# SECTION 11-C
# AIR CONDITIONER

## CONTENTS OF SECTION 11-C



## 11-12 SPECIFICATIONS

### a. Tightening Specifications

| Part | Location | Torque Ft. Lbs. |
|---|---|---|
| Nut | Drive Plate Nut to Compressor Shaft | 14-16 |
| Nut | Compressor Rear head to Shell | 19-23 |
| Cap | Schrader Service Valve | 4-5 |

For Compressor mounting bracket bolts see Figure 11-73.

| Metal Tube Outside Diameter | Thread and Fitting Size | Steel Tubing Torque Lb.-Ft. | Aluminum or Copper Tubing Torque Lb.-Ft. | Nominal Torque Wrench Span |
|---|---|---|---|---|
| 1/4 | 7/16 | 10-15 | 5-7 | 5/8 |
| 3/8 | 5/8 | 30-35 | 11-13 | 3/4 |
| 1/2 | 3/4 | 30-35 | 11-13 | 7/8 |
| 5/8 | 7/8 | 30-35 | 18-21 | 1 1/16 |
| 3/4 | 1 1/16 | 30-35 | 23-28 | 1 1/4 |

If a connection is made with steel to aluminum or copper, use torques for aluminum. In other words, use the lower torque specification.

Use steel torques only when both ends of connection are steel.

Figure 11-32—Pipe and Hose Connection Torque Chart

### b. Compressor Specifications

| | |
|---|---|
| Type | Six Cylinder Axial |
| Make | Frigidaire |
| Displacement - (cu. in.) | 12.6 |
| Oil | Frigidaire 525 viscosity |
| Oil Content (New) | 10-1/2 oz. Fluid |
| Internal clearances | See Figure 11-46. |
| Air Gap between Clutch Drive Plate and Pulley | .022" to .057" |
| Clutch Type | Magnetic |
| Belt Tension | See Figure 11-74. |

**c. Miscellaneous**

| | |
|---|---|
| Refrigerant | Freon 12, Ucon 12, Genetron 12, Isotron 12 |
| System Capacity (Fully Charged) | 4-1/2 lbs. |
| Blower Motor Fuse | 30 Amp located on Fuse Block |
| Type of Temperature Control | Suction Throttle Valve |

## 11-13 DESCRIPTION AND OPERATION OF AIR CONDITIONER SYSTEM

The Air Conditioner is dash mounted with all the components located in or ahead of the dash. The compressor is mounted over the right cylinder head and is connected to the evaporator and condenser by flexible synthetic rubber hoses. The condenser is mounted forward of the radiator core and the receiver-dehydrator vertically to the right of the condenser. The evaporator is located at the extreme right end of the dash panel beneath the fender. The blower and air valve housing is on the dash panel to the rear of the right cylinder head. See Figure 11-33.

The air conditioner uses an air distribution system entirely separate from the heater and defroster, however, the same blower and valve housing is used to force air through the air conditioner ducts or the heater ducts or both systems simultaneously. Air conditioner air distribution system is shown in Figure 11-34.

A larger capacity radiator and fan to increase cooling system efficiently are included on all cars equipped with the air conditioner. Also a fan clutch is used.

All air condition equipped cars have the fuel vapor by-pass system. This consists of a special fuel filter and fuel return lines which allows a constant flow of fuel from gas tank to filter and back to tank. This reduces the possibility of vapor lock when operating in extreme hot weather.

Any service work that requires loosening a refrigerant line connection should be performed only by qualified service personnel who have attended either Buick or other automotive air conditioner training schools. Whenever a hose or pipe is disconnected from any unit, refrigerant will escape. Any work involving the handling of refrigerants require special equipment and a knowledge of its proper use.

The air conditioner uses Shrader valve fittings instead of shut-off service valves; therefore, whenever a part is removed that is in the refrigeration circuit or a line disconnected, the refrigerant must be discharged from system as described in paragraph 11-16.

**a. Description of Components**

NOTE: See paragraph 11-14 for description of compressor.

1. Hoses. The connecting elements are made from a high temperature, high pressure synthetic rubber hose with double cord reinforcements. The hose ends are fitted with "O" ring fittings. See Figure 11-35.

2. Schrader Service Valves. Three Schrader valves are used on the air conditioner system as shown in Figure 11-33. The one on the compressor discharge line is used for all service operations. The low pressure valves must be used as follows:

(a) Schrader valve located on compressor suction line at rear of compressor -- This valve is used only for evacuation and charging of air conditioner system.

(b) Schrader valve located on Suction Throttle Valve -- This valve is used only for functional testing system and adjusting Suction Throttle Valve.

3. Condenser. The condenser is similar to the ordinary car radiator but is designed to withstand much higher pressures. The condenser is mounted in front of the radiator so that it receives a high volume of air. Air passing over the condenser cools the hot high pressure refrigerant gas, causing it to condense into high pressure liquid refrigerant.

4. Receiver-Dehydrator. The receiver-dehydrator is located at the right front of engine compartment. A liquid indicator or sight glass is an integral part of the outlet pipe of the receiver-dehydrator. The sight glass serves as an aid to diagnosis. The appearance of bubbles or foam beneath the sight glass when

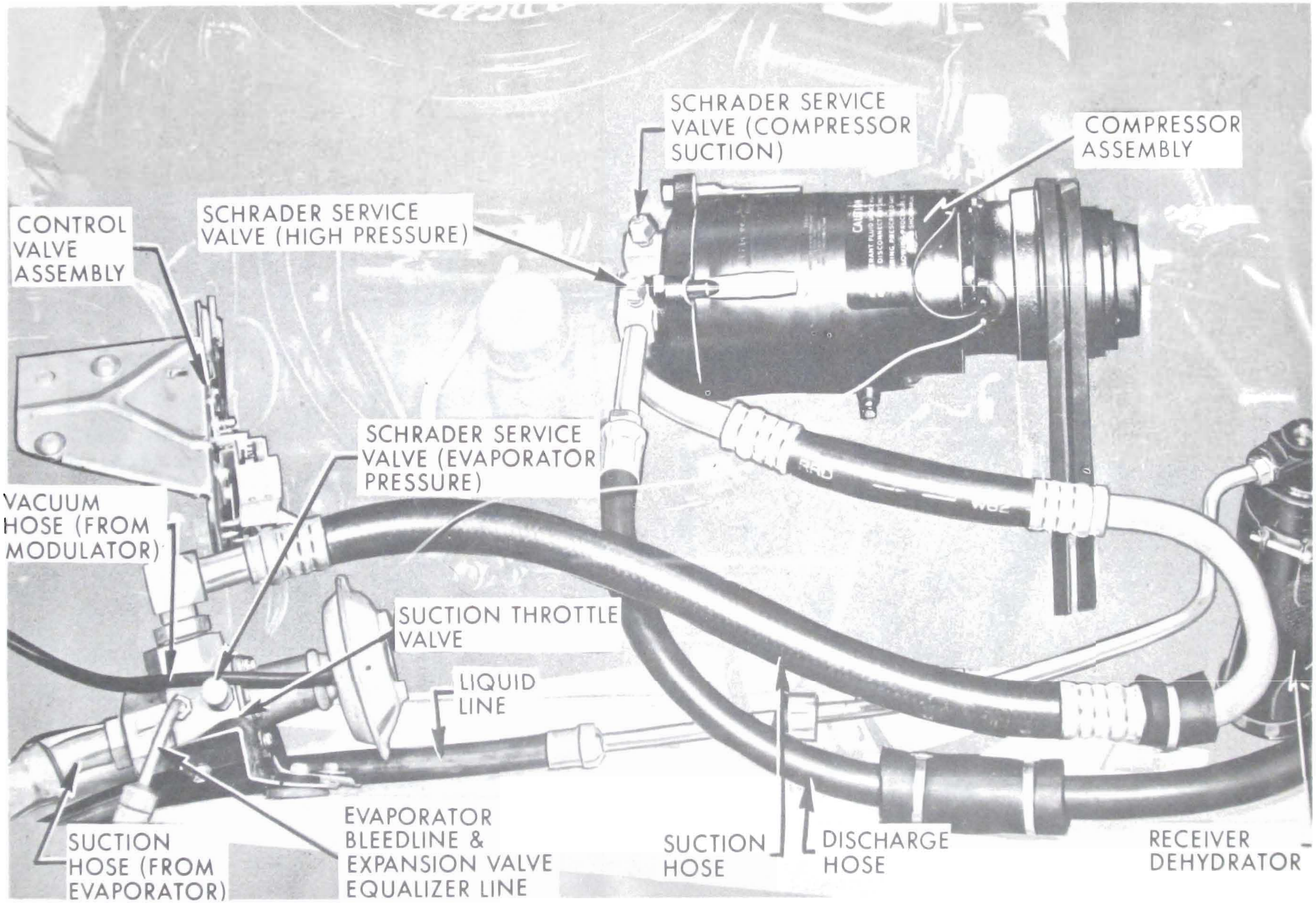


Figure 11-33—Air Conditioner Installation

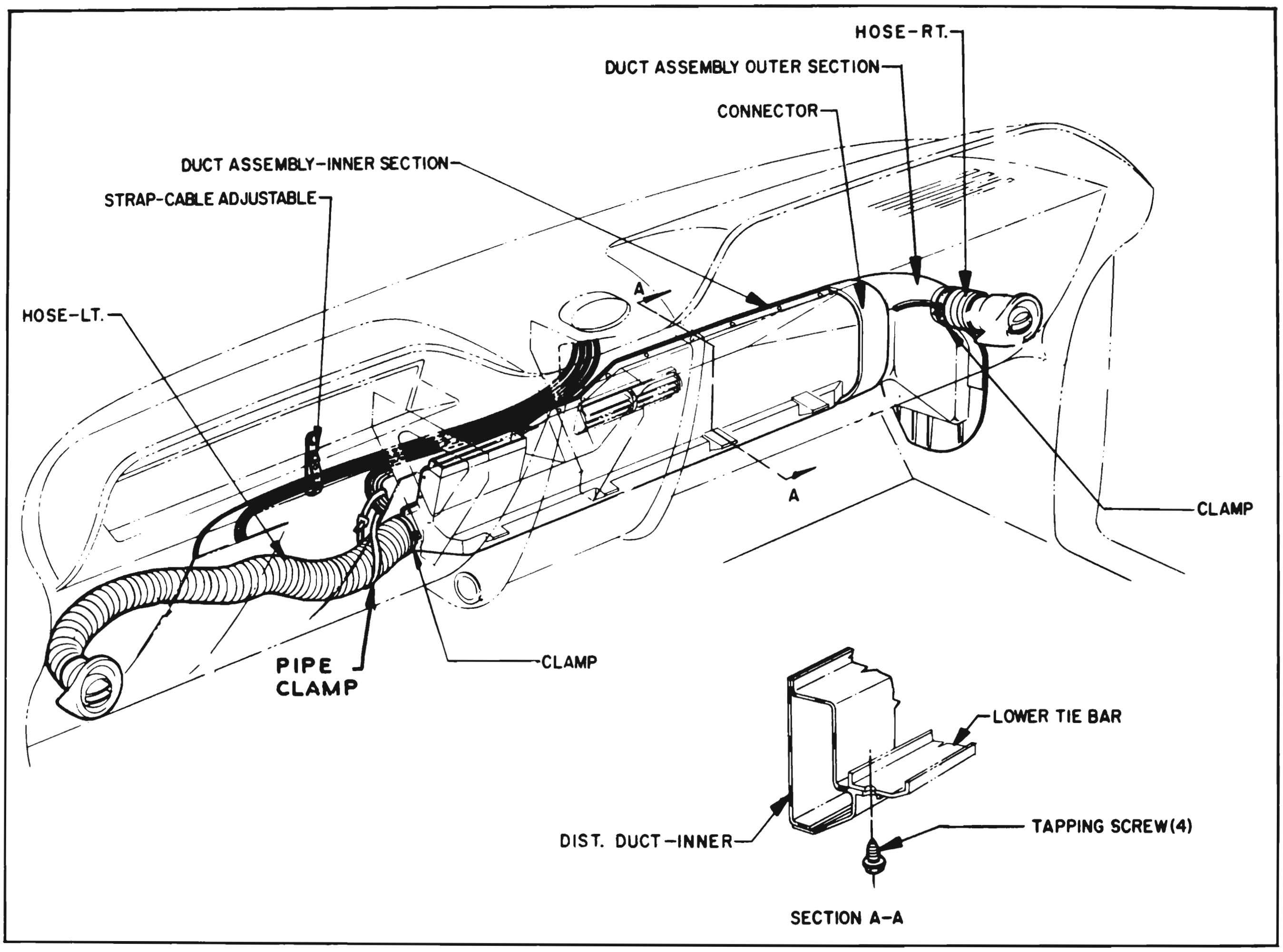


Figure 11-34—Air Conditioner Air Outlets

ambient temperature is higher than 70°F indicates air or a shortage of refrigerant in the system.

CAUTION: Continuous bubbles may appear in a properly charged system on a cool day. This may be considered normal if temperature of surrounding air is low.

The purpose of the receiver part of assembly is to insure a solid column of liquid refrigerant to the thermostatic expansion valve at all times, provided the system is properly charged. The dehydrator part of assembly is to absorb any moisture that might be present in system after assembly. Also, it traps foreign material which may have entered system during assembly.

5. Thermostatic Expansion Valve. The thermostatic expansion valve is located at the inlet to the evaporator core inside the evaporator case.

The thermostatic expansion valve consists of a capillary bulb and tube which is connected to an operating diaphragm (which is sealed within the valve itself) and an equalizer line which connects the valve and the low pressure suction throttling valve outlet pressure. See Figure 11-36.

The valve contains three operating pins, valve stationary seat, valve, valve carriage, adjusting spring and screw, an inlet which has a fine mesh screen, and an outlet connection (which attaches to the evaporator). The fine mesh screen at the inlet of the valve provides protection to the valve by preventing dirt and other foreign material from entering the valve.

While this valve is located at the inlet of the evaporator, the thermo bulb is attached to the evaporator outlet pipe.

The equalizer line joins the expansion valve to the suction throttle valve outlet so that this pressure will register in the expansion valve.

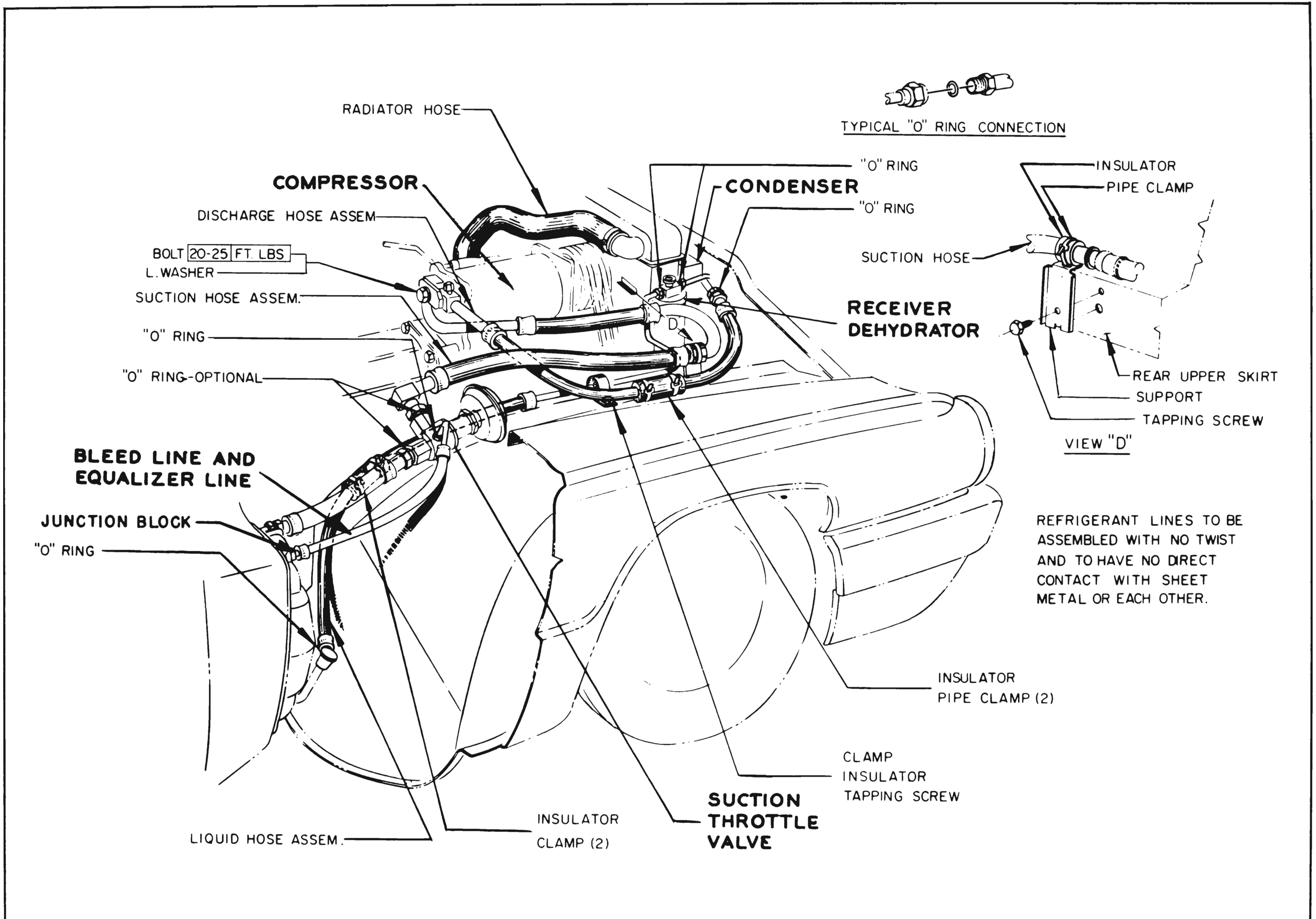


Figure 11-35—Air Conditioner Hose Installation

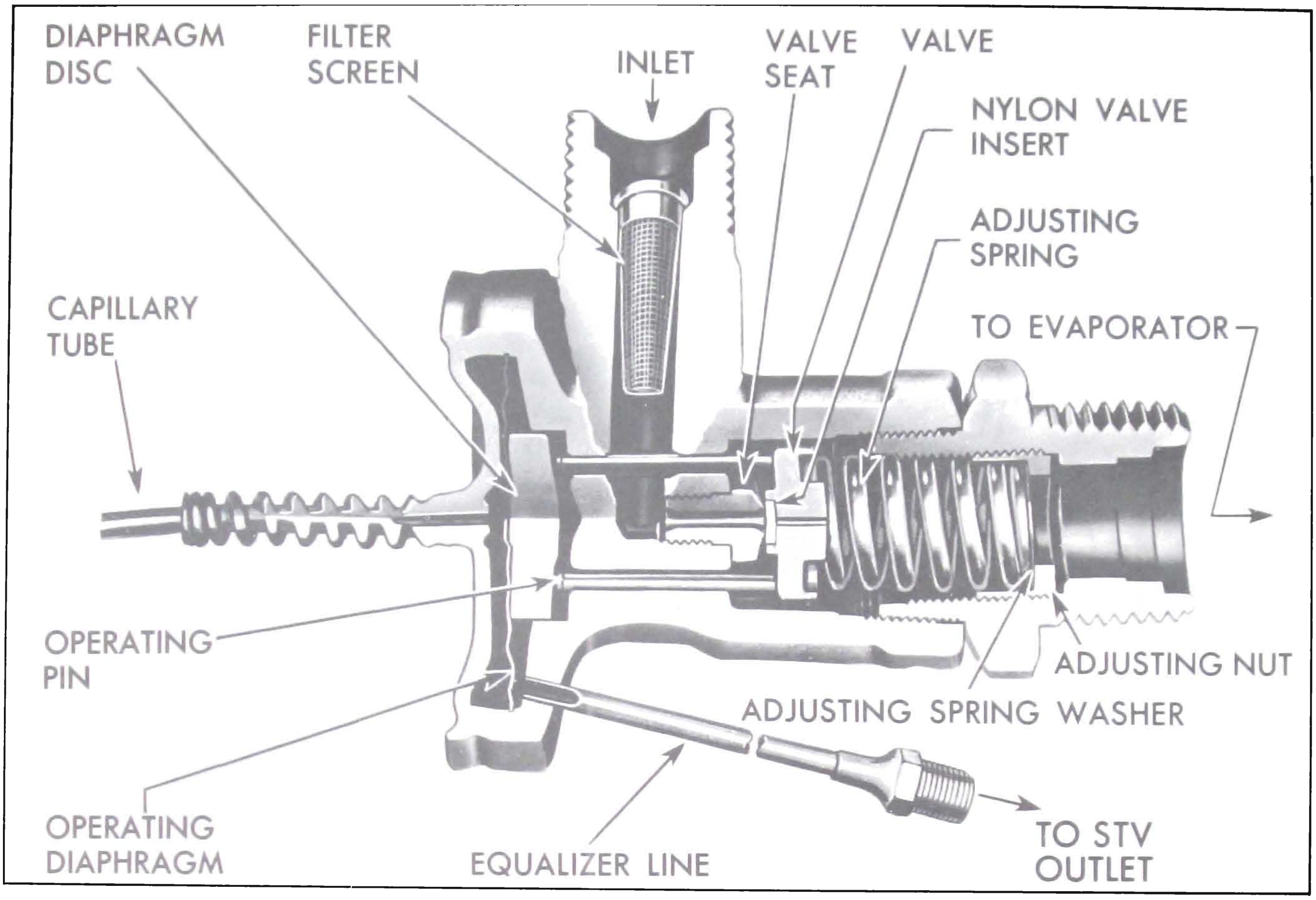


Figure 11-36—Thermostatic Expansion Valve

The purpose of the thermostatic expansion valve is to regulate the flow of liquid refrigerant into the evaporator automatically in accordance to the requirements of the evaporator.

This valve is the dividing point in the system between high pressure liquid refrigerant supplied from the receiver and relatively low pressure liquid and gaseous refrigerant in the evaporator. It is so designed that the temperature of the refrigerant at the evaporator outlet must have 4°F. of superheat before more refrigerant is allowed to enter the evaporator. Superheat is an increase in temperature of the gaseous refrigerant above the temperature at which the refrigerant vaporized.

A capillary tube filled with carbon dioxide and the equalizer line provide the temperature regulation of the expansion valve. This capillary tube is fastened to the low pressure refrigerant pipe coming out of the evaporator so that it communicates the temperature of the refrigerant at this point to the expansion valve. If the temperature differential between the inlet and outlet decreases below 4°F., the expansion valve will automatically reduce the amount of refrigerant entering the evaporator.

If the temperature differential increases, the expansion valve will automatically allow more refrigerant to enter the evaporator.

It is the temperature of the air passing over the evaporator core that determines the amount of refrigerant that will enter and pass through the evaporator. When the air is very warm, the heat transfer from the air to the refrigerant is great and a greater quantity of refrigerant is required to cool the air and to achieve the proper superheat on the refrigerant gas leaving the evaporator. When the air passing over the evaporator is cool, the heat transfer is small and a lesser quantity of refrigerant is required to cool the air and to achieve the proper superheat on the refrigerant gas leaving the evaporator.

A mechanical adjusting nut located within the valve is provided to regulate the amount of refrigerant flow through the valve; when turned, moves the spring seat to increase or decrease the tension on the needle valve carriage spring. By varying the tension on this spring, it is possible to regulate the point at which the needle valve begins to open or close, thereby regulating refrigerant flow into the evaporator. As this adjustment feature is inside the valve, no external adjustment is possible. All valves are preset at the time of manufacture.

When the air conditioning system has not been operating, all pressures within the thermostatic expansion valve assembly will have equalized at the ambient (surrounding air) temperature, thus the pressure above and below the operating diaphragm and at the inlet and outlet side of the valve will be equal. (Pressure under the diaphragm is evaporator pressure. It reaches this area by means of clearance around the operating pins which connects the area under the diaphragm with the evaporator pressure area.) While pressures in the expansion valve are almost equal, the addition of the valve adjusting spring pressure behind the needle will hold the needle valve over to close the needle valve orifice.

When the air conditioning system first begins to operate, the compressor will immediately begin to draw refrigerant from the evaporator, lowering the pressure in the evaporator and in the area under the operating diaphragm. As the pressure in this area decreases, the pressure above the diaphragm exerted by the carbon dioxide in the capillary tube will overcome spring pressure and push the diaphragm against the operating pins, which in turn will force the needle off its seat.

Refrigerant will then pass through the expansion valve into the evaporator where it will boil at a temperature corresponding to the pressure in the evaporator. This will begin cooling the air passing over the evaporator, and, also it will begin to cool the evaporator outlet pipe.

The valve adjusting spring is calibrated so that the pressure of the refrigerant in the evaporator outlet pipe and equalizer line to the valve plus the spring force, will equal the force above the operating diaphragm when the temperature of the refrigerant in the evaporator outlet is 4°F. above the temperature of the refrigerant entering the evaporator. In other words, the refrigerant should remain in the evaporator long enough to completely vaporize and then warm (superheat) 4°F.

If the temperature differential begins to go below 4°F. (outlet pipe becoming too cold) carbon dioxide pressure in the capillary tube and area above the diaphragm decreases, allowing the valve adjusting spring to move the needle valve towards its seat closing off the flow of refrigerant past the needle valve.

If the temperature differential begins to go above 4°F. (outlet pipe too warm), the pressure in the capillary tube and area above the operating diaphragm will increase, pushing this diaphragm against the operating pins to open the needle valve further, admitting more refrigerant to the evaporator.

The equalizer line permits the STV outlet pressure to be imposed on the expansion valve diaphragm, thus, over-riding its normal control of liquid refrigerant. As the compressor capacity becomes greater than the evaporator load, the drop in compressor suction line pressure forces the expansion valve to flood liquid through the evaporator and STV, thus preventing the suction pressure from dropping below a predetermined pressure.

The equalizer line is used primarily to prevent prolonged and constant operation of the compressor in vacuum conditions. This operation is considered undesirable both from a noise angle and from possibility of subjecting the compressor to reduced oil return. Second considerations for having the external equalized expansion valve is to maintain a full evaporator during throttling, and also guard against non-condensibles entering the system especially through loosened fittings.

6. Evaporator. The evaporator core consists of an aluminum brazed plate type coil. The evaporator core is housed in an insulating plastic case mounted at the extreme right side of the dash panel beneath the right fender.

