SECTION 12

INSTRUMENTS AND RELATED SYSTEMS

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GENERAL.

The stationary instrument panel is a part of the fuselage structure and is ordinarily not considered removable. The two individual shock-mounted panels, either of which may be removed individually, are attached to the stationary panel by the use of shock-mounts, an angle assembly, nuts and screws. The LH shock-mounted panel houses the flight instruments while the RH panel houses the radio controls, fuel and engine operation instruments. Individual instruments are positioned behind and secured to each panel with bolts and nuts. Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide for all removals and installations.

INSTRUMENTS.

Vacuum System Instruments.

a. The Directional Gyro is a flight instrument incorporating an air-driven gyro stabilized in the vertical plane. The gyro is rotated at high speed by lowering the pressure in the airtight case with the engine-driven vacuum pumps and simultaneously allowing air at atmospheric pressure to enter against the gyro buckets. Due to gyroscopic inertia, the spin axis continues to point in the same direction, even though the aircraft yaws to the left or right. This relative motion between the gyro and the instrument case is shown on the instrument dial which is similar to a compass card. The dial, when set to agree with the aircraft's magnetic compass, provides a "dead beat" azimuth indicator that is free from "swing."

b. The Slaved Directional Gyro includes a single, synchro-driven pointer and in some gyros, a dual pointer for use with ADF/VOR inputs to provide continuous indication of the bearing to specific ground stations. The slaved directional gyro operates with a slaving meter and a flux detector, to produce input to the electronic compass circuit in the gyro. The flux detector is remotely located in the tailcone of the aircraft. Refer to Compass Alignment procedure for compensating the slaved directional gyro.

c. The Horizontal Gyro is essentially an air-driven gyroscope rotating in a horizontal plane, operated by the same supply of vacuum as the directional gyro. Due to gyroscopic inertia, the spin axis continues to point in the vertical direction providing a constant visual reference to the attitude of the aircraft relative to its pitch and roll axis. A bar across the face of the indicator represents the horizon and a miniature adjustable aircraft is mounted to the case. Aligning the miniature aircraft to the horizon bar simulates the alignment of the aircraft to the actual horizon and any deviation simulates the deviation of the aircraft from the true horizon. The indicator is marked from zero to 90 degrees.

d. The Suction Gage is calibrated in inches of mercury and indicates the amount of vacuum created by the engine-driven vacuum pumps. The vacuum gage has three connecting lines. The upper line is routed directly to the directional gyro to monitor vacuum. The lower lines are attached to the vacuum system

manifold for the purpose of monitoring vacuum pump function.

e. Directional and Attitude Gyro Precession. Acceptable limits for gyro drift is 4° in either direction from a heading during a ten minute period. Excessive gyro precession can be caused by low vacuum system pressure; therefore, the following items should specifically be checked prior to gyro removal and/or replacement.

1. Vacuum system lines for kinks or leaks.
2. Central air filter or instrument filter for dirt. The filter should be cleaned and/or replaced.
3. Suction gage for proper operation.
4. Vacuum relief valve for proper adjustment. Adjustment instructions are outlined in Adjustment of Vacuum Relief Valve Procedures.

NOTE

A gage reading of 5.3 inches of mercury is desirable for gyro instruments; however, a range of 4.75 to 5.25 inches of mercury is acceptable.

5. Vacuum pump for proper operation.

Pitot-Static Instruments.

a. The Sensitive Altimeter is a pressure instrument that measures the change in static pressure and by means of an indicator, translates this change into altitude above sea level. A barometric scale is incorporated in the instrument. The barometric pressure scale is calibrated in inches of mercury and is set manually by a knob on the lower left-hand corner of the altimeter case. Three pointers on the dial of the instrument indicate altitude in units of 100 feet, 1,000 feet and 10,000 feet.

b. The Airspeed Indicator measures the differential between ram, or impact air pressure taken at the pitot tube, and static air pressure. The instrument dial is calibrated in both knots and miles per hour. Should airspeed indicator require maintenance and recalibration, recalibrate in accordance with FAA TSO-2C.

c. The True Airspeed Indicator is composed of three elements; airspeed, altitude and temperature. The altitude and temperature mechanisms are correlated to operate a rotating dial over which the indicated airspeed indicates the true airspeed. The true airspeed indicator senses changes in pressure and temperature. This combination of altitude and temperature change results in a sum total of airspeed corrections to indicate true airspeed.

d. The Vertical Velocity Indicator measures the rate of change in static pressure when the aircraft is climbing or descending. By means of a pointer and dial it indicates the rate of ascent and descent of the aircraft in feet per minute.

Engine Instruments.

a. Fuel Quantity Indicator. On Aircraft 310P0001 to 310Q0001, a fuel quantity indicator with two pointers on the dial, one for each wing, is located in the lower right-hand portion of the instrument panel. The fuel quantity indicator receives electrical signals from variable resistor-type fuel quantity sending units located inside the wing tanks and indicates, in gallons, the amount of remaining usable fuel. On aircraft 310Q0001 and ON, the fuel quantity indicator is located in the upper center of the instrument panel. The indicator receives electrical signals from the signal conditioners which receives its signal from the main or auxiliary tank sending units, depending on the fuel tank selection. The indicator is calibrated in pounds and gallons to indicate the amount of remaining usable fuel.

b. Dual Fuel Flow Gage. On Aircraft 310P0001 to 310Q0001, the dual fuel flow gage senses the pressure at which the fuel is delivered to the fuel injection nozzles. The gage is marked as a flowmeter. Two pointers indicate the fuel flow for the left and right engines. The gage is a direct reading pressure gage. On aircraft 310Q0001 and ON, the dual fuel flow gage is calibrated in pounds and gallons per hour. The White scale indicating pounds per hour, and the Blue scale indicating gallons per hour.

c. The Manifold Pressure Gage is a direct reading gage used to indicate the pressure of the fuel-air mixture in the engine intake system. Two pointers indicate the manifold pressure in inches of mercury absolute.

d. The Engine Combination Gages, (Cylinder Head Temperature, Oil Temperature, and Oil Pressure) one for each engine are remote electrical indicators. Each gage is connected electrically to a cylinder head temperature bulb located underneath the number three cylinder of the respective engine. On Turbo 310 the temperature bulb is located on No. 3 cylinder of RH engine and No. 2 cylinder of LH engine. As the temperature of the bulb changes, the combination gage measures the change and the pointer indicates the temperature in degrees Fahrenheit. The oil temperature is electrically received from the oil temperature bulb, located in the engine oil passage and calibrated in degrees Fahrenheit. Oil pressure is taken directly from the pressurized engine oil passage. It is routed through small lines and hoses to the combination gage which calibrates the pressure to pounds per square inch.

e. The Dual Tachometer is a remote electrical instrument that is connected by electrical leads to a tachometer generator on each engine. The tachometer calibrates electrical current from the tachometer generator to revolutions per minute. The pointers, one marked for each engine, are concentrically mounted so that the engines may be synchronized visually by over-lapping the pointers.

f. Economy Mixture Indicator (Optional Equipment) is an exhaust gas temperature (EGT) sensing device which is used to aid the pilot in selecting the most desirable fuel-air mixture for cruising flight of less than 75% power. EGT varies with the ratio of fuel-to-air mixture entering the engine cylinders. Refer to Section 13 for removal, installation and calibration procedures.

Miscellaneous Instruments.

a. The Turn-and-Bank Indicator is a combination instrument. The turn indicator is an electrically-driven gyro mounted in a horizontal gimbal that is

attached to a pointer which indicates the rate of turn. The slip indicator consists of a curved, liquid-filled glass tube in which an inclinometer ball, moving with dampened motion, changes positions according to the gravitational and centrifugal force acting upon the aircraft.

b. The Ammeters measure the current received, or current drain on the battery, one being used for alternators the other for optional propeller deice system.

c. The Magnetic Compass is located on the windshield. It consists of a pair of parallel magnetic bars surrounded by a circular calibrated compass card visible through a window in the compass case. The compass case is a metal bowl filled with liquid to dampen dial oscillation. Lighting is integral and controlled by a rheostat on the switch panel. The compass has two adjusting set screws, one for N-S headings and one for E-W headings. These set screws are located on lower face of compass behind the metal disc.

d. The Stall Warning Horn is mounted behind the instrument panel on the left hand side. A stall warning transmitter, mounted on the leading edge of the left wing, energizes the electrical circuit when the aircraft approaches a stall and causes the horn to operate. The stall warning transmitter incorporates a heater element, operated by the pitot heater switch, to prevent ice from hampering its operation.

e. The Outside Air Temperature Gage is located in the lower right portion of the instrument panel. It is calibrated in degrees Fahrenheit and operated electrically from a free air temperature bulb located in the fresh air duct in the nose of the fuselage.

f. (310-0001 to 310P0222) The flap position indicator is electrically operated and indicates the position of the flaps from zero to 35 degrees. The indicator operates in conjunction with a flap position transmitter located just aft of the fuselage rear spar. Refer to Section 8 for flap position transmitter removal and installation procedures.

g. (310P0222 and On) The flap position is indicated by the flap preselect system pointer on the stationary instrument panel.

h. The clock is a standard eight-day aircraft clock with a sweep second hand. A winding stem is provided in the lower left-hand portion of the case.

Typical Instrument Removal. (See figure 12-2.)

NOTE

For steps "a" through "d" refer to figure 12-1.

a. Remove screws attaching instrument panel section, in which instrument is attached, to angle assembly.

b. Remove nuts from upper portion of instrument panel section.

c. Hinge instrument panel section aft on the lower shock mount.

d. Tag and disconnect electrical wires and hoses from back of instrument being removed.

e. Plug all hoses and cap fittings to prevent the entry of foreign matter.

f. Remove the connectors (8), nuts (7), and lockwashers (6).

g. Remove lower attaching nuts and bolts.

NOTE

If the instrument is to be replaced, remove the hose fittings or electrical connector and install the replacement unit.

Typical Instrument Installation. (See figure 12-2.)

NOTE

Lubricate straight threads with VV-P-236 petrolatum; tapered threads with JAN-A-669 antiseize compound. Apply lubricant to male threads only, omitting the first two threads.

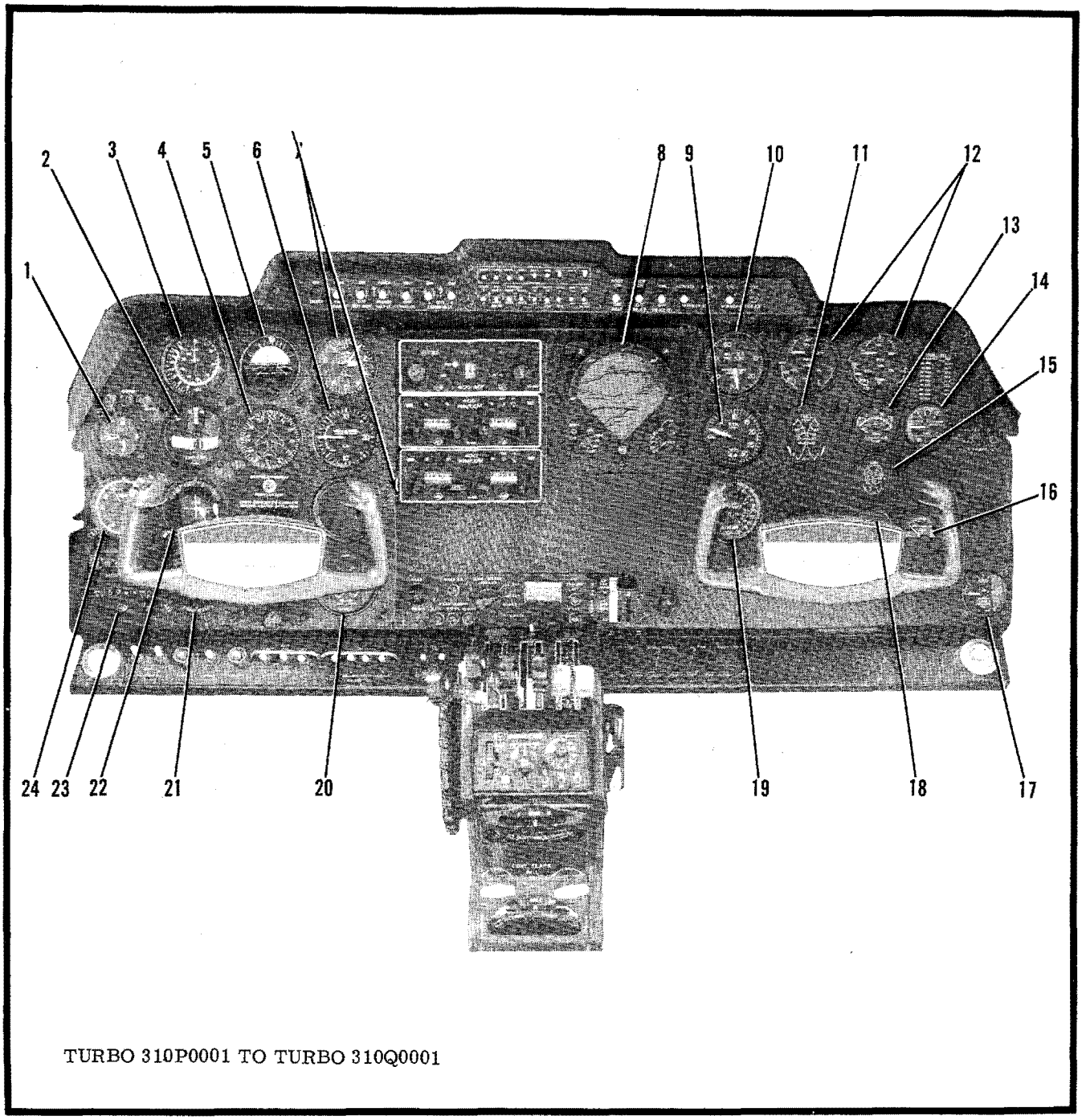
a. Position instrument on back of instrument panel and secure with lower attaching bolts and nuts illustrated in figure 12-2.

b. Install lighting fixtures (1) and rubber washers (2), secure with lockwashers (6) and nuts (7).

c. Attach connectors (8) to lighting fixtures (1).

d. Connect hoses or electrical connector as tagged at removal.

