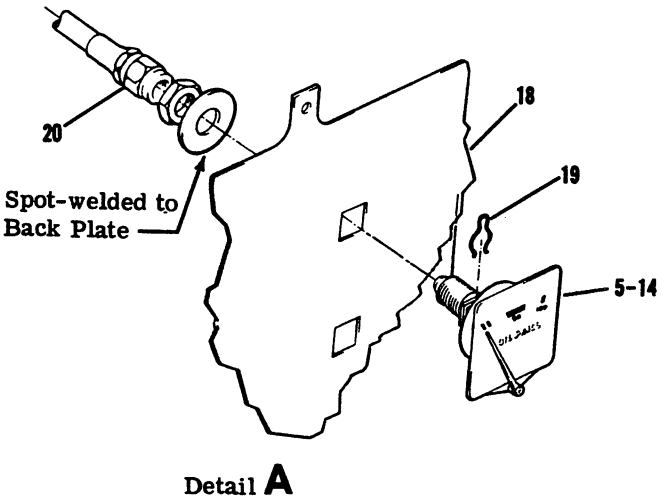
Dummy gages installed in place of auxiliary fuel quantity gages when aircraft is not equipped with the optional auxiliary fuel system.

Resistor units (2) installed on each cylinder head temperature gage. Position resistors to clear adjacent wiring and terminals.

To facilitate removal and installation, use tape to secure cover to back plate.



MODEL 337



Detail A

1. Rear Cylinder Head Temperature Gage
2. Resistor
3. Front Cylinder Head Temperature Gage
4. Separator
5. Front Oil Pressure Gage
6. Front Oil Temperature Gage
7. Ammeter
8. Voltmeter
9. Spacer
10. Cover
11. Instrument Panel
12. Right Main Fuel Quantity Gage
13. Rear Oil Temperature Gage
14. Rear Oil Pressure Gage
15. Right Auxiliary Fuel Quantity Gage
16. Left Auxiliary Fuel Quantity Gage
17. Left Main Fuel Quantity Gage
18. Back Plate
19. Retainer Spring
20. Hose

Figure 14-3. Instrument Cluster (Sheet 1 of 3)

NOTE

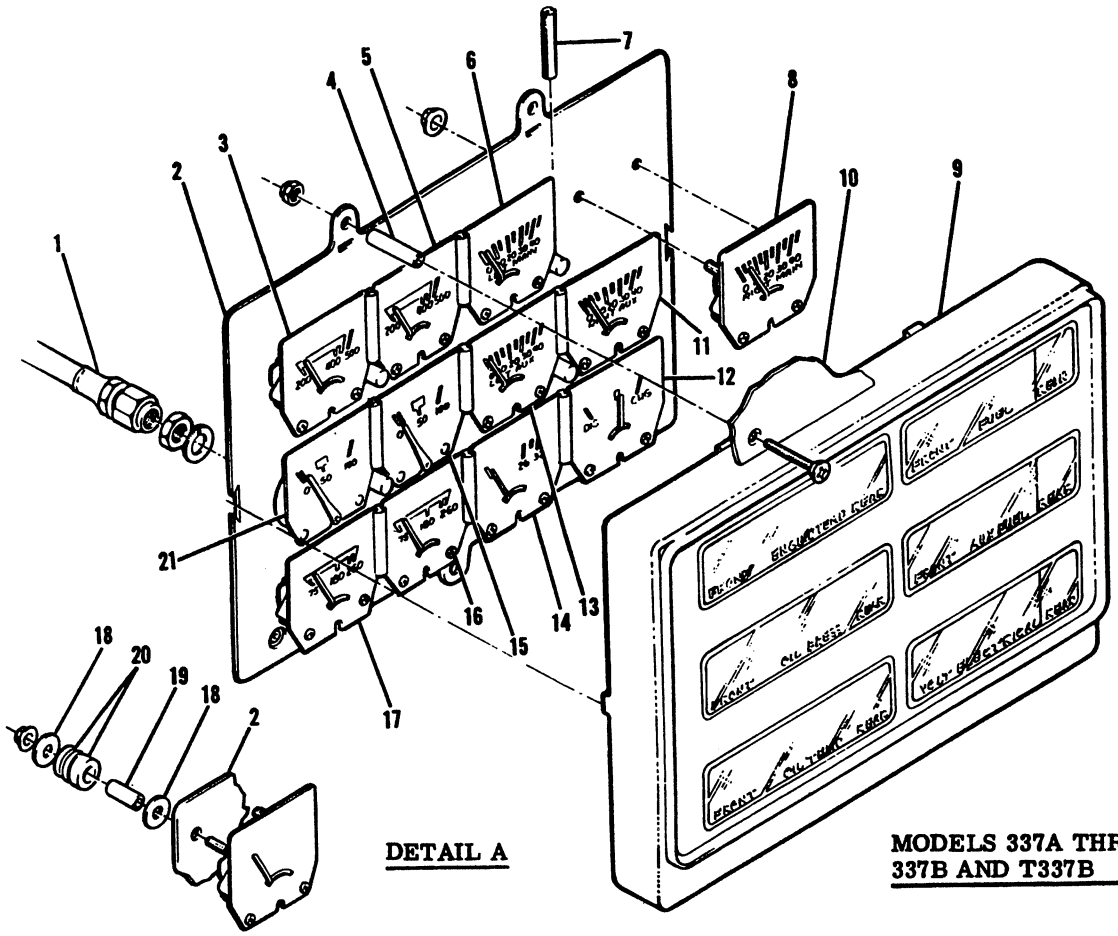
The cluster is equipped with a "printed" circuit, so there are no leads directly to the gages. The gage posts intersect circuit paths which lead to a row of terminals at the bottom of the cluster. Leads from each operating system connect to these terminals.

Dummy gages installed in place of auxiliary fuel quantity gages when aircraft is not equipped with the optional auxiliary system.

Resistors (20) are installed on temperature gages (3), (5), (16), and (17) and must be installed as shown in Detail A in order to function properly.

To facilitate removal and installation, use tape to secure cover to back plate.

Beginning in 1968, the ammeter and voltmeter are deleted, and the main and auxiliary fuel indicating gages are combined. Individual tank readings are obtained by pressing a switch on the overhead console.

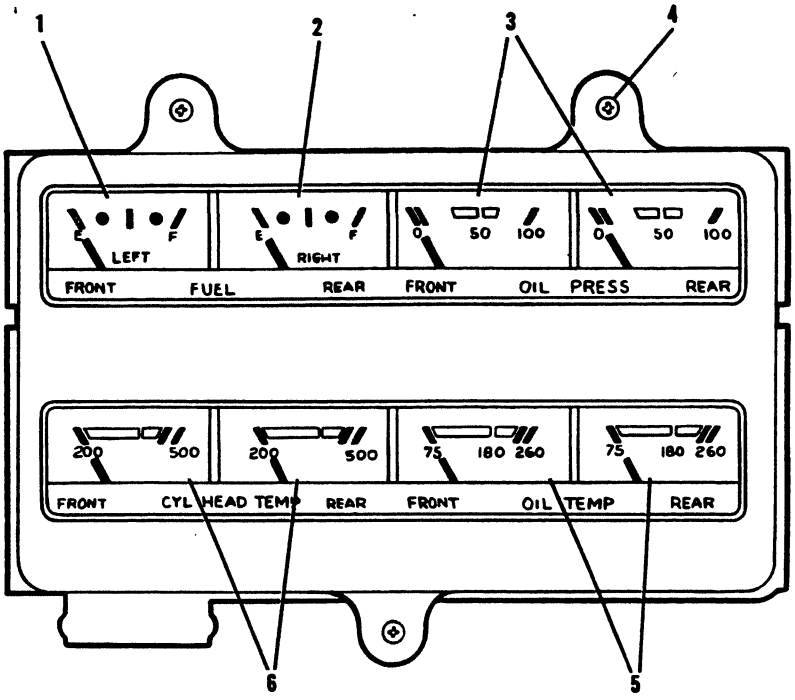


1. Oil Pressure Hose
2. Circuit Board
3. Front Cylinder Head Temperature Gage
4. Spacer
5. Rear Cylinder Head Temperature Gage
6. Left Main Fuel Quantity Gage
7. Separator
8. Right Main Fuel Quantity Gage
9. Cover
10. Stationary Panel
11. Right Auxiliary Fuel Quantity Gage
12. Ammeter
13. Left Auxiliary Fuel Quanity Gage
14. Voltmeter
15. Rear Oil Pressure Gage
16. Rear Oil Temperature Gage
17. Front Oil Temperature Gage
18. Brass Washer
19. Sleeve
20. Resistor
21. Front Oil Pressure Gage