The purpose of the evaporator core is to cool and dehumidify the air that is flowing through it when the system air conditioner is in operation. High pressure liquid refrigerant flows through the orifice in the thermostatic expansion valve into the low pressure area of the evaporator. This regulated flow of refrigerant boils immediately. Heat from the core surface is lost to the boiling and vaporizing refrigerant which is cooler than the core, thereby cooling the core. The air passing over the evaporator loses its heat to the cooler surface of the core. As the process of heat loss from the air to the evaporator core surface is taking place, moisture in the air condenses on the outside surface of the evaporator core and is drained off.

Since Refrigerant-12 will boil at 21.7°F. below zero at atmospheric pressure while

**REFRIGERANT-12**
**PRESSURE-TEMPERATURE RELATIONSHIP**

The table below indicates the pressure of Refrigerant-12 at various temperatures. For instance, a drum of Refrigerant at a temperature of 80°F. will have a pressure of 84.1 psi. If it is heated to 125°F. the pressure will increase to 167.5 psi. It also can be used conversely to determine the temperature at which Refrigerant-12 boils under various pressures. For example, at a pressure of 30.1 psi, Refrigerant boils at 32°F.

| TEMP. (°F.) | PRESSURE (PSIG) | TEMP. (°F.) | PRESSURE (PSIG) |
|---|---|---|---|
| -21.7 | 0 (atmospheric pressure) | 55 | 52.0 |
| | | 60 | 57.7 |
| -20 | 2.4 | 65 | 63.7 |
| -10 | 4.5 | 70 | 70.1 |
| - 5 | 6.8 | 75 | 76.9 |
| 0 | 9.2 | 80 | 84.1 |
| 5 | 11.8 | 85 | 91.7 |
| 10 | 14.7 | 90 | 99.6 |
| 15 | 17.7 | 95 | 108.1 |
| 20 | 21.1 | 100 | 116.9 |
| 25 | 24.6 | 105 | 126.2 |
| 30 | 28.5 | 110 | 136.0 |
| 32 | 30.1 | 115 | 146.5 |
| 35 | 32.6 | 120 | 157.1 |
| 40 | 37.0 | 125 | 167.5 |
| 45 | 41.7 | 130 | 179.0 |
| 50 | 46.7 | 140 | 204.5 |

Figure 11-37—Pressure - Temperature Relationship of Refrigerant - 12

water freezes at 32°F., it becomes obvious that the temperature in the evaporator must be controlled so that the water collecting on the core surface will not freeze in the fins of the core and block off the air passages. In order to control the temperature, it is necessary to control the amount of refrigerant entering the core and the pressure inside the evaporator.

To obtain maximum cooling, the refrigerant must remain in the core long enough to completely vaporize and then superheat a minimum of 4°F. If too much or too little refrigerant is present in the core, then maximum cooling efficiency is lost. A thermostatic expansion valve in conjunction with the suction throttling valve is used to provide this necessary refrigerant volume control.

The evaporator has an oil bleedline connected from its bottom tank to the outlet side of the suction throttle valve (compressor suction). This bleedline is connected to a check valve located on the junction block. The junction block is connected by a line to a fitting on the suction throttle valve. The check valve is a special low force spring valve core and may be identified by the black color of the gasket cup and head of the center pin. Only this valve should be used at this location.

The bleedline is in the system as an insurance measure to provide increased compressor life during times of low refrigerant charge. During normal-charge conditions this line is of no particular benefit as the compressor runs on an adequate oil supply. With partially depleted F-12 charge any excess oil and refrigerant mixture will flow from the bottom tank of the evaporator through the oil bleed line to the compressor. This oil flow helps to prevent oil deficiencies in the compressor that could arise under these conditions. During times of zero-change no refrigerant will be available to carry oil back to the compressor. It is therefore important that completely discharged systems be kept to a minimum of operation, thus preventing seizure.

The bleed line's check valve located in the junction block, opens at 5 p.s.i. differential pressure between the evaporator inlet pressure and STV outlet pressure. This check valve is fully open when these two pressures exceed 12 p.s.i. differential. Below the 5 p.s.i. differential, the check valve will be closed to prevent capacity loss. This feature prevents by-passing the evaporator at traffic conditions when cooling demands are greatest.

At all times when the compressor capacity (evaporator inlet pressure) exceeds the evaporator load demands by 5 p.s.i. or greater, this valve starts to open. It then permits refrigerant and oil to flow from the evaporator bottom tank to the inlet of the compressor.

7. Suction Throttle Valve

The suction throttle valve (STV) controls the evaporator pressure and in turn the evaporator air outlet temperature. Also the STV prevents freezing of the condensation on the evaporator core surface. The STV consists of a valve body, piston, piston diaphragm, control spring, diaphragm cover, diaphragm cap and vacuum diaphragm. See Figure 11-38.

The inside of the piston is hollow and is open to the piston diaphragm by small holes in the end of the piston. Located in the lower extremity of the piston is a fine mesh screen, held in place by a retainer. The purpose of this screen is to prevent any foreign particle of any substance entering the piston and lodging in the holes drilled in the piston wall and possibly scoring the surface of the body, thus interfering with its proper operation.

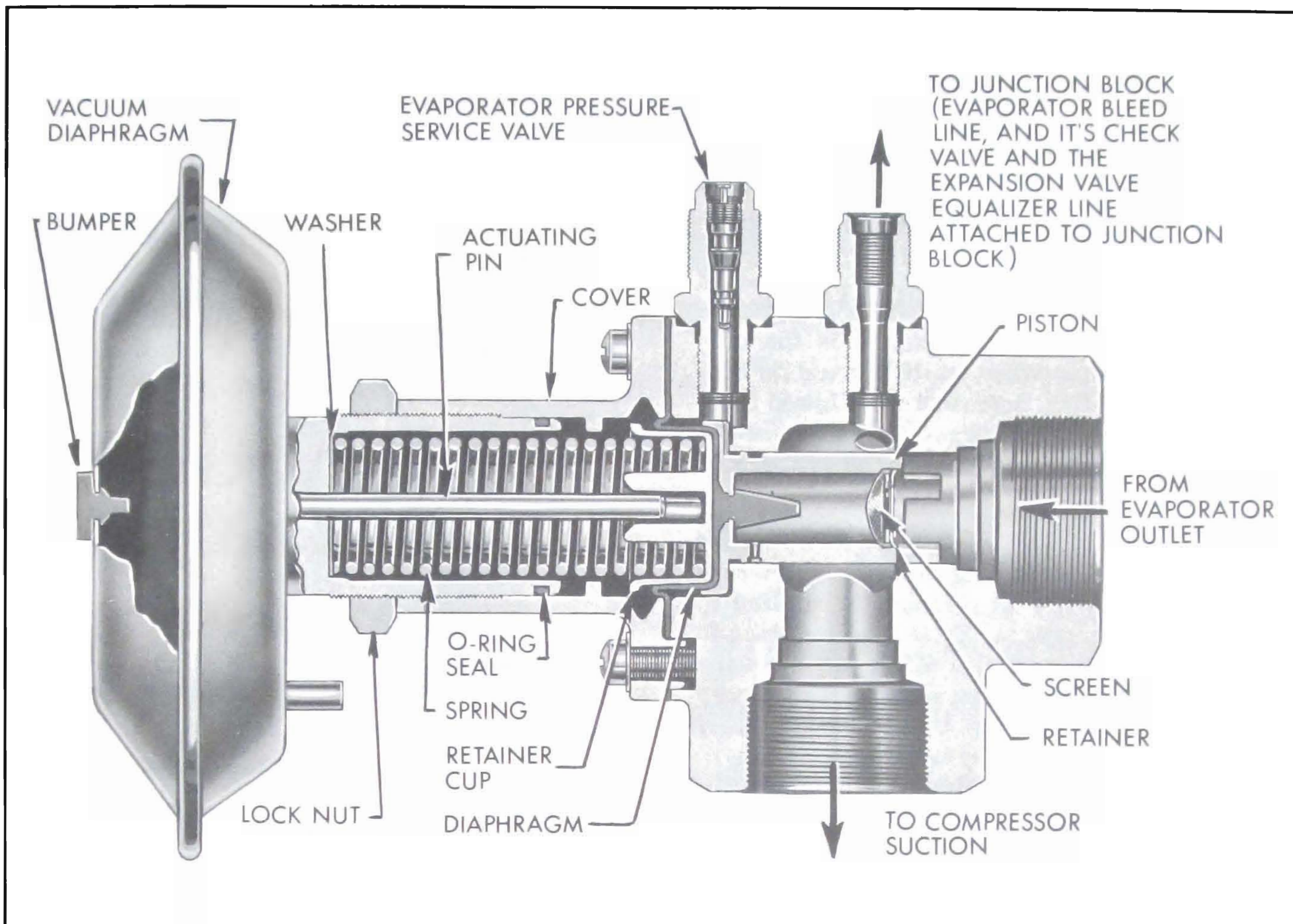


Figure 11-38—Suction Throttle Valve

The piston diaphragm retains the piston to it by a tab on the front side and has the cup held against it by the spring on the rear side. The vacuum diaphragms actuating pin fits in the end of the cup. The body of the vacuum diaphragm threads into the valve's cover and determines the amount of spring tension on the cup. The vacuum diaphragm is locked to the cover after it has been set by a lock nut.

A vacuum connection on the vacuum diaphragm is connected to the vacuum modulator on the instrument panel by a small hose. When vacuum is present on the diaphragm, it is pulled toward the piston and its pin adds to the spring pressure on the piston diaphragm.

The STV inlet is connected to the evaporator outlet and its inlet is connected to the compressor suction port. See Figure 11-33.

The flow of the low pressure vapor from the evaporator to the compressor is determined and controlled by the position of the piston in the valve body of the STV. See Figure 11-38. The position of the piston in the body is determined by the balance of the forces that are applied to the piston diaphragm. These forces consist of the refrigerant vapor pressure returning from the evaporator on one side and the spring tension, plus the force of the actuating pin if vacuum is present at vacuum diaphragm on the other side. Movement of the piston permits vapor to pass by scallops in the piston skirt and then on to the compressor inlet.

During the time that maximum cooling is being produced, the STV vacuum diaphragm does not have engine vacuum applied to it. The full flow of low pressure refrigerant vapor is being returned to the compressor to permit it to exert its full capacity on the evaporator and produce maximum cooling. Under most all operating conditions, STV inlet and outlet pressures will not be the same as there will be some throttling to prevent evaporator icing.

When the operator desires to raise the temperature within the car, the controls are changed to apply engine vacuum to the vacuum diaphragm. This checks or throttles the flow of the low pressure vapor returning to the compressor. This results in a higher pressure to be maintained in the evaporator assembly. The STV outlet pressure will also increase, but the differential between inlet and outlet will be much greater than when STV is at maximum cooling.

(1) Maximum cooling setting of STV -- The maximum cooling setting of the STV is obtained when there is no vacuum present at it's vacuum diaphragm and the spring tension is the only controlling factor. When at the maximum cool position evaporating pressure is allowed to go to a minimum of 27 to 29 p.s.i. If pressure is allowed to go any lower, icing of the evaporator core will occur.

(2) Minimum cooling setting of STV -- The minimum cooling setting of the STV is obtained when 6 1/2" (±1/2") of vacuum is applied to STV vacuum diaphragm. To move the piston in the STV, the evaporator pressure must overcome spring tension plus the force applied by the actuating pin to the piston diaphragm. This force on the piston's diaphragm maintains an evaporator pressure of approximately 50 p.s.i. minimum.

The STV has a low pressure gauge fitting used for checking evaporator pressure when performing the functional test on the air conditioner system or when adjusting the STV. Also the valve has a fitting which connects STV outlet pressure to the junction block.

NOTE: At 60 MPH it will not be unusual for the compressor inlet pressure to be from 10 to 15 p.s.i., while the evaporator is controlled at 30 p.s.i. By consulting the pressure-temperature chart (Figure 11-37) it will be noted that compressor inlet conditions result in approximately 5 to 10°F. Frost accumulates on the compressor inlet line after prolonged operation at these conditions. At minimum, or further reduced-load conditions, when the throttling demands on the STV are again increased, the compressor inlet pressure may drop to zero p.s.i. or even 6"-8" of vacuum. Compressor inlet temperatures at these reduced load conditions may approach minus 30°F. so that even frosting of the compressor rear head is probable.

8. Vacuum Modulator

The vacuum modulator which controls the amount of vacuum to the suction throttle valve's vacuum diaphragm, is mounted on the air conditioner control lever assembly on the in-

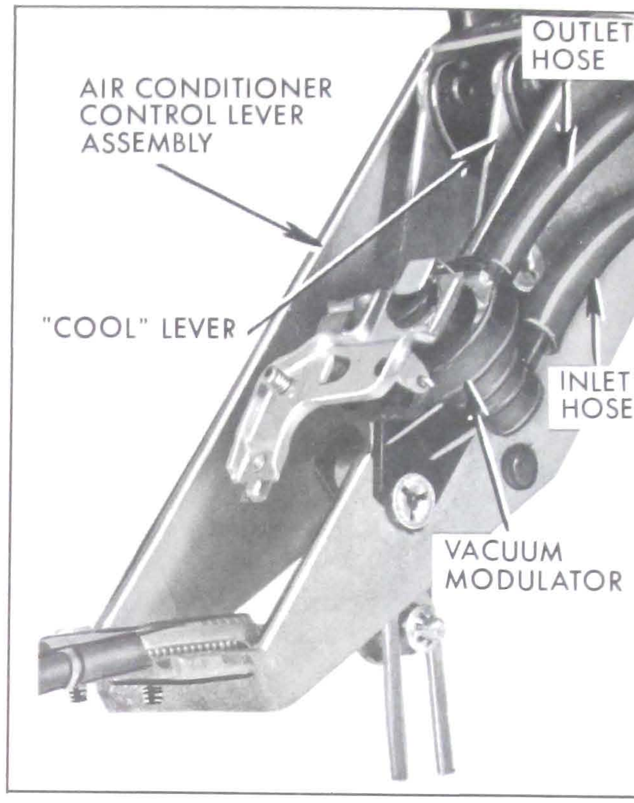


Figure 11-39—Vacuum Modulator

strument panel. It is activated by the "Cool" control lever. See Figure 11-39.

Engine intake manifold vacuum is present at the vacuum modulator when the air conditioner control system is energized. (The vacuum modulator vacuum source hose is tapped into the #4 vacuum diaphragm's hose which is located on the blower and valve housing and explained in Par. 11-15.) The vacuum modulator controls output vacum to the STV from 6-7 inches Hg. at minimum cooling ("cool" lever just on) to 0 inches Hg. at maximum cooling ("cool" control lever full on).

9. Air Distribution System. The air conditioner air distribution system is entirely separate from the car heater air distribution system. The air conditioner air distribution duct mounts forward of the car heater duct with the right end positioned against the evaporator housing. See Figure 11-34.

Air is introduced into the car through three outlets, two at each end of the instrument panel and one at the upper center of the instrument panel. The center outlet vanes may be tilted to change air flow direction. The disc may be turned fully "up" to shut off air flow from the center outlet. See Figure 11-40.

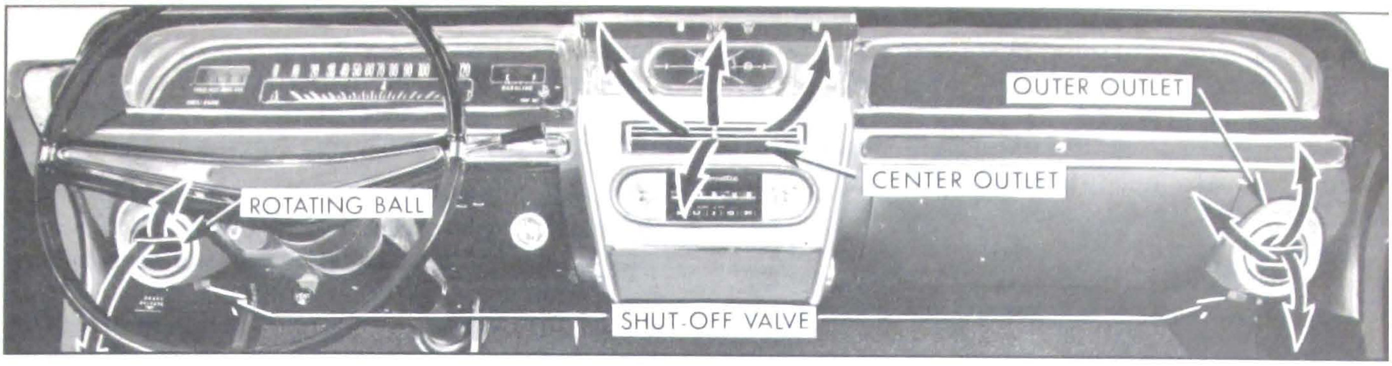

Figure 11-40—Air Conditioner Outlets

The outer outlets have a rotating ball to control air flow direction. See Figure 11-40. The ball may be set in any desired position to direct air flow for maximum comfort. A shut off valve is provided in each of the outer outlets which is controlled by a knob on underside of outlet assembly.

10. Controls. The air conditioner control levers are located to the left of the steering column, replacing the ventilator levers on non-air conditioner cars. See Figure 11-41.

The "Cool" and "Air" levers provide full control of the air conditioner and also allow for use of the air conditioner air distribution system for outside air ventilation, without cooling, if desired.

When the "Cool" lever is moved from the off position, the compressor clutch is energized and blower is turned on low speed. See Figure 11-132 for electrical circuit for controlling air conditioner. The suction throttle valve is set and the air valves in the blower and valve housing are set for proper air distribution of all outside air. The air valves are positioned by a sequence of opening and closing vacuum switches on the control plate assembly. Further movement of the "Cool" lever sets the STV to a cooler position. The last portion of travel repositions the air valves for recirculated air. Low blower speed only is obtained by this lever. When the heater "Air" lever is on, recirculated air for air conditioner is not available.

The "Air" lever controls blower speed for medium and high when used with air conditioning (with "Cool" lever moved from off position). Each speed has a detent feel. When the air conditioner system is to be used for outside air ventilation (no cooling) the "Cool" lever is left off, and the complete control is through the "Air" lever. When outside air ventilation is desired, movement to the first

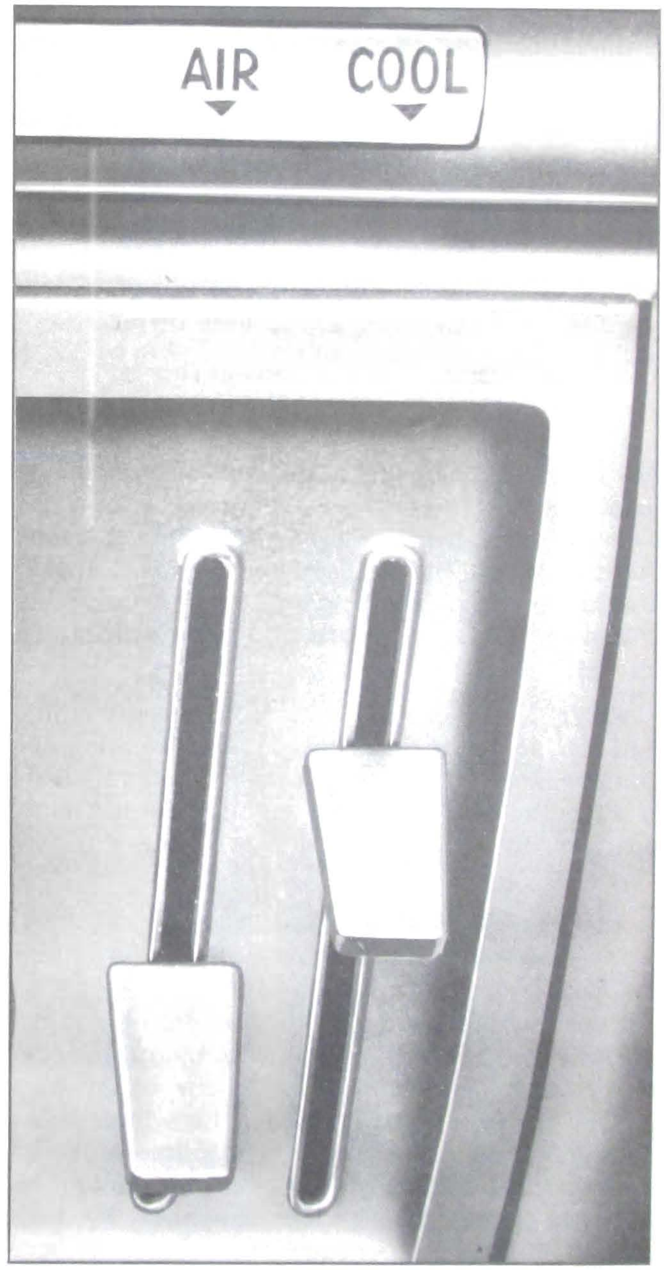

Figure 11-41—Air Conditioner Control Levers

detent sets the air valves and turns on the low blower speed. Further movement increases blower speed through medium and high.

The complete mechanism for controlling heater and air conditioner is located in the engine compartment and is mounted on the blower and valve housing. The control mechanism is protected from dust, dirt and splash by a plastic protective cover.

NOTE: The complete description of the air distribution system is covered in Par. 11-15.

The vacuum modulator control for the STV is mounted on the air conditioner control lever assembly. See Figure 11-39.

#### b. Operation of Controls

To place the air conditioner in operation (cooling):

1. Make sure heater and ventilator are off.
2. Move "Cool" lever to full on position.
3. Move "Air" lever to full on position.
4. Start engine. See note below.
5. When desired car interior temperature has been reached, reposition "Cool" lever to maintain car interior temperature at a satisfactory level. It may also be desirable to lower blower speed by repositioning "Air" lever. Maximum air conditioner performance is achieved with all windows and ventilators closed.

NOTE: The wiring to the compressor clutch coil is so arranged that during cranking the compressor clutch is disengaged, thus eliminating the necessity of turning the air conditioner off while starting the engine.

#### c. Operation of Air Conditioner Refrigeration Circuit

Cool refrigerant gas is drawn into the compressor from the evaporator and pumped from the compressor to the condenser under high pressure. See Figure 11-42. This high pressure gas will also have a high temperature as a result of being subjected to compression. As this gas passes through the condenser, the high pressure, high temperature gas rejects its heat to the outside air as the air passes over the surfaces of the condenser. The cooling of the gas causes it to condense into liquid refrigerant. The liquid refrigerant, still under high pressure passes from the bottom of the condenser into the receiver-dehydrator. The receiver acts as a reservoir for the liquid.

The liquid refrigerant flows from receiver-dehydrator to the thermostatic expansion valve. The thermostatic expansion valve meters the high pressure refrigerant flow into the evaporator. Since the pressure in the evaporator is relatively low, the refrigerant immediately begins to boil. As the refrigerant passes through the evaporator, it continues to boil, drawing heat from the surface of the evaporator core warmed by the air passing over the surfaces of evaporator core. In addition to the warm air passing over the evaporator rejecting its heat to the cooler surfaces of the evaporator core, any moisture in the air condenses on the cool surfaces of the core, resulting in cool dehydrated air entering inside the car. By the time the gas leaves the evaporator, it has completely vaporized and is slightly superheated. Superheat is an increase in temperature of the gaseous refrigerant above the temperature at which the refrigerant vaporized.

The pressure in the evaporator is controlled by the suction throttle valve as described in subpar. a.

Refrigerant vapor passing through the evaporator, flows through the STV and is returned to the compressor where the refrigeration cycle is repeated.

## 11-14 DESCRIPTION AND OPERATION OF AIR CONDITIONER COMPRESSOR

The compressor is mounted on the right-front of the engine over the generator.

The compressor is of basic double action piston design. Three horizontal double acting pistons make up a six cylinder compressor, and are mounted axially around the compressor shaft to operate in a front and rear cylinder assembly. These pistons operate in a 1 1/2" bore, have a 1 1/8" stroke and are actuated by a swash plate pressed on the compressor shaft. See Figure 11-43.

Reed type suction and discharge valves are mounted in a valve plate between the cylinder assembly and the head at each end of the compressor. The ends are connected with each other by gas-tight passage ways which direct refrigerant gas to a common output.