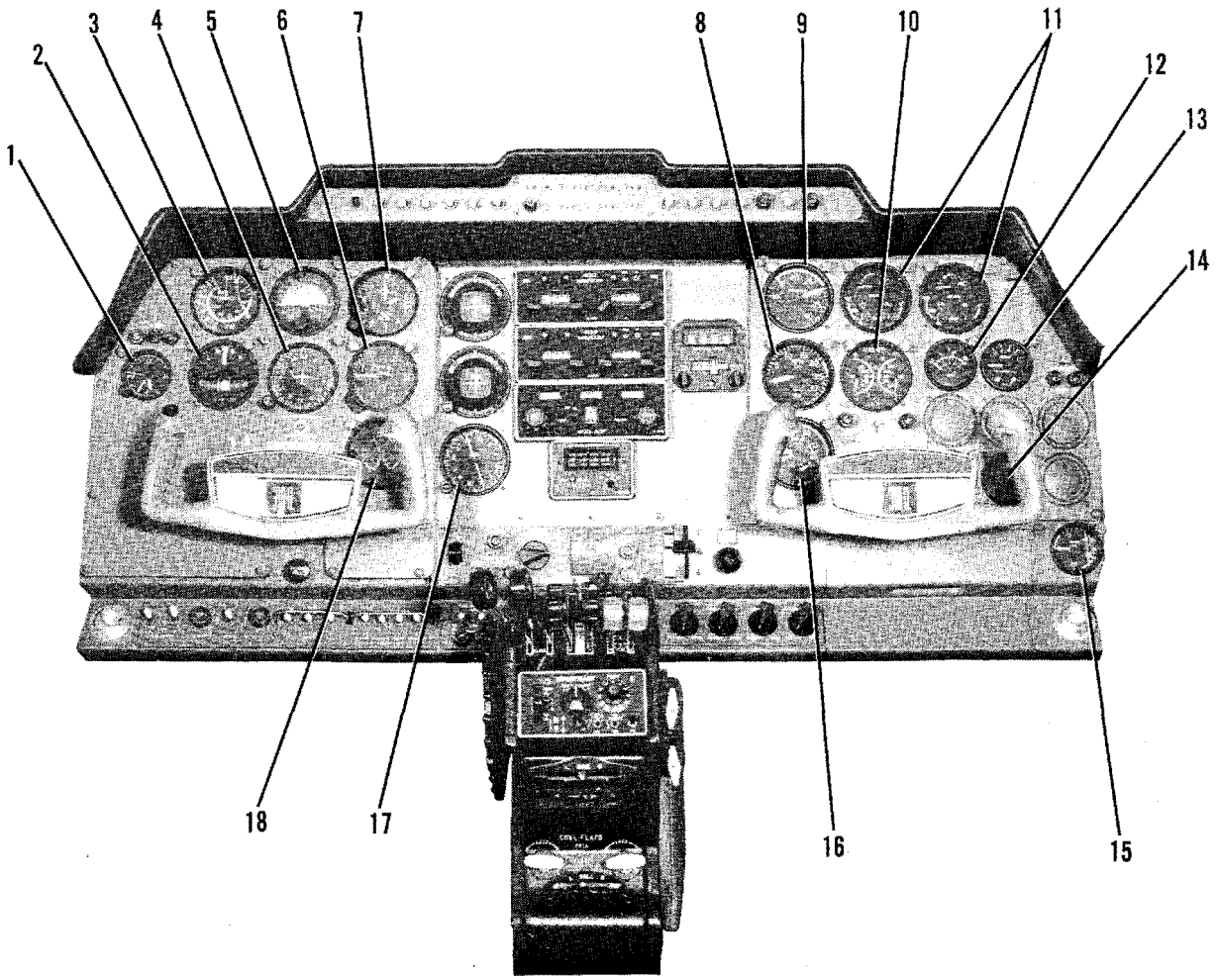
e. Hinge instrument panel section forward on lower shock mounts and secure to stationary instrument panel with screws.



TURBO 310P0001 TO TURBO 310Q0001

1. Clock
2. Turn and Bank Indicator
3. Airspeed Indicator
4. Directional Gyro
5. Horizontal Gyro
6. Vertical Speed Indicator
7. Altimeter
8. Radar Display Indicator (Optional)
9. Tachometer
10. Manifold Pressure Gage
11. Fuel Quantity Indicator
12. Engine Combination Gages
13. Outside Air Temperature Gage
14. Suction Gage
15. Auxiliary Fuel Quantity Indicator (Optional)
16. Propeller Deice Ammeter (Optional)
17. Oxygen Gage (Optional)
18. Flight Hour Recorder (Optional)
19. Fuel Flow Gage
20. Exhaust Temperature Gage
21. Number 2 Omni Course Selector Indicator
22. Number 1 Omni Course Selector Indicator
23. Nautical Miles Indicator
24. ADF Indicator

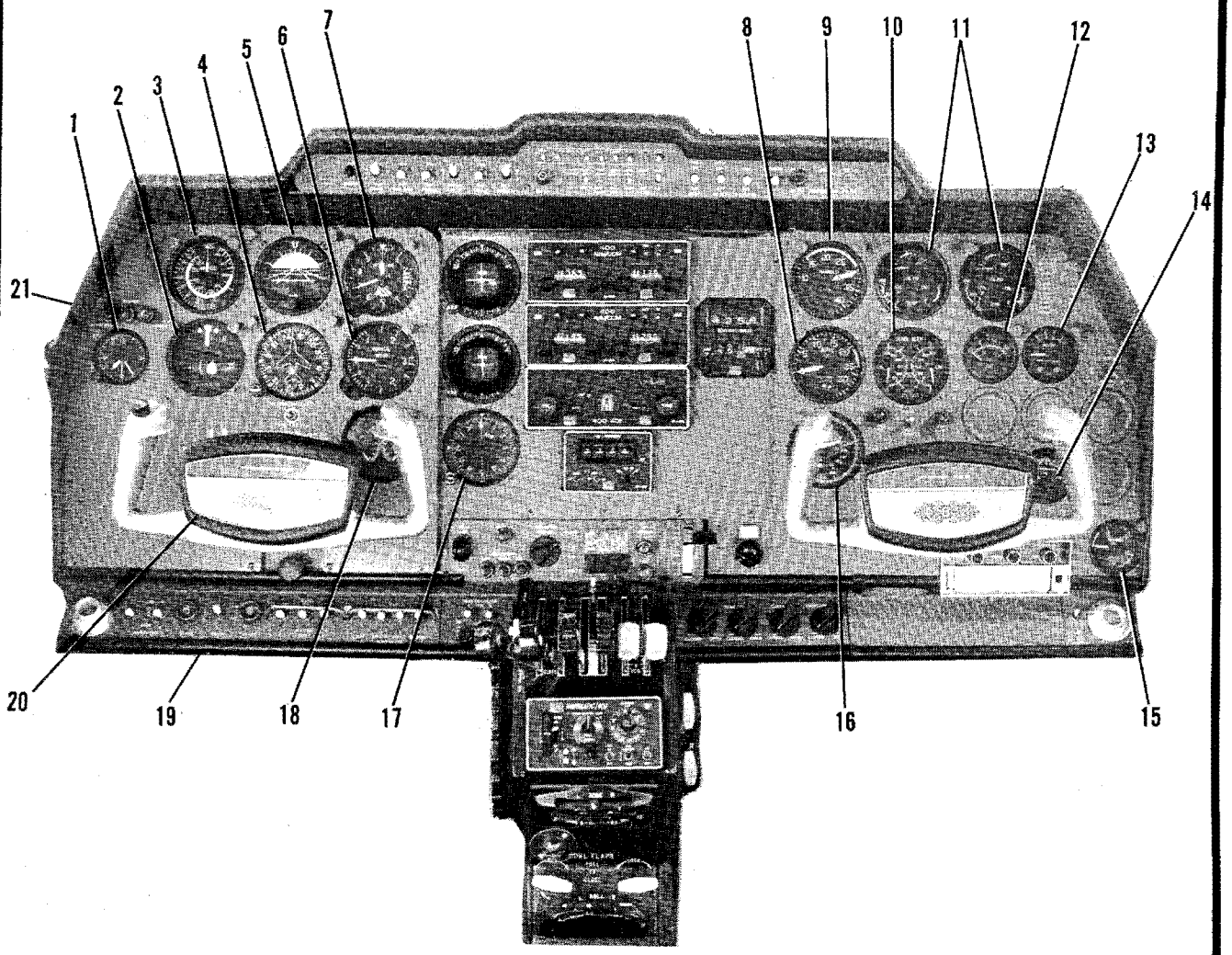
Figure 12-1. Instrument and Instrument Panel



TURBO 310Q0001 TO 310Q0201

1. Clock
2. Turn and Bank Indicator
3. Airspeed Indicator
4. Directional Gyro
5. Horizontal Gyro
6. Vertical Speed Indicator
7. Altimeter
8. Tachometer
9. Manifold Pressure Gage
10. Fuel Quantity Indicator
11. Engine Combination Gages
12. Outside Air Temperature Gage
13. Suction Gage
14. Propeller Deice Ammeter (Optional)
15. Oxygen Gage
16. Fuel Flow Gage
17. ADF Indicator
18. Exhaust Temperature Gage