Figure 14-3. Instrument Cluster (Sheet 2 of 3)

1. LH Fuel Gage
2. RH Fuel Gage
3. Oil Pressure Gage
4. Screw
5. Oil Temp Gages
6. Cylinder Head Temp Gages

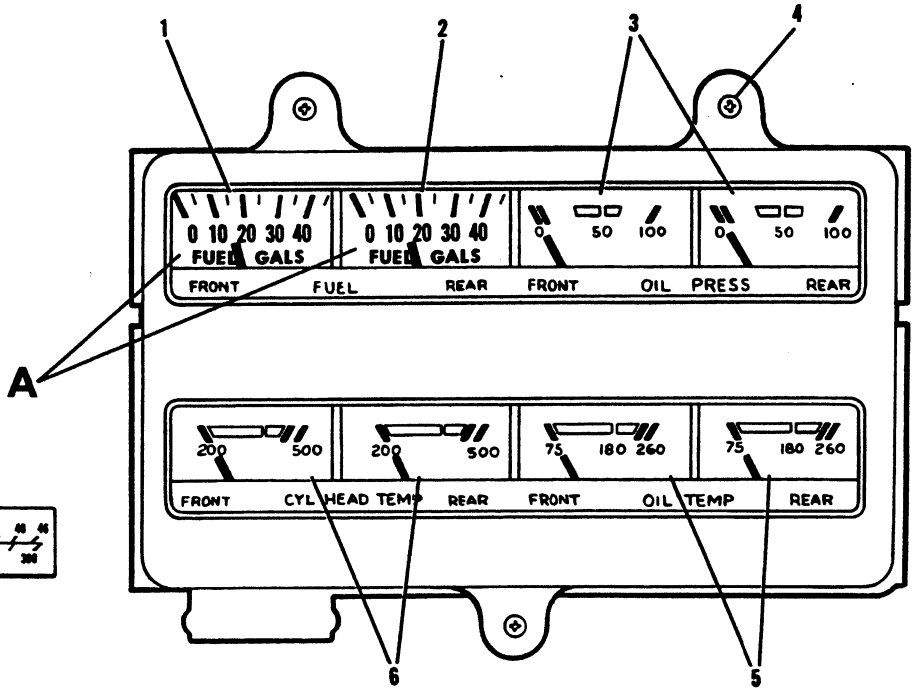
MODELS 337C THRU 337D AND T337C THRU T337D



NOTE

Figure 14-3, sheet 2 may be used as a guide for removal and installation of the cluster and instruments.

MODELS 337E AND T337E AND ON



Detail A

MODELS 337F AND T337F AND ON

Figure 14-3. Instrument Cluster (Sheet 3 of 3)

100 feet of altitude loss as indicated on altimeter.

8. If leakage rate is within tolerance, slowly release suction source, then remove tape used to seal static 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.

9. 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.

10. Repeat leakage test to check whether static pressure system or the removed 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.

11. Attach a source of positive pressure to static source opening. Figure 14-5 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.

12. 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, static pressure alternate source valve and static source flange with solution of mild soap and water, watching for bubbles to locate leaks.

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

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

b. BEGINNING WITH AIRCRAFT SERIAL 33701463 AND F33700056. The following procedure outlines inspection and testing of the static and pitot systems, assuming the altimeter has been tested and inspected in accordance with current Federal Aviation Regulations.

1. Ensure static system is free from entrapped moisture and restrictions.

2. Ensure no alterations or deformations of airframe surface have been made which would affect the relationship between air pressure in the static pressure system and true ambient static air pressure for any flight configuration.

3. Seal both static ports and pitot head openings with pressure sensitive tape. This seal must be air tight.

4. Open static pressure alternate source control.

5. Attach a source of suction to the alternate static source fitting after removing line (3) on the alternate static source valve and to the tee fitting in the pitot line located in the wing inboard of the wing strut. If alternate static source is not installed attach line to one static line at the sump.

CAUTION

Make sure both lines are connected properly so both pitot and static systems are evacuated equally as damage could occur to the airspeed indicator. Also make sure no other lines are open.

6. Slowly apply suction until the altimeter indicates a 1000-foot increase in altitude.

7. Close off suction source to maintain a closed system for one minute. Leakage shall not exceed 100-feet of altitude loss as indicated on the altimeter.

8. If leakage rate is within tolerance, slowly release suction source and disconnect lines.

9. Reconnect alternate static source line to alternate static source valve and reinstall cap on the pitot line fitting.

10. Remove tape from the static ports and the pitot head on the wing strut.

11. If leakage exceeds maximum allowable, first tighten all connections, then repeat leakage test.

12. If leakage still exceeds maximum allowable, check all fittings for cross-threading.

13. Check all lines for cracks or other damage, replace as necessary. Then repeat leakage test.

14. When fault has been determined and corrected, disconnect vacuum source and repeat steps 9 and 10.

14-14. PITOT SYSTEM INSPECTION AND LEAKAGE TEST.

a. THRU AIRCRAFT SERIALS 33701462 AND F337-00055.

1. Fasten a piece of rubber or plastic tubing over the pitot tube.

2. Place a piece of tape over the drain hole on the pitot tube.

3. Close the end of the tubing and slowly roll up tube until airspeed indicator registers in cruise range.

4. Secure tube and after a few minutes recheck airspeed indicator.

5. Slowly unroll tubing before removing it, so pressure is reduced gradually.

6. If test reveals a leak in the system check all connections for tightness and recheck system.

b. BEGINNING WITH AIRCRAFT SERIALS 337-01463 AND F33700056.

a. Seal pitot openings with pressure sensitive tape. This seal must be air tight.

b. Connect a source of pressure, (Figure 14-5 shows one method of obtaining positive pressure) to the tee fitting in the pitot line located in the wing leading edge inboard of the wing strut.

c. Apply pressure until the airspeed indicator registers in the cruise range.

CAUTION

Do not exceed airspeed limits as damage could occur to the airspeed indicator.