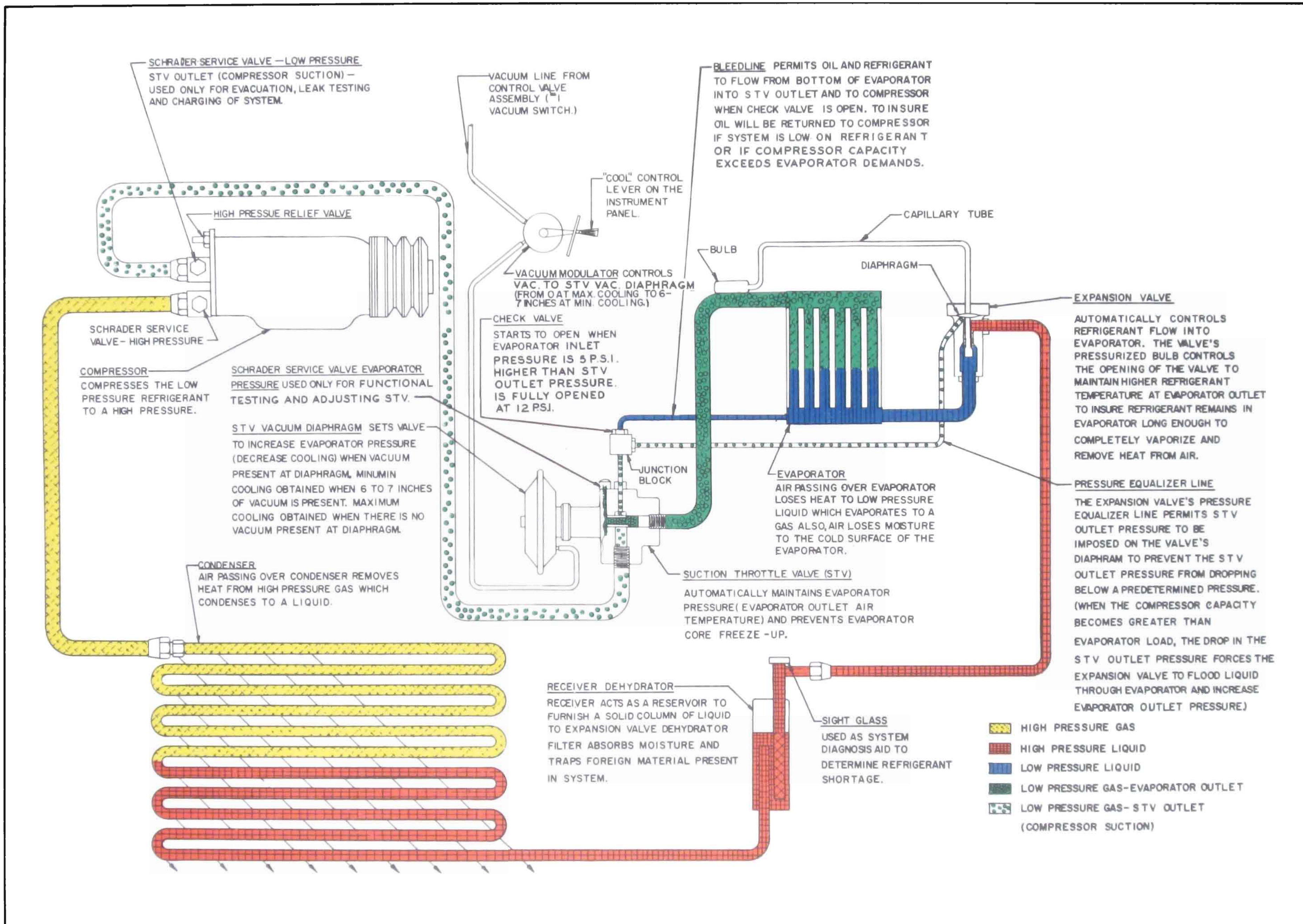


Figure 11-42—Air Conditioner Refrigeration Circuit and Temperature Controls

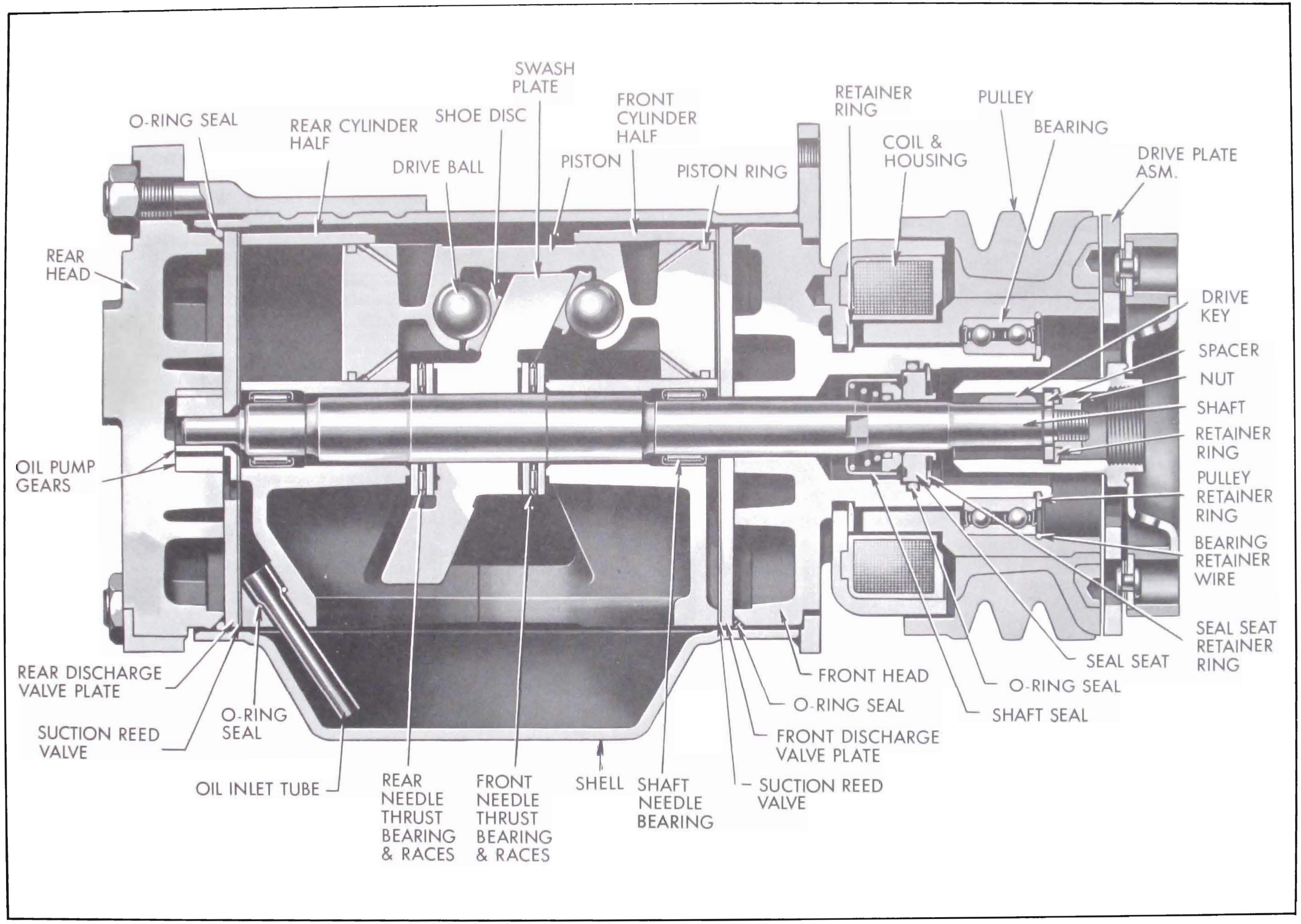


Figure 11-43—Sectional View of Compressor

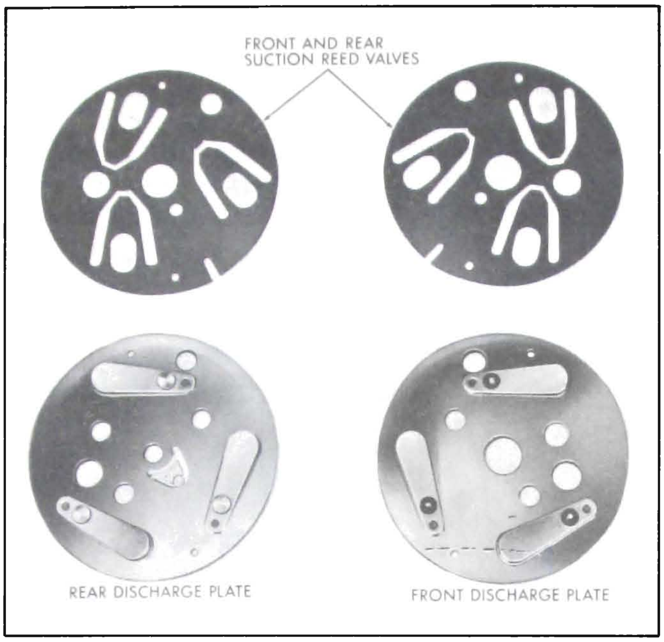


Figure 11-44—Suction and Discharge Valves

**a. Suction Reed Valves and Discharge Valve Plates**

A three-reed suction valve disc is assembled to both the front and rear cylinder heads. See Figure 11-44. These reeds open when the pistons are on the intake portion of their stroke to allow the low pressure vapor to flow into the cylinders.

When the pistons reverse and are on the compression portion of their stroke, the reed valves close against their seats to prevent the high pressure vapor being forced back into the low side of the system.

There are two discharge valve plate assemblies, each having three reeds and retainers positioned to direct the high pressure vapor from the cylinders into the outer annular cavities of the front and rear head castings. When the piston has completed its compression stroke and reverses to the suction stroke, the high pressure vapor in the discharge cavity causes the reeds to close, thus maintaining the differential of pressure between the high and low pressure areas.

**b. Cylinder Heads**

Each cylinder head contains suction and discharge cavities. In addition, the rear head contains an oil pump cavity in the center of the suction cavity to house the oil pump gears (which are driven by the compressor main-shaft). The suction cavity is in the center and indexes with the suction reeds. The discharge cavity is around the outside and indexes with the discharge reeds.

These cavities are sealed from each other with a teflon seal molded onto the cylinder head. The discharge cavity is sealed from the outside of the compressor by an O-ring seal which rests in a chamfered relief in the cylinder head and compresses against the compressor body.

Both cylinder heads are connected with each other; the suction cavities by a flat suction crossover "cover", the discharge cavity by a tube pressed into each head. (Service discharge crossover tube assemblies are sealed with O-rings and spacers.)

**c. Oil Pump**

An oil pump mounted at the rear of the compressor picks up oil from the bottom of the compressor and pumps it to the internal parts. The inner gear has a "D" shaped hole in the center which fits over a matching "D" flat on the rear of the main shaft. The outer driven gear has internal gear teeth which mesh with the external teeth on the inner (drive) gear.

**d. Main Shaft**

The compressor main shaft is driven by the pulley when the coil is energized. It extends through the compressor front head, to the compressor rear head and drives the oil pump in the rear head. The shaft is supported by a needle roller bearing located in the front half of the cylinder and a similar needle roller bearing in the rear half of the cylinder.

A 3/16" diameter oil passage extends from the rear oil pump cavity to the shaft seal cavity. Four 5/64" diameter holes are drilled at 90° to the main oil passage. These drilled passages direct oil under pump pressure to the shaft seal surfaces, thrust bearings, and shaft-cylinder bearings.

**e. Thrust Bearings and Races**

Two flat-type thrust needle bearings are seated around the shaft and are located near the center of the compressor. These bearings have rollers placed radially in their housing. Each bearing is "sandwiched" between two steel thrust races, and this combination of three pieces is placed between the shoulders of the swash plate and the shoulders of the cylinder hubs on the front and rear halves of the cylinder.

The FRONT end combination, consisting of a needle bearing with a selected thrust race on

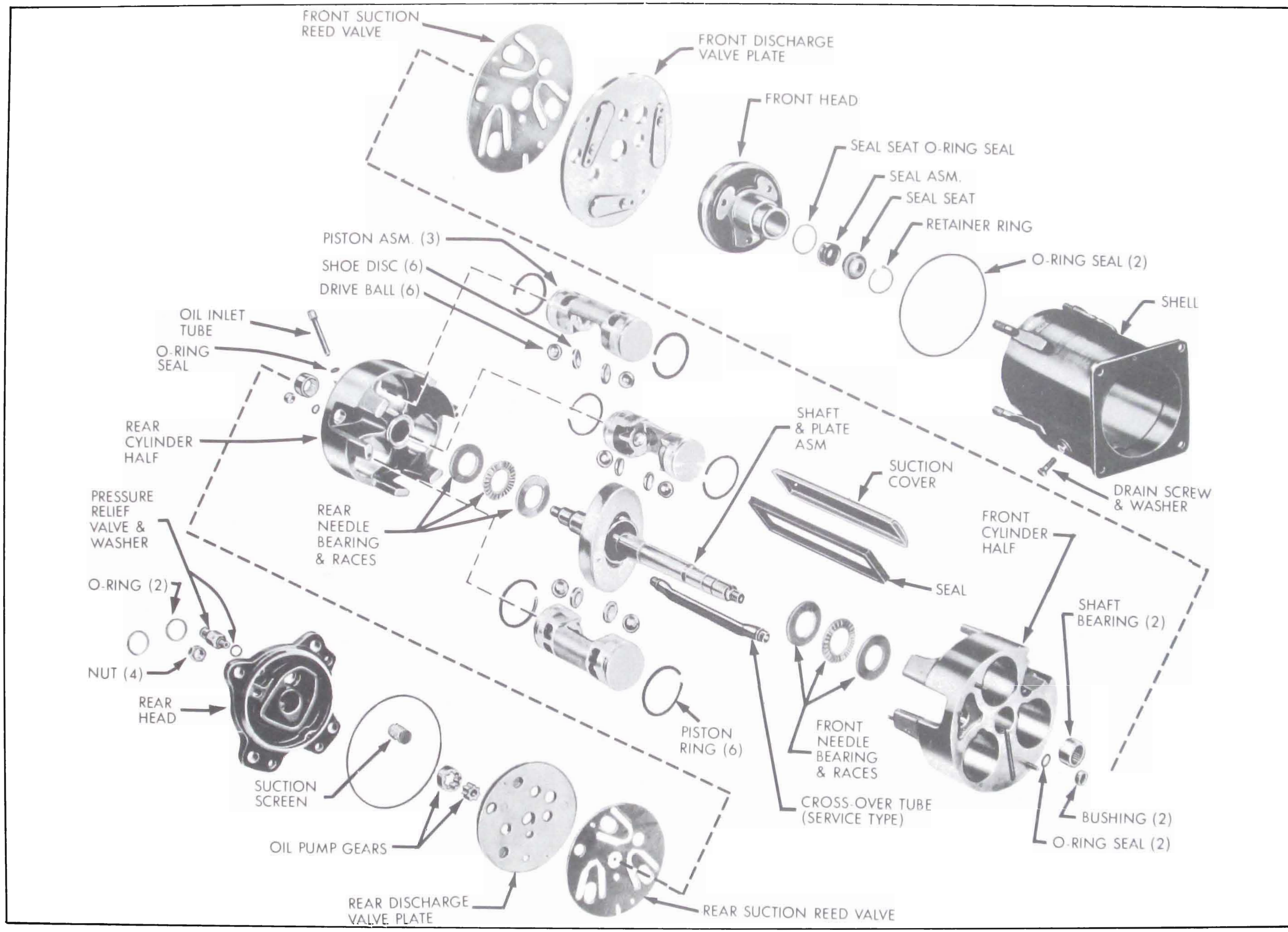


Figure 11-45—Exploded View of Compressor (Less Clutch and Coil)

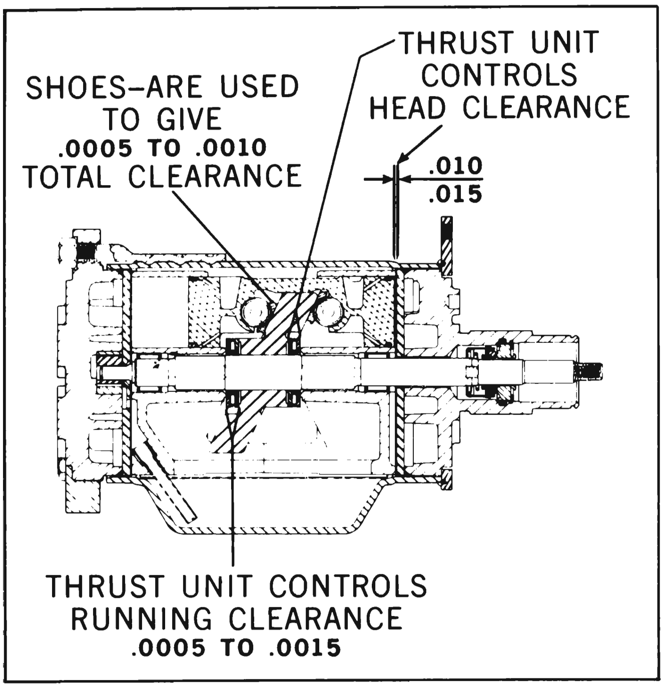


Figure 11-46—Compressor Internal Clearances

each side, provides the proper head clearance below the top of cylinder and the underside of the suction and discharge valve plates. See Figure 11-46.

The REAR end combination, consisting of a needle bearing with a selected thrust race on each side, obtains a .0005 to .0015 running clearance between the hub surfaces of the swash plate and the front and rear hubs of the cylinder. See Figure 11-46.

#### f. Cylinder Block and Piston

The cylinder block consists of two halves, front and rear. Three piston bores in each half are line bored as one assembly during production to assure proper alignment and parallelism. After boring, the cylinder block is parted at the center and these faces are ground parallel to the two outer ends of the cylinder.

Alignment and register of the two halves are maintained by two cylindrical locator (roll) pins. It is important that the two halves of the cylinder be kept together to assure correct relationship of parts. Cylinder block assemblies are only serviced in sets (front and rear halves).

The double end pistons are made of cast aluminum, with a "bridge" connecting each end. Each piston has a notch cast in this bridge. This notched end of the piston is to be positioned toward the FRONT end (pulley end) of the compressor.

Both ends of the pistons have a groove to receive a piston ring. Two oil return holes are drilled behind the ring groove and extend toward the center area of the piston to allow oil to drain to the compressor oil sump. The piston rings have an oil scraper groove at one edge (to be positioned toward the center of the piston) to wipe any excess oil back into the oil sump (reservoir) through the oil return holes.

A spherical cavity is located in the inside center on each side of the pistons to receive the piston hardened steel drive balls.

#### g. Shoe Discs

Shoe discs are made of bronze and one side is a flat surface which contacts the surface of the swash plate. The opposite side has a coined concave surface into which is assembled the drive ball.

These shoes are provided in .0005" variations and ten sizes are available for servicing these parts. Included in these ten is a basic ZERO shoe to permit simple gauging operations.

All service shoes will be marked with the shoe size, which will also correspond to the last three digits of the part number.

#### h. Swash Plate

An angular shaped member (swash plate) is located near the center of the compressor. The swash plate changes the rotating action of the shaft to provide a reciprocating driving force to each of the three pistons. This driving force is applied, through the shoes and balls, to the mid-point of each of the double end pistons. The swash plate has two angular faces ground smooth and parallel to permit smooth sliding of the shoe discs.

The plate is a press fit on to the drive shaft and is positioned by a Woodruff key located in the shaft. The swash plate and shaft are serviced only as an assembly.

#### i. Suction Cross-Over Cover

Since the pistons are double-acting, low pressure vapor from the suction throttle valve must be supplied to both ends of the compressor and pistons.

The inlet (suction) port on the rear head of the compressor is connected by a hose to the outlet side of the suction throttle valve. A fine mesh suction screen is located in the low pressure inlet cavity of the rear head. Its purpose is to trap any material (larger than the mesh

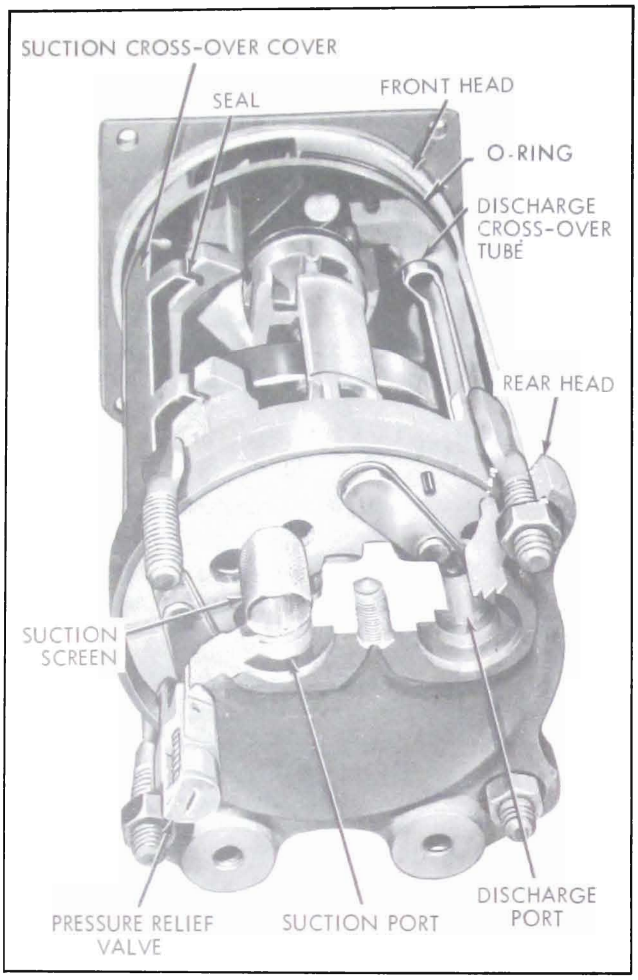


Figure 11-47—Cutaway Compressor - Rear View

size) that could damage the compressor mechanism. See Figure 11-47.

A flat rectangular cavity is cast into the outer face of the front and rear cylinders. The edges of this cavity are machined into a "dove-tail" shape to retain a rectangular suction cross-over cover with a neoprene seal around its edges. This cover and seal form a passage for the low pressure vapor to flow from the rear head of the compressor to the front head and thus supply suction refrigerant to the pistons and cylinders at the front of the compressor.

### j. Production Type Discharge Cross-Over Tube

The double-acting pistons also produce high pressure vapor at both ends of the compressor. The outlet (discharge) port for the high pressure vapor is located in the rear head of the compressor. See Figure 11-47.

A discharge vapor tube is used to connect the

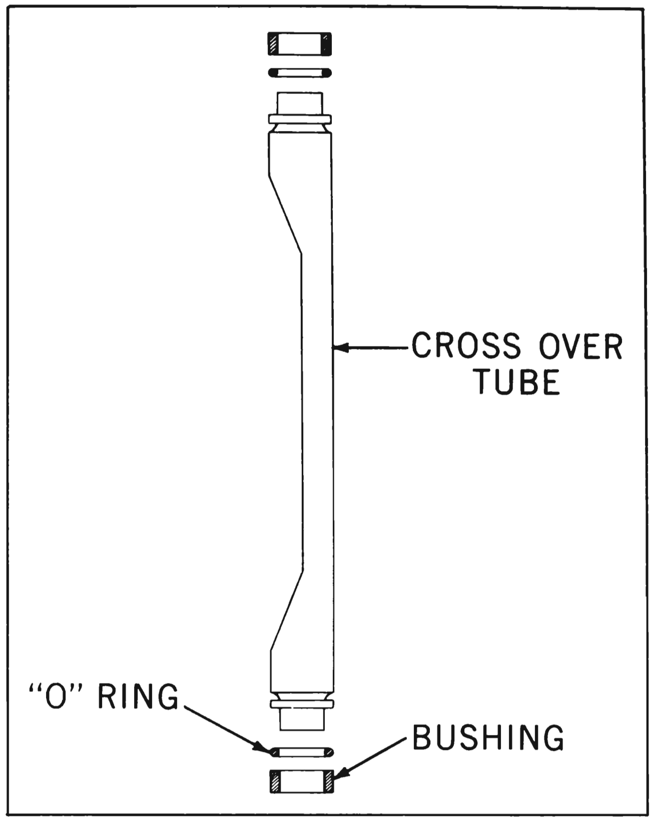


Figure 11-48—Service Type Discharge Cross-Over Tube

front head discharge cavity to the rear head discharge cavity. This tube has cylindrical ends that are spun into a hole in the front and rear cylinder head casting to provide a vapor-tight joint. The center of this tube has a flattened cross-section to provide clearance between the swash plate and tube.

When the pistons in the front end of the cylinder are on their compression stroke, the high pressure vapor is caused to flow into the discharge cavity in the front head, through the discharge tube and into the rear head discharge cavity. This vapor combines with the high pressure vapor produced by the pistons in the rear cylinder head during their compression stroke and flows out the compressor discharge port.

### k. Service Type Discharge Cross-Over Tube

The function and design of the service discharge tube are the same as that for the production type tube with the exception of shouldered sleeves located in both ends of the service tube. See Figure 11-48. These shoulders provide a surface for the O-rings and compression bushings. Since the production discharge tube is vapor sealed to the front and rear cylinder heads by "spinning in" the ends of the tube, equipment to perform this "spin in" operation during service operations would not be economical. Therefore, if it should be necessary to separate the cylinder halves during a service operation, a service type discharge tube should be used when reassembling the mechanism.

**l. Pressure Relief Valve**

The compressor is fitted with a high pressure relief valve. See Figure 11-47. If the discharge pressure ever exceeds approximately 440 psi, the relief valve opens automatically to relieve the pressure and closes again when the pressure recedes.

Opening of the relief valve will be accompanied by a loud popping noise, and perhaps the ejection of some oil with the refrigerant. Any condition that causes this valve to open should be corrected immediately.

**m. Oil Drain Screw**

An oil drain screw is located on the under side of the compressor shell. This screw is used just for draining and adding oil. It is not an oil test outlet as the oil level cannot be checked while the compressor is installed on the engine due to the design of the compressor. It is not necessary to check compressor oil unless a large amount of oil has been lost. This could happen only with a sudden breaking of a line or some other serious break in system. If there has been a major loss of oil, the compressor should be removed and drained and oil added as outlined under Checking Compressor Oil and Adding Oil, Par. 11-16, Sub. paragraph k.

**n. Shell**

The shell of the compressor has a mounting flange on the front end and four threaded screws welded to the outside at the rear. An oil sump is formed into the bottom of the shell with a baffle plate over the sump on the inside of the shell. The oil drain screw and gasket are in the wall of the shell.

The compressor serial number is located on a plate on top of the compressor. This number should be included in all Product Information Reports, claims or correspondence concerning the compressor. The compressor part number is also shown on the serial number plate.

**o. Clutch and Pulley Assembly**

The pulley assembly contains an electrically controlled magnetic clutch, permitting the compressor to operate only when refrigerated air is desired.

When the compressor clutch is not engaged, the compressor shaft does not turn, although the pulley is still being turned by the compressor belts.