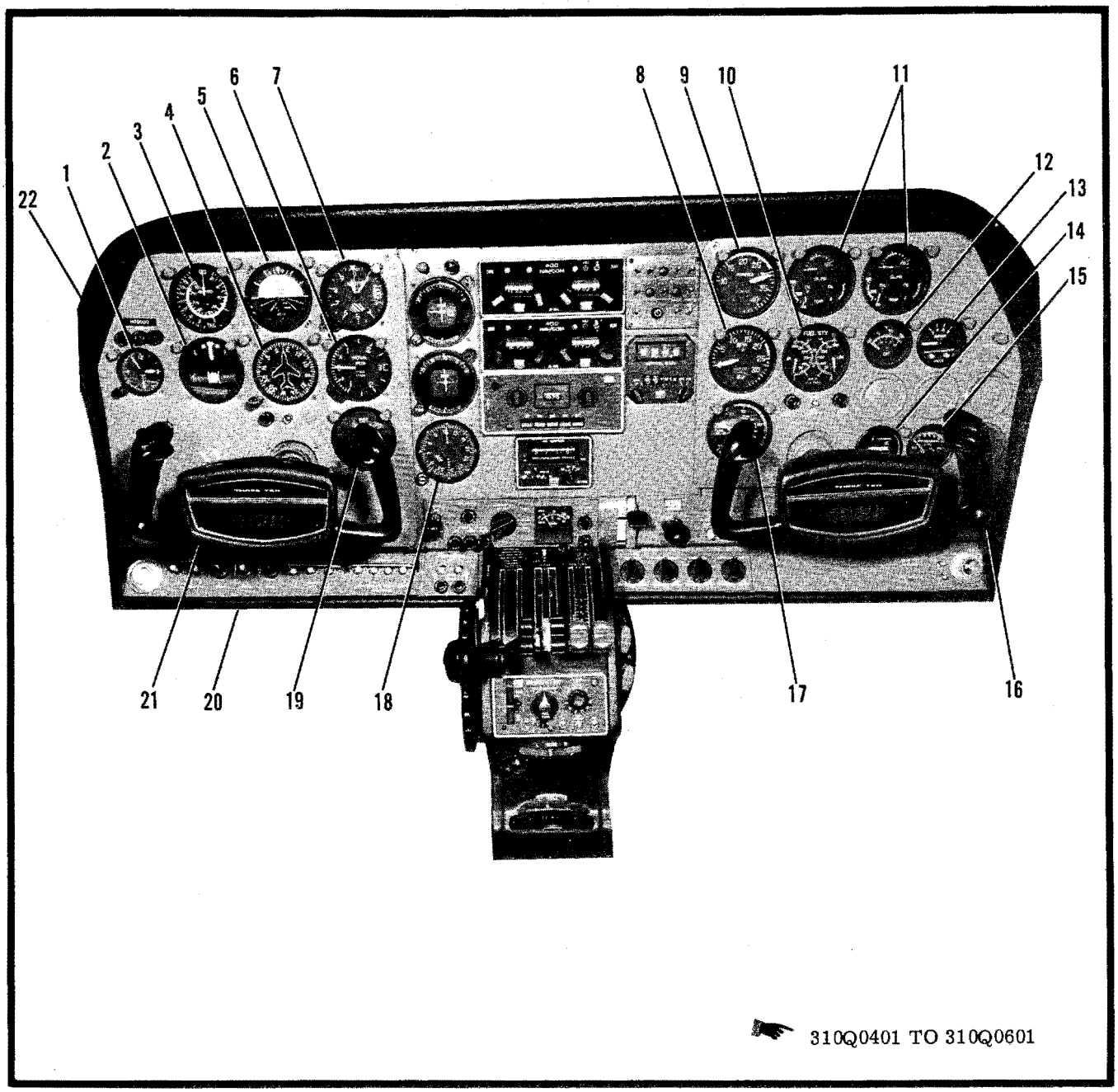
Figure 12-1A. Instrument and Instrument Panel



TURBO 310Q0201 TO 310Q0401

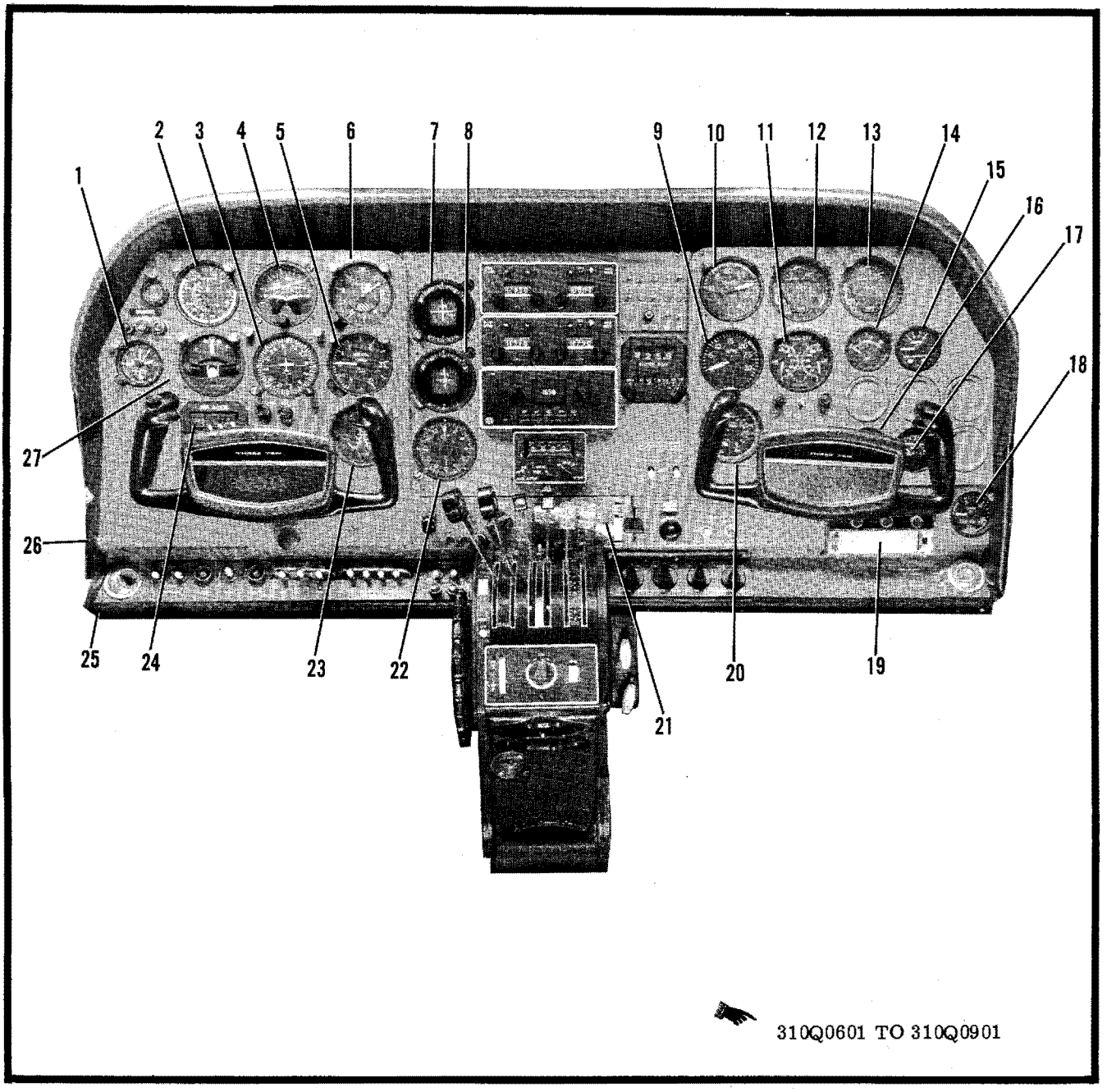
1. Clock
2. Turn and Bank Indicator
3. Airspeed Indicator
4. Directional Gyro
5. Horizontal Gyro
6. Vertical Speed Indicator
7. Altimeter
8. Tachometer
9. Manifold Pressure Gage
10. Fuel Quantity Indicator
11. Engine Combination Gages
12. Outside Air Temperature Gage
13. Suction Gage
14. Propeller Deice Ammeter (Optional)
15. Oxygen Gage
16. Fuel Flow Gage
17. ADF Indicator
18. Exhaust Temperature Gage
19. Padded Stationary Panel
20. Padded Control Wheel
21. Padded Glareshield

Figure 12-1B. Instrument and Instrument Panel



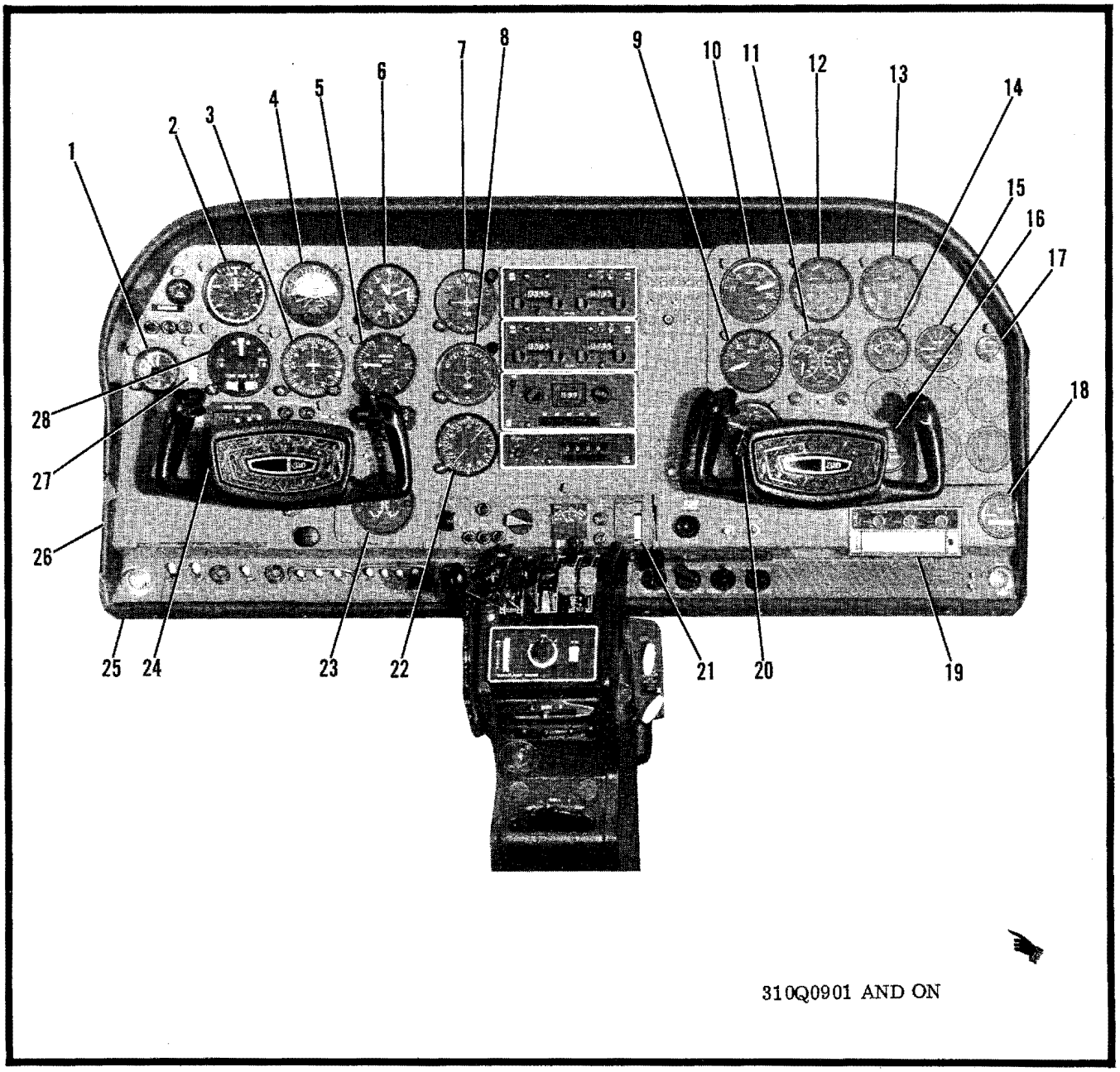
1. Clock
2. Turn and Bank Indicator
3. Airspeed Indicator
4. Directional Gyro
5. Horizontal Gyro
6. Vertical Speed Indicator
7. Altimeter
8. Tachometer
9. Manifold Pressure Gage
10. Fuel Quantity Indicator
11. Engine Combination Gages
12. Outside Air Temperature Gage
13. Suction Gage
14. Flight Hour Recorder (Optional)
15. Propeller Deice Ammeter (Optional)
16. Oxygen Gage
17. Fuel Flow Gage
18. ADF Indicator
19. Exhaust Temperature Gage
20. Padded Stationary Panel
21. Padded Control Wheel
22. Padded Glare Shield