d. Close pressure source to maintain a closed sys-

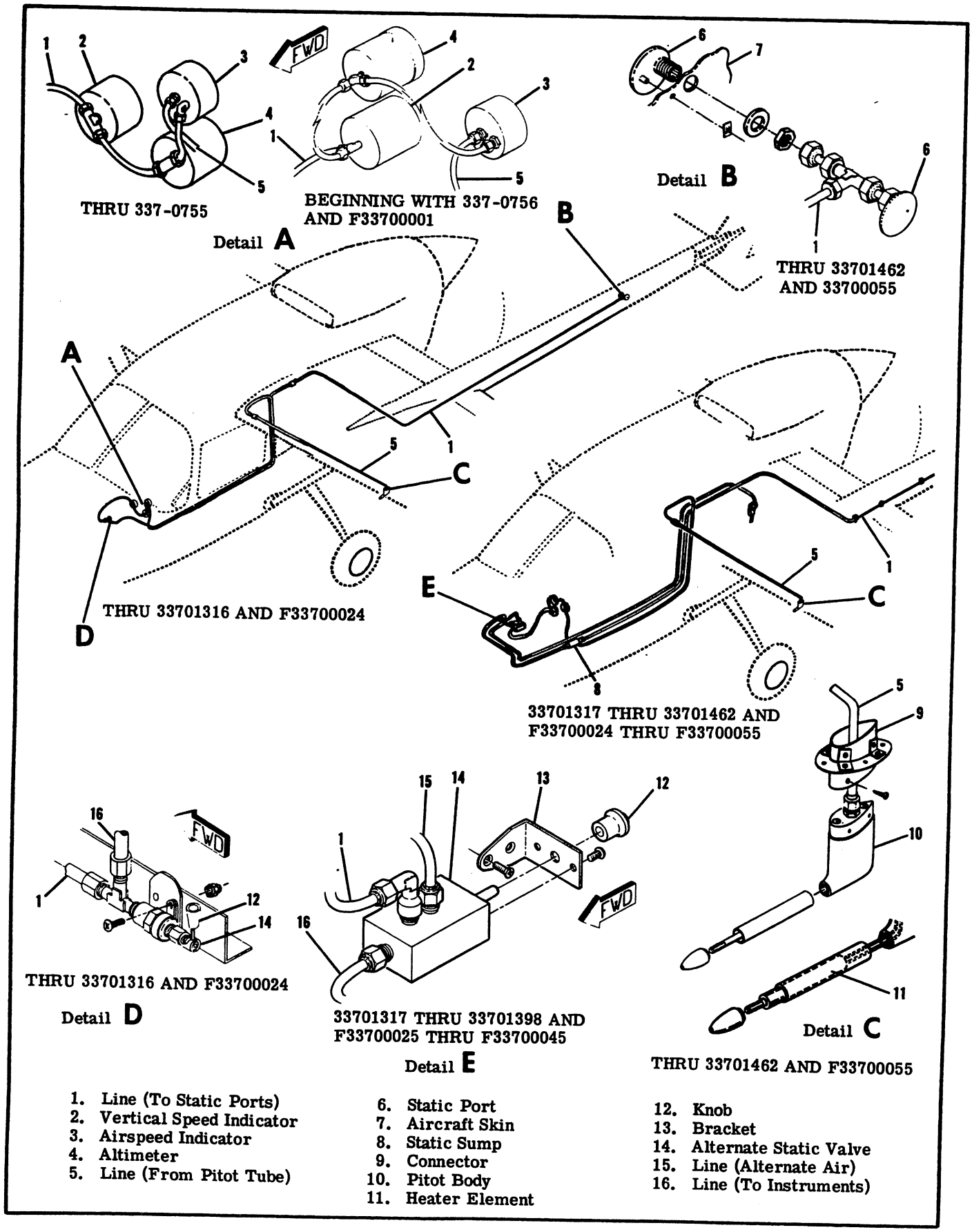


Figure 14-4. Pitot-Static System (Sheet 1 of 2)

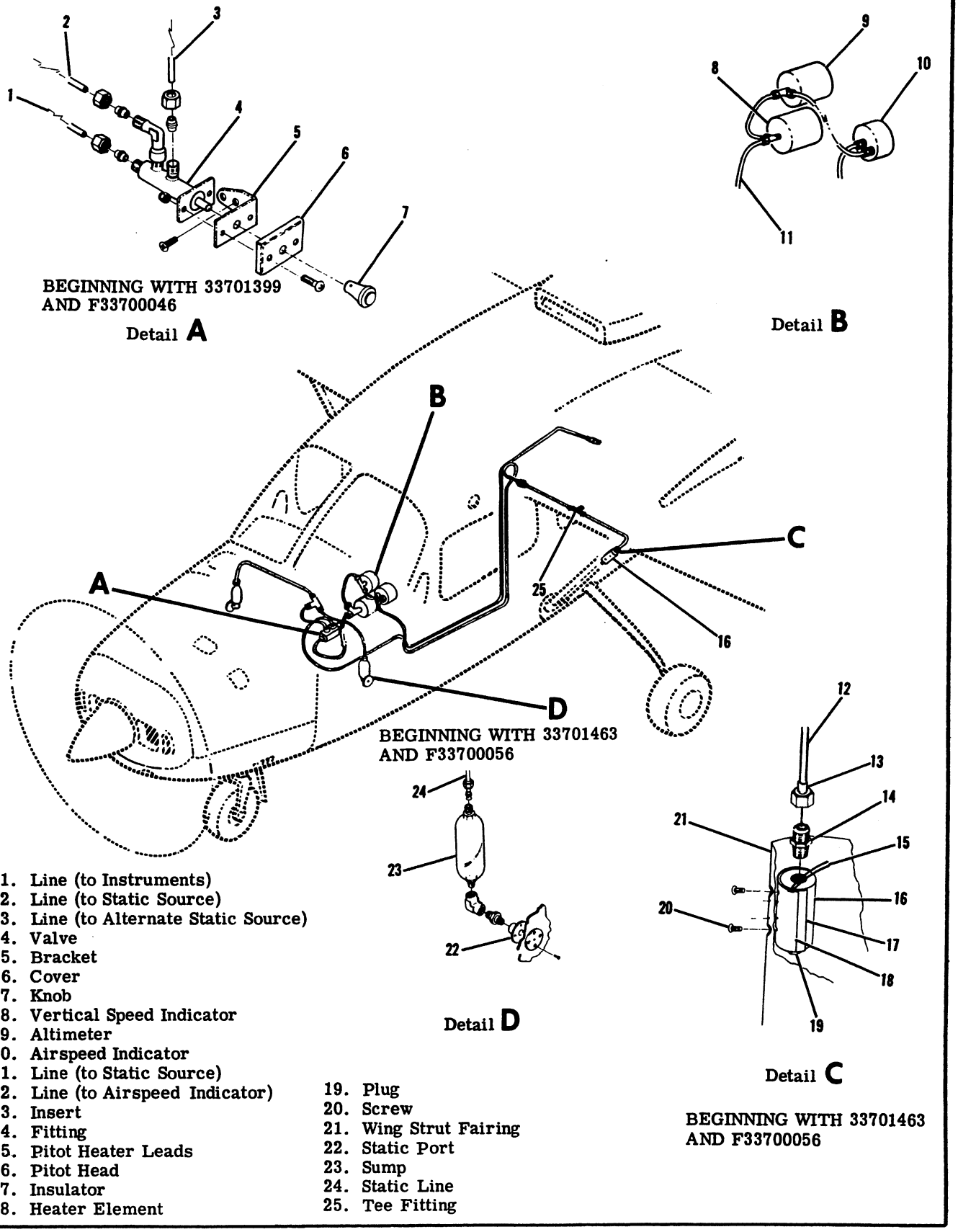
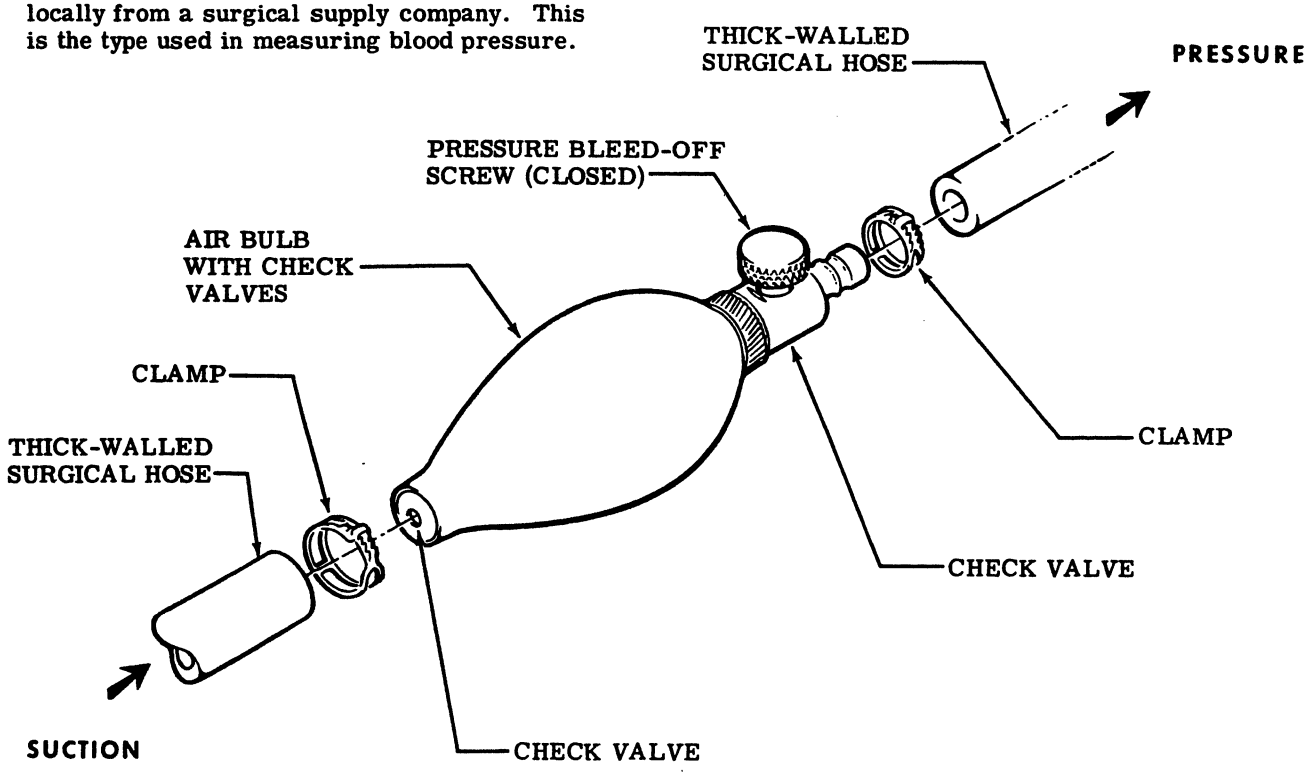