The clutch armature plate, which is the movable member of the drive plate assembly, is attached to the drive hub through driver springs and is riveted to both members. The hub of this assembly is pressed over the compressor shaft and is aligned with a square drive key located in the keyway of the com-

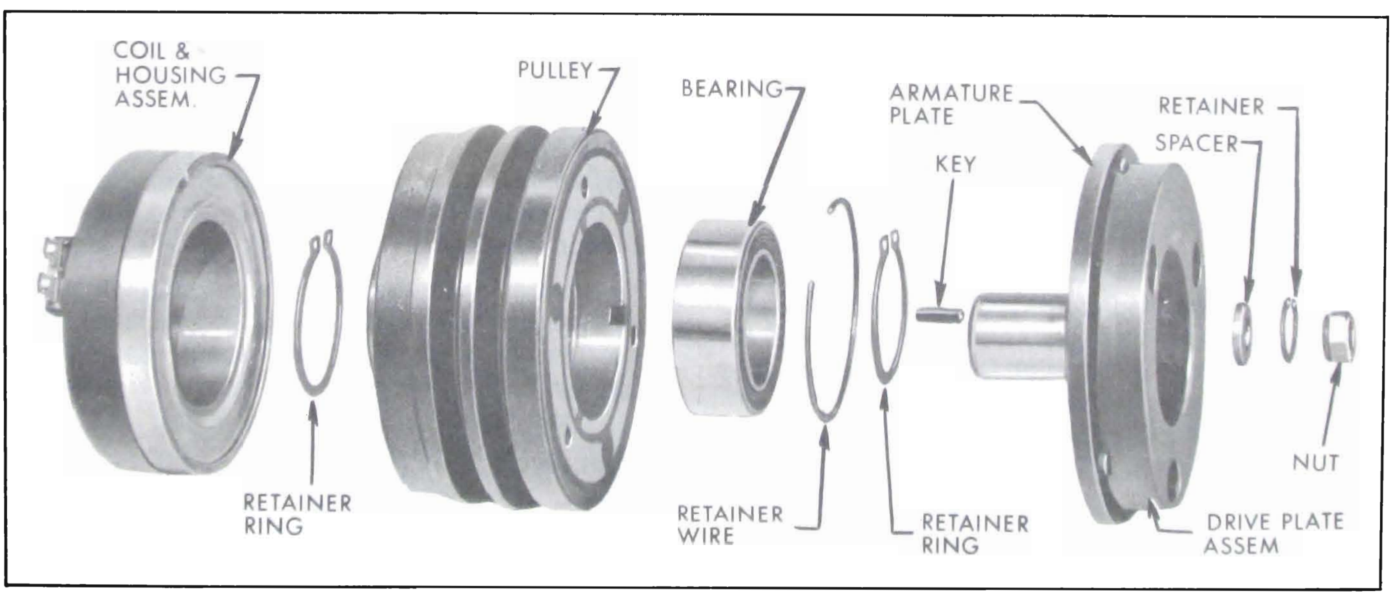


Figure 11-49—Compressor Clutch Assembly

pressor shaft. This hub and drive plate assembly is retained by a spacer and retainer ring (assembled to the shaft) and is held in place with a lock nut. See Figure 11-49.

The pulley hub and ring assembly consists of three parts: (1) pulley rim, (2) power element ring, and (3) pulley hub. These three parts form a final assembly by molding a frictional material between the hub and the rim. A power element rim is embedded in the forward face of the assembly, between the outer rim and the inner hub.

A two-row ball bearing is pressed into the hub of the pulley and held in place by a retainer wire. This pulley and bearing assembly is pressed over the front head of the compressor and held in place by a retainer ring.

The clutch actuating coil is molded into the coil housing with a filled epoxy resin; therefore, the coil and housing are replaceable only as a complete assembly.

The coil has 3.85 ohms resistance at $80^{\circ}$F. (surrounding temperature) and should not demand more than 3.2 amperes at 12 volts D.C.

Three protrusions on the rear face of the coil housing fit into alignment holes in the front head of the compressor. When the coil and housing assembly is aligned and engaged with the front head (and indexed with the protrusions), it is secured in place by a retainer ring. If removed, it is important that the coil and housing be reassembled in their original position so that the wiring harness connector may be plugged on the coil terminals.

When the air conditioner controls are set for cooling, current flowing through the coil creates a magnetic force which flows through the pulley to draw the armature plate (forward of the pulley assembly) rearward toward the pulley. As the armature plate moves toward the pulley, it contacts the pulley face (which rotates freely on the hub of the front head).

The design of the clutch and coil is such that maximum magnetic holding force is obtained to magnetically lock the armature plate and pulley together as one unit. Since the armature plate hub is pressed on, and keyed to, the compressor shaft, the compressor shaft will then turn with the pulley.

When the air conditioner controls are turned "off" the electric circuit to the compressor clutch is opened and magnetic pull on the clutch no longer exists. The armature plate to armature plate hub actuating springs will then pull the armature plate away from the pulley and the plate loses contact with the pulley. With the clutch released, the pulley rotates freely on its bearing. In this condition, the compressor shaft does not rotate.

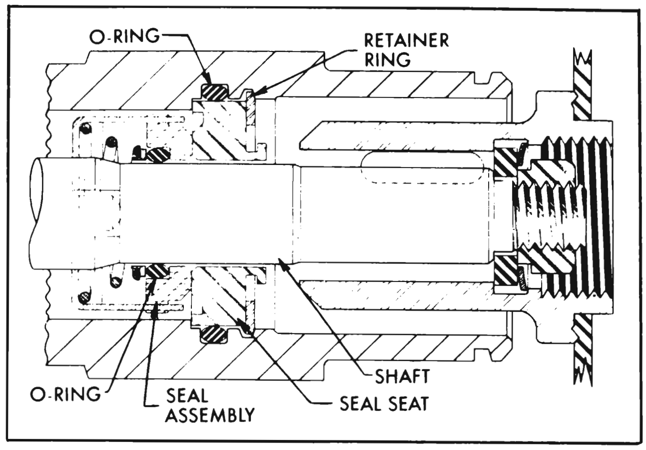


Figure 11-50—Shaft Seal Assembly

It may be noted that if the air conditioning system was in use when the engine was turned off, the armature plate may remain in contact with the pulley, due to residual magnetism. This will cause no trouble, as the armature plate and pulley will separate as soon as the engine is started.

**p. Compressor Shaft Seal**

A replaceable seal is used at the front of the compressor to seal the air conditioning system from atmosphere when the compressor is operating or at rest, regardless of pressures in the compressor.

Components of the seal located in the neck of the front head of the compressor are the retaining ring, the small O-ring, the compressor spring-loaded shaft seal, the cast iron seal seat and the large O-ring. See Figure 11-50. The seal indexes with two flats machined on the compressor shaft and turns with the compressor shaft.

A spring in the shaft seal assembly holds the seal against the seal seat which is held stationary in the neck of the compressor front head by a retainer ring.

Because of the constant pressures inside the compressor, this surface must be protected against any damage, such as scratches and nicks (even finger markings may cause surface damage) to prevent oil and/or refrigerant leaks past this seal.

The small O-ring seals between the shaft and

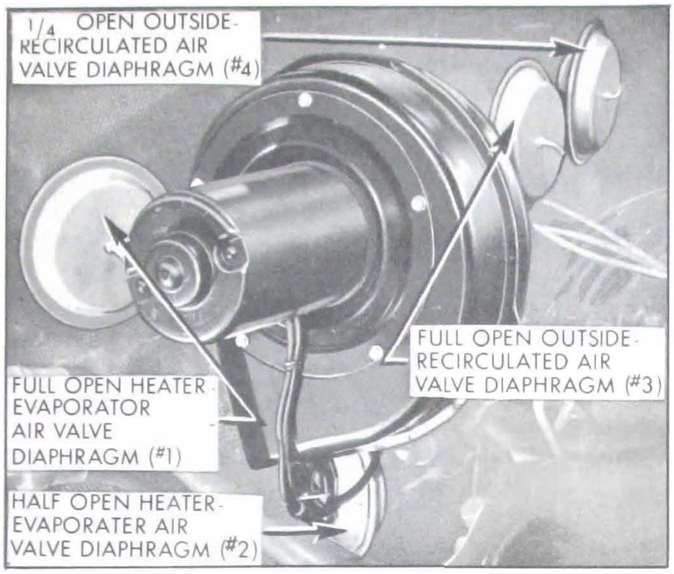


Figure 11-51—Functions of Vacuum Controlled Diaphragms

the seal, and the large O-ring seals the area between the seal seat and the compressor front head.

Service shaft seal parts are supplied in a complete kit containing all necessary replacement parts.

## 11-15 AIR DISTRIBUTION SYSTEM OPERATION AND TROUBLE DIAGNOSIS

### a. Vacuum Valve Diaphragms

Three vacuum switches control the four diaphragms which are located on the housing assembly. See Figure 11-51.

These diaphragms are connected to two air valves. These valves are the outside-recirculated valve and the heater-evaporator valve. Two diaphragms are used in operating each air valve to provide three valve positions. Figure 11-54 is a schematic of these valves with both air conditioner and heater in the "Off position.

The diaphragms are bolted to the outside of the blower and valve housing and they work in pairs. One diaphragm in each pair acts directly upon each valve so that when vacuum moves the diaphragm, the wire connected to it moves the valve the same distance. The other diaphragm in each pair controls only the intermediate position holding the valve 1/4 or 1/2 open through a linkage arrangement. The two diaphragms which operate the outside and recirculating air valve are the number 3 and 4 diaphragms. The number 4 diaphragm is the 1/4 open outside and recirculating air valve diaphragm, which opens the valve through the linkage arrangement, and the number 3 diaphragm is the full open outside and recirculating air valve diaphragm which works directly. The other two diaphragms are the No. 1, which is the full open heater and evaporator valve diaphragm that works directly, and the No. 2, which holds the valve in the intermediate position. The number 2 diaphragm is the half open heater core and evaporator air valve diaphragm. Each of these valves operate in three positions -- open, intermediate and closed. The vacuum diaphragms operate the valve in the "open" and "intermediate" positions, while spring pressure holds the valve closed. After each operation the vacuum diaphragms are vented back through the vacuum switches.

### b. Vacuum Switches

The air conditioner control valve assembly has three vacuum switches. The #1 vacuum switch is open (allows vacuum to pass through) when its plunger is fully released and the #2 and #3 vacuum switches are open when their plungers are fully depressed.

The vacuum source (intake manifold) is connected to the #1 and #2 vacuum switches. The #1 vacuum switch allows vacum to be present at the #2 and #4 valve diaphragms and at the #3 vacuum switch when it is open.

The #2 vacuum switch allows vacuum to be present at the #3 valve diaphragm when open. When #1 and #3 vacuum switches are open, vacuum is present at the #1 valve diaphragm.

### c. Vacuum Hose Connections

Figure 11-52 shows the correct vacuum hose connections to the air valve vacuum diaphragms and vacuum switches. The hoses must be routed and connected as shown for the air distribution system to operate correctly.

### d. Operation

A check valve located at the intake manifold, allows vacuum to be present at the air conditioner control valve assembly. When manifold vacuum drops below a predetermined amount, the check valve closes so that vacuum will be maintained at the vacuum diaphragms and the operation of the air valves will not be affected.

A tee is in the vacuum hose which goes to the #4 vacuum diaphragm on the valve housing. The hose to the vacuum modulator (located at instrument panel) is connected to this tee.

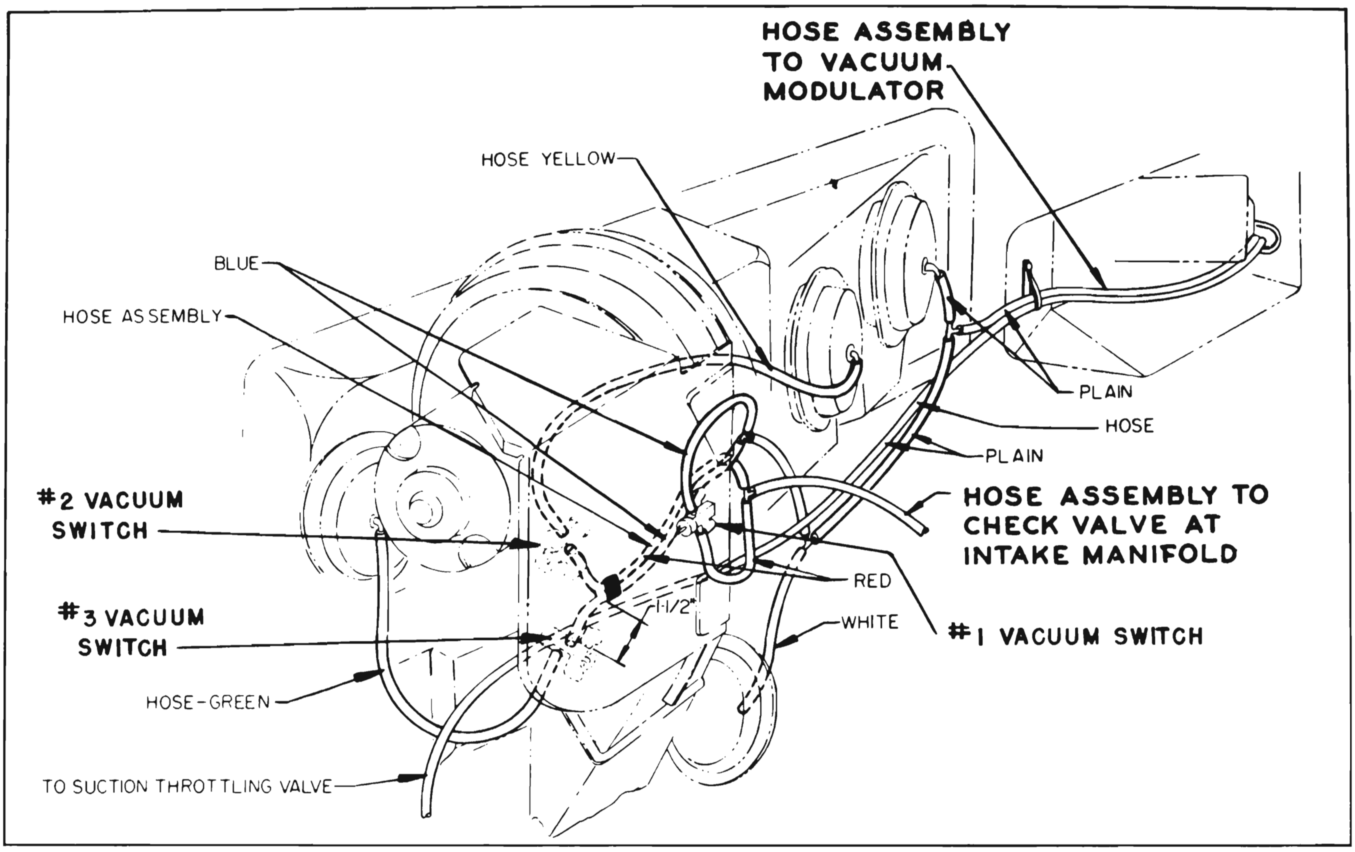


Figure 11-52—Vacuum Hose Connections

Vacuum is present at the #4 diaphragm when the #1 vacuum switch is open.

The position of the air valves in the housing and the vacuum switches that are open to allow vacuum to the vacuum diaphragms with heater and/or air conditioner on is described below.

1. Air Conditioner and Heater Off

When both the heater and air conditioner controls are off, the heater-evaporator and the outside-recirculated air valves are held in their respective closed positions by spring tension. Outside air will be closed off and the blower will not be operating. By the position of the valves, no air will be circulated through either of them. See Figure 11-54. The #1 and #2 vacuum switches are closed, thus, there is no vacuum to valve diaphragms.

2. Air Conditioner Off, Heater On

With the heater "Air" control on, the heater-evaporator air valve remains in its natural position (being fully open to heater core) and the outside-recirculated air valve will fully open bringing in all outside air which will circulate into the heater core. See Figure 11-55. The #2 vacuum switch is open, thus, there is vacuum to the #3 valve diaphragm.

3. Air Conditioner Normal, Heater Off

With the air conditioner "Cool" control on, but not fully on and/or the "Air" control on, the outside recirculated air valve will be fully open allowing 100% outside air for normal cooling or ventilation. Under this condition, the heater-evaporator air valve will fully open allowing all air to be directed into the evaporator. See Figure 11-56. All three vacuum switches are open, thus, vacum is to all four valve diaphragms and vacuum modulator.

4. Air Conditioning Maximum, Heater Off

The heater-evaporator air valve will remain fully open to the evaporator and closed to the heater core with the air conditioning "Cool" control in the maximum on (down) position. The outside-recirculated air valve will be 1/4 open. This will allow approximately 25% outside air and 75% recirculated air to mix and be directed to the evaporator. See Figure 11-57. The #1 and #3 vacuum switches are open, thus, there is vacuum to #1, #2 and #4 valve diaphragms and vacuum modulator.