Figure 12-1C. Instrument and Instrument Panel



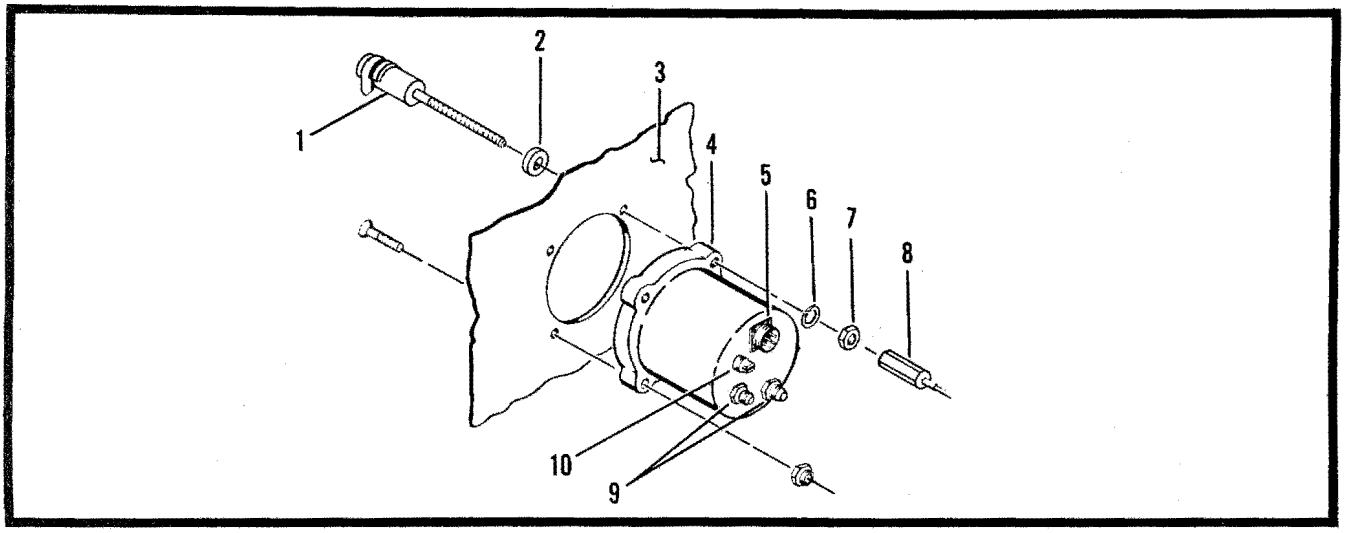
1. Clock
2. Airspeed Indicator
3. Directional Gyro
4. Attitude Director Indicator
5. Vertical Speed
6. Altimeter
7. No. 1 OBS Indicator
8. No. 2 OBS Indicator
9. Tachometer Indicator
10. Manifold Pressure Indicator
11. Fuel Quantity Indicator
12. LH Engine Combination Gage
13. RH Engine Combination Gage
14. Outside Air Temperature Gage
15. Suction Gage
16. Flight Hour Recorder
17. Propeller Deice Ammeter
18. Oxygen Pressure Gage
19. Mini 8 Stereo
20. Fuel Flow Indicator
21. Flap Position Indicator
22. ADF Indicator
23. Exhaust Temperature Indicator
24. Mode Selector
25. Padded Stationary Panel
26. Padded Glare Shield
27. Yaw Damper Switch

Figure 12-1D. Instrument and Instrument Panel



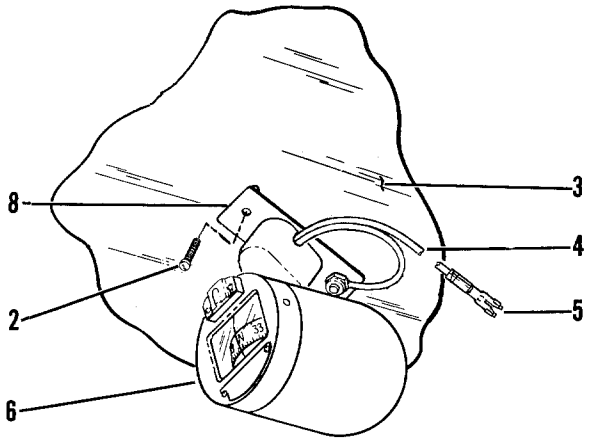
1. Clock
2. Airspeed Indicator
3. Directional Gyro
4. Attitude Director Indicator
5. Vertical Speed
6. Altimeter
7. No. 1 OBS Indicator
8. No. 2 OBS Indicator
9. Tachometer Indicator
10. Manifold Pressure Indicator
11. Fuel Quantity Indicator
12. LH Engine Combination Gage
13. RH Engine Combination Gage
14. Outside Air Temperature Gage
15. Suction Gage
16. Flight Hour Recorder
17. Propeller Deice Ammeter
18. Oxygen Pressure Gage
19. Mini 8 Stereo
20. Fuel Flow Indicator
21. Flap Position Indicator
22. ADF Indicator
23. Exhaust Temperature Indicator
24. Mode Selector
25. Padded Stationary Panel
26. Padded Glare Shield
27. Yaw Damper Switch
28. Turn and Slip Indicator

Figure 12-1E. Instrument and Instrument Panel

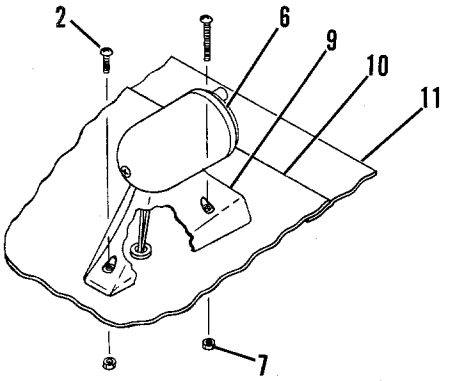


1. Lighting Fixture
2. Rubber Washer
3. Instrument Panel
4. Instrument
5. Electrical Connector
6. Lockwasher
7. Nut
8. Connector
9. Hose Fittings
10. Vent Plug

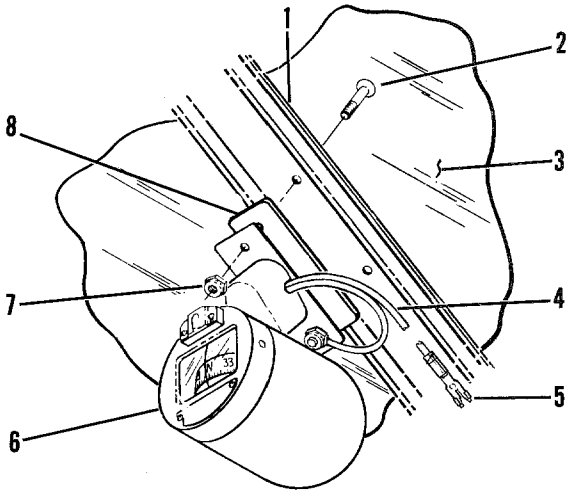
Figure 12-2. Typical Instrument Installation



310P0001 TO 310Q0401



310Q0401 AND ON



AIRCRAFT EQUIPPED WITH HEATED WINDSHIELD

1. Windshield Centerstrip
2. Bolt
3. Windshield
4. Compass Light Wire
5. Wrist Lock
6. Magnetic Compass
7. Nut
8. Mounting Bracket
9. Pedestal
10. Panel
11. Glare Shield

Figure 12-3. Magnetic Compass

Removal of Magnetic Compass. (See figure 12-3.)

a. Remove two screws securing compass to bonded base plate. On aircraft 310Q and on, remove panel (10) to gain access; remove three screws and nuts securing pedestal to panel.
b. Uncouple wrist lock (5) provided on compass light wire (4).

Installation of Magnetic Compass. (See figure 12-3.)

The installation of the magnetic compass is the reversal of the removal procedure.

NOTE

Use nonmagnetic screw and nuts for mounting compass and pedestal.

Compass Alignment Procedure.

The following procedures pertain to alignment of the magnetic (standby) compass and the flux detector on the slaved directional gyro. A calibrated compass rose must be used to accomplish the alignment procedures.
a. Insure compensator adjustments are set to a neutral position. The compensators are located on flux detector or gyro, depending on system.
b. Using a hand held magnetic compass, check all ferrous material parts for magnetism near the magnetic compass and flux detector.
c. Degauss any parts within two feet which cause greater than 10° deflection of the magnetic compass, and any part within four feet which cause greater than 90° deflection of the magnetic compass.
d. Insure that each of the applicable systems are controlled from the proper circuit breakers, and the corresponding "HDG" flag appears when the circuit breaker is disengaged.
e. Insure slave meter is operative.
f. Insure the systems fast slaving circuitry is operational.
g. Insure all electrical instruments for the aircraft are installed and operative.
h. Insure other aircraft and vehicles are a safe out of the way distance.
i. Position aircraft on the 270° heading of the compass rose.
j. With both engines running 1000 RPM, turn on the following:
1. All circuit breakers.
2. Inverters.
3. All lights except landing lights and reading lights.
4. All avionics systems.
5. All electrical systems except pitot heat, stall and static heaters.
6. Allow slaved gyro system to stabilize (stabilization speed may be increased by using fast slave).
7. Record the slaved gyro system error in degrees and direction with the slave meter nulled.
8. Record the standby compass error in degrees and direction.

NOTE

High readings are positive errors, low readings are negative errors.

9. Position aircraft on the 360° heading of the compass rose and repeat steps 1 thru 8.
10. Position aircraft on the 90° heading of the compass rose and repeat steps 1 thru 8.
11. Position aircraft on the 180° heading of the compass rose and repeat steps 1 thru 8.

Index Error Alignment.

This alignment should insure that the compass systems flux detector is positioned for minimum index error.
a. Algebraically sum the four cardinal heading errors obtained in preceeding paragraph, steps j, 1 thru 8.
b. Divide the sum obtained by four. This result is the index error correction and direction of rotation of the flux detector.
c. Rotate flux detector the direction and amount as calculated in steps a and b. CCW rotation of the flux detector is required to correct a positive error.

NOTE

Approximately five degrees rotation equals approximately 1/8 inch distance measured on the outer circumference of the flux detector.

d. Repeat compass alignment procedure step j, 1 thru 8.
e. The remaining error at the cardinal headings as received in step d should equal the difference between the initial cardinal heading errors obtained originally in compass alignment procedure, step j, 1 thru 8.
f. Recalculate error and assure the remaining error is 0 ±0.5 degrees.

Compensation Adjustments.

a. If the corrected error as calculated in index error alignment paragraph step a is greater than ±2° the compensators must be adjusted. The index corrected errors are used to calculate the required amount of degrees of compensation required for the remote compass. The errors obtained in the compass alignment procedure step j, 1 thru 8 for the standby compass will be used to determine the required amount and degree of compensation for the standby compass.

Compensation Calculations.

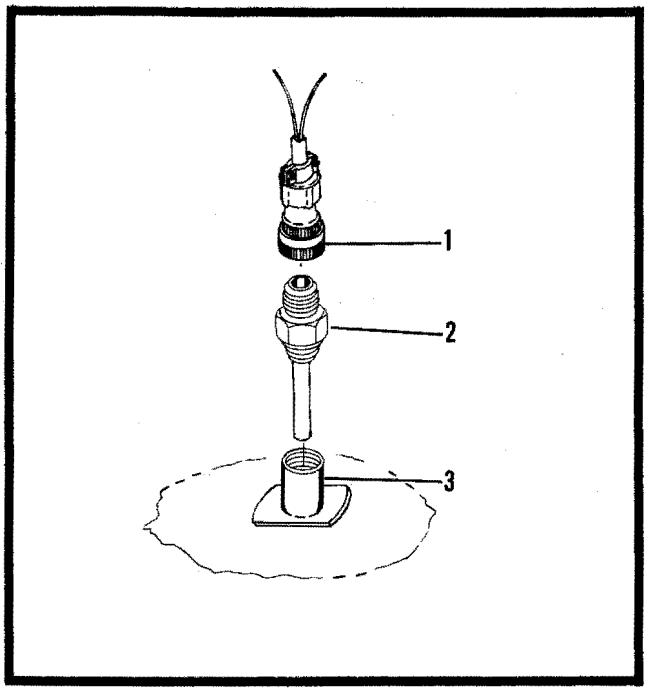
a. Using cardinal heading errors calculated in index error alignment step e for remote compass system and compass alignment procedure for the standby compass, algebraically sum the north and south errors, divide this sum by two and change the sign of the result. The resulting number is the amount and direction of north/south compensator adjustment.
b. Repeat step a for east/west errors.

Compass Compensation.

a. At one cardinal heading, adjust the appropriate compensator the amount calculated in the compensation calculations paragraph step a.
b. Rotate the aircraft 90° and adjust the appropriate compensator the amount calculated.
c. Rotate the aircraft to the next two cardinal headings and insure that no errors greater than two degrees for slaved gyro systems or five degrees for the standby compass are present.
d. With normal aircraft power, all electrical systems on, rotate the aircraft to 30° headings (including cardinals). Stop on each heading long enough to allow the gyros to stabilize and the slave meter to null.
e. Observe and record the headings indicated by the slaved gyro system.
f. Record the headings indicated by the standby compass at the 30° positions.
g. No error greater than ±5° shall be indicated by the standby compass.