Figure 14-4. Pitot-Static System (Sheet 2 of 2)

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 14-5. Static System Test Equipment

tem.

e. After a few minutes recheck airspeed indicator for pressure loss.

f. If a loss in pressure has occurred, check all connections for tightness and recheck system.

g. After system check is complete, remove pressure source, reinstall cap on tee fitting and remove tape from pitot openings.

14-15. 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 clean 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. Static source sumps collect moisture and keept system clear. However, when necessary, disconnect static line at the 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.

14-16. REMOVAL AND INSTALLATION. (Refer to figure 14-4). 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 the cabin and right door. When replacing components of the 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. The pitot head is removed as follows:

a. Thru aircraft serials 33701462 and F3370055.

1. Remove the four mounting screws on the side connector (9).

2. Pull mast out of connector far enough to disconnect pitot line (5).

3. Disconnect electrical connections to the heater assembly (if installed) through the access opening just inboard of the mast.

4. Reverse the preceding steps for installation

b. Beginning with aircraft serials 33701463 and F33700056.

1. Remove upper strut cuff from recess and slide down strut fairing.

2. Remove screws securing pitot head and pull head from strut fairing.

3. Disconnect tube and electrical leads from pitot head, cap line and pitot head fitting.

4. Reverse this procedure for installation. Make sure holes in strut fairing are open.

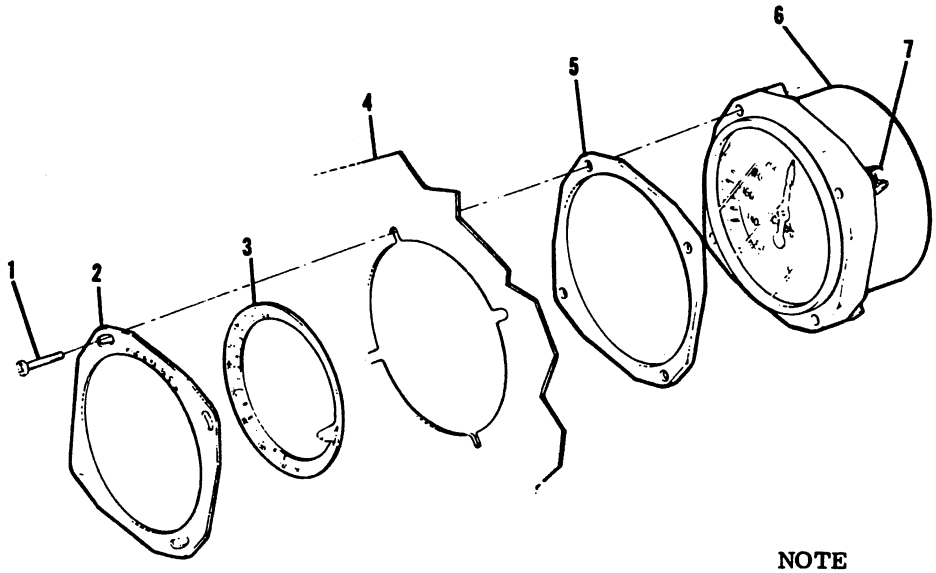
5. Check for leaks, refer to paragraph 14-14.

14-17. TROUBLE-SHOOTING--PITOT-STATIC SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
LOW OR SLUGGISH AIRSPEED 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.	Blow out line per paragraph 14-15. Repair or replace line.
	Alternate static source valve open.	Close for normal operation.

14-18. TRUE AIRSPEED INDICATOR.

14-19. DESCRIPTION. 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 14-6 for removal and installation. Upon installation, before tightening mounting screws (5), calibrate the instrument as follows: Rotate ring (7) until 120 mph on adjustable ring aligns with 120 mph on indicator. Holding this setting, move retainer (6) until 60°F aligns with zero pressure altitude, then tighten mounting screws (5) and replace decorative cover (4).



1. Mounting Screw
2. Retainer
3. True Airspeed Ring
4. Instrument Panel
5. Spacer
6. Airspeed Indicator
7. Nut

NOTE

Specific airspeed indicators, listed by part number in applicable Parts Catalogs, must be used in the true airspeed installation. Internal mechanism, face plate, and calibration are different from those of a standard instrument.

Do not overtighten screws (1) and do not lubricate any parts.

Figure 14-6. True Airspeed Indicator

SHOP NOTES:

14-20. TROUBLE SHOOTING.

NOTE

Refer to paragraph 14-15 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/shock mounts.	Tighten mounting screws. Replace defective shock mounts.
	Excessive tubing vibration.	Tighten clamps and connections, add extra clamps if necessary.

14-21. TROUBLE SHOOTING -- ALTIMETER.

NOTE

Refer to paragraph 14-15 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.
HAND OSCILLATES.	Static pressure irregular.	Blow out lines, tighten connections.
	Leak in airspeed or vertical speed indicator installations.	Blow out lines, tighten connections.

14-22. TROUBLE SHOOTING -- VERTICAL SPEED INDICATOR.

NOTE

Refer to paragraph 14-15 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.
	Defective instrument.	Substitute known-good instrument. Replace instrument.
INCORRECT INDICATION.	Partially plugged static line.	Blow out lines.
	Ruptured diaphragm.	Replace instrument.
	Pointer off zero.	Reset pointer to zero.
	Alternate static source valve open.	Close for normal operation.
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.
HAND VIBRATES.	Excessive panel vibration.	Check for loose screws/defective shock mounts. Tighten screws, replace defective shock mounts.
	Defective instrument.	Substitute known-good instrument. Replace insturment.

14-23. 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.	Reset breaker.
	Break in wiring.	Repair wiring.
	Heating element burned out.	Replace element.

14-24. VACUUM SYSTEM

14-25. DESCRIPTION. A dry vacuum pump, which requires no lubrication of any kind, is located on the accessory section of each engine. Relief valves are located outside of the engine compartments for cleanliness of incoming air. The front relief valve is located inside the cabin on the aft side of the front firewall and the rear relief valve is located under the floorboard, just forward of the rear firewall. Routing of vacuum lines and hoses, and location of other components of the system are shown in figure 14-7. Two red buttons on the suction gage indicate suction source from front or rear engine. In the event of failure of suction, a button will protrude to indicate the inoperative source. Check valves in the manifold prevent reverse flow. The system has a common central filter in addition to individual instrument filters. Beginning in 1967, the gyros have no instrument filters.

NOTE

The dry vacuum pumps are replaced with oil-lubricated pumps and oil separators when the optional de-ice system is installed. Refer to Section 13.

14-26. TROUBLE SHOOTING -- VACUUM SYSTEM. A hose long enough to reach from the rear vacuum pump into the cabin, a suction gage, and suitable fittings to adapt the hose to various vacuum system connections is recommended for trouble shooting. This will enable suction to be checked at various points in the system, while engines are running, without danger from propellers. Beginning in 1967, the gyros are not equipped with individual instrument filters.