5. Air Conditioning Normal or Maximum, Heater On

With the air conditioner "Cool" control on,

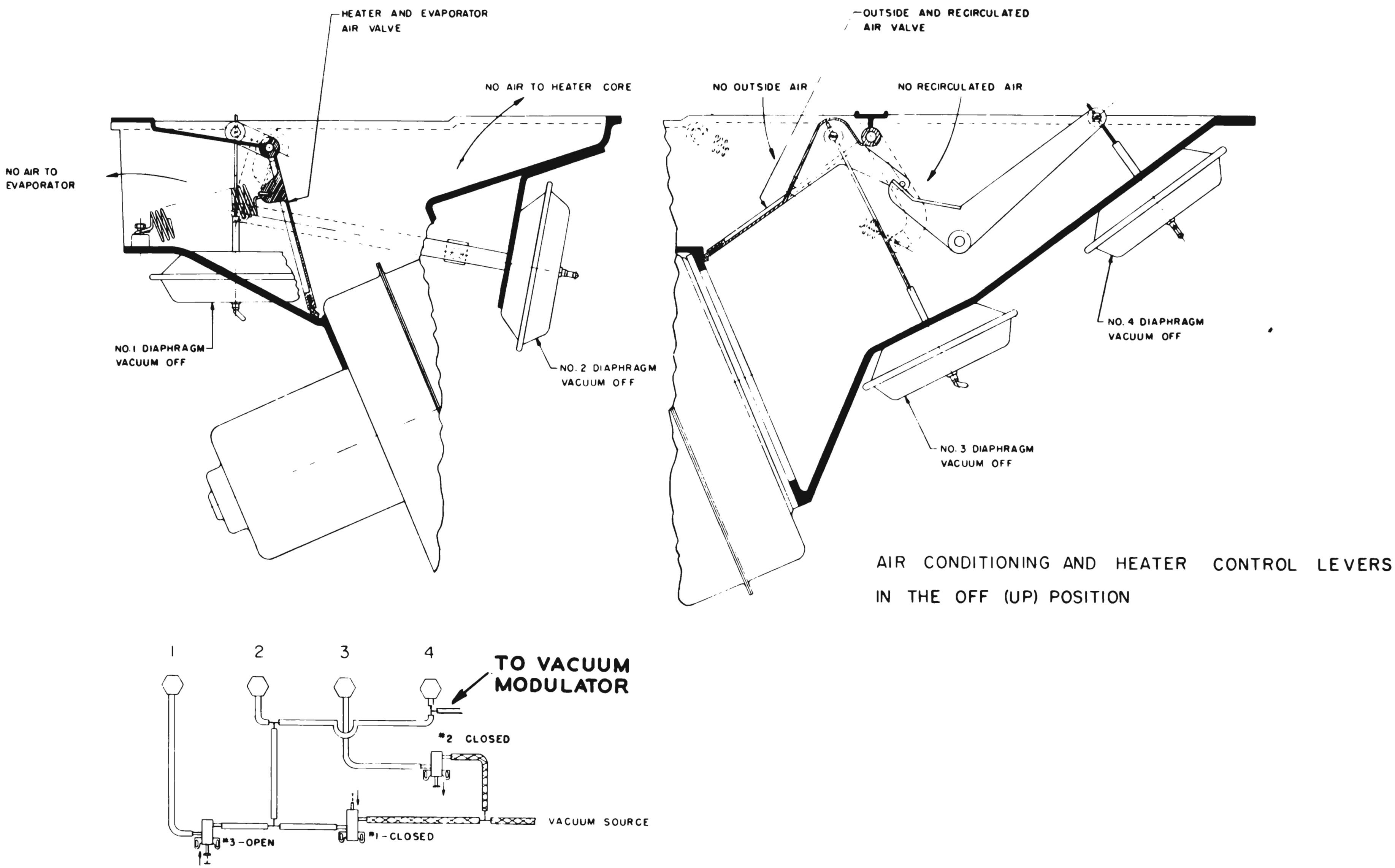


Figure 11-54—Air Conditioner and Heater Off

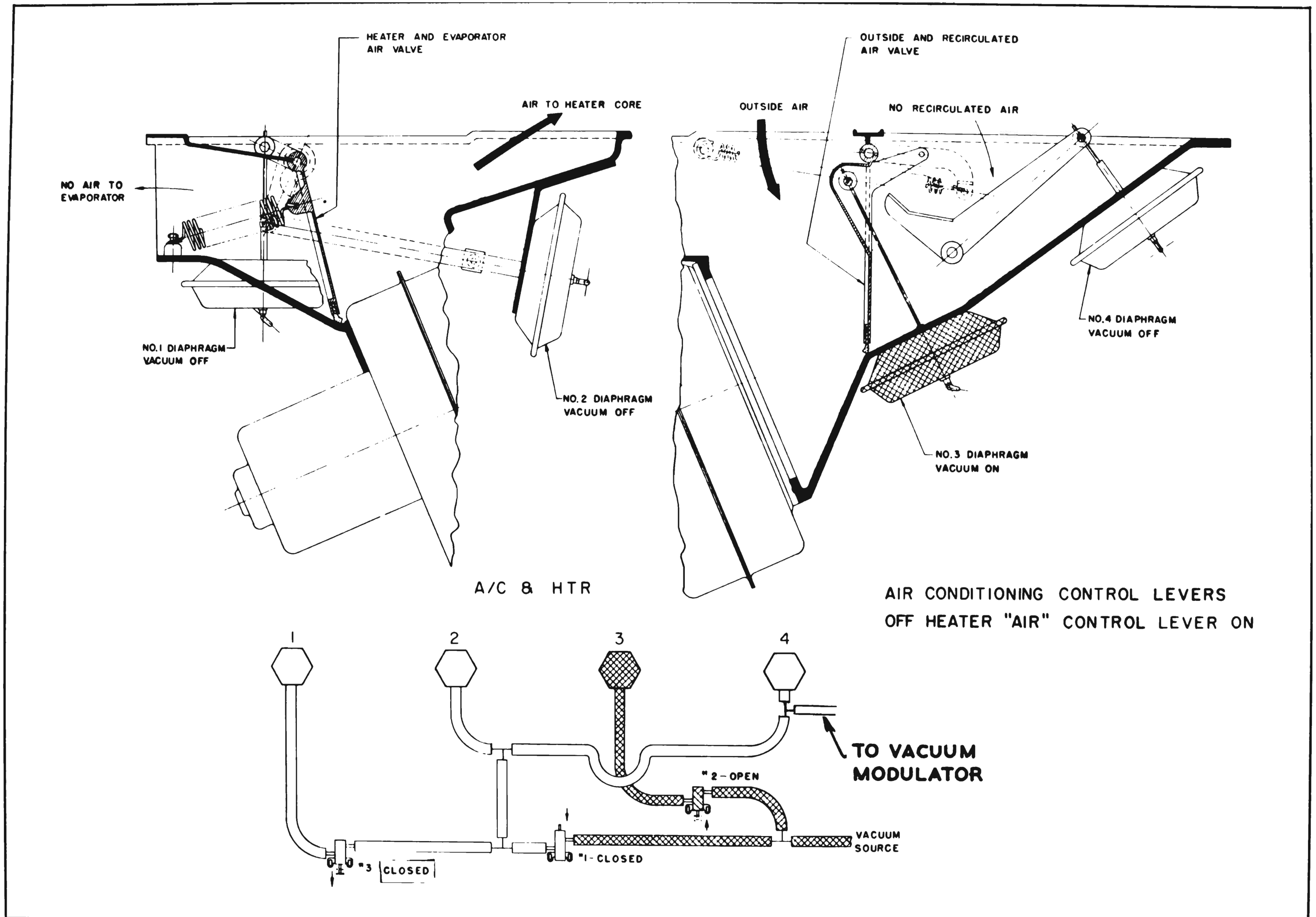


Figure 11-55—Air Conditioner Off, Heater On

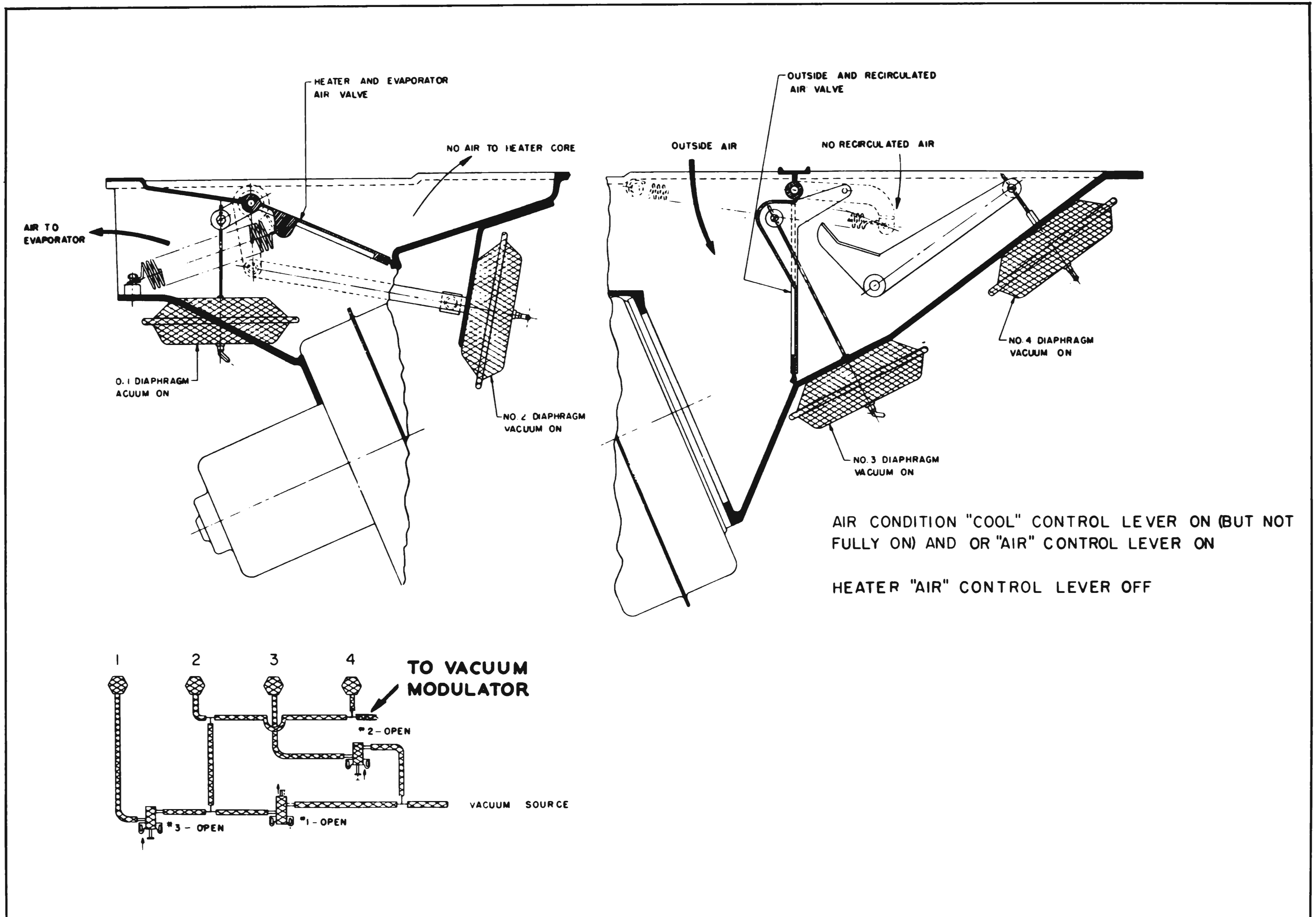


Figure 11-56—Air Conditioner Normal, Heater Off

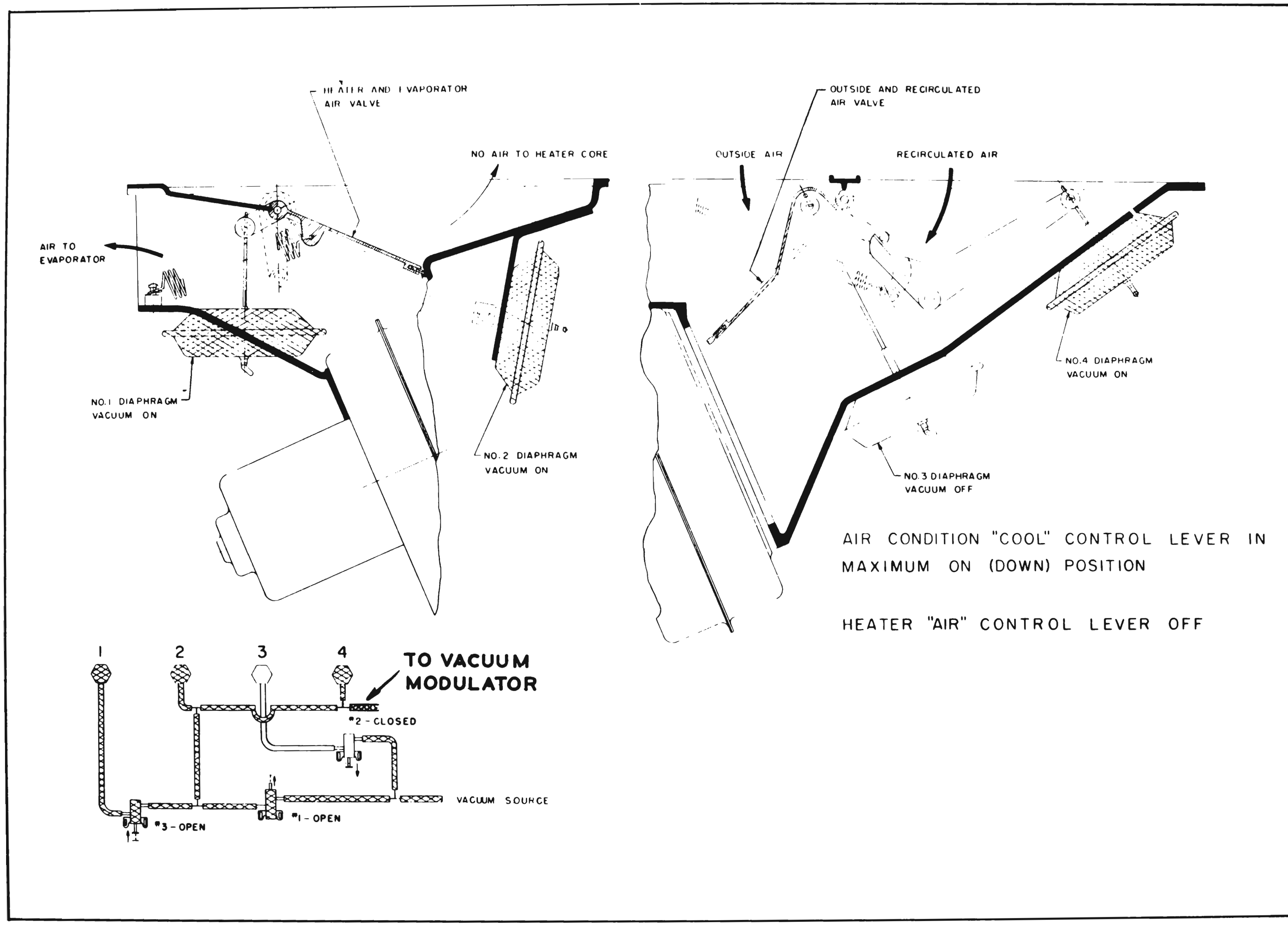


Figure 11-57—Air Conditioner Maximum, Heater Off

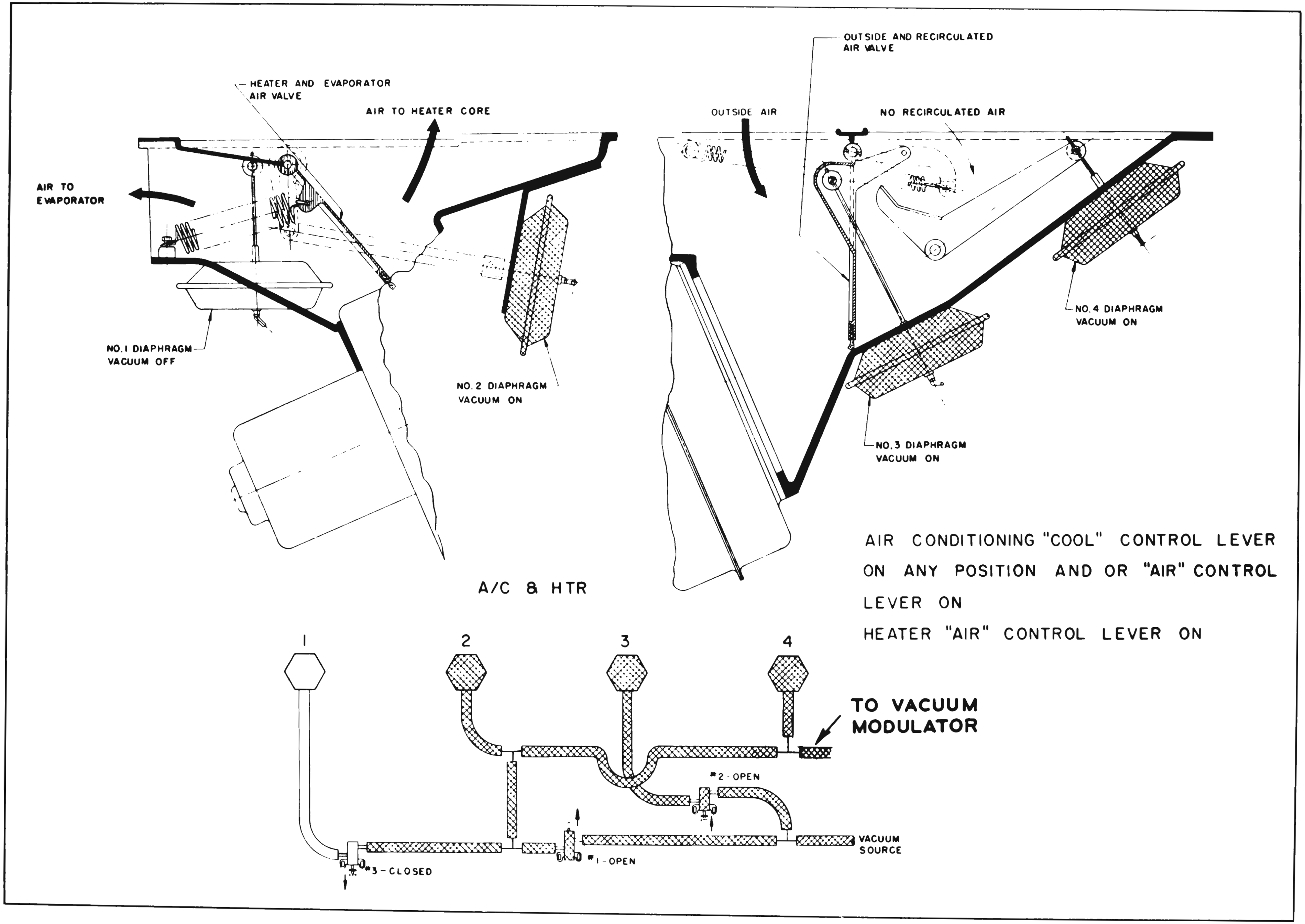


Figure 11-58—Air Conditioner Normal or Maximum, Heater On

and the heater "Air" control on, the heater-evaporator air valve will half open allowing air to be directed to both the evaporator and the heater core. The outside recirculated air valve will fully open allowing all outside air to be distributed to the evaporator and heater core. See Figure 11-58. The #1 and #2 vacuum switches are open, thus, there is vacuum to #2, #3 and #4 valve diaphragms and vacuum modulator.

**e. Air Distribution Chart**

Listed in the chart below are the positions of the control levers, diaphragms in operation, vacuum switch that is open and the air distribution.

IMPORTANT: Although applied diaphragms are diaphragms actually holding air valves in proper positions; vacuum may also be present to one or two other diaphragms. For example:

| Heater Air Control | Air Conditioner Cool and Air Controls | Diaphragms Applied | #1 Vacuum Switch | #2 Vacuum Switch | #3 Vacuum Switch | Air Distribution |
|---|---|---|---|---|---|---|
| Off | Off | None | Closed | Closed | Open | No air |
| On | Off | #3 | Closed | Open | Closed | Heater outlets only |
| Off | Cool control on, but not full on and/or Air control on | #1, #2, #3, #4 | Open | Open | Open | A/C outlets only |
| Off | Cool control full on | #1, #2, #4 | Open | Closed | Open | A/C outlets only |
| On | Cool control on and/or Air control on | #2, #3, #4 | Open | Open | Closed | A/C and heater outlets |

When #3 diaphragm (full open outside and recirculated air valve) is shown as applied, vacuum is also present at #4 diaphragm (quarter open outside and recirculated air valve). This in no way affects operation of #3 diaphragm. Likewise, when #1 diaphragm (full open heater and evaporator valve) is applied, vacuum is also present at #2 diaphragm (half open heater and evaporator valve). As the full open diaphragm overrides the half open diaphragm, vacuum applied to #2 has no effect on #1 diaphragm. On normal cooling with no heater operation, vacuum is applied to all four diaphragms. However, only #1 and #3 diaphragms (full open) are holding the valves in their proper positions.

When the plunger of the #1 vacuum switch is depressed it is closed, and when the plungers of the #2 and #3 vacuum switches are depressed they are open.

**f. Outside-Recirculated Air Valve Operating Arm**

The outside-recirculated air valve operating arm is located on top of the blower and valve housing assembly. See Figure 11-59. The position of the air valve can be determined by the location of its spring loaded crank arm. The valve is in the closed position when the arm is pointing forward. When the valve is full open the arm is at approximately 90 degrees to centerline of car and when it is in the

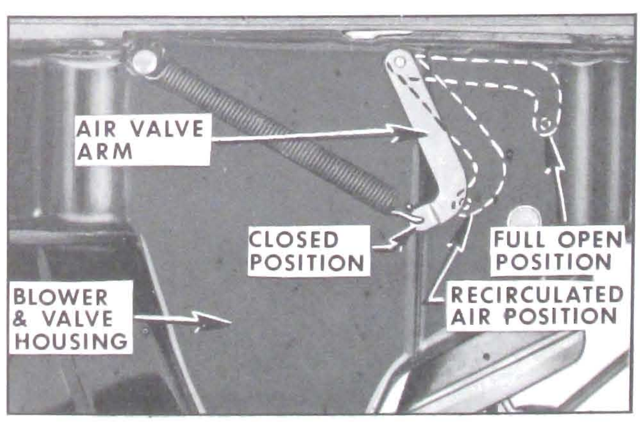


Figure 11-59—Outside-Recirculated Air Valve Crank Arm

recirculated air position the arm is 1/4 from closed position.

The heater-evaporator air valve can best be checked for proper functioning by determining if the air distribution through air conditioner and heater outlets is correct.

**g. Trouble Diagnosis**

If the air conditioner air distribution system is not functioning properly, first check the vacuum hose connections, Figure 11-52, the control cable adjustments and the vacuum switch adjustment as instructed in paragraph 11-16. If this does not correct complaint, check for vacuum at valve diaphragms, for proper functioning of vacuum switches and position of air valves as shown in Figures 11-54 through 11-58. Figure 11-59 shows the location of outside-recirculated air valve arm when the valve is in closed, full open and recirculated positions. Refer to trouble diagnosis chart for possible causes of complaint.

IMPORTANT: If complaint is that air flow changes or shuts off when car is accelerated, check valve at intake manifold may be defective. Also, if there is no vacuum to STV when "Cool" lever is on (not full on), check for the vacuum hoses being off vacuum modulator, hose being kinked or modulator being defective.

**h. Vacuum Switch Trouble Diagnosis**

| CONDITION | COMPLAINT | POSSIBLE CAUSE |
|---|---|---|
| All controls off | Air out of A/C outlets | #1 and 2 vacuum switches adjusted improperly or defective |
| | Air out of heater | #1 vacuum switch adjusted incorrectly allowing #2 to remain open. #2 vacuum switch adjusted incorrect or defective. |
| Heater "Air" on | Recirculated air only - no outside air, windows steam up, air in car stale | #2 vacuum switch adjusted incorrectly or defective, does not allow outside air valve to open. |
| | Air out of A/C outlets | #1 vacuum switch adjusted incorrectly or defective, allowing vacuum to #2 valve diaphragm. |
| A/C "Cool" control on normal and/or A/C "Air" control on. | All air out of heater outlets | #1 vacuum switch adjusted incorrect or defective. |
| | Recirculated air through heater | #1 vacuum switch defective, #2 adjusted incorrectly or defective, no vacuum to any of the diaphragms. |
| | 1/4 outside air only | #2 not adjusted correctly or defective, no vacuum to diaphragm #3. |
| | Air out of A/C and heater outlets | #3 vacuum switch adjusted incorrectly or defective, no vacuum to #1 diaphragm. |

**h. Vacuum Switch Trouble Diagnosis— (Cont'd)**

| CONDITION | COMPLAINT | POSSIBLE CAUSE |
|---|---|---|
| A/C "Cool" control on maximum | No recirculated air | #2 vacuum switch incorrectly adjusted or defective, vacuum to #3 diaphragm. |
| A/C "Cool" and/or "Air" control on and heater "Air" control on | All air through heater outlets | #1 vacuum switch defective no vacuum to #2 diaphragm. |
| | All air through A/C outlets | #3 vacuum switch defective, vacuum to #1 diaphragm. |
| | 1/4 outside air only | #2 vacuum switch incorrectly adjusted or defective, no vacuum to #3 diaphragm. |

## 11-16 SERVICE PROCEDURES

NOTE: See Paragraphs 11-17 and 11-18 for service procedures on compressor assembly.

### a. Safety Precautions

The following safety precautions should always be used when servicing the air conditioner refrigeration system.

1. Do not leave drum of Refrigerant-12 uncapped.
2. Do not carry drum in passenger compartment of car.
3. Do not subject drum to high temperature.
4. Do not weld or steam clean on or near system.
5. Do not fill drum completely.
6. Do not discharge vapor into area where flame is exposed or directly into engine air intake.
7. Do not expose eyes to liquid refrigerant; always wear safety goggles.

### b. Installation Precautions

1. All subassemblies are shipped sealed and dehydrated. They are to remain sealed until just prior to making connections.
2. All subassemblies should be at room temperature before uncapping. This prevents condensation of moisture from air that enters the system.
3. All precautions should be taken to prevent damage to fittings or connections. Even minute damage to a connection could cause it to leak.
4. Any fittings with grease or dirt on them should be wiped clean with a cloth dipped in alcohol.

Do not use chlorinated salts such as trichlorethylene for cleaning agents as they are contaminants. If dirt, grease or moisture gets inside the pipes and cannot be removed, the pipe is to be replaced.

5. Use a small amount of refrigeration oil on all tube and hose joints and lubricate the O-ring seal in this oil before assembling the joint as this oil will help in making a leak-proof joint. When tightening joints use a second wrench to hold the stationary part of the connection to prevent twisting and to prevent hose kinking as kinked hoses are apt to transmit noise and vibration.

CAUTION: Tighten all connections in accordance with recommended torques. See pipe and hose connection chart, par. 11-12, sub par. a. Insufficient torque when tightening can result in loose joints and excessive torque, when over-tightening can result in distorted joint parts and either condition can result in refrigerant leakage.

6. Do not connect receiver dehydrator assembly until all other seals of assemblies have been connected. This is necessary to insure optimum dehydration and maximum moisture protection of the system.

### c. Discharging Refrigerant from Air Conditioner System

When a part is removed or disconnected that is in the Air Conditioner refrigeration circuit, the refrigerant must be discharged from system using the following procedure.

1. Remove protective caps from schrader valve gauge fittings of suction and discharge lines located at rear of compressor.

2. Using adapters J-5420, connect charging lines of pressure gauge and set Manifold J-5415 to shrader valves as shown in Figure 11-128 with both valves of manifold closed. See Figure 11-60.

3. Slowly open valves on Manifold and discharge all pressure from system.

CAUTION: Do not open valves too fast as excessive oil will be blown out of system. Place rag over end of discharge service line to prevent oil or liquid refrigerant from spraying on car or person.

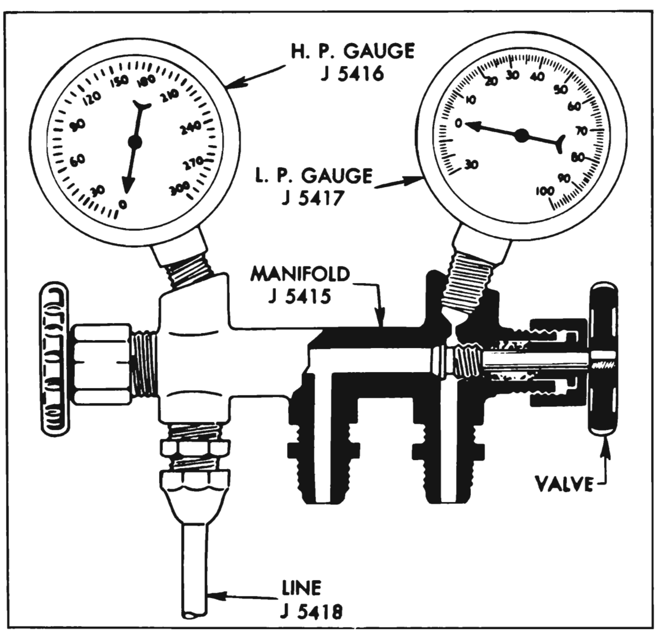


Figure 11-60—Pressure Gauge Set

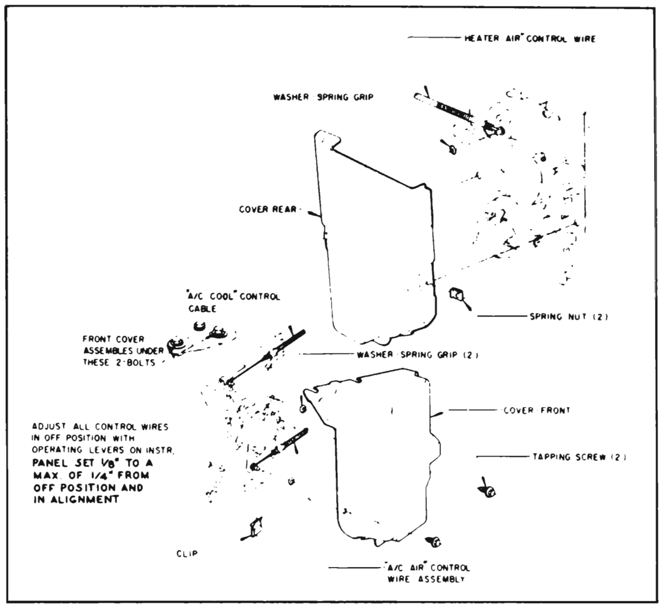


Figure 11-61—Control Wire Adjustment

### d. Adjustments

There is no service adjustment on the blower switches, the thermostatic expansion valve or the vacuum modulator.

1. "Air" and "Cool" control wires. With the control valve assembly levers in the off position, the control levers on instrument panel should be 1/4" from off (full up). See Figures 11-61 and 11-62. To adjust, loosen control wire cables at valve assembly and reposition cables. Tighten clamps securely.

NOTE: The heater "Air" control wire is adjusted in the same manner.

2. Suction Throttle Valve Adjustment. In the event it becomes necessary to adjust the suction pressure, the following procedure should be used:

(a) Remove the vacuum hose from the STV vacuum diaphragm.

(b) Have service gauge set connected to schrader valves as shown in Figure 11-129.

IMPORTANT: When checking and adjusting STV, low pressure gauge line must be connected to schrader valve located on STV.

(c) Close gauge set valves.

(d) With engine speed set at 1600 RPM and air conditioner on maximum cooling, adjust evaporator pressure as specified in functional test chart, Figure 11-130.

(e) To adjust valve, loosen lock nut on sleeve of STV vacuum diaphragm. See Figure 11-63. Turn diaphragm into cover of valve to increase evaporator pressure. Turn valve out of cover to decrease evaporator pressure.

(f) After STV has been adjusted to specified pressure, tighten lock nut and reinstall vacuum hose.

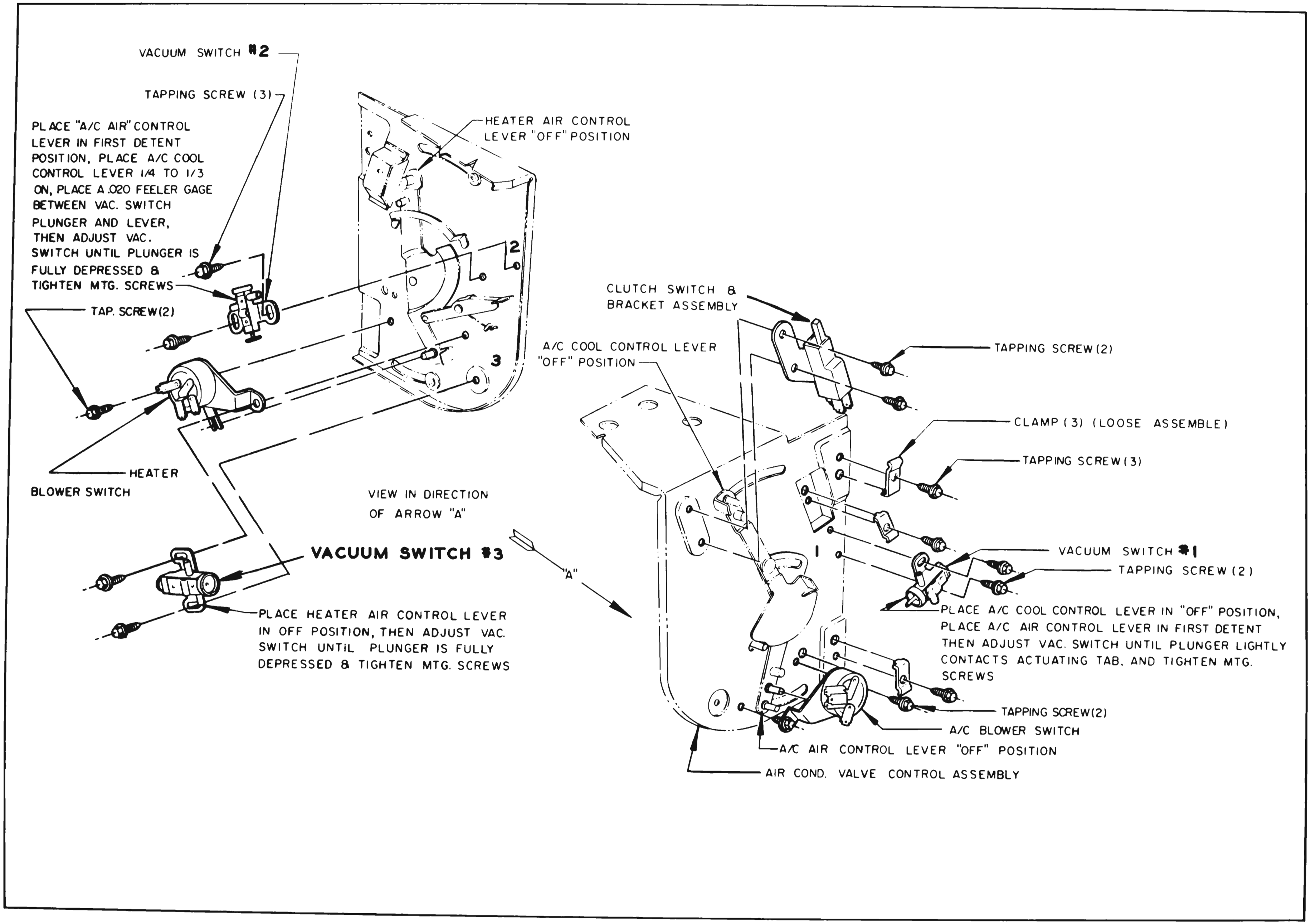


Figure 11-62—Vacuum Switch Adjustment

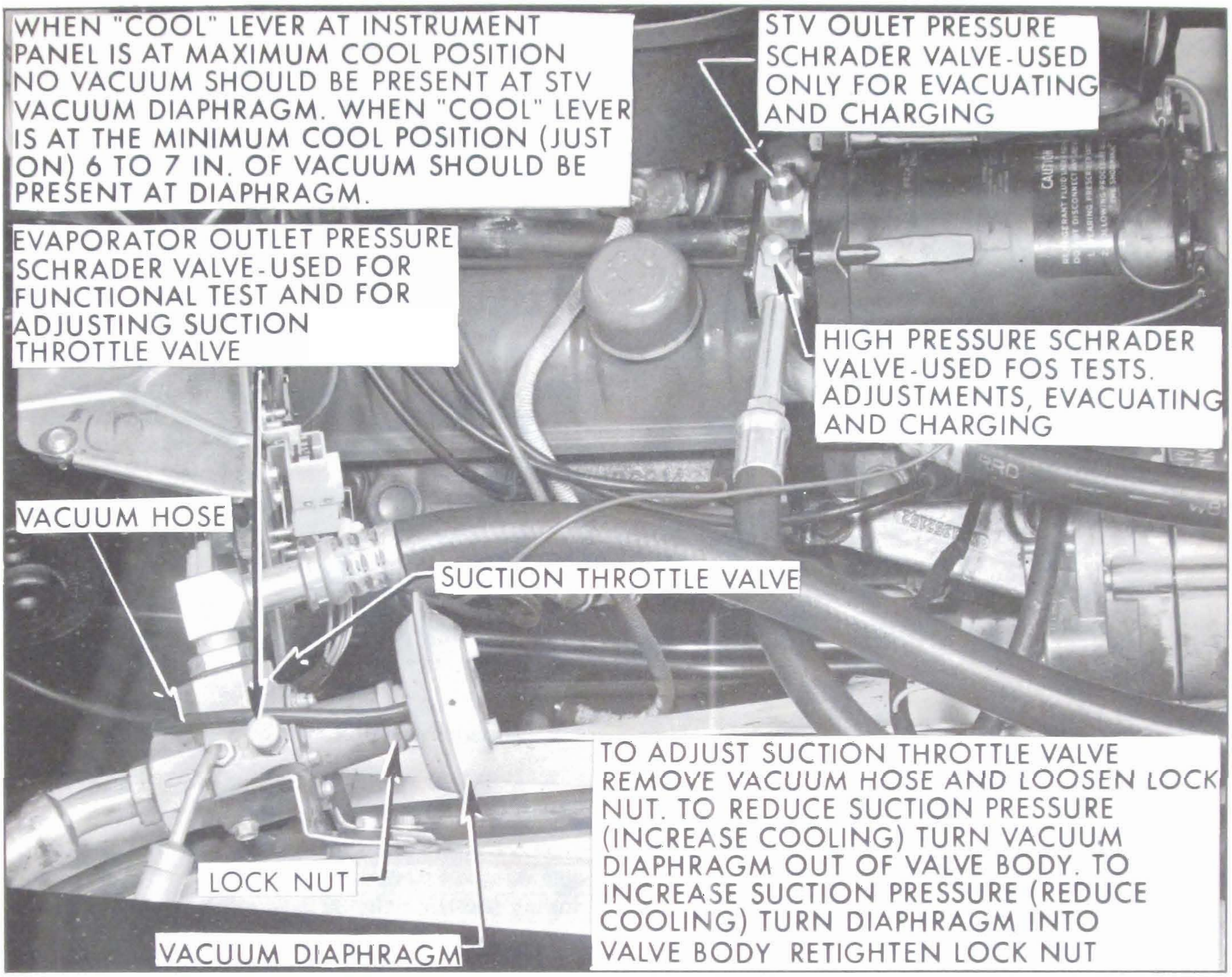


Figure 11-63—Suction Throttle Valve Adjustment

(g) To check the operation of the STV and the vacuum modulator, move the air conditioner "cool" lever on instrument panel to the minimum cooling position (just on). With the "cool" lever in this position, the evaporator pressure should show a minimum of approximately 50 p.s.i. Return the "cool" control to the maximum cooling position to re-check the setting of the STV.