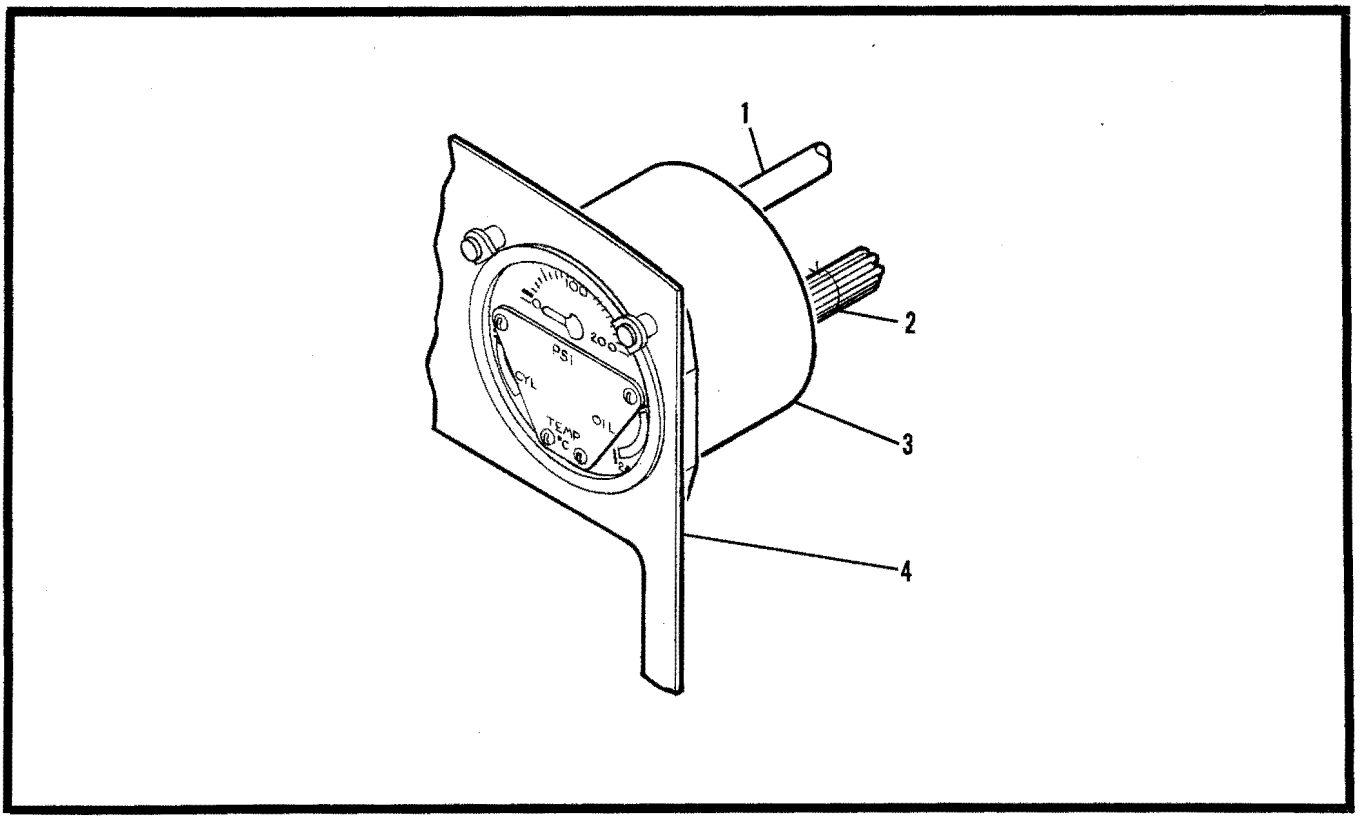
Typical Bulb Removal and Installation. (See figure 12-4.)

a. Tag and disconnect electrical connector (1).
b. Remove bulb (2).
c. Install bulb by reversing removal procedures.



1. Electrical Connector 2. Bulb 3. Flange

Figure 12-4. Indicator Bulb



1. Oil Pressure Line 2. Wire Bundle 3. Gage 4. Instrument Panel

Figure 12-5. Engine Combination Gage

Troubleshooting Instruments.

TROUBLE	PROBABLE CAUSE	CORRECTION
	VACUUM SYSTEM INSTRUMENTS	
BOTH VACUUM INSTRUMENTS MALFUNCTIONING	Dirty filter element. Restricted airflow or improper adjustment.	Clean and replace filter. Adjust vacuum relief valve.
ONE VACUUM INSTRUMENT MALFUNCTIONING, OTHER VACUUM INSTRUMENT OPERATING NORMAL	Defective instrument.	Replace instrument.
DIRECTIONAL GYRO PRECESSES AND/OR SPINS	Insufficient suction.	Repair or replace vacuum pump and/or check system.
	Filter element dirty.	Replace filter element.
	Excessive vibration of instrument panel.	Replace instrument panel shock mounts.
	Operation limits exceeded.	Replace or overhaul directional gyro.
GYRO HORIZON WILL NOT ERECT, TUMBLES, AND IS SLUGGISH IN OPERATION	Insufficient suction.	Repair or replace vacuum pump and/or check system.
	Filter element dirty.	Replace filter element.
	Excessive vibration of instrument panel.	Replace instrument panel shock mounts.
	Operational limits exceeded.	Replace or overhaul gyro horizon.
	SENSITIVE ALTIMETER	
INDICATING POINTERS FAIL TO RESPOND	Static line obstructed.	Disconnect static line from all instruments and altitude hold on autopilot computer, and blow out line with dry compressed air.
EXCESSIVE POINTER VIBRATION	Excessive vibration of static line or hose.	Secure to aircraft structure or components.
ERRONEOUS INDICATIONS	Water or foreign matter in static line.	Disconnect static line from all instruments and altitude hold on autopilot computer, and blow out line with dry compressed air.
	Loose static line connection.	Test and repair in accordance with testing static pressure line.
	Defective instrument.	Replace instrument.
	AIRSPEED INDICATOR	
POINTER FAILS TO RESPOND	Clogged pitot line.	Disconnect tube from instru-

TROUBLE	PROBABLE CAUSE	CORRECTION
POINTER FAILS TO RESPOND (CONT)	Clogged pitot line.	ment and blow out line with dry compressed air.
ERRONEOUS INDICATIONS	Water or restriction in pitot and/or static line.	Disconnect tube from all pitot static system instruments and altitude hold on autopilot computer and blow out line with dry compressed air.
	Leak in pitot and/or static line.	Test and repair in accordance with testing of pitot pressure line.
	Pitot and/or static line improperly connected.	Connect lines as illustrated in figure 12-8.
	VERTICAL SPEED INDICATOR	
POINTER FAILS TO RESPOND	Water or restriction in static line.	Disconnect static line from all pitot static system instruments and altitude hold on autopilot computer and blow out with dry compressed air.
	Defective instrument.	Replace instrument.
	TURN-AND-BANK INDICATOR	
	NOTE To operate any of the electrical instruments, the battery switch must be in the ON position.	
BALL OFF CENTER	Incorrectly mounted.	Mount correctly.
	Defective instrument.	Replace instrument
TURN INDICATED	Open circuit.	Reset circuit breaker. Check and repair circuit.
	Defective instrument.	Replace instrument.
	DUAL TACHOMETER	
ERRONEOUS INDICATION OR INDICATOR INOPERATIVE	Defective circuit.	Check and repair circuit.
	Defective instrument.	Replace instrument.
	Defective tachometer generator.	Replace tachometer generator.
	DUAL FUEL QUANTITY INDICATOR	
310P0001 TO 310Q0001 NO INDICATION	Sunken float.	Replace float.
	Open circuit.	Reset circuit breaker. Check and repair circuit.
	Defective fuel quantity sending unit.	Replace fuel quantity sending unit.
	Defective indicator.	Replace indicator.
310P0001 TO 310Q0001 ERRONEOUS INDICATOR	Damaged float.	Replace float.

TROUBLE	PROBABLE CAUSE	CORRECTION
310P0001 TO 310Q0001 ERRONEOUS INDICATOR (CONT.)	Defective circuit.	Check and repair circuit.
	Malfunctioning fuel quantity sending unit.	Check in accordance with Section 11. Replace if necessary.
	Defective indicator.	Replace indicator.
310Q0001 AND ON NO INDICATION	Open circuit.	Reset circuit breaker. Check and repair circuit.
	Defective tank unit.	Replace tank unit.
	Defective signal conditioner.	Replace signal conditioner.
310Q0001 AND ON ERRONEOUS INDICATOR	Defective circuit.	Check and repair circuit.
	Malfunctioning tank unit.	Replace tank unit.
	Defective indicator.	Replace indicator.
	System needs calibrating.	Calibrate in accordance with Calibration Procedures.
	O.A.T. INDICATOR	
POINTER FAILS TO RESPOND	Open circuit.	Reset circuit breaker. Check and repair circuit.
ERRONEOUS INDICATION	Defective circuit.	Check and repair circuit.
	Defective air temperature bulb.	Replace air temperature bulb.
	Defective indicator.	Replace indicator.
	STALL WARNING INDICATOR	
HORN FAILS TO OPERATE	Open circuit.	Reset circuit breaker. Check and repair circuit.
	Defective transmitter.	Replace transmitter.
	Defective horn.	Replace horn.
	COMBINATION GAGES	
NO INDICATION ON OIL TEMPERATURE GAGE	Open circuit.	Reset circuit breaker. Check and repair circuit.
	Defective oil temperature bulb.	Replace oil temperature bulb.
	Defective instrument.	Replace instrument.
ERRONEOUS INDICATION OF CYLINDER TEMPERATURE GAGE	Defective circuit.	Check and repair circuit.
	Defective cylinder head temperature bulb.	Replace cylinder head temperature bulb.
	Defective instrument.	Replace instrument.
ERRONEOUS OIL PRESSURE INDICATION	Defective instrument.	Replace instrument.
	Broken or restricted oil pressure line.	Repair or replace oil pressure line.

TROUBLE	PROBABLE CAUSE	CORRECTION
ERRONEOUS OIL PRESSURE INDICATION (CONT)	Defective oil pressure relief valve.	Repair or replace relief valve.
	MANIFOLD PRESSURE GAGE	
SLUGGISH POINTER OPERATION	Damaged or restricted lines.	Remove line from instrument and blow out restriction. Replace line or hoses as necessary.
	Defective instrument.	Replace instrument.
	MAGNETIC COMPASS	
EXCESSIVE COMPASS ERROR	Improper compensation.	Compensate the compass.
	External magnetic interference.	Locate the interference and eliminate if possible.
FAILURE TO RESPOND TO COMPENSATION	Compensating magnets demagnetized.	Replace instrument.
	FUEL FLOW GAGE	
ERRONEOUS FUEL PRESSURE INDICATION	Clogged or restricted fuel lines.	Clean fuel lines and fuel strainer.
	Broken or restricted fuel flow lines.	Replace fuel flow lines.
	Defective fuel pump.	Replace fuel pump.
	Defective instrument.	Replace instrument.
	AMMETER	
NO INDICATION ON AMMETER	Defective ammeter.	Check/replace ammeter.
	Defective ammeter leads.	Check/repair or replace.
	PROPELLER DEICE AMMETER	
NO INDICATION ON AMMETER	Defective ammeter.	Check/replace ammeter.
	Defective ammeter leads.	Check/repair or replace.

INSTRUMENT PANELS.

Removal of Shock-Mounted Instrument Panels. (See figure 12-1.)

a. Disconnect tubing and lines to instruments and tag.

NOTE

Most hose fittings are more accessible if disconnected from the forward bulkhead.

b. Remove nuts from shock mounts and pull shock-mounted panel away from stationary panel enough to disconnect electrical leads from terminal block. Tag all electrical leads.

c. Plug hoses and cap all fittings to prevent entry of foreign matter.

d. Remove shock-mounted panel from aircraft.

Installation of Shock-Mounted Instrument Panel. (See figure 12-1.)

CAUTION

Clean bonding area between stationary and instrument panel before installing instrument panel.

a. Inspect rubber shock mounts and bonding straps for deterioration and cracks. If either is damaged, replace before installing instrument panel.

NOTE

On aircraft 310Q0401 and On, the instrument panel is mounted on spacers instead of shock mounts.

b. Secure shock mounted panel in place on mounts.

c. Remove plugs and caps in all lines and fittings.

d. Connect electrical leads to instruments and ter-

minal strip. Remove tags.
e. Connect all hoses and lines to instruments.
f. Secure shock panel to support angle with screws and tighten nuts on shock mounts.

VACUUM SYSTEM.

A dry vacuum pump, which requires no lubrication of any kind, is located on the aft right accessory mount pad of each engine. The pump outlets are exhausted into the engine nacelle. The vacuum line plumbing is routed from the vacuum pumps through the nacelles and wings to the relief valves. The adjustable relief valves are provided to give the desired vacuum system pressure. From the relief valve, the lines are routed to the vacuum manifold located on the left side of the forward cabin bulkhead. The manifold has check valves included to prevent reverse flow, in the event of failure of either vacuum pump. Hoses are routed from the manifold to the directional gyro, horizontal gyro, and suction gage. Other hoses connect the gyros to the vacuum air filter and suction gage. The suction gage indicates the amount of vacuum present in the system; also provided are inoperation indicator buttons for each pump. The vacuum air filter is provided to remove dust particles and vapor from the air, providing dry, clean air for the instruments.