TROUBLE	PROBABLE CAUSE	REMEDY
NO SUCTION INDICATED AT ONE SOURCE.	Defective vacuum pump.	Replace pump.
	Disconnected, broken, or plugged lines or hoses.	Clean or replace lines and hoses.
	Defective relief valve.	Replace relief valve.
	Defective suction gage.	Replace suction gage.
NO SUCTION INDICATED, BUT GYROS OPERATE NORMALLY.	Defective suction gage.	Replace gage.
SUCTION GAGE FLUCTUATES.	Excessive vibration.	Determine cause of vibration and correct.
	Defective suction gage.	Replace gage.
HIGH SUCTION.	Relief valve air filters dirty.	Clean or replace filters.
	Defective or improperly adjusted relief valves.	Adjust relief valves per paragraph 14-31. Replace if defective.
LOW SUCTION.	Defective vacuum pump.	Replace pump.
	Leaking or restricted lines or hoses.	Clean or replace lines and hoses.
	Defective or improperly adjusted relief valves.	Adjust relief valves per paragraph 14-31. Replace if defective.
	Defective check valves.	Replace manifold assembly.

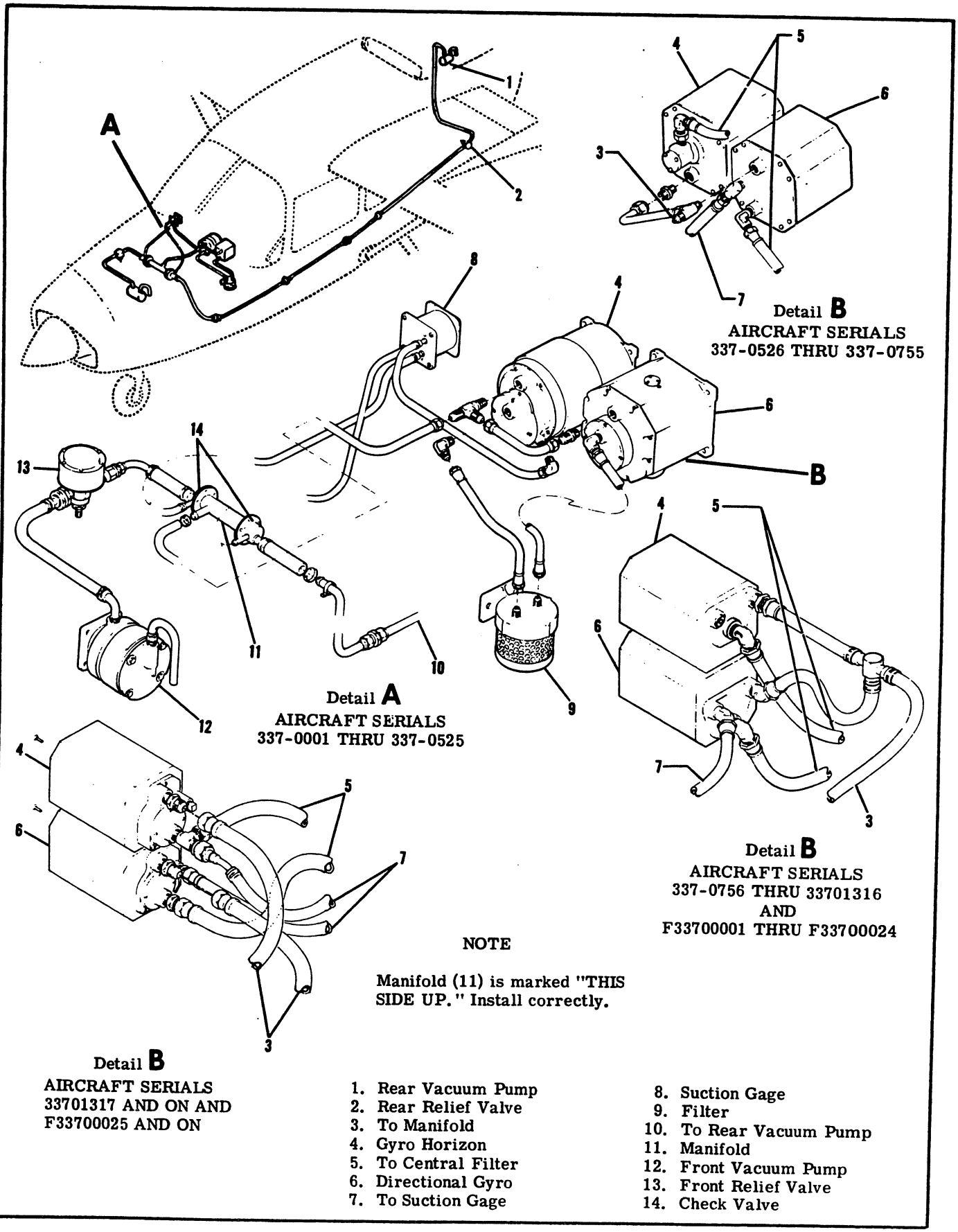


Figure 14-7. Vacuum System (Typical)

14-27. TROUBLE SHOOTING -- GYROS.

TROUBLE	PROBABLE CAUSE	REMEDY
HORIZON BAR FAILS TO RESPOND.	Central air filter dirty.	Clean or 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.	Clean or 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.	Clean or 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.

14-28. TROUBLE SHOOTING -- VACUUM PUMP.

TROUBLE	PROBABLE CAUSE	REMEDY
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.
LOW PRESSURE	Safety valve leaking.	Replace safety valve.
	Vacuum pump failure.	Replace vacuum pump.

14-29. REMOVAL AND INSTALLATION OF VACUUM SYSTEM COMPONENTS. (Refer to figure 14-7.) The various components of the 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 thread lubricant sparingly and ONLY on male threads. Avoid over-tightening connections. Before reinstalling a vacuum pump, place the mounting pad gasket in position over studs. After installing pump, before connecting the plumbing, start the engine and hold a piece of paper over the pump discharge to check for evidence of oil in air discharge. Adequate precautions must be taken to assure that oil, grease, thread lubricants, eleaning fluids or other foreign material cannot enter the pumps. When blowing out lines and hoses, always disconnect them at both ends. When checking for leaks, disconnect at both ends and plug one end. Apply pressure to the opposite end and use a coating of soap and water or Leak Teck to detect leaks.

14-30. CLEANING. In general, low-pressure, dry compressed air should be used in cleaning the vacuum system components. Components exposed to engine oil and dirt, should be washed with Stoddard solvent, then dried with low-pressure air. Check hoses for collapsed inner liners as well as external damage.

CAUTION

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

14-31. RELIEF VALVE ADJUSTMENT. Since each suction source requires a relief valve, separate adjustments must be made.

a. Start the rear engine.

b. Observe that the right red button on the suction gage retracts, indicating suction from the rear engine. If both buttons disappear, a faulty manifold check valve is indicated.

c. Operate rear engine at 1900 rpm and check that suction gage reading is approximately 4.8 inches of mercury.

d. To obtain this reading, use the trial-and-error method, rotating the relief valve adjusting screw clockwise to increase suction. Because of danger from the rear propeller, do not make adjustments while engine is running.

e. After adjusting the rear relief valve, also start the front engine. Check that left red button on the suction gage retracts.

f. With both engines operating at 1900 rpm, adjust the front relief valve, located inside the cabin at the front firewall, to obtain 5.2 inches of mercury on the suction gage.

NOTE

In flight, with both engines operating, the desired suction gage reading is 5.3 inches of mercury. A range of 5.0 to 5.4 is acceptable.

g. Shut down both engines and check that the locknuts at the relief valve adjusting screws are secure.

14-32. ENGINE INDICATORS.

14-33. FUEL QUANTITY INDICATING SYSTEM.

14-34. INDICATORS. (Refer to figure 14-3).

14-35. DESCRIPTION. Two fuel quantity indicators, graduated in gallons through 33701316 and F33700024 and pounds/gallons beginning with 33701317 and F337-00025 are located in the instrument cluster. These electromagnetic type indicators, are used in conjunction with a control monitor (5) and capacitance type sensing units.

14-36. FUEL QUANTITY TRANSMITTER. (THRU AIRCRAFT SERIAL 337-1193).

14-37. DESCRIPTION. Fuel quantity transmitters are installed in the top of fuel tanks. They are the

float arm actuated, variable resistor type and are powered by the aircraft electrical system. The two transmitters in the main tanks, one in each tank, are connected in parallel and transmit to a common gage. The transmitter in the outboard tank controls the fuel gage reading from FULL to approximately 1/2 full. The transmitter in the inboard tank controls the fuel gage reading from approximately 1/2 full to EMPTY.