NOTE: If evaporator pressure does not increase when "cool" lever is at minimum cooling position, check operation of vacuum modulator by connecting a vacuum gauge to the hose that goes to the STV. The modulator should regulate manifold vacuum from 6 to 7 inches when the "cool" lever is moved just down from the off position. The vacuum should decrease to 0 inches when the "cool" lever is moved to the extreme down position. If modulator does not function properly, check vacuum hose connections, check for kinked hose or for defective modulator.

3. Vacuum Switch Adjustment. Check operation of vacuum switches by referring to Figures 11-54 through 11-58. Place the control levers as indicated in each figure and check for vacuum at each diaphragm by pulling the hose off the diaphragm fitting and holding finger over end of hose. If vacuum switches are functioning correctly, vacuum will be present only at these diaphragms indicated by "Vacuum on" in each figure. The adjustment procedure for each vacuum switch is listed below and on Figure 11-62.

(a) Vacuum Switch #1. Loosen switch mounting screws. With air conditioner "Cool" lever in off position and "Air" lever in first detent, adjust vacuum #1 until plunger just lightly touches actuating tab of lever mechanism. Tighten mounting screws. See Figure 11-64.

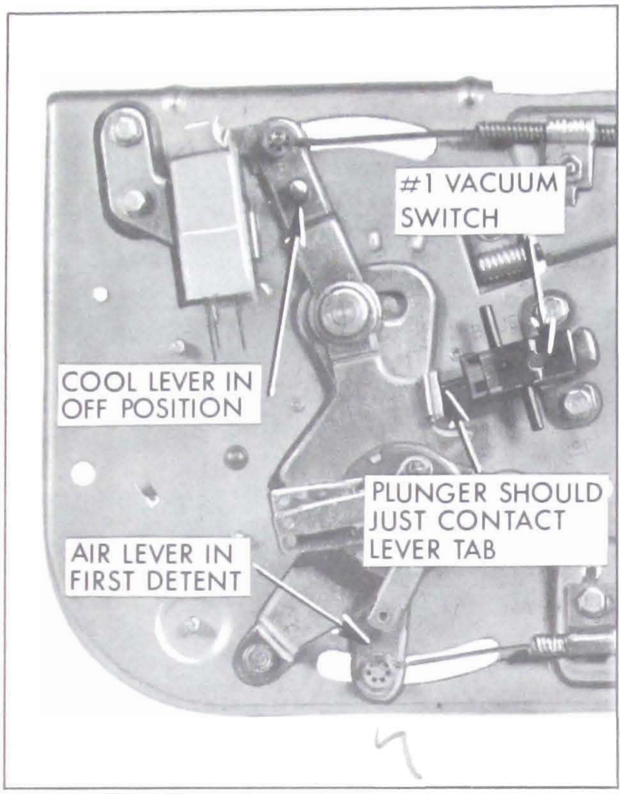


Figure 11-64—Number 1 Vacuum Switch Adjustment

(b) Vacuum #2. Loosen switch mounting screws. With air conditioner "Air" lever in first detent from off position and "Cool" lever 1/4 to 1/3 on, place a .020 feeler gauge between vacuum switch plunger and lever, then adjust switch until plunger is fully depressed and tighten mounting screws. See Figure 11-65.

(c) Vacuum Switch #3. Loosen switch mounting screws. With heater "Air" lever in off position, adjust switch until plunger is fully depressed and tighten mounting screws. See Figure 11-66.

NOTE: If vacuum switches are adjusted, check adjustment of control wires.

4. Compressor Clutch Switch Adjustment - Bend switch operating tab (on lever that "cool" control wire is attached to) so that switch is in the extreme off position when "cool" lever is in the off position.

#### e. Removal and Installation of Suction Throttle Valve

1. Discharge refrigerant from system as described in subparagraph c.

2. Disconnect lines from valve.

3. Remove valve mounting screws and remove valve. See Figure 11-67.

NOTE: All of the openings to the air conditioning system should be capped or plugged during the time the STV is removed.

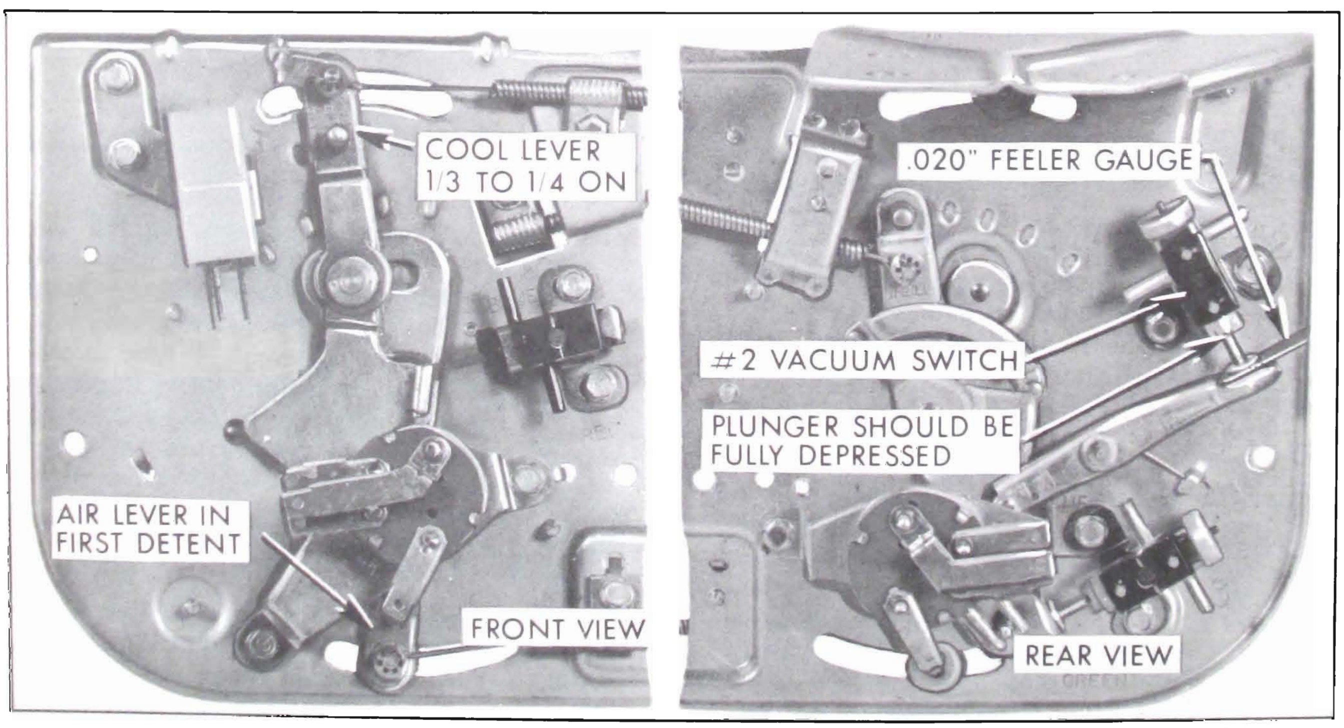


Figure 11-65—Number 2 Vacuum Switch Adjustment

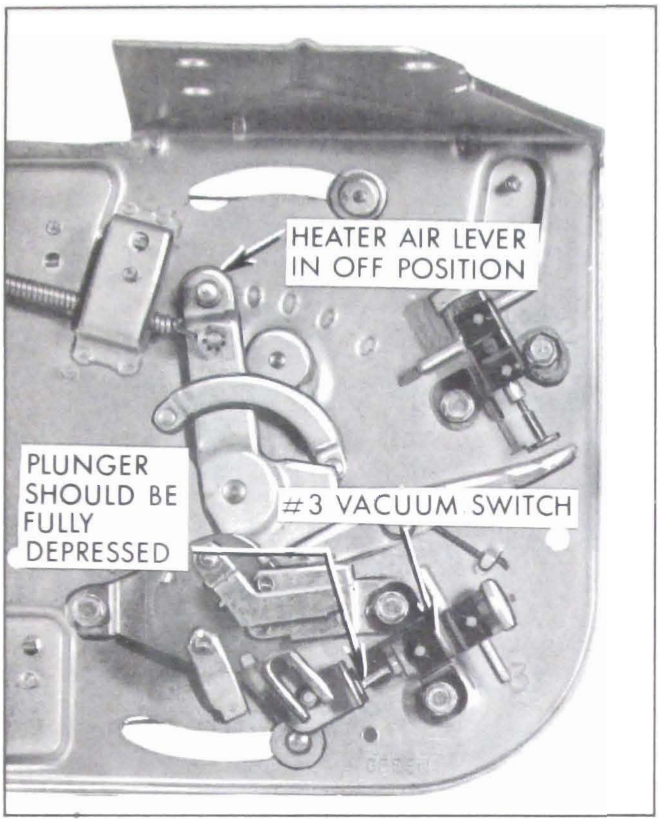


Figure 11-66—Number 3 Vacuum Switch Adjustment

4. Install valve by reversing procedure for removal, paying attention to the following:

(a) Install new O-rings on line fittings.

(b) Evacuate and charge the system. Leak test valve and connections. Correct any leaks.

(c) To check operation of STV, refer to subparagraph d, step 2.

**f. Disassembly and Assembly of Suction Throttle Valve**

If test indicated STV is defective, the valve may be overhauled as follows:

1. With STV removed from car, loosen lock nut on vacuum diaphragm and turn diaphragm assembly out of cover. Discard O-ring on sleeve of diaphragm. See Figure 11-68.

2. Remove spring from cover.

3. Remove the five screws that retain cover to body of valve and remove cover.

4. Remove diaphragm and piston assembly. The diaphragm may be removed from the piston by grasping the piston in one hand and the diaphragm with the other hand, stretching the diaphragm until the tab is released from the piston. The diaphragm should be handled with care to avoid damage by scuffing, cutting or abrading the rubber and fabric surfaces. The screen and retainer in the lower portion of the piston should not be removed. It should, however, be examined for any foreign material or contamination. If necessary clean screen with a volatile solvent. All solvent should be removed from parts after cleaning.

In the event the exterior surface of the piston is damaged such as scored or scratched or nicked, in such a way as to cause it to bind in the bore, it should be replaced.

NOTE: It is recommended that no attempt be made to scrap, stone or crocus cloth these damaged areas due to the close tolerance that is required in the fitting of the parts for proper operation.

In the event the diaphragm is found to be damaged it should be replaced with a new one. If a new diaphragm is to be installed, first apply a light coat of 525 viscosity Frigidaire oil to the tab of the diaphragm. Hold the piston in one hand and insert the thumb of the other hand into the top of the diaphragm and carefully insert the tab into the hole in the top of piston, slowly press with a downward and rotating motion until the tab is seated into position.

A very light application of powdered Molykote Type Z should be applied to the upper or fabric surface of the depressed section of the diaphragm where the spring retainer cup will fit into it.

NOTE: The source for the material is:
Alpha-Molykote Corporation,
Stamford, Connecticut.
No other material is recommended.

Examine the body bore surfaces for any surface imperfections, foreign material and any obvious damage that would cause the piston to not operate freely. The body should be replaced if the bore is damaged or if any cross threading or damage has been sustained around the connector ports.

NOTE: Again, do not attempt to scrape, stone or "dress out" any damage as it may result in improper performance of the valve.

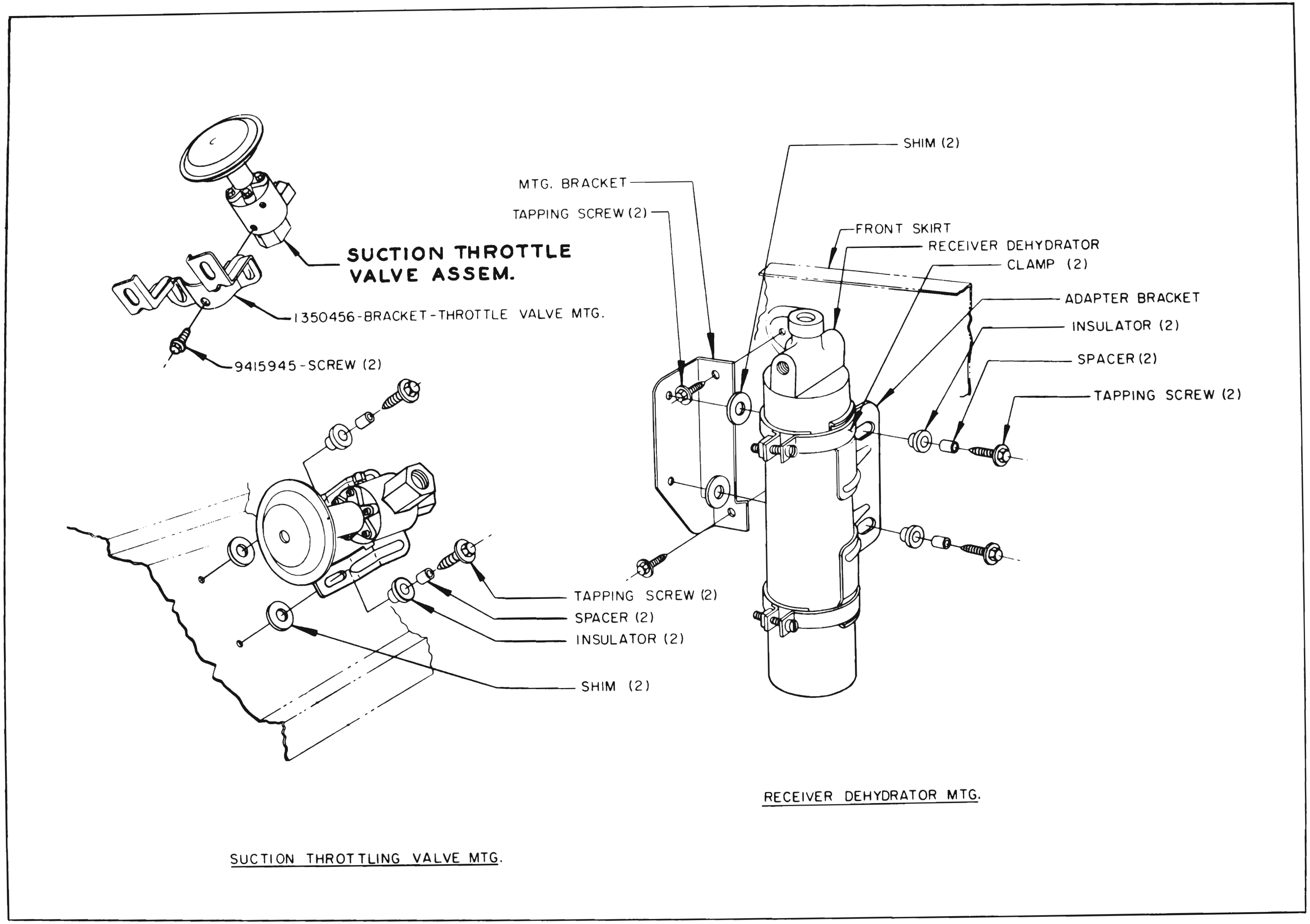


Figure 11-67—Suction Throttle Valve and Receiver-Dehydrator Installation

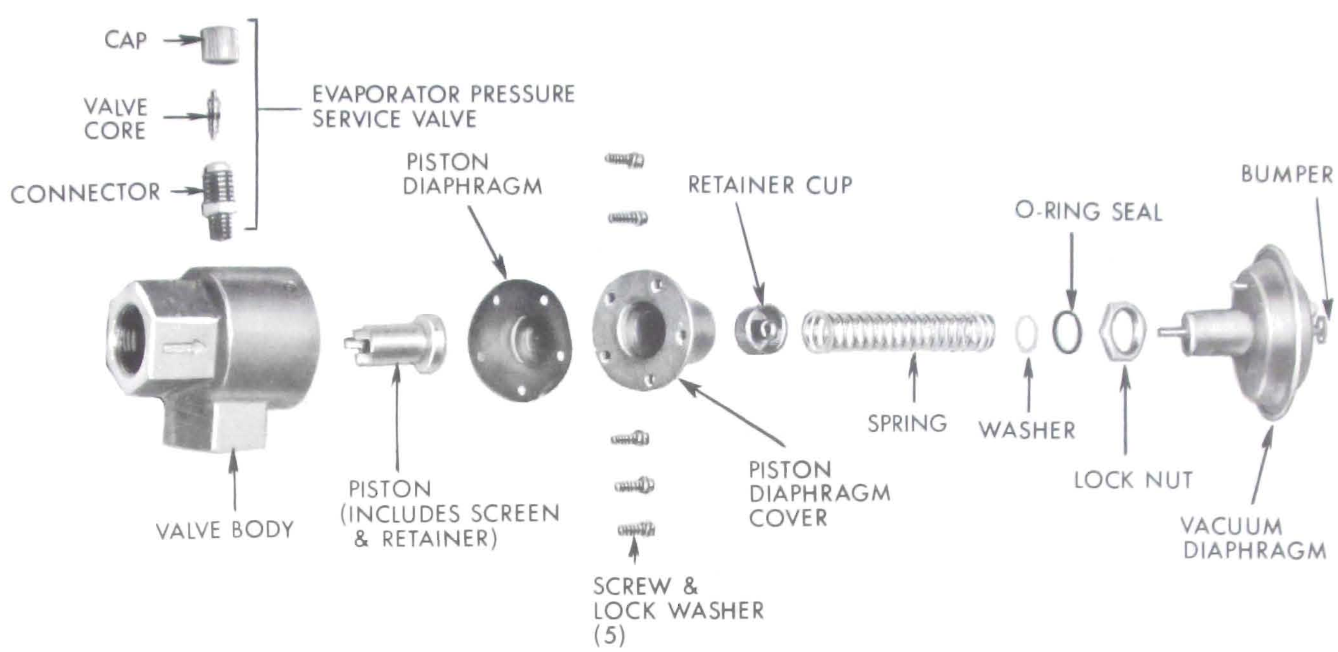


Figure 11-68—Exploded View of Suction Throttle Valve

5. Apply a light coat of 525 viscosity oil to the wall of the piston and insert it into the body of the valve.

6. Assemble the spring cup to the diaphragm and place the cover in proper location over the diaphragm, being sure the diaphragm holes are in line with the locating protrusions under the cover flange. Start the five screws into the body, but DO NOT TIGHTEN.

7. With the cover and body held loosely in one hand, insert a clean smooth rod, approximately 3/8" in diameter, through the inlet opening so as to contact the screen retainer in the bottom of the piston.

Carefully push the piston into the cover so that the diaphragm positions properly into the cavity of the cover and does not become "pinched" under the flange.

Now remove the rod from the inlet opening and insert it through the upper portion of the cover. It should contact the center post of the cup. Press lightly downward so as to cause the piston to seat against the inner shoulder of the body. While the cup, diaphragm and piston are held down, tighten the five screws to 45 to 50 inch pounds torque.

8. Insert thrust washer and spring in cover.

9. Place lock nut on vacuum diaphragm and install a new O-ring on diaphragm. Install assembly in cover approximately ten turns being sure pin of diaphragm engages hole in retainer cup.

10. Install STV as described in sub. par. e and adjust as described in sub. par. d.

**g. Removal of Evaporator and Air Distribution System Parts**

1. Replacement of Vacuum Diaphragms. The half open position heater evaporator air valve diaphragm #2 may be changed from the engine compartment.

The other three diaphragms (#1, #3 and #4) can only be changed when the blower housing is removed from the cowl. The diaphragms may then be disconnected from the valve operating levers and the nuts removed from the mounting screws. Assembly may be accomplished by reversing the procedure.

2. Evaporator Assembly Removal. To remove evaporator the right front fender and skirt assembly must be removed. Refrigerant must be discharged from system as described in subparagraph c. Care must be used when handling evaporator. Before installing evaporator it is important that the drain hose be checked to be sure it is open.

3. Air Distribution Outer Duct. Figure 11-70 shows correct installation of the air distribution outer duct.

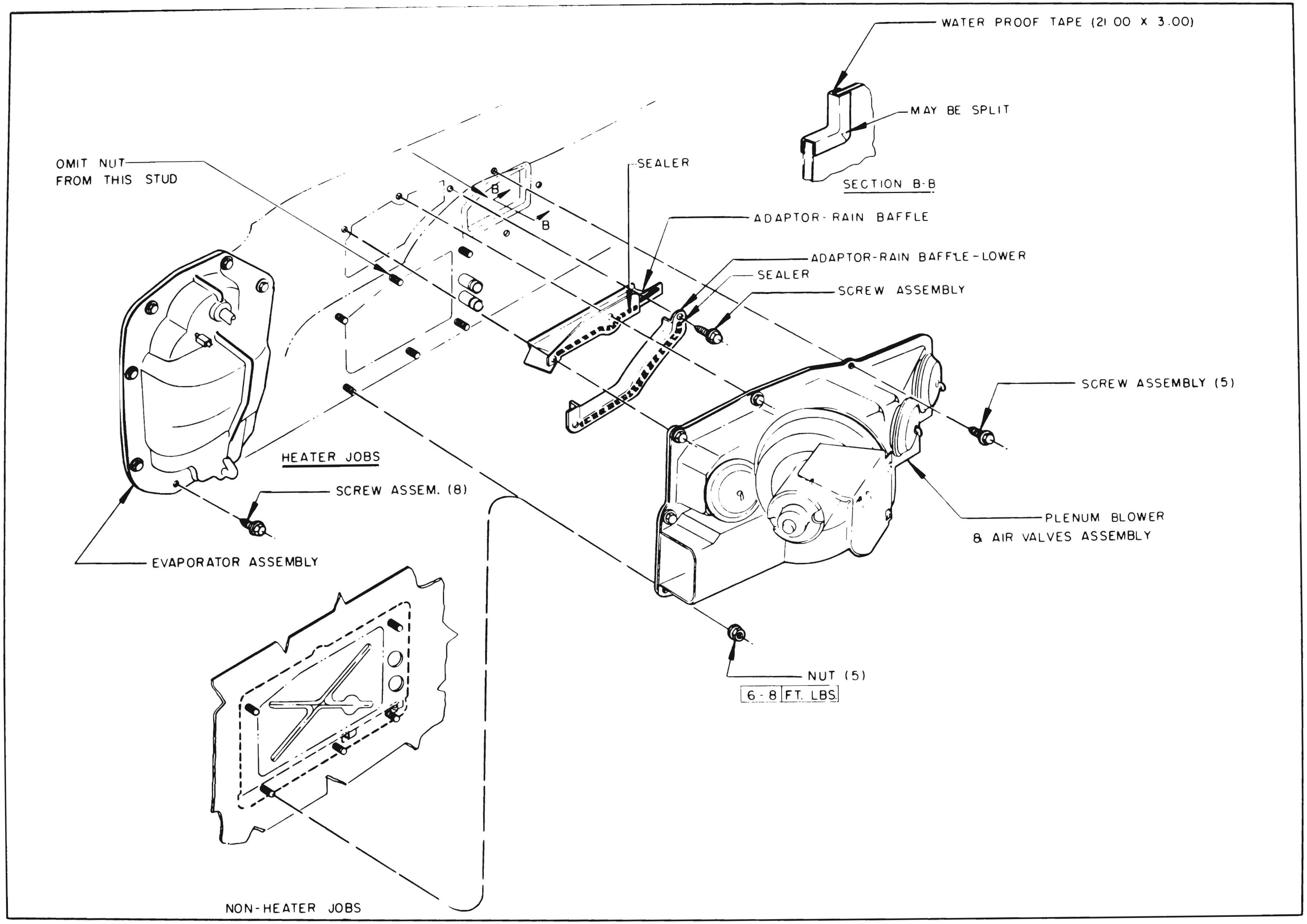


Figure 11-69—Evaporator and Blower and Valve Housing Installation

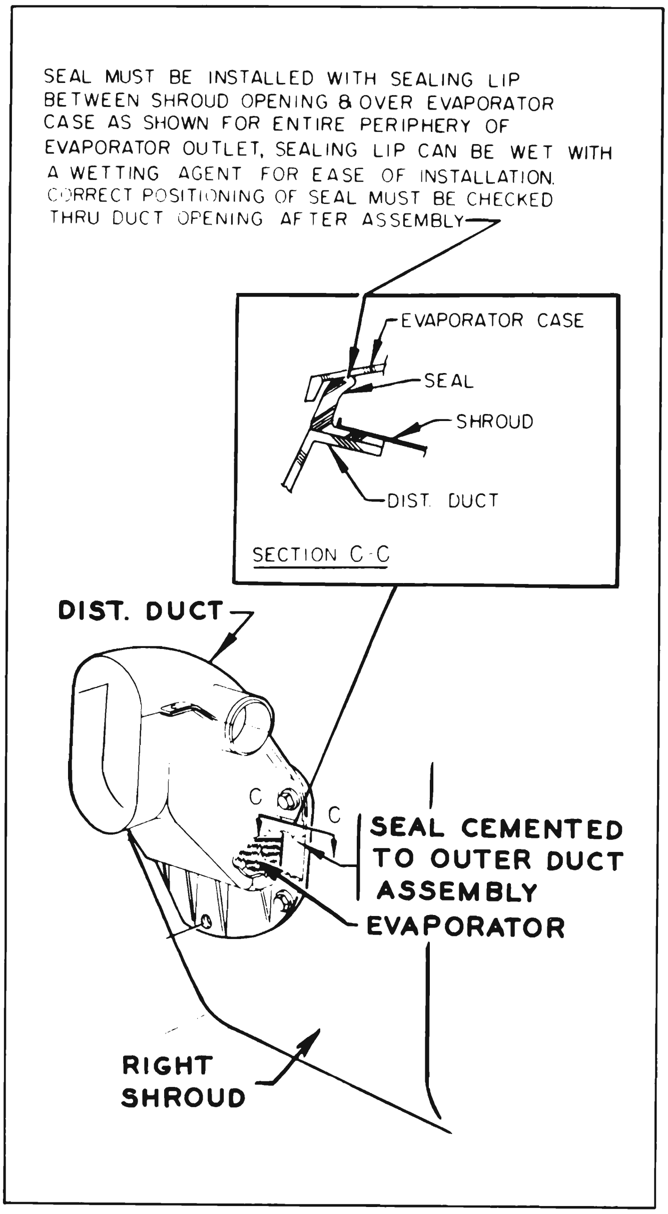


Figure 11-70—Air Distribution Outer Duct

4. Center Outlet. Figure 11-71 shows the installation of the center outlet.

### h. Removal of Thermostatic Expansion Valve

To remove expansion valve, refrigerant must be discharged from system as described in subparagraph c and right front fender removed. It is not necessary to remove fender inner skirt.