NOTE

All flexible and fixed line fittings, clamps, relief valves, and filters must be cleaned and suitably protected by caps or bags until installed in aircraft. The vacuum system shall not be open while awaiting the remaining parts to be installed. Prior to running of the vacuum pumps, the lines shall be flushed with air to approximately seven cubic feet per minute while alternately closing off the ends of the lines. This will create pressure pulses to dislodge and eject foreign matter.

Troubleshooting the Vacuum System.

TROUBLE	PROBABLE CAUSE	CORRECTION
NO SUCTION INDICATED AT ONE SOURCE	Defective vacuum pump.	Check suction at pump. Replace pump.
	Disconnected, broken or plugged lines or hoses.	Check suction through lines and hoses. Clean or replace lines and hoses.
	Defective relief valve.	Check suction to and from relief valve. Replace relief valve.
	Defective suction gage.	Check suction at applicable line to test indicator buttons. Replace suction gage.
NO SUCTION INDICATED, BUT GYROS OPERATE NORMALLY	Defective suction gage.	Check suction to gage. Replace gage.
LOW SUCTION	Defective vacuum pump.	Check suction at pump. Replace pump.
	Leaking or restricted lines or hoses.	Clean or replace lines and hoses. Check suction through lines and hoses.
	Defective or improperly adjusted relief valves.	Check suction to relief valves. Adjust relief valve in accordance with adjusting procedures. Replace if defective.
	Defective check valves.	Check operation of check valves. Replace manifold assembly.
HIGH SUCTION	Relief valve air filters dirty.	Check operation with filters removed. Clean or replace filters.
	Defective or improperly adjusted relief valves.	Check suction to relief valves. Adjust relief valves in accordance with adjusting procedures. Replace if defective.

TROUBLE	PROBABLE CAUSE	CORRECTION
SUCTION GAGE FLUCTUATES	Excessive vibration.	Visually check for panel, gage, or plumbing vibration. Determine cause of vibration and correct.
	Defective suction gage.	Check for fluctuating suction to gage. Replace gage.

Removal of Vacuum Pump. (See figure 12-6.)

a. Remove upper nacelle cowls.
b. Loosen the two hose clamps securing hose between line assembly (15) and vacuum pump (16).
c. Remove vacuum pump (16) by removing four attaching nuts and washers.

NOTE

Do not clean vacuum pump (16) in solvent. Clean by wiping with a clean cloth.

Installation of Vacuum Pump. (See figure 12-6.)

NOTE

If a new vacuum pump is being installed, remove the serviceable fittings from the old pump and install the fittings on the new pump. Use no oil of any sort, no thread lubricant of any description on any fitting used on the inlet side of the vacuum pumps.

a. Align splines on the vacuum pump drive with splines on the engine drive and slide vacuum pump into position so the ports are facing to the right.
b. Secure vacuum pump (16) to the engine with four washers and nuts.
c. Slide coupling hose (17) over line assembly (15) and secure with clamp.
d. Slide coupling hose over fitting onto "in" port on vacuum pump (16) and secure with clamp.
e. Install upper nacelle cowl.

Removal and Installation of Vacuum Air Filter. (See figure 12-6.)

a. Disconnect filter hoses (9 and 10) from filter (11).
b. Remove vacuum air filter (11) from forward cabin bulkhead, left hand side, by removing attaching bolts and washers.
c. Install vacuum air filter (11) by reversing procedures as outlined in steps "a" and "b" above.

Replacement of Vacuum Air Filter Element. (See figure 12-6.)

NOTE

It is not required to remove air filter to replace the element.

a. Remove wing nut from bottom of vacuum air filter assembly (11).
b. Remove vacuum air filter element.
c. Install new vacuum air filter element.
d. Fasten element in place using wing nut.

Removal and Installation of Vacuum Relief Valve. (See figure 12-6.)

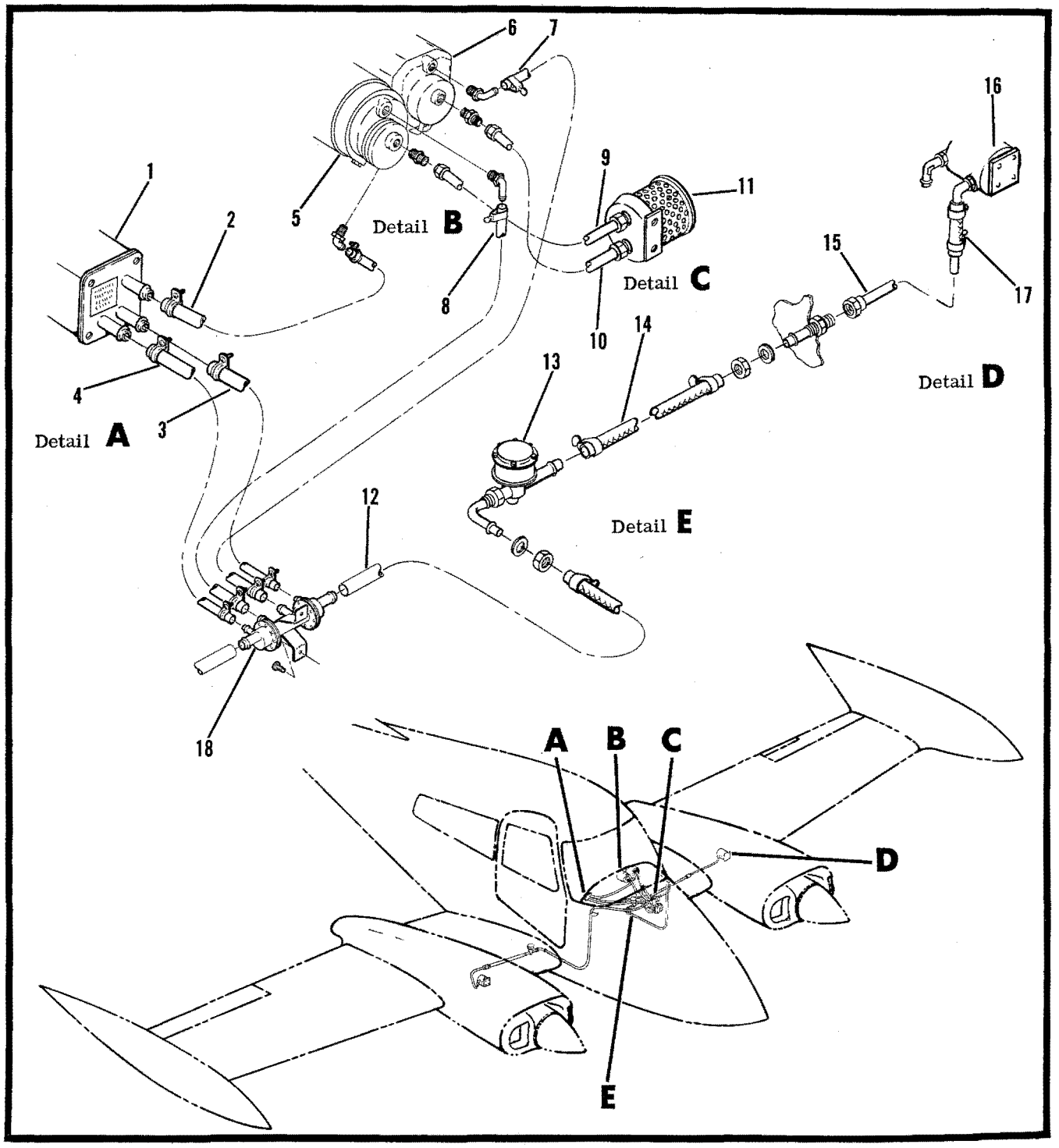
a. Remove wing root fillets by removing attaching screws.
b. Refer to Section 3, remove the following items:
1. Front seats.
2. Front carpet.
3. Lower center upholstery panel.
c. Remove clamps attaching hoses (12) and (14) to relief valve (13).
d. Remove relief valve (13) from fuselage skin by removing attaching washer and nut.
e. Install vacuum relief valve (13) by reversing procedures as outlined in steps "a" thru "d" above.

Adjustment of Vacuum Relief Valve.

NOTE

Since a relief valve is used for each vacuum source, each relief valve must be adjusted separately.

a. Remove wing fairings by removing attaching screws.
b. Start the engines and idle the right engine.
c. With left engine operating and tachometer reading 1700 RPM, the suction gage should read 5.00 inches of mercury.
d. Adjust the left relief valve by loosening the knurled screw locknut and adjusting to obtain the desired vacuum reading, clockwise rotation of the adjusting screw increases the vacuum.
e. Idle the left engine and operate the right engine so tachometer reads 1700 RPM.
f. Adjust the right relief valve by loosening the knurled screw locknut and adjusting to obtain the 5.00 vacuum reading. Clockwise rotation of the adjusting screw increases the vacuum.
g. With both engines operating at tachometer RPM of 1700, the suction gage should read 5.00 ±0.25 inches of mercury. If the gage reading is not within these limits, the relief valves should be readjusted to these limits.
h. Shutdown both engines and check that the locknuts on the knurled adjusting screw are tight.
i. Install wing fairings.



1. Suction Gage
2. Suction Gage to Horizontal Gyro Hose
3. Suction Gage to LH Manifold Hose
4. Suction Gage to RH Manifold Hose
5. Horizontal Gyro
6. Directional Gyro
7. Directional Gyro to Manifold Hose
8. Horizontal Gyro to Manifold Hose
9. Filter to Horizontal Gyro Hose
10. Filter to Directional Gyro Hose
11. Vacuum Air Filter Assembly
12. Manifold to Regulator Valve Hose
13. Relief Valve
14. Regulator Valve to Engine Nacelle Hose
15. Engine Nacelle Line Assembly
16. Vacuum Pump
17. Coupling Hose
18. Manifold

Figure 12-6. Vacuum System Installation

Removal of Vacuum System Plumbing. (See figure 12-6.)

NOTE

Removal procedures will be given for left engine installation only. Removal of right engine installation is basically the same.

a. Refer to Section 9 and remove engine nacelle cowls.
b. Refer to Section 3 and remove the following items:
1. Front and rear seats; or middle seats (optional equipment).
2. Center carpet.
3. Lower center upholstery panel.
c. Disconnect engine nacelle line assembly (15) from vacuum pump (16) by removing clamps and coupling hose (17).
d. Disconnect line assembly (15) from bulkhead fitting and remove line from engine nacelle.
e. Remove three wing access covers from underside of wing.
f. Loosen clamps on hose (14) at relief valve (13) and bulkhead fitting on engine nacelle. Route hose (14) from wing using outboard access openings.
g. Loosen clamps and disconnect hose (12) from relief valve (13) and manifold (18) and remove hose from fuselage.
h. Loosen clamps and disconnect hoses (3, 4, 7 and 8) from manifold (18).
i. Loosen clamps and disconnect hoses (3 and 4) from vacuum gage and hoses (7 and 8) from directional gyro (6) and horizontal gyro (5) respectively. Remove hoses from fuselage.
j. Loosen clamps on hose (2) and disconnect from vacuum gage and directional gyro. Remove hose from fuselage.
k. Disconnect hose assemblies (9 and 10) from air filter (11), directional gyro (6) and horizontal gyro (5). Remove hose assemblies from aircraft.

Installation of Vacuum System Plumbing. (See figure 12-6.)

NOTE

Use no oil of any sort, no thread lubricant of any description on any fitting used on the inlet side of the vacuum pumps.

a. Reverse the vacuum system plumbing removal procedures, except do not install access panels and upholstery until system check is completed.
b. Check vacuum system and adjust relief valves if system vacuum gage indication is not within specified limits.
c. Install access covers, upholstery, carpets, seats and engine nacelle cowling.

PITOT-STATIC SYSTEM

A pitot tube, with an electrical heating element to prevent ice from obstructing passage of ram air pressure, is mounted in the nose of the fuselage. The ram air pressure is routed from the pitot tube to the airspeed indicator through hose and line assemblies. Static pressure is routed from two static pressure flanges, mounted on opposite sides of the aft fuselage, to the airspeed indicator, altimeter, and vertical velocity indicator by a series of hoses, tees, and line assemblies. A drain line and drain valve assembly, located in forward left hand cabin area, is provided to release accumulated moisture and serve as the alternate static pressure source.

Removal of Pitot Tube. (See figure 12-8.)

a. Remove three screws attaching pitot tube (18) from mount tube (16).
b. Remove nose cap by removing attaching screws.
c. Disconnect pitot pressure line (12) from pitot tube (18).
d. Tag and disconnect pitot tube heating element wires.
e. Slide pitot tube (18) forward from mount tube (16).