14-38. REMOVAL.

NOTE

Be sure fuel level in tanks is low enough that fuel will not drain from tank as transmitter unit is removed.

a. Remove access cover immediately above transmitter to be removed.
b. Disconnect electrical wire and remove screws attaching transmitter. Remove gasket between transmitter and tank; remove transmitter.

14-39. INSTALLATION. Installation of the fuel quantity transmitter may be accomplished by reversing the procedures outlined in paragraph 11-9. Use new gaskets around opening in fuel tank and under screw heads. Do not damage float or bend the float arm when placing the transmitter into tank as incorrect fuel readings can result. After installation is complete, turn on master switch and check fuel gage reading against known quantities in the tank. Minor adjustments can be made by bending float arm on the fuel quantity transmitter unit. Install a gasket under fuel quantity transmitter access door.

14-40. SENDING UNITS. (BEGINNING WITH AIRCRAFT SERIALS 33701194 AND F33700001).

14-41. DESCRIPTION. A fuel quantity sending unit is located in each fuel tank. These sending units are basically tubular capacitors whose elements are two electrodes fixed in one position. Since the electrodes are fixed, the capacitance produced by the size of these electrodes can be varied by the change of dielectric. The dielectric, is the combination of fuel vs air in the fuel tank and is twice as great when the tank is full as when empty. Any change of fuel quantity between full and empty, produces a corresponding change in capacitance. These changes are amplified by the control monitor(s) and actuate the fuel quantity indicators.

14-42. REMOVAL AND INSTALLATION.
a. Place fuel selector valves in OFF position.
b. Remove sump tank access cover and drain all fuel from tanks by removing quick-drain valve. Strainer can be removed to expedite fuel draining. (Observe precautions outlined in Section 11).
c. Remove screws attaching access cover adjacent to sending unit to be removed.

NOTE

Access cover is bonded to wires and therefore can be removed with sending unit attached.

d. Remove safety wire from sending unit and clips at bracket inside tank.
e. Rotate sending unit counterclockwise and remove from clips.
f. Lift sending unit with wires attached out through access hole.
g. Disconnect wires at sending unit. Connect wires to new sending unit and reinstall in clips inside tank. Rotate unit clockwise in clips to secure, and install safety wire.
h. Prior to reinstalling access plates, calibrate system in accordance with procedures outlined in paragraph 14-46.

14-43. CONTROL MONITOR(S).

14-44. DESCRIPTION. The control monitor(s) is located behind the headliner in the right cabin area just inborad of the aft door post. A zipper is provided for access. The monitor(s) is a solid state device with adjustment provisions for fuel quantity system calibration. The provisions are recessed screwdriver adjustments marked: "FULL ADJ", "EMPTY ADJ" right tank and "FULL ADJ", "EMPTY ADJ" left tank respectively. For calibration refer to paragraph 14-46.

14-45. REMOVAL AND INSTALLATION.
a. Open the monitor zipper to gain access thru 33701462 and 33700055.
b. Remove monitor mounting screws.
c. Disconnect all wiring. (Note connections for reference when reconnecting.)
d. Reverse the preceding steps for installation.
e. Calibrate system in accordance with paragraph 14-46.

14-46. CALIBRATION.

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 condition.

a. Place selector valves in "OFF" position.
b. Drain all fuel from tanks. Remove fuel sump drain valves to expedite draining of MAIN tanks and remove quick-drain valves to expedite draining of AUX tanks. (Observe precautions in Section 11.)
c. Reinstall and safety all drains removed in step "b".
d. Open the zipper for access to control monitor(s).
e. Turn master switch "ON" and allow a few seconds for indicators to stabilize.

CAUTION

All adjustments made to control monitor(s) are to be made with a small insulated screwdriver. Using a metallic shank screwdriver increases the possibility of shorting the potentiometer to ground and damaging control monitor circuitry.

f. Adjust left and right MAIN tank “EMPTY ADJ” and left and right AUX tank “EMPTY ADJ” for “O” indication on the fuel quantity indicators.
g. Turn the master switch “OFF” and completely fill all fuel tanks.
h. Turn master switch “ON” and allow indicators to stabilize.
i. Adjust left and right MAIN tank “FULL ADJ” for 46-gallon indication on the fuel quantity indicators and left and right AUX tank “FULL ADJ” for 18-gallon indication.

NOTE: Unusable fuel in each of the MAIN tanks is approximately ½ gallon and approximately 1 gallon in each of the AUX tanks. Beginning with 1973 models on the long-range system, 3 ½ gallons per wing, (3 tanks).

j. Reinstall all items removed for access to monitor(s).

14-47. TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
No fuel quantity indication	Fuel bays empty	Service with proper grade and amount of fuel.
	Circuit breaker open or unserviceable.	Reset. Replace if unserviceable.
	Unserviceable fuel quantity indicator or transmitter.	Substitute known-good indicator or transmitter. Replace instrument.
	Loose connections or open circuit.	Tighten connections; repair or replace wiring.

14-47A. FUEL QUANTITY INDICATING SYSTEM OPERATIONAL TEST.

A. For airplane serials 337-0001 thru 33701193.

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. Refer to Section 2, Ground Handling, Servicing, Lubrication and Inspection.
4. Drain all fuel from wing fuel tanks. Refer to Section 2, Ground Handling, Servicing, Lubrication and Inspection.
5. 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.
   b. 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 14-39. for instructions to adjust 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 14-39 for instructions to adjust 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 14-39 for instructions to adjust Stewart Warner fuel indicating systems.

NOTE: 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 this procedure, remove maintenance-warning tags and connect the airplane battery.

B. For airplane serials 33701194 and On and F33700001 and On.

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.
2. Attach maintenance-warning tags to the battery connector and external power receptacle stating:

   DO NOT CONNECT ELECTRICAL POWER A MAINTENANCE IN PROGRESS.

3. Electrically ground the airplane.
4. Level the airplane. Refer to Section 2, Ground Handling, Servicing, Cleaning, Lubrication and Inspection.
5. Drain all fuel from wing fuel tanks. Refer to Section 2, Ground Handling, Servicing, Cleaning, Lubrication and Inspection.
6. With the fuel selector valve in the OFF position, add unusable fuel quantity to each fuel tank.
7. 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.
8. 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.
9. 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.

14-48. DUAL TACHOMETER.

14-49. DESCRIPTION. The dual tachometer is an electronic instrument which converts electrical current to movement of the pointers along scales indicating engine RPM. Pick-up coils located on the bottom side of the right magneto on each engine provide the current source. As the magnetos rotate, current is induced in the pick-up coils. During the 1967 model-year breaker points replaced the pick-up coils in the right magnetos. However, the breaker points perform the same function as the pick-up coils. Also during the 1967 model-year, the transmitter became an integral part of the indicator, although its function remains the same. Refer to Section 10 for breaker point adjustment.

14-50. TROUBLESHOOTING. If the airplane is equipped with the optional synchroscope, a cross-check of the tachometer and synchroscope will indicate condition of the pick-up coil, as both instruments use common pick-up coils.

TROUBLE	PROBABLE CAUSE	REMEDY
No indication for either engine.	Circuit breaker out.	Reset circuit breaker. If it pops out again, determine cause and correct.
	Circuit breaker.	Replace circuit breaker.
	“Hot” wire to tachometer or ground wire.	Repair wiring.
	Tachometer.	Replace tachometer.
No indication for one engine.	Tachometer.	Replace tachometer.
	Pick-up coil lead/breaker point lead or ground wire.	Repair wiring.
	Pick-up coil/breaker points.	Replace pick-up coil/breaker points.

TROUBLE	PROBABLE CAUSE	REMEDY
Erroneous indication for one engine.	Tachometer or pick-up coil/breaker points.	Replace tachometer or pick-up coil/breaker points.
	Loose electrical connections.	Tighten loose connections.
Erroneous indication for both engines.	Tachometer.	Replace tachometer.
	Loose electrical connections.	Tighten loose connections.
Indication is for opposite engine.	Pick-up coil/breaker point leads reversed at back of tachometer.	Interchange leads at back of tachometer.