### i. Vacuum Modulator

Figure 11-72 shows the installation of the vacuum modulator. It is mounted on the air conditioner control lever assembly and retainer by special clips which may be snapped out of place if necessary to replace modulator.

### i. Removal and Installation of Compressor

1. Discharge refrigerant from system as described in subparagraph c.

2. Remove retaining bolt and lockwasher to remove valve retaining plate from rear end of compressor.

3. Cover the openings in lines and compressor with tape to exclude dirt.

4. Disconnect clutch coil wire, then loosen the belts and remove compressor from its mounting on engine. See Figure 11-73.

Do not place compressor in sun or near heat because it still contains some refrigerant.

5. Remove parts from replaced compressor and install on service compressor following instructions received with new compressor.

IMPORTANT: Whenever a compressor replacement is being made the oil in the original compressor should be drained and measured. The new compressor should contain the same amount of new 525 viscosity oil as was drained from the original compressor. This step is necessary as some of the oil from the original compressor remains in the system. The addition of a complete charge of oil, in addition to the oil remaining in the system, would impair the cooling ability of the unit.

CAUTION: If it is evident that the air conditioner has lost a large amount of oil, refer to subparagraph k for procedure for adding oil to compressor.

6. Install compressor by reversing procedure for removal, paying attention to the following points:

(a) Inspect drive belts and pulley grooves for conditions that might cause slippage. If a belt is cracked, frayed, or oil soaked, or is worn so that it bottoms in pulley grooves, replace both belts. Belts are furnished in matched sets only, to insure even tension.

(b) Use new O-rings when attaching valve assemblies to compressor.

(c) Adjust compressor belt tension. See Figure 11-74.

(d) Evacuate, leak test and charge air conditioner system (par. 11-19).

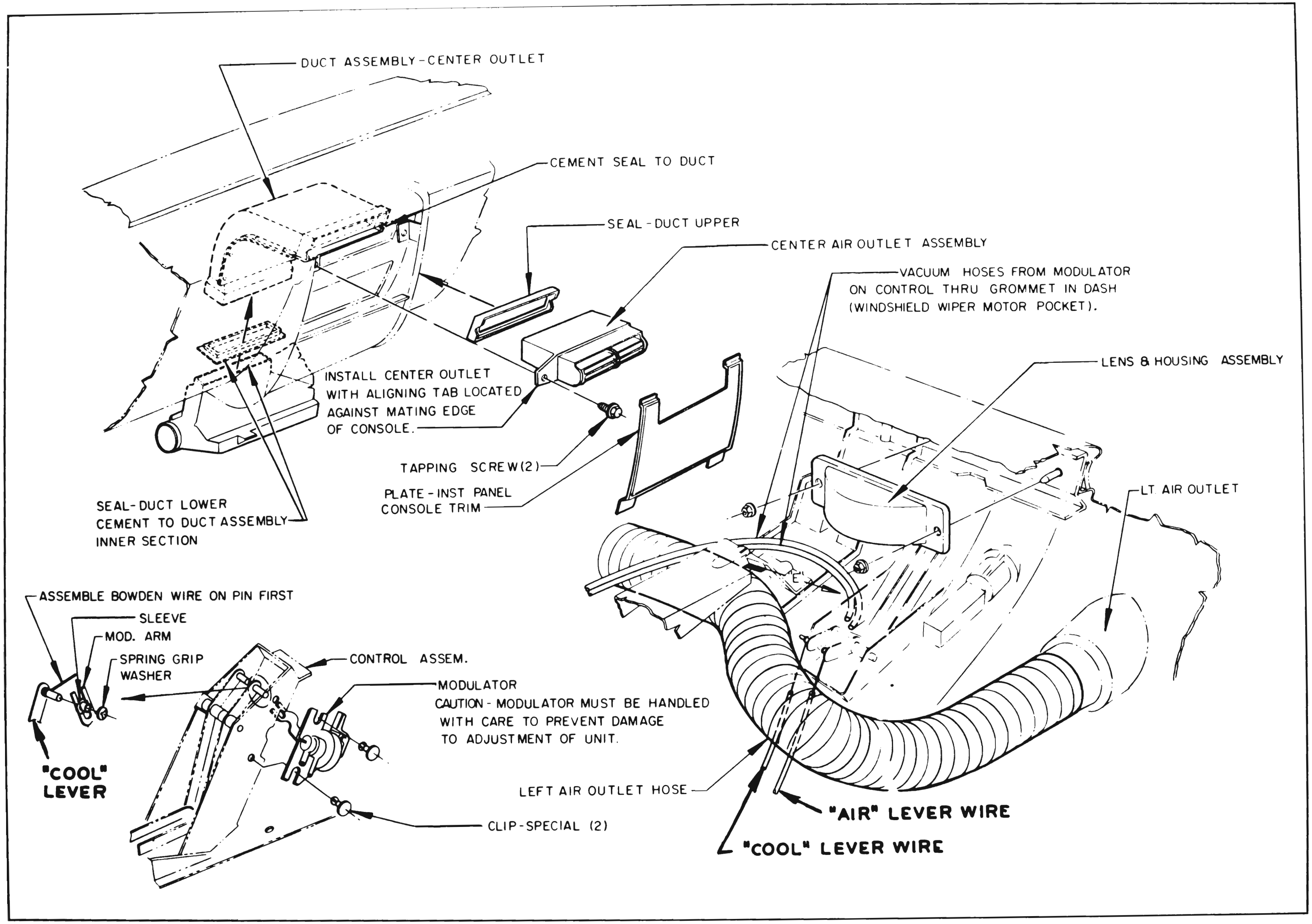


Figure 11-71—Center Outlet and Control Wire Installation

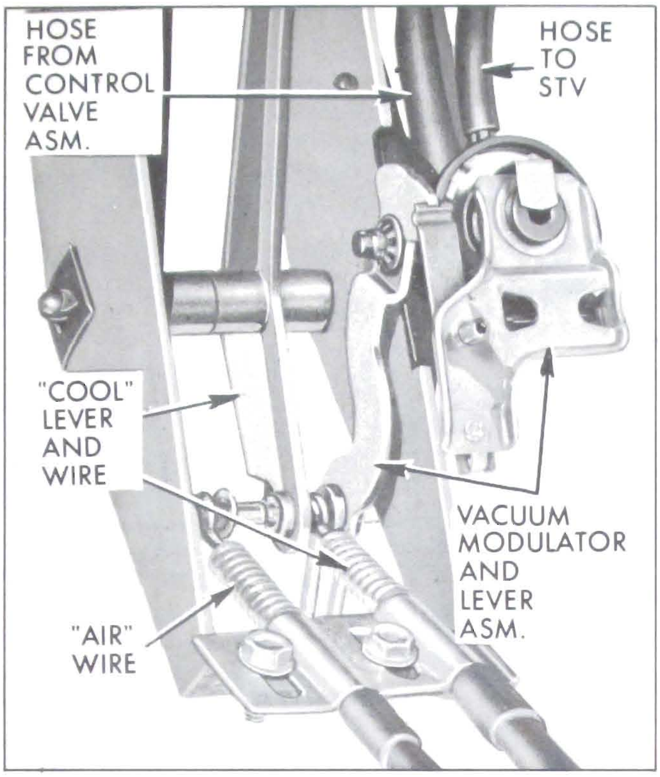


Figure11-72—Vacuum Modulator Installation

**k. Checking Compressor Oil and Adding Oil**

The six cylinder air conditioner compressor is initially charged with 10 1/2 fluid ounces of 525 viscosity Frigidaire Refrigerant oil. After the air conditioner system has been operated, oil circulates throughout the system with the refrigerant. Hence, while the system is running, oil is leaving the compressor with the high pressure gas and is returning to the compressor with the suction gas.

When the air conditioner is operated at around 1000 to 1500 engine RPM's, in the maximum cooling position and blower on high, approximately 4 ounces of oil remains in the compressor, while the rest is distributed in the various air conditioner components. At high engine RPM's, a lesser amount of oil will be retained in the compressor (as little as 2 ounces of oil which is adequate for lubrication of compressor).

The oil balance in the system has been carefully established. It is important in any servicing operations to neither add nor subtract oil which would cause the total oil charge in the system to vary from 10 1/2 fluid ounces. If the total oil charge is less, lubrication of the compressor may not be adequate; if too much oil is in the system this will reduce the refrigerating capacity of the system. The compressor oil cannot be checked while the compressor is installed on the car.

The oil level in the compressor should not be checked as a matter of course such as is done in the car engine crankcase. The compressor oil level should be questioned only in cases where there is evidence of a major loss of system oil such as:

1. Broken hose or severe hose fitting leak.

2. Oil sprayed in large amounts under the hood due to a very badly leaking compressor seal.

3. Collision damages to system components.

To check the oil and to determine amount to install in compressor, the compressor must be removed and drained. This same procedure is used to determine amount to install in a replacement compressor or in a compressor that has been disassembled for repair. To drain compressor, remove drain plug and place compressor in a horizontal position with drain plug opening downward. Allow all oil to drain into a container, measure total amount, then discard oil. To determine the amount of oil that should be installed in the compressor if there has been a major loss of oil, when replacing a compressor with a service compressor or when compressor has been disassembled and rebuilt use the following chart.

IMPORTANT: If oil drained from compressor contains any foreign materials such as chips or there is evidence of moisture in the system it will be necessary to replace receiver dehydrator and flush the other component parts with Refrigerant-12. The full 10 1/2 oz. of oil should then be added to compressor.

NOTE: The service compressor will also contain 10 1/2 oz. of 525 oil. In most cases, it will be necessary to drain all of the oil from the service compressor, then install oil so that it will be the required amount determined by the chart.

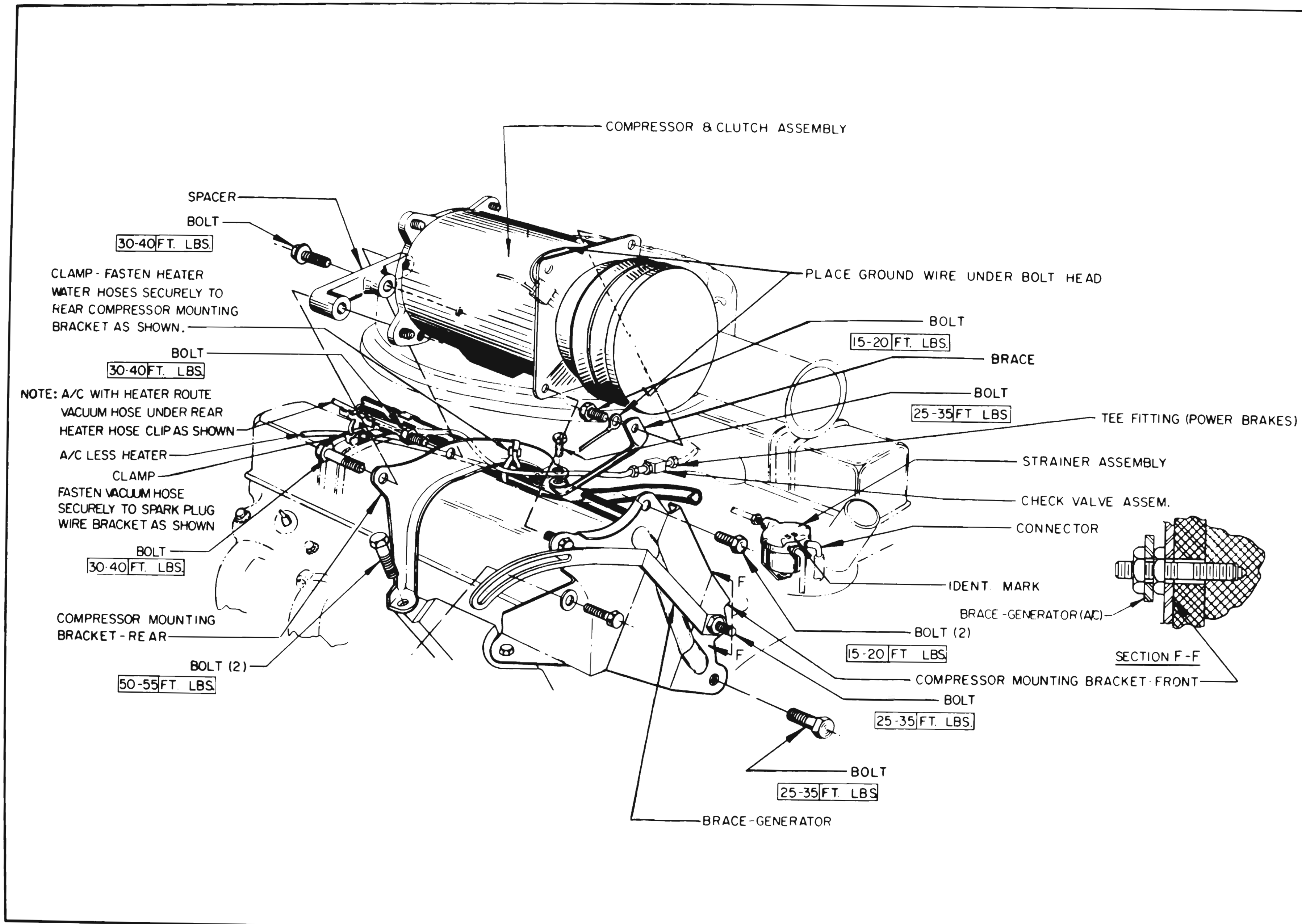


Figure 11-73—Compressor Installation

| CONDITION | AMOUNT OF OIL DRAINED FROM COMPRESSOR | AMOUNT OF 525 OIL TO INSTALL IN COMPRESSOR |
|---|---|---|
| 1. Major loss of oil and a component (not compressor) has to be replaced. | a. More than 4 oz.<br>b. Less than 4 oz. | a. Amount drained from compressor plus amount for component being replaced as follows:<br>Evaporator - Add 3 oz.<br>Condenser - Add 1 oz.<br>Receiver Dehydrator - Add 1 oz.<br>b. Install 6 oz. plus amount for component being replaced as shown above. |
| 2. Compressor being replaced with a service compressor and there wasn't a major loss of oil from the air conditioner system. | a. More than 1 1/2 oz. (See Note)<br>b. Less than 1-1/2 oz. | a. Same amount as drained from compressor being replaced.<br>b. Install 6 oz. |
| 3. Same as step 2 except there has been a major loss of oil. | a. More than 4 oz.<br>b. Less than 4 oz. | a. Same amount as drained from compressor being replaced.<br>b. Install 6 oz. |
| 4. Compressor has been inoperative and rebuilt and there wasn't a major loss of oil from air conditioner system. | a. More than 1 1/2 oz. (See Note)<br>b. Less than 1-1/2 oz. | a. Same amount as drained from compressor plus 1 oz. additional.<br>b. Install 7 oz. |
| 5. Same as step 4 except there has been a major loss of oil. | a. More than 4 oz.<br>b. Less than 4 oz. | a. Same amount as drained from compressor plus 1 oz. additional.<br>b. Install 7 oz. |
| NOTE: If more than 1 1/2 oz. of clean oil was drained from compressor and there is little or no signs of oil being lost from system, install this amount of oil in replacement compressor (plus 1 oz. additional in repaired compressor). | | |

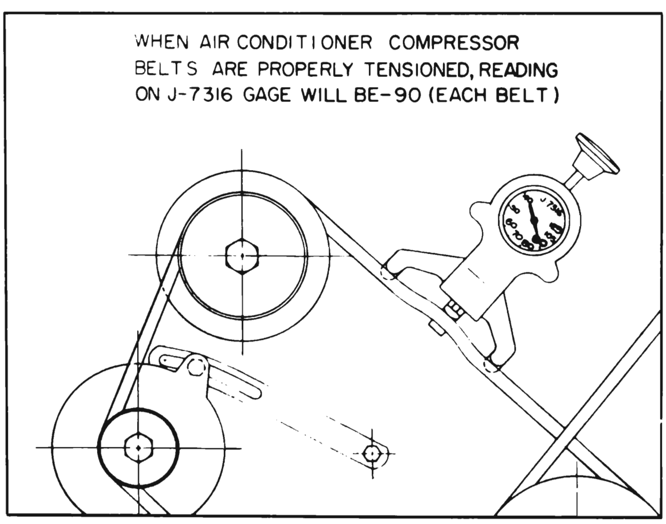


Figure 11-74—Compressor Belt Tension

During normal service operations where a condenser, receiver or evaporator is replaced with a new unit and where no major loss of oil is involved, add oil to the new unit per item 1 on chart. The oil can be poured directly into the part being replaced.

## 11-17 COMPRESSOR CLUTCH, COIL AND SHAFT SEAL REMOVAL AND INSTALLATION

It is not necessary to remove compressor from refrigeration system to service clutch parts. It may be necessary to loosen it on its mounting to remove clutch pulley.

CAUTION: <u>Never stand compressor on pulley end.</u>

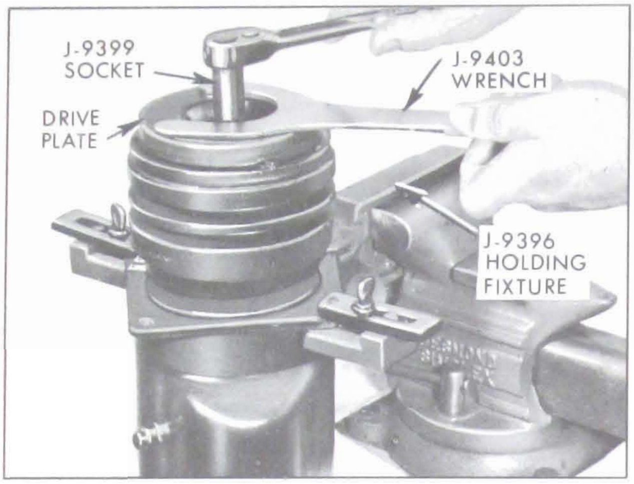


Figure 11-75—Removing Shaft Nut

**a. Clutch Drive Plate Removal**

1. Hold the clutch drive plate hub with J-9403 wrench and use J-9399 special thin wall 9/16" socket to remove shaft nut. See Figure 11-75.

2. Screw threaded hub puller J-9401 into the drive plate hub. Hold body of tool with a wrench and tighten the center screw to remove drive plate assembly. See Figure 11-76.

3. Remove drive plate key from compressor shaft or from drive plate hub.

4. Remove drive plate assembly retainer ring, using J-5403, No. 21 Truarc pliers. See Figure 11-77. Remove spacer from inside hub of drive plate.

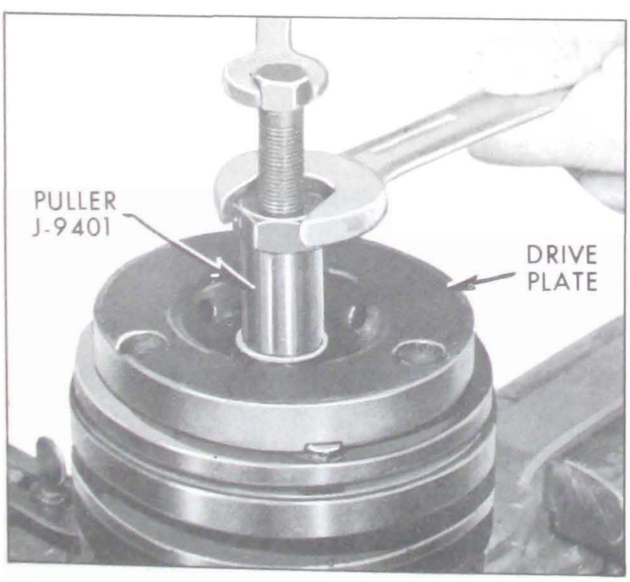


Figure 11-76—Removing Drive Plate Assembly

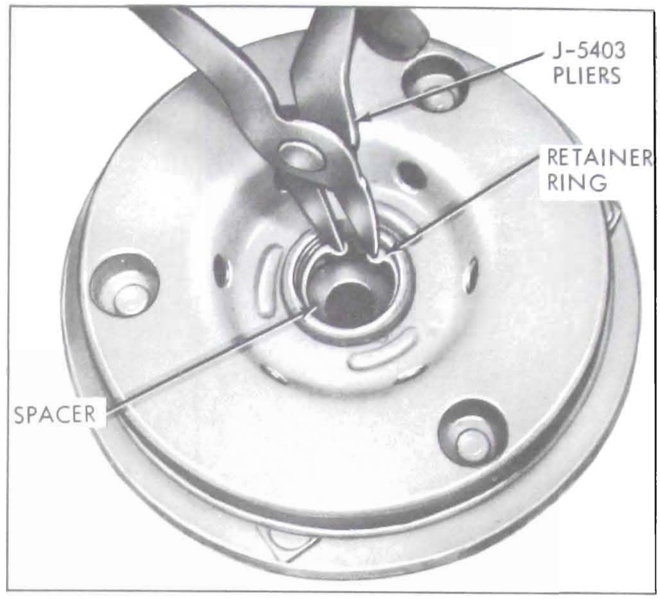


Figure 11-77—Removing Drive Plate Retainer Ring

**b. Drive Plate Installation**

1. Insert square drive key into hub of drive plate so it projects approximately 3/16" out of end of keyway. See Figure 11-78.

2. Line up key in hub with keyway in shaft and position drive plate on shaft. See Figure 11-78.

3. Place "Free" spacer J-9480-2 on drive plate installer J-9480-1 and thread installer on end of compressor shaft. See Figure 11-79. Press the drive plate on shaft until there is approximately 3/32" (.094") space between the frictional faces of the drive plate and pulley as shown.

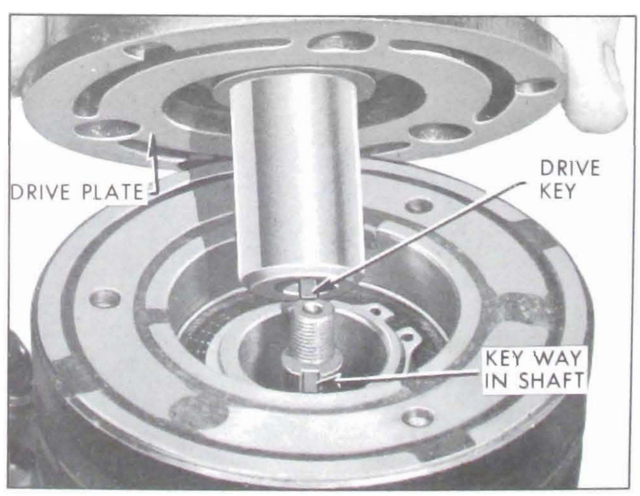


Figure 11-78—Positioning Drive Plate on Shaft

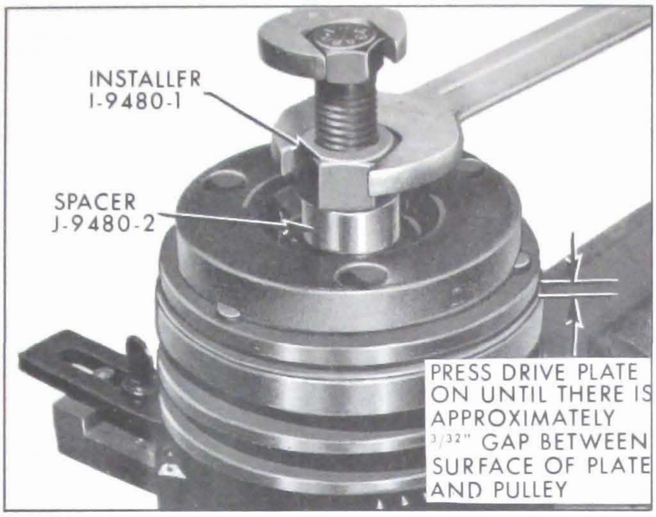


Figure 11-79—Installing Drive Plate Assembly

4. Remove installer and insert spacer around shaft and inside drive plate hub.

5. Install drive plate assembly retainer ring with flat side of ring facing spacer, using J-5403, No. 21 Truarc pliers.

6. Install a new shaft nut, using J-9399, special thin wall 9/16" socket. Tighten to 15 lb. ft. torque. The air gap between the frictional faces of the pulley and drive plate should now be between .022" to .057" (1/32" to 1/16") clearance. See Figure 11-80.