Installation of Pitot Tube. (See figure 12-8.)

a. Slide pitot tube (18) into mount tube (16).

NOTE

Position pitot tube so drain hole is downward.

b. Attach pitot pressure line (12) to pitot tube (18).
c. Attach heater element wires as tagged at removal.
d. Install nose cap and attaching screws.
e. Install three screws attaching pitot tube (18) to mount tube (16).

CAUTION

The pitot heater should not be operated on the ground as it will overheat and damage the heating element.

Removal of Pitot and Static Lines. (See figure 12-8.)

The locations of all pitot and static lines are shown in figure 12-8. All lines are standard aluminum tubing except for the flexible hoses attached to the instruments. All the lines and hoses are equipped with conventional fittings and may be removed when necessary.

NOTE

Static line (3) must be cut to facilitate removal and should only be removed if replacement is necessary.

Installation of Pitot and Static Lines. (See figure 12-8.)

Install lines as illustrated in figure 12-8 using petro-

latum to lubricate all male fittings, omitting the first two threads.

NOTE

Install static line (3) through grommets. Install nut (23) and sleeve (22) on static line (3) before flaring forward end of line.

Testing the Static Pressure System. (See figure 12-8.)

a. Set altimeter to read 1500 feet by rotating pressure setting knob.

NOTE

Check to see that static drain valve is closed.

b. Seal static opening (1) on one side of fuselage with masking tape.
c. Connect a suction source to static opening (1) on opposite side of fuselage.

NOTE

If autopilot is installed, the autopilot static line must be disconnected and plugged during testing.

d. Slowly apply suction until altimeter shows a 2000 foot increase in altitude (3500 feet reading), "pinch off" tube and hold for one minute.

CAUTION

When applying or releasing suction, take care not to exceed rate range of vertical velocity indicator.

e. The leak down rate should not exceed 100 feet of altitude in one minute (3400 feet reading).
f. If leak down rate exceeds 100 feet per minute, slowly remove suction source and proceed as follows:
g. Disconnect static lines from altimeter, vertical velocity indicator and airspeed indicator. Plug static lines and attach a source of pressure to static opening (2).

CAUTION

Do not apply positive pressure to static lines with instruments connected. Be sure that the altitude hold on autopilot computer is disconnected.

h. Apply a slight pressure and coat lines with a mild solution of soap and water to locate leak.
i. Tighten or repair faulty connections or replace damaged lines. Remove line plugs and pressure source and reconnect hoses to respective units.
j. Repeat steps "c" through "e" to be sure instruments are connected correctly and do not leak.
k. If scale drop of altimeter pointer is less than 100 feet in one minute, leak is negligible. Slowly remove static suction source.
l. Remove masking tape from static opening (2).

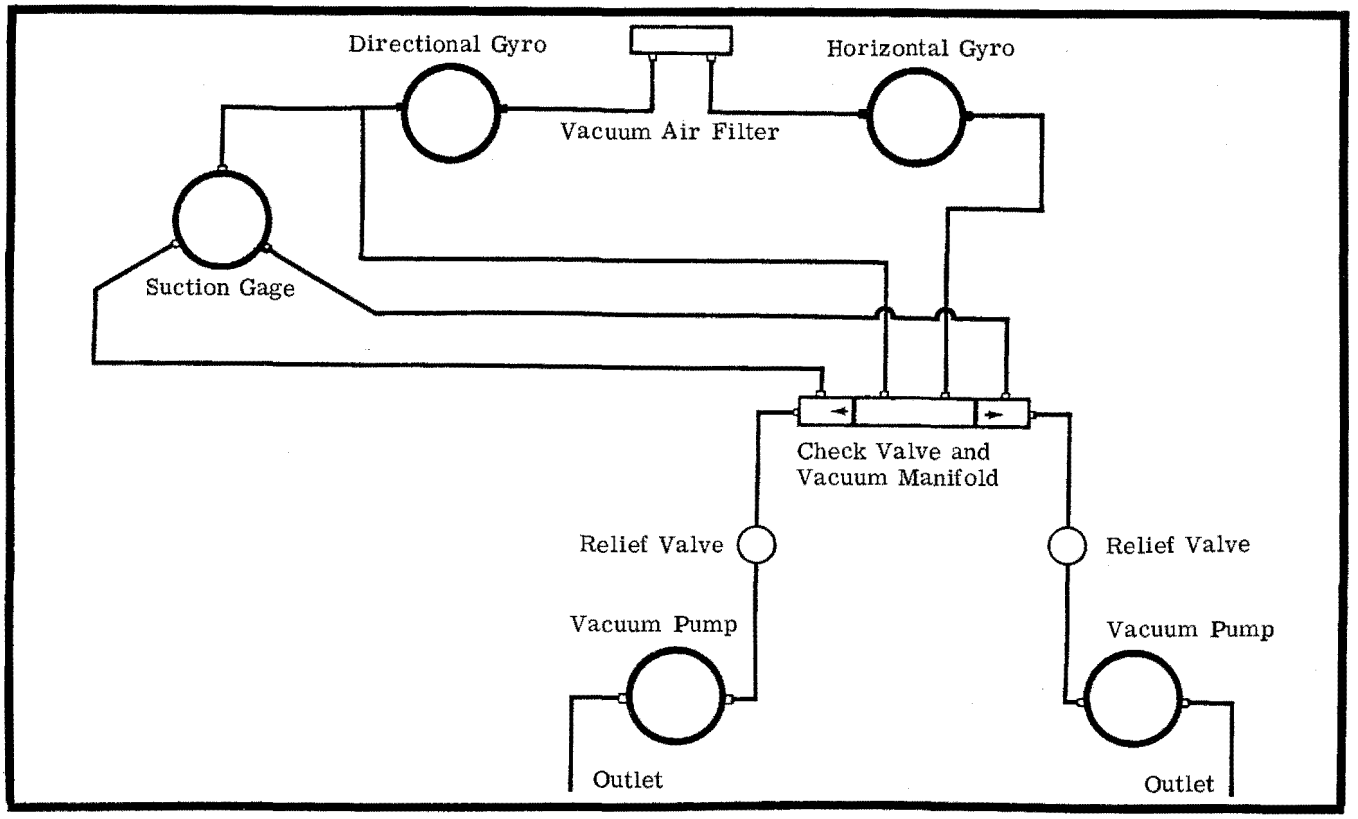
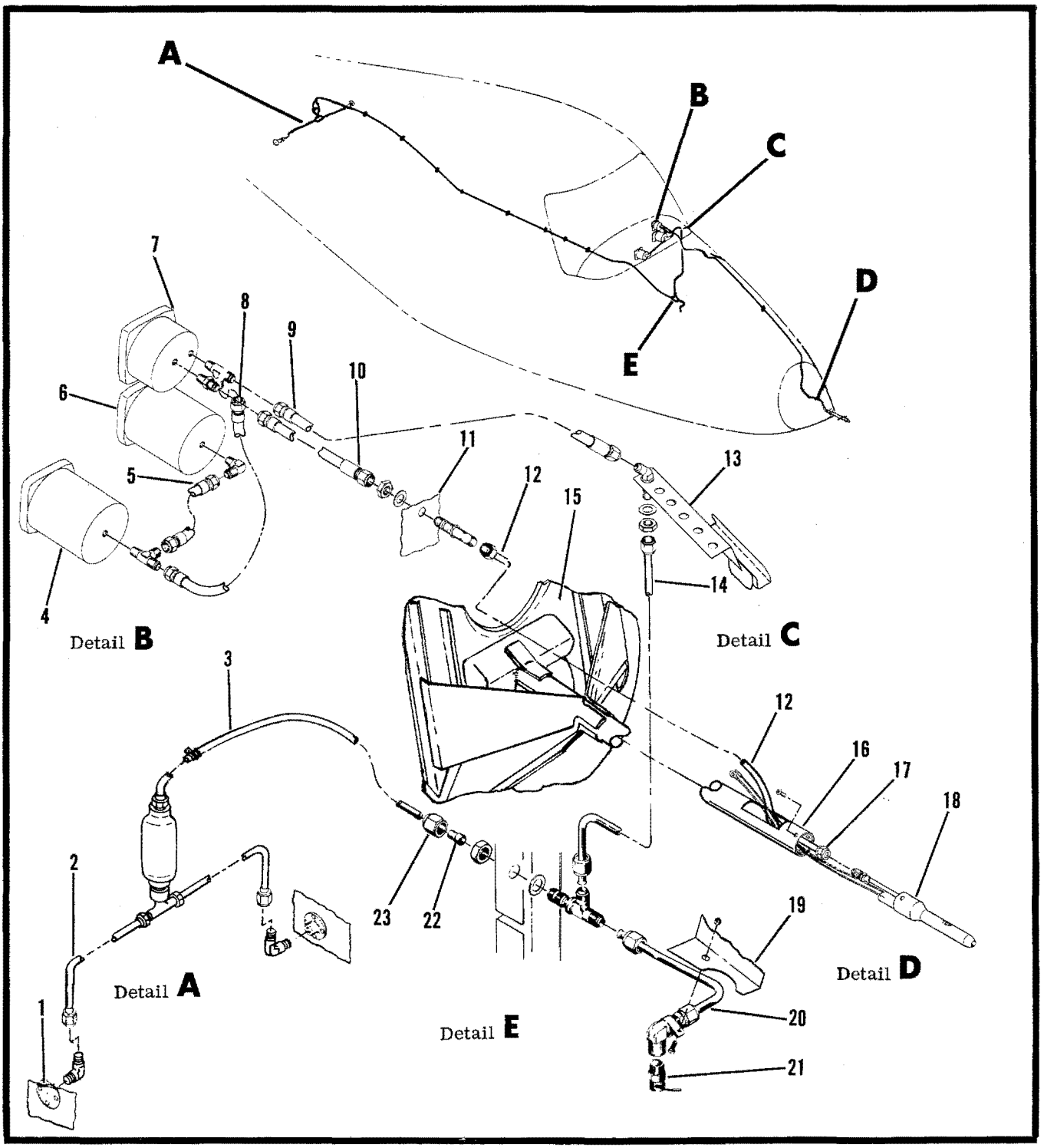


Figure 12-7. Vacuum System Schematic



1. Static Opening
2. Static Crossover Line
3. Static Line
4. Vertical Velocity Indicator
5. Hose (Vertical Velocity to Altimeter)
6. Altimeter
7. Airspeed Indicator
8. Hose (Vertical Velocity to Airspeed)
9. Hose (Airspeed to Bracket)
10. Hose (Airspeed to Bulkhead)
11. Forward Cabin Bulkhead
12. Pitot Pressure Line
13. Tube Support Bracket
14. Forward Static Line
15. Nose Bulkhead
16. Mount Tube
17. Pitot Extension Line
18. Pitot Tube
19. Parking Brake Bracket
20. Static Drain Line
21. Drain Valve
22. Sleeve
23. Nut

Figure 12-8. Pitot-Static System Installation

Testing the Pitot Pressure Lines. (See figure 12-8.)

The pitot pressure line, which carries impact pressure to the airspeed indicator, is tested as follows:

a. Connect a pressure source to opening in pitot tube assembly (18).
b. Apply pressure slowly until airspeed indicator reads 150 MPH. Shut off pressure, seal opening, and wait one minute.

CAUTION

The amount of pressure required for a 150 MPH indication is less than 1/2 psi. Avoid high pressures as instrument damage will result.

c. If airspeed indicator drops more than 10 MPH in one minute, disconnect hose from airspeed indicator.
d. Plug hose and apply pressure.
e. Coat lines and connections with a solution of soap and water to locate leak.
f. Tighten or repair faulty connections. Connect hose to instrument and repeat step "b" to be certain connections and lines do not leak.

CAUTION

Do not apply suction to pitot pressure line.

Purging Pitot or Static Lines.

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

CAUTION

Never blow through the pitot or static lines toward the instruments. Doing so may damage them.

Like the pitot lines, the static pressure lines must be kept clear and the connections tight. The system has static source sumps that collect moisture and keep the system clear. However, when necessary, purge the system as follows:

a. Disconnect static line to instruments from the static line drain valve tee.
b. Cap or plug open end of tee.
c. Open static source drain valve.
d. Plug one static port.
e. Purge the system from the drain valve with clean moisture free air for a period of at least two minutes.