14-51 DUAL MANIFOLD PRESSURE GAGE.

14-52. DESCRIPTION. The dual manifold pressure gage is a barometric instrument which indicates absolute pressure, in inches of mercury, in the intake manifold of each engine. A manifold pressure line is routed from the intake manifold of each engine to separate connections at the back of the gage. Inlet ports on the back of the instrument are labeled, FRONT and REAR.

14-53. TROUBLESHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive error at existing barometric pressure.	One or both pointers shifted.	Replace instrument.
	Leak in vacuum bellows.	Replace instrument.
	One or both pointers loose.	Replace instrument.
	Leak in pressure lines.	Repair or replace damaged line, tighten connections.
	Condensate or fuel in lines.	Blow out lines.
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.
	Mechanism.	Replace instrument.
	Leak in pressure lines.	Repair or replace damaged line or lines, tighten connections.
Sluggish operation of pointer.	Foreign matter in lines.	Blow out lines.
	Damping needle dirty.	Replace instrument.
	Leak in pressure lines.	Repair or replace damaged line or lines, tighten connections.
Excessive pointer vibration.	Tight rocker pivot bearings.	Replace instrument.
	Excessive vibration.	Replace unserviceable shock-mounts.
Improper calibration.	Faulty mechanism.	Replace instrument.
No pointer movement.	Faulty mechanism.	Replace instrument.
	Broken pressure line.	Repair or replace damaged line.

14-54 DUAL FUEL FLOW INDICATOR.

14-55. DESCRIPTION. The dual fuel flow indicator is a direct reading pressure instrument calibrated to indicate the approximate gallons per hour of fuel being metered to each engine. Fuel pressure is transmitted from each fuel manifold valve (fuel distributor) through individual metal-shielded flexible hoses to the forward firewall and to the rear horizontal firewall. From the forward firewall, a metal line is routed to the inlet port on the back of the instrument labeled FRONT. From the rear horizontal firewall, a metal line is routed through the tunnel, the length of the fuselage, to the inlet port on the back of the instrument labeled REAR. In addition to the pressure ports, labeled “P” on the back of the instrument, two vent ports, labeled “V”, are provided. Vented plastic plugs are installed in vented ports. The indicators are vented to atmospheric pressure with standard engine installations and to turbocharger outlet pressure with turbocharger engine installation. A restrictor is used where each system connects to the indicator.

14-56. TROUBLESHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive vibration of pointers.	Excessive panel vibration.	Correct panel vibration.
	Check security of pressure lines.	Secure lines; add clamps as necessary.
Erratic or sluggish movement of pointers.	Excessively restricted pressure lines or vent line.	Clean out restrictions, replace damaged line.
	Indicator.	Replace indicator.
	Air in the pressure line.	Disconnect pressure line at the back of the instrument, turn on battery and auxiliary fuel pump switches, and bleed lines. Connect pressure line.
Indication is for opposite engine.	Pressure lines are reversed at back of indicator.	Interchange pressure lines.
Erroneous indication for one engine.	Leak in pressure line.	Repair or replace line.
	Excessively restricted pressure line.	Clean pressure line, second check restrictor.
	Vent at the back of the indicator restricted.	Repair or replace vent plug.
	Indicator.	Replace indicator.
Erroneous indication for both engines.	Indicator.	Replace indicator.
No indication for one engine.	Indicator.	Replace indicator.
	Disconnected or broken pressure line.	Connect or replace line.
	Pressure line or vent line plugged.	Clean lines or replace unserviceable parts.
No indication for either engine.	Indicator.	Replace indicator.

14-57. INSTRUMENT CLUSTER.

14-58. DESCRIPTION. The instrument cluster, located in the right side of the stationary instrument panel, contains the cylinder head temperature gages, oil temperature gages, main fuel quantity gages, auxiliary fuel gages (optional equipment), an ammeter, a voltmeter, and oil pressure gages. The oil pressure gages are of the Bourdon tube type. All other instruments in the cluster are operated electrically. Refer to paragraph 14-9 for removal and installation.

NOTE: Beginning with the Model 337A and T337 series the instrument cluster is equipped with a printed circuit. Since there are no leads connected directly to an individual instrument, the terminals at the bottom of the cluster can be used during the interchanging-of-wires test. Refer to Section 18 wiring diagrams to trace a gage to its applicable terminals. Extension wires can be used to check the continuity of the circuit board by bypassing the terminals and connecting the operating system leads directly to the gages

14-59. CYLINDER HEAD TEMPERATURE GAGES.

14-60. DESCRIPTION. The temperature-sending unit in the engine regulates electrical power through the cylinder head temperature gages. 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. 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 1. to determine if the Rochester Cylinder head temperature gage is operating properly.

14-61. TROUBLESHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Gage inoperative.	No current to circuit.	Repair electrical circuit.
	Gage or bulb.	Replace gage or bulb.
Gage fluctuates rapidly.	Loose or broken wire permitting alternate make or break of gage circuit.	Repair or replace wire.
Gage reads too high on scale.	High voltage.	Check voltage supply.
	Gage off calibration.	Replace gage.
Gage reads too low on scale.	Low voltage.	Check voltage supply.
	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.	Gage.	Replace gage.
	Incorrect calibration.	Replace gage or bulb.

TABLE 1. CYLINDER HEAD TEMPERATURE INDICATING SYSTEM RESISTANCE TABLE.
The following table is provided to assist in the troubleshooting the Rochester cylinder head temperature indicating system components.

Select the cylinder head temperature sending unit part number that is used in your airplane 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 Ω	34.8 Ω	46.4 Ω
S1372-2	CHT		310.0 Ω	34.8 Ω	
S1372-3	CHT			113.0 Ω	
S1372-4	CHT			113.0 Ω	
S2334-3	CHT	745.0 Ω			38.0 Ω
S2334-4	CHT	745.0 Ω			38.0 Ω

14-62. OIL PRESSURE GAGES.

14-63. DESCRIPTION. The Bourdon tube-type oil pressure gages are direct-reading instruments, operated by pressure pickup lines connected to the engines main oil galleries. The oil pressure lines from the instruments to the engines can be filled with kerosene, especially during cold weather operation, to attain an immediate oil indication.

14-64. TROUBLESHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Oil pressure gages show no indication.	Gage.	Replace gage.
	Broken and disconnected pressure line or fitting.	Replace line or fitting.
	Pressure line plugged.	Clean line with solvent and blow out with compressed air.
Erroneous oil pressure indication for one engine.	Leak in pressure line.	Replace line.
	Restricted pressure line.	Blow out line with compressed air. Replace if damaged.
	Gage.	Replace gage.
Erratic or sluggish movement of oil indication.	Restricted pressure line.	Clean line with solvent and blow out with compressed air.
	Gage.	Replace gage.
Indication is for opposite engine.	Pressure line is reversed at back of gage.	Interchange lines at back of gage.

14-65. OIL TEMPERATURE GAGES.

14-66. DESCRIPTION. The oil temperature gages are electrically operated indicators, located in the instrument cluster and connected to sending units located in the oil passages above the oil coolers. The gage and sending unit require little or no maintenance other than cleaning, making sure leads are properly supported and all connections are clean, tight, and properly insulated. Refer to Table 2. to determine if the Rochester oil temperature gage is operating properly.

TABLE 2. ROCHESTER OIL TEMPERATURE INDICATING SYSTEM RESISTANCE TABLE.

The following table is provided to assist in the troubleshooting the Rochester oil temperature indicating system components.

Select the oil temperature sending unit part number that is used in your airplane 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 Ω	
S1630-3	Oil Temp		620.0 Ω			52.4 Ω
S1630-4	Oil Temp		620.0 Ω			52.4 Ω
S1630-5	Oil Temp			192.0 Ω		
S2335-1	Oil Temp	990.0 Ω				34.0 Ω

14-67. HOURMETER (FLIGHT HOUR RECORDER).

14-68. DESCRIPTION. The hour meter is mounted on the stationary instrument panel. The 337-0755 an air-operated switch is installed on the inside of the fuel pump access plate, located on the underside of the left wing between the boom and the fuselage. A vane, extending downward through a hole in the access plat, is actuated by air passing beneath the wing at approximately 40 mph. When actuated the air switch completes the circuit and causes the gage to register. Beginning with 337-0756 and F33700001 a switch is installed in the oil pressure line for the front engine, aft of the forward engine firewall. Oil pressure actuates the switch as the forward engine is started.