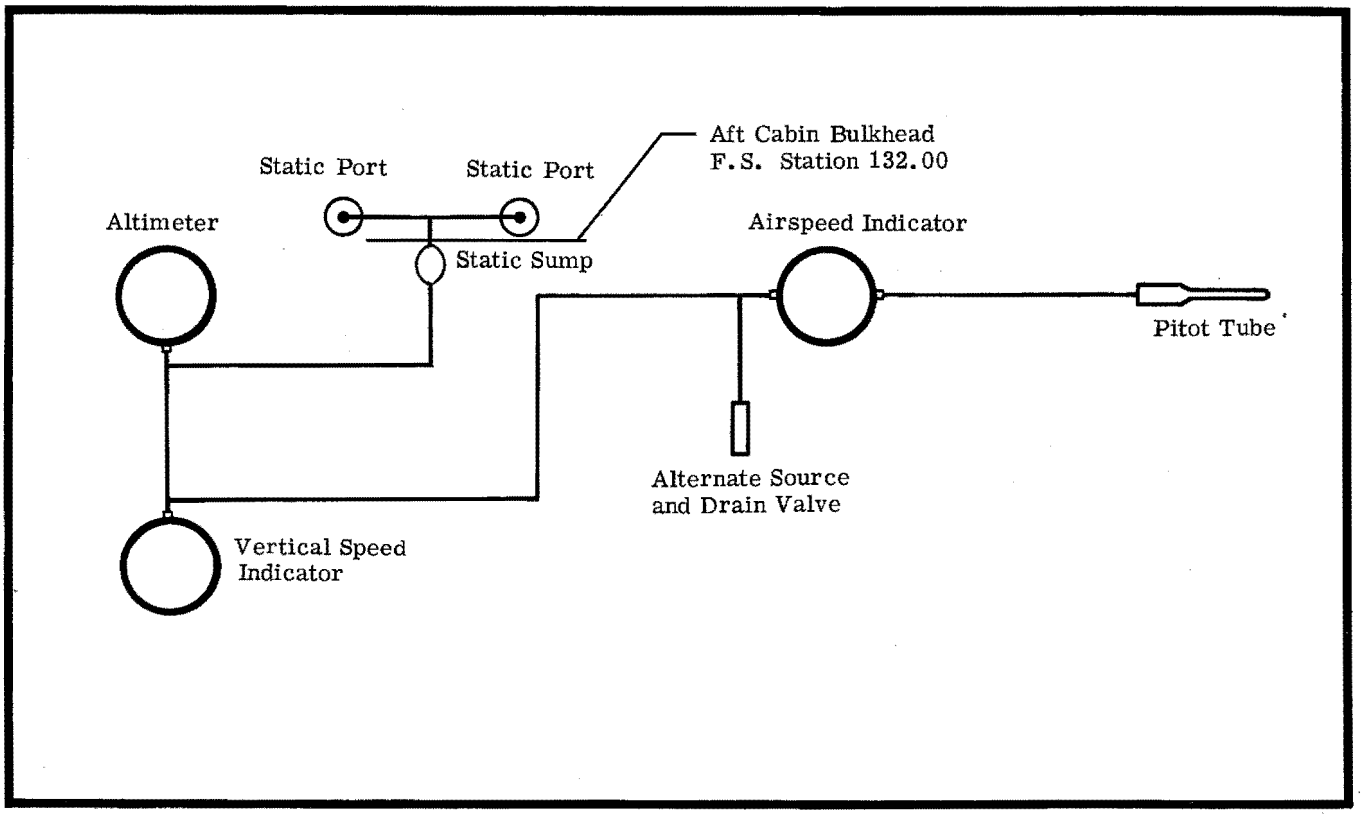
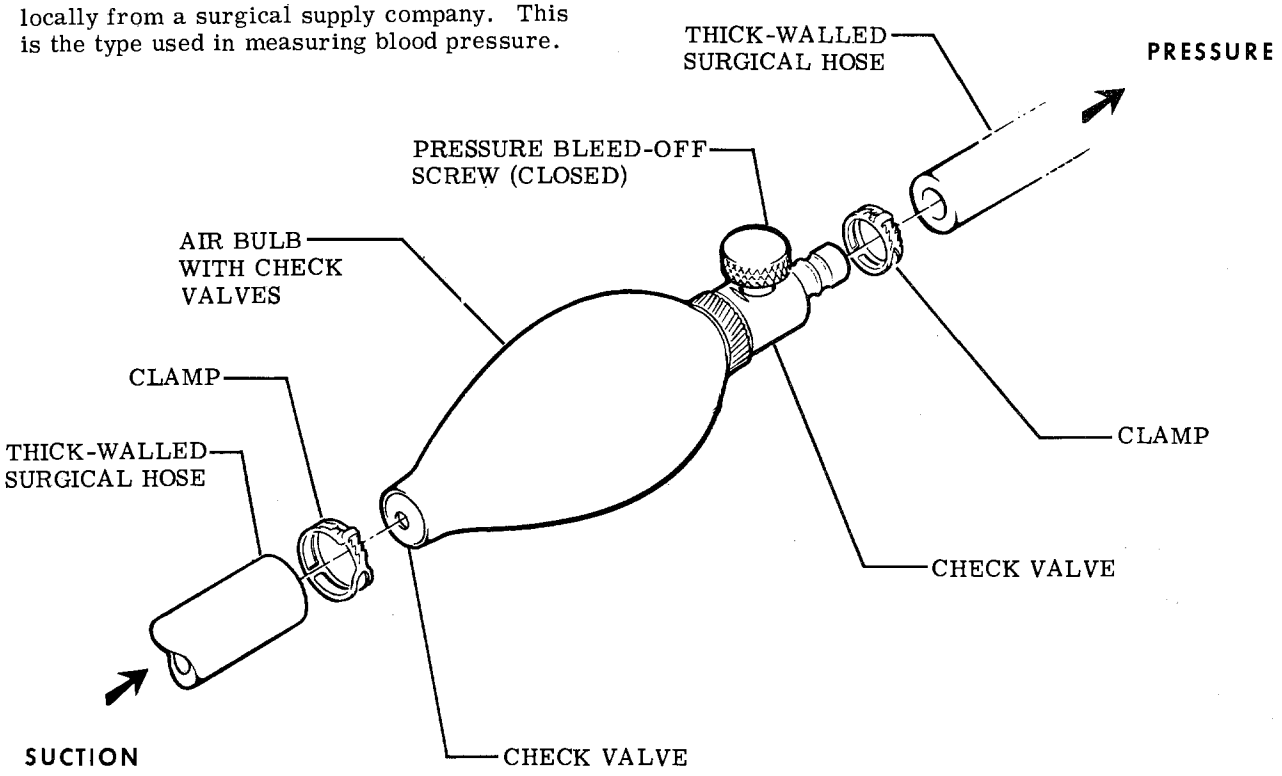


Figure 12-9. Pitot Static System Schematic

NOTE

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



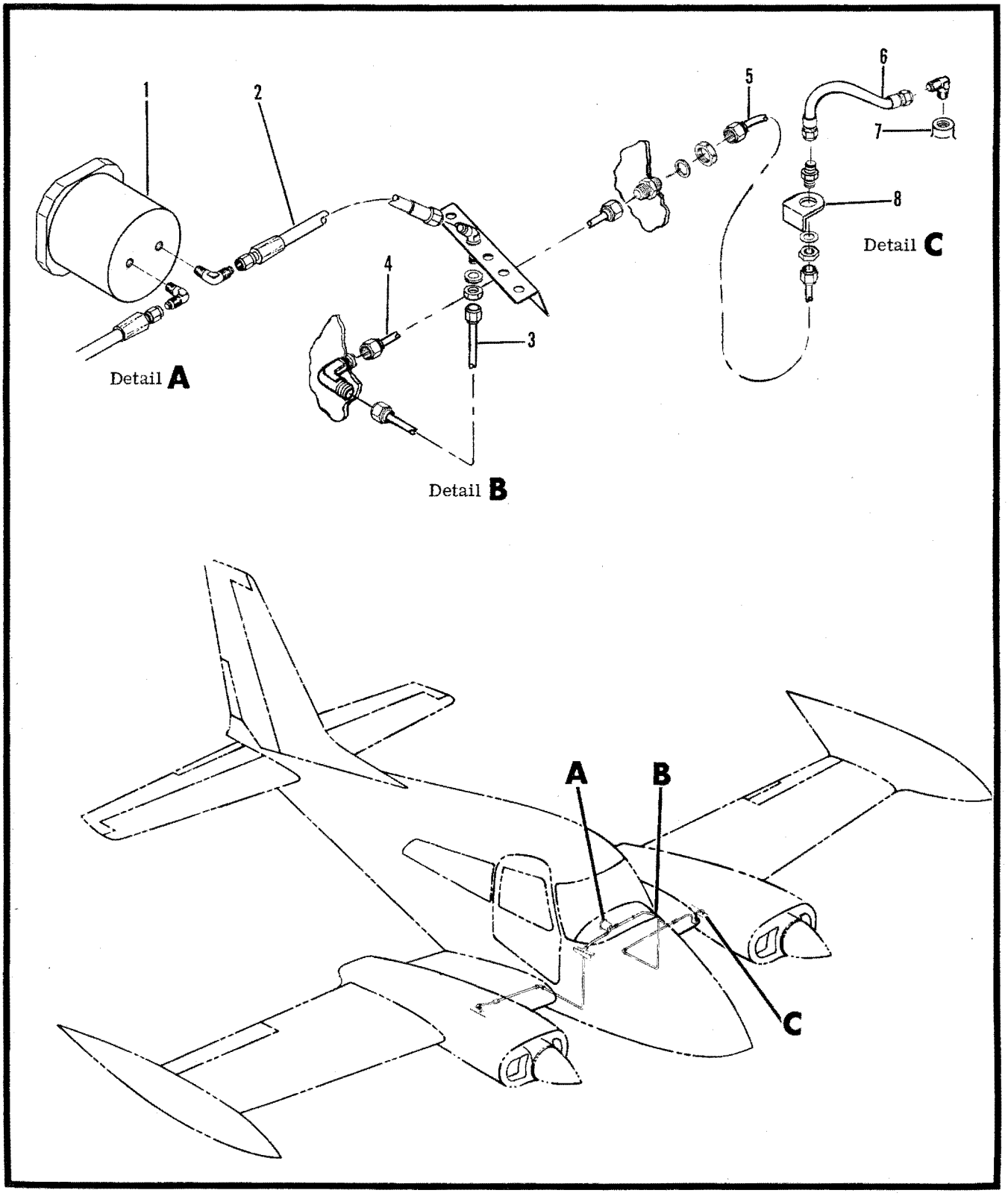
TO APPLY SUCTION:

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. Continue to admit this small amount of air intermittently until all suction is released, then remove test equipment.

TO APPLY PRESSURE:

1. Connect pressure hose to pitot tube.
2. Slowly squeeze air bulb to apply desired pressure to pitot 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 12-10. Static System Test Equipment



1. Manifold Pressure Gage
2. Hose Assembly (Gage to Bracket)
3. Line Assembly (Bracket to Fuselage Skin)
4. Line Assembly (Fuselage Skin to Nacelle Rib)
5. Line Assembly (Nacelle Rib to Bracket)
6. Hose Assembly (Bracket to Manifold)
7. Intake Manifold
8. Bracket

Figure 12-11. Manifold Pressure System Installation

f. Plug opposite static port and repeat step e.
g. Remove cap or plug from static line drain valve tee.
h. Connect static line to instruments to the static line drain valve tee.
i. Leak check static system in accordance with testing procedures.

MANIFOLD PRESSURE SYSTEM.

The manifold pressure system consists of a dual manifold pressure gage mounted in the instrument panel. The manifold pressure lines are routed from the intake manifold of each engine to separate connections at the back of the gage. The gage is calibrated in inches of mercury, it indicates the absolute pressure in the intake manifold of each engine.

Removal of Manifold Pressure Lines. (See figure 12-11.)

a. Refer to Section 9 and remove engine cowls.
b. Refer to Section 3 and remove the following items:
1. Front seats.
2. Front carpet.
3. Lower center upholstery panel.
c. Disconnect hose assembly (2) from manifold gage (1) and bracket.
d. Disconnect line assembly (3) from bracket and elbow at fuselage skin.
e. Disconnect line assembly (4) from elbow at fuselage skin and union at nacelle root rib. Route line assembly from wing.

NOTE

It may be necessary to bend the line slightly to facilitate removal, however, excessive bending should be avoided to prevent possible damage to line.

f. Disconnect line assembly (5) from unions on nacelle root rib and bracket (8) and remove line assembly from engine compartment.
g. Disconnect hose assembly (6) from union on bracket (8) and intake manifold (7).

NOTE

Apply a small amount of suitable thread lubricant to male threads of all fittings before installation. Slight bending of the manifold pressure lines may be required to facilitate installation, however, excessive bending should be avoided.

Installation of Manifold Pressure Lines. (See figure 12-11.)

a. Install manifold pressure lines by reversing removal procedures.