14-69. TROUBLESHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Gage inoperative. (For airplane serial numbers 337-0001 thru 337-0755.)	Circuit to gage.	Check continuity through fuse or circuit breaker and electrical circuit to gage. Replace circuit breaker, repair electrical circuit.
	Circuit from gage.	Check continuity through electrical circuit from gage. Repair electrical circuit.
	Gage or air switch.	Check continuity through air switch as vane is operated manually. If air switch operates properly, gage is probably unserviceable. Replace unserviceable air switch or gage.
NOTE: For airplane serial numbers 337-0001 thru 337-0755, if hour meter registers properly when air switch is actuated manually, and it does not register in flight, replace air switch.		

14-69. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
GAGE INOPERATIVE, BEGINNING WITH AIRCRAFT SERIAL 337-0756.	Defective circuit to gage.	Check continuity through circuit breaker and electrical circuit to gage. Replace circuit breaker, repair electrical circuit.
	Defective circuit from gage.	Check continuity through electrical circuit from gage. Repair electrical circuit.
	Defective gage or pressure switch.	Check continuity through pressure switch. If pressure switch operates properly, gage is probably defective. Replace pressure switch or gage.

14-70. SYNCHROSCOPE.

14-71. DESCRIPTION. An electrically operated synchroscope mounted on the stationary instrument panel provides a visual reference for making engine synchronization. Thru 337-0755, electrical impulses are fed to the transmitter from pick-up coils on the magnetos and relayed to the indicator. These pick-up coils also provide input signals for the dual tachometer. Beginning with 337-0756 and F33700001, breaker points in the magnetos replace the pick-up coils.

In the synchroscope system a transmitter is electrically connected in parallel with the dual tachometer, both receive signals from breaker points on the right magneto of each engine. The signals are compared in the synchroscope transmitter and their difference in electrical phase is displayed by deflection of the pointer in the synchroscope. A large differential in electrical phase (caused by a large differential in engine rpm) will not indicate on the synchroscope. When the engines are more closely adjusted a short rapid deflection of the pointer will occur. As the rpm differential becomes less the pointer deflections will become longer but at a slower rate, with properly synchronized engines, the pointer will center and become stationary.

NOTE

When synchronizing engines, either engine rpm may be set up and used as a master, and the other engine synchronized to it. Minor differences in tachometer readings after engine synchronization may occur due to tolerance in the system, but should not be cause for concern.

14-72. TROUBLE SHOOTING. A cross-check of the dual tachometer and synchroscope will indicate condition of the pick-up coils as both instruments use common pick-up coils (Models prior to 337-0756).

TROUBLE	PROBABLE CAUSE	REMEDY
HAND FAILS TO RESPOND.	Defective circuit.	Repair circuit.
	Defective transmitter.	Replace transmitter.
	Defective indicator.	Replace indicator.
	Thru 337-0755, defective pick-up coil. Beginning with 337-0756, defective breaker points.	Replace defective pick-up coil or breaker points.

14-73. DUAL ECONOMY MIXTURE INDICATOR.

14-74. DESCRIPTION. The economy mixture indicator is an exhaust gas temperature (EGT) sensing device which aids 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 appropriate aircraft Owner's Manual for operating procedure of the system.

14-75. TROUBLE SHOOTING.

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 14-76.
FLUCTUATING READING.	Loose, frayed or broken lead, permitting alternate make and break of current.	Tighten connections and repair or replace defective leads.

14-76. CALIBRATION. Two different types of indicators have been used. The early type (type "A") was equipped with calibration adjustment knobs on the face of the instrument and small calibration adjustment screws on the back of the case. The later type (type "B") was equipped with calibration adjustment knobs on the face of the instrument only.

NOTE

The meter reading will change slightly after initial calibration because of lead deposit build-up on the probe. These deposits, however, will reach an equilibrium level and will result in a small drop in EGT indication, so that a small recalibration will be desirable. These lead deposits do not in any way affect the use of the indicator for mixture control or trouble detection. Leads and/or probes can be interchanged between types "A" and "b."

TYPE "A" CALIBRATION:

The calibration adjustment knobs located on the face of the instrument are used to position the pointers over the reference increment lines (4/5 of scale) at peak EGT with 65% cruise power.

NOTE

This setting will provide relative temperature indications for normal cruise power settings within the range of the instrument.

Rotation of a knob will adjust its pointer three small divisions up or down (±75°F). The knob operates a cam and may be rotated either direction through 360°, without damage to the instrument. If further calibration is required to place the pointer over the reference line at peak EGT with 65% power, remove the instrument and use the small calibration adjustment screw located on the back of the case. Each screw may be rotated in either direction without damage to the instrument. Rarely will adjustment of this nature be required after initial installation. Repeat this procedure for opposite engine. The pointers should indicate within 1/2 increment of each other at peak EGT.

TYPE "B" CALIBRATION:

The calibration adjustment knobs located on the face of the instrument are used to position the pointers over the reference increment lines (4/5 of scale) at peak EGT with 75% cruise power.

NOTE

This setting will provide relative temperature indications for normal cruise power settings within the range of the instrument.

Rotation of a knob will adjust its pointer seven small divisions up or down (±175°). Stops are provided for the knobs; do not force knobs against stops.

14-77. REMOVAL AND INSTALLATION. For removal of indicator refer to paragraph 14-9. For removal of probes proceed as follows:

a. Remove engine cowl, refer to Section 10.
b. Disconnect electrical connections.
c. Remove safety wire.
d. Remove clamp and probe.
e. Reverse this procedure to install, torque probe clamp to 45 pound-inches and safety wire.
f. Check operation.

14-78. MISCELLANEOUS INSTRUMENTS.

14-79. MAGNETIC COMPASS.

14-80. DESCRIPTION. The magnetic compass, located on the windshield centerstrip, is a lighted, liquid filled instrument containing expansion provisions for temperature changes. It is equipped with compensating magnets adjustable from the front of the instrument. Access to the compass light bulb and the compensating magnets is provided by pivoted covers, thru 33701398 and F33700045, and removing the compass case cover, 33701462 thru F33700055. A slot in the bezel is provided for adjustment beginning with 33701463 and F33700056. Torque mounting screw 10-15 lb-inches to prevent compass rotation in flight.

14-81. TURN-AND-SLIP INDICATOR.

14-82. DESCRIPTION. The turn-and-slip indicator is an electrically operated gyro instrument, powered by the aircraft electrical system. It operates whenever the master switch is turned on.

14-83. TROUBLE SHOOTING.

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.	Correct voltage.
NOISY GYRO.	High voltage.	Correct voltage.
	Loose or defective rotor bearings.	Replace instrument.

14-84. OUTSIDE AIR TEMPERATURE GAGE.

14-85. DESCRIPTION. Aircraft may be equipped with a mechanical and/or electrical type outside air temperature gage. The electrical gage receives signals from a temperature bulb mounted under the left wing in the forward boom section. The signals vary with temperature changes, and the gage converts these changes in current to temperature readings.

14-86. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
GAGE INOPERATIVE.	Defective circuit to gage.	Check continuity through circuit breaker and electrical circuit to gage. Replace circuit breaker, repair electrical circuit.
	Defective circuit from gage.	Check continuity through electrical circuit from gage. Repair electrical circuit.
	Defective gage or bulb.	Substitute known-good gage or bulb. Replace defective item.
GAGE FLUCTUATES RAPIDLY.	Loose or broken wire permitting alternate make and break of gage circuit.	Inspect circuit wiring. Repair or replace defective wire.
	Defective gage or bulb.	Substitute known-good gage or bulb. Replace defective item.
OBVIOUSLY INCORRECT READING.	Low voltage to gage.	Turn on master switch and check for approximately 24 volts to gage. Determine cause of low voltage and correct. Refer to Section 15.
	Defective circuit from gage.	Check continuity through electrical circuit from gage. Replace electrical circuit.
	Defective gage or bulb.	Substitute known-good gage or bulb. Replace defective item.