### c. Pulley and Bearing Removal

1. Remove clutch drive plate. Sub. par. a.

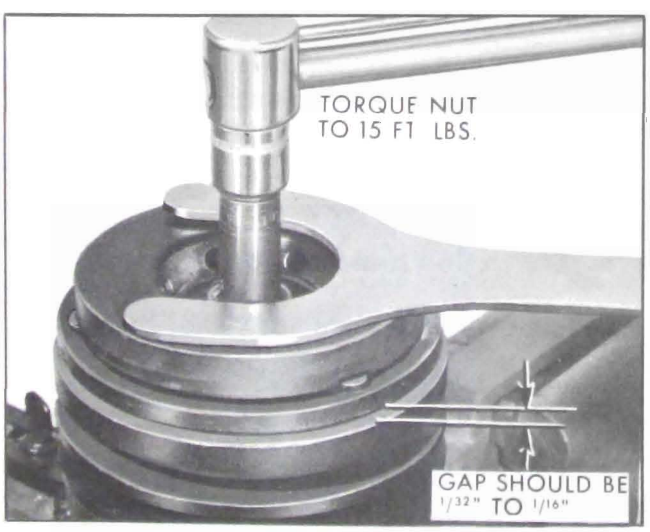


Figure 11-80—Torquing Shaft Nut

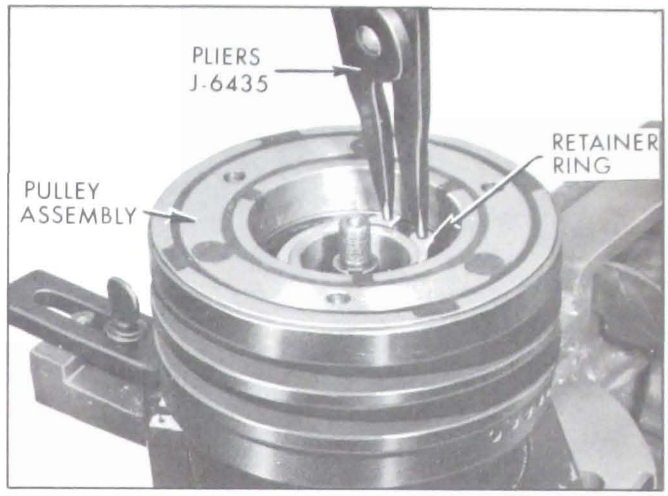


Figure 11-81—Removing Pulley Retainer Ring

2. Remove pulley assembly retainer ring, using J-6435, No. 26 Truarc pliers. See Figure 11-81.

3. Place J-9395 puller pilot over compressor shaft and remove pulley assembly, using J-8433 puller. See Figure 11-82.

IMPORTANT: Puller pilot must be used or force will cause shaft to move in swash plate, resulting in damage to the cylinder mechanism.

NOTE: Do not remove pulley bearing unless it is going to be replaced.

4. Remove pulley bearing wire retainer with a small screwdriver. See Figure 11-83.

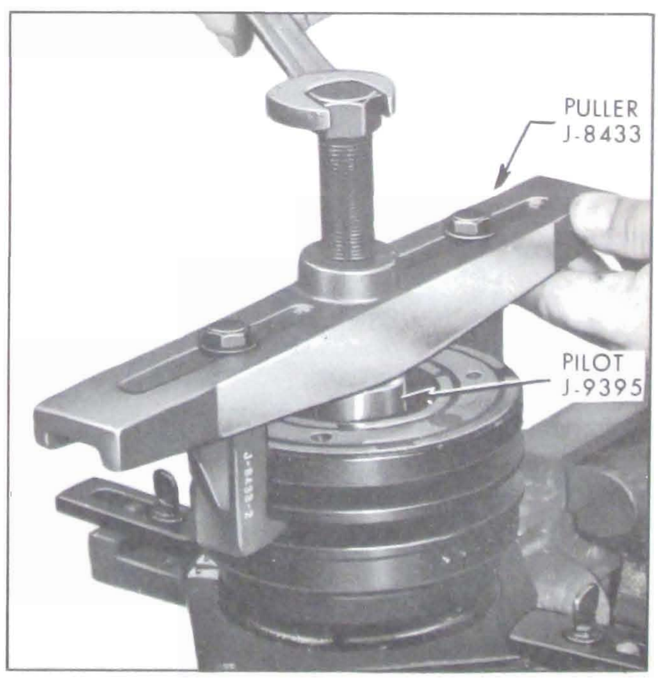


Figure 11-82—Removing Pulley Assembly


Figure 11-83—Removing Bearing Retainer Wire

5. Remove bearing, using punch or a suitable socket.

### d. Pulley and Bearing Installation

If the existing pulley and drive plate and hub assembly are to be reused, clean the drive faces on each part with trichlorethylene, alcohol or similar solvent. If these parts show evidence of warpage, due to overheating, they should be replaced.


Figure 11-84—Installing Pulley Bearing

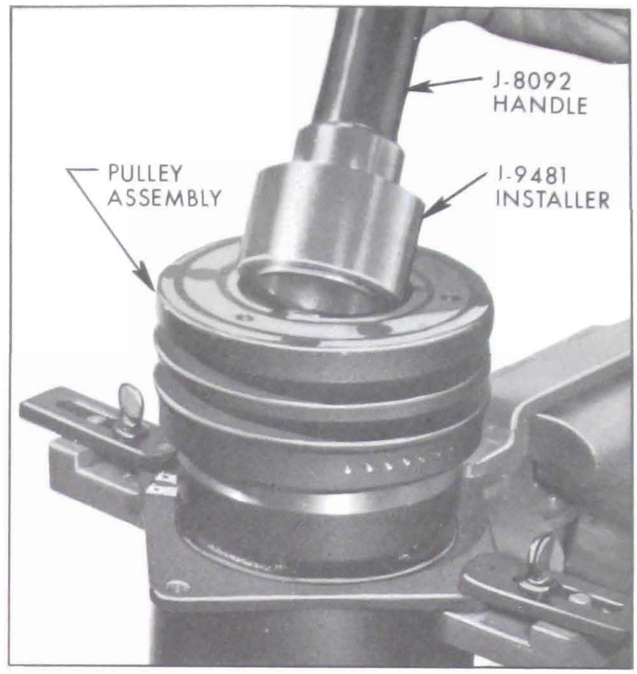


Figure 11-85—Installing Pulley Assembly

1. When replacing a new ball bearing assembly into the pulley, use J-9481 pulley bearing installer and drive handle J-8092 as shown. See Figure 11-84.

2. Replace the pulley assembly wire retainer ring in pulley, being sure it is properly seated in its groove.

3. Support bottom of compressor and press or tap the pulley and bearing assembly on the neck of the compressor, using J-9481 installed on J-8092 as shown. See Figure 11-85. Pulley should rotate freely.

4. Install pulley retainer with flat side of retainer toward bearing, using J-6435, No. 26 Truarc pliers.

5. Install drive plate assembly. Sub. par. b.

### e. Clutch Coil and Housing Removal

1. Remove drive plate assembly. Sub. par. a.

2. Remove pulley and bearing assembly. Sub. par. c.

3. Note position of electrical terminals and scribe location of coil housing terminals on compressor body to insure correct location of terminals when coil is reinstalled.

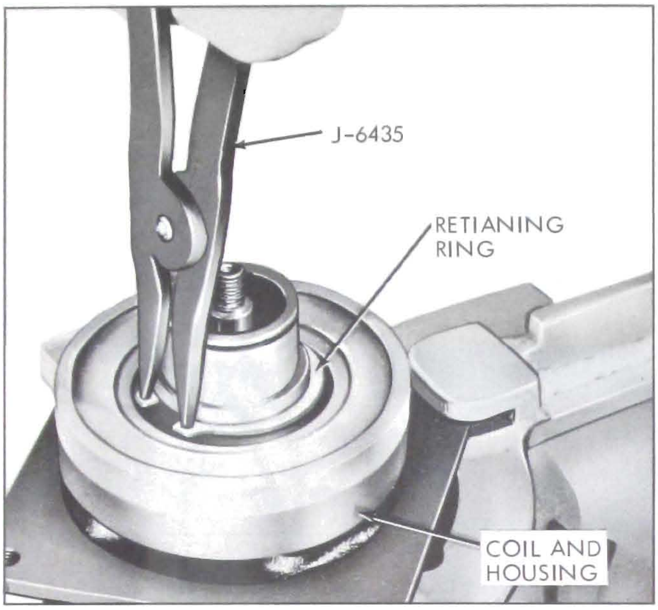


Figure 11-86—Removing Coil and Housing Retaining Ring

4. Use J-6435, No. 26 Truarc pliers and remove coil housing retaining ring, then remove coil assembly. See Figure 11-86.

**f. Clutch Coil and Housing Installation**

1. Position clutch coil on compressor front head casting so electrical terminals are in their proper location as previously scribed on compressor body. Make certain coil is properly seated on dowels.

2. Replace the coil retainer ring with flat side of ring facing coil, using J-6435, No. 26 Truarc pliers.

3. Install pulley and bearing assembly. Sub. par. d.

4. Install drive plate assembly. Sub. par. b.

**g. Shaft Seal Removal**

1. Remove drive plate assembly. Sub. par. a.

2. Remove shaft seal seat retaining ring from inside front head, using J-5403, No. 21 Truarc pliers. See Figure 11-87.

3. Remove shaft seal seat, using J-9393-1 and 2 to grasp flange on seal seat. See Figure 11-88. Pull straight out at end of tool to remove seal seat.

4. Engage tabs on compressor shaft seal assembly with locking tangs on J-9392 seal installer and remover. Press down on tool and

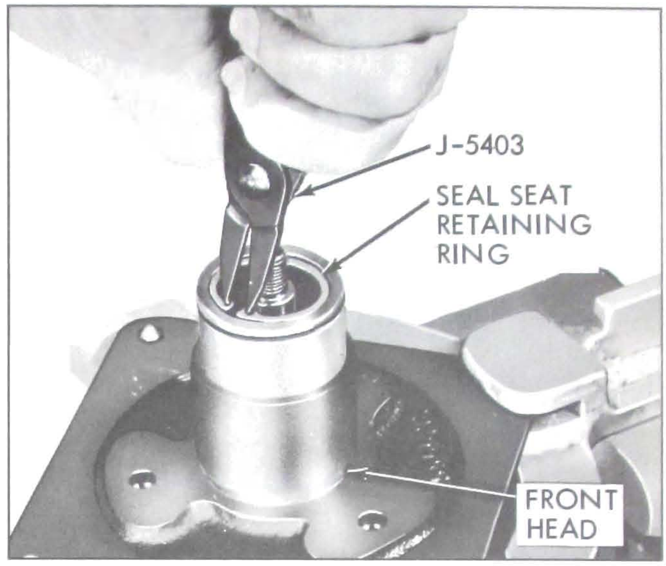


Figure 11-87—Removing Shaft Seal Seat Retaining Ring

twist clockwise to engage seal. Remove seal assembly by pulling straight out from shaft. See Figure 11-89.

5. Remove O-ring from interior of front head casting bore, using J-9553 remover. See Figure 11-90.

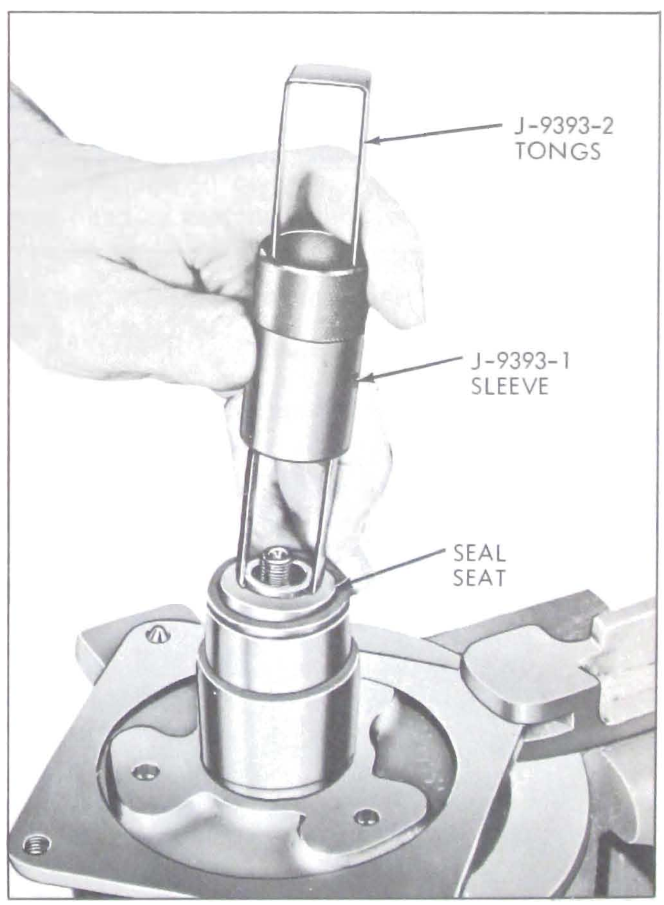


Figure 11-88—Removing Shaft Seal Seat

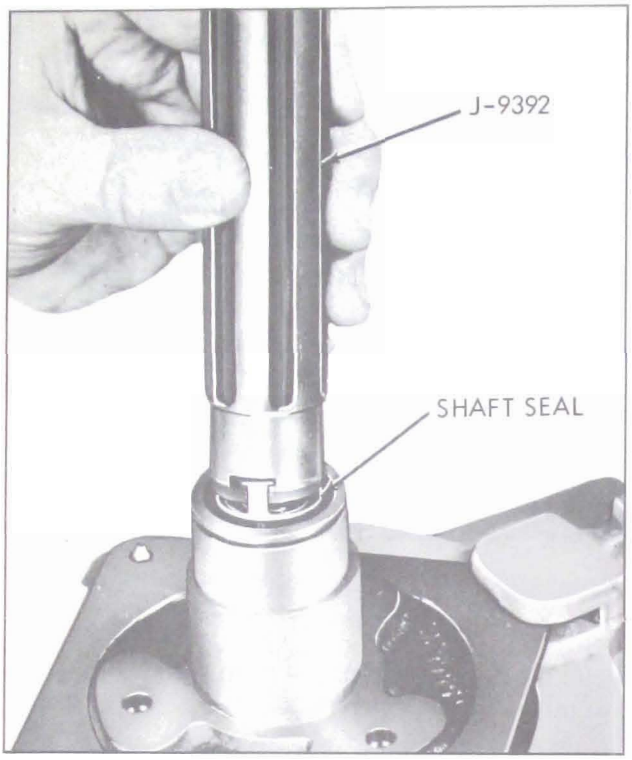

Figure 11-89—Removing Shaft Seal

#### h. Shaft Seal Installation

NOTE: Apply 525 compressor oil to seal parts during assembly.

1. Install a new seal seat O-ring in its groove inside front head. Be sure it is not in retaining ring groove. See Figure 11-50.

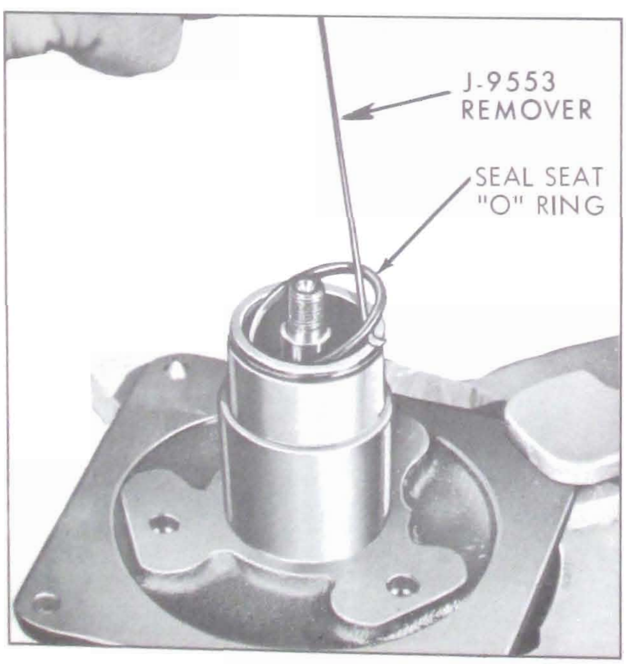

Figure 11-90—Removing Shaft Seal Seat O-Ring

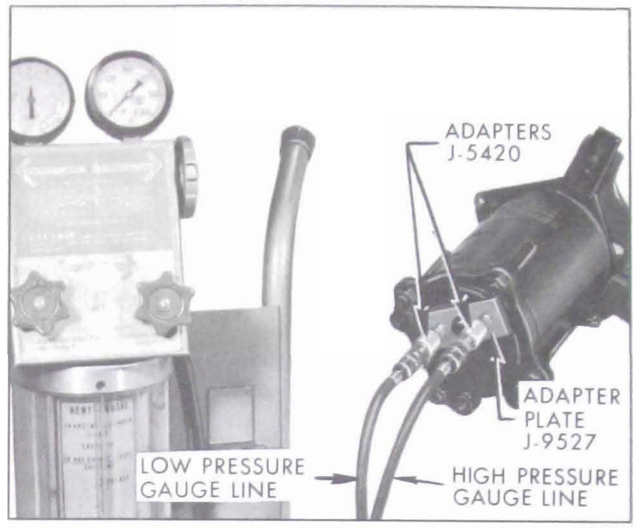

Figure 11-91—Charging Line Adapter Plate

2. Place shaft seal on J-9392 installer and insert seal on shaft inside front head. Be sure seal is properly seated on shaft. The shaft has two flats provided for the seal.

3. Position seal seat on shaft and use sleeve J-9393-1 to push seat down inside front head.

4. Install seat retaining ring with flat side of ring going toward seat, using J-5403, No. 21 Truarc pliers. If necessary, position sleeve J-9393-1 on retaining ring and push down on it to engage ring in its groove.

5. Attach charging line adapter plate, J-9527 on rear of compressor and pressurize suction side of compressor with Refrigerant-12 at pressure corresponding to room temperature. Rotate compressor shaft several times. See Figure 11-91. Leak test with leak detector and correct any leaks.

6. Install drive plate assembly. Sub. par. b.

## 11-18 DISASSEMBLY, INSPECTION AND ASSEMBLY OF COMPRESSOR INTERNAL PARTS

IMPORTANT: A clean work bench, orderliness of the work area and a place for all parts being removed and replaced are of great importance. Any attempt to use makeshift or inadequate equipment may result in damage and/or improper operation of the compressor.

#### a. Rear Head and Oil Pump Removal

CAUTION: Under NO circumstances should compressor be placed on the pulley end.

1. Seal compressor fittings opening and openings in compressor rear head.

2. Thoroughly clean exterior of compressor assembly and blow dry with compressed air.

3. Place compressor assembly on clean, dry work bench.

NOTE: If compressor is not going to be disassembled any further than rear head or oil pump, omit steps 4, 5, 6, 7 and 8.

4. Remove compressor oil drain plug, tilt compressor and drain oil into clean dry container. It may be possible to get only 4 to 6 ozs. of oil from the compressor.

5. Remove clutch drive plate assembly. Par. 11-17, Sub. par. a.

6. Remove clutch pulley assembly. Par. 11-17, Sub. par. c.

7. Remove clutch coil and housing. Par. 11-17, Sub. par. e.

8. Remove shaft seal assembly. Par. 11-17, Sub. par. g.

9. Attach J-9396 holding fixture to compressor and firmly mount assembly in vise. See Figure 11-92.

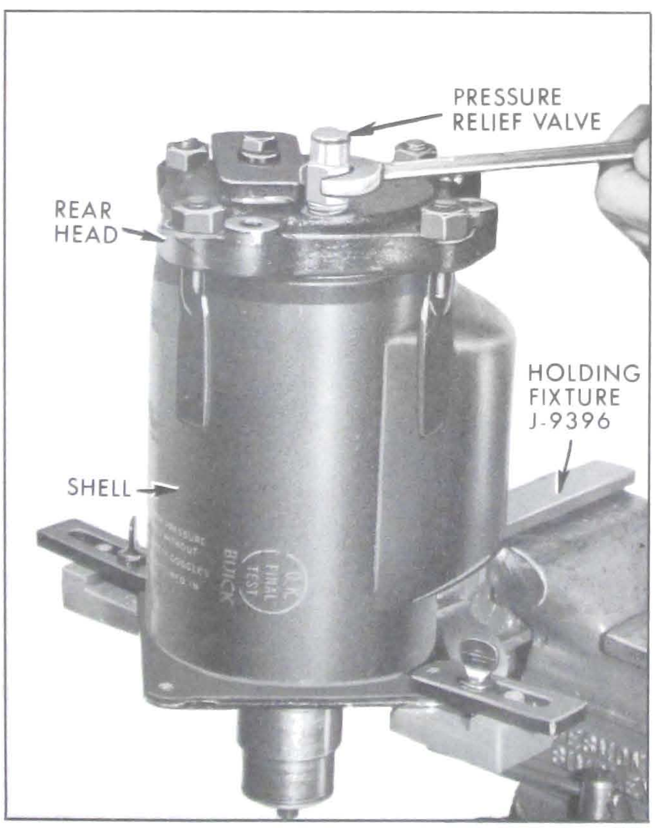


Figure 11-92—Removing Pressure Relief Valve

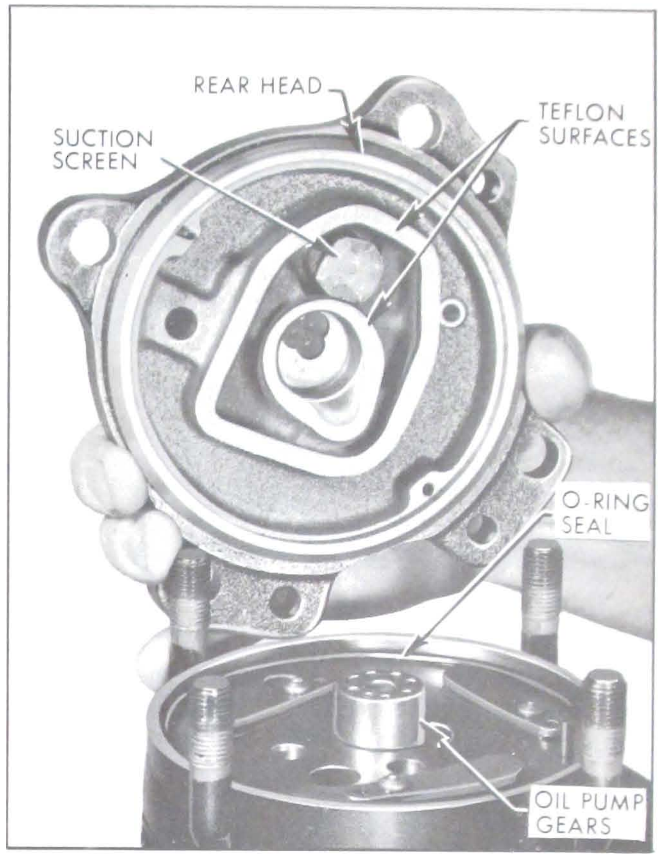


Figure 11-93—Rear Head Teflon Surface

10. Remove compressor pressure relief valve and washer if head is going to be replaced.

11. Remove four lock nuts from threaded studs welded to compressor shell and remove rear head by tapping lightly with plastic mallet.

12. Examine teflon surface on the rear head casting webs. If any damage is observed, the head should be replaced. See Figure 11-93.

13. Remove suction screen and examine for damage or contamination. Clean or replace as necessary.

14. Mark rear side of both oil pump gears with a pencil so that they can be reinstalled in same position. Remove gears and inspect for damage. Replace both gears if one or both show damage.

15. Remove and discard rear head to compressor shell O-ring seal.

16. Carefully remove rear discharge valve plate assembly by prying up on assembly as shown with screwdrivers and examine discharge valve reeds and seats. See Figure 11-94. Replace entire assembly if excessively scored or if any one of the three reeds are broken or seats are damaged.

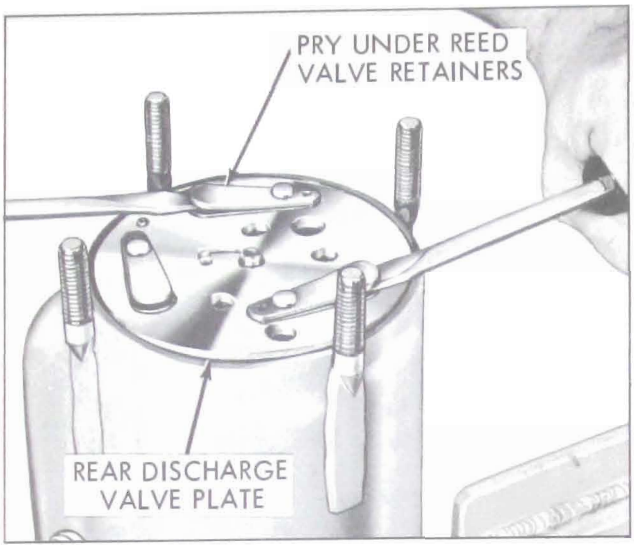


Figure 11-94—Removing Rear Discharge Valve Plate

17. If rear suction reed valve didn't come out with valve plate, carefully remove reed as shown with two small screwdrivers. See Figure 11-95. Replace reed valve if damaged.

NOTE: See sub par 3 for installation of head and oil pump.

### b. Compressor Cylinder Assembly and Front Head Removal

1. Remove oil inlet tube, using J-6586 Remover. See Figure 11-96. If tube O-ring did not come out with tube, remove it from cylinder with small wire.

2. Push on front of compressor shaft to remove cylinder assembly from shell. See Figure 11-97. The cylinder assembly will slide out of shell when shell is inverted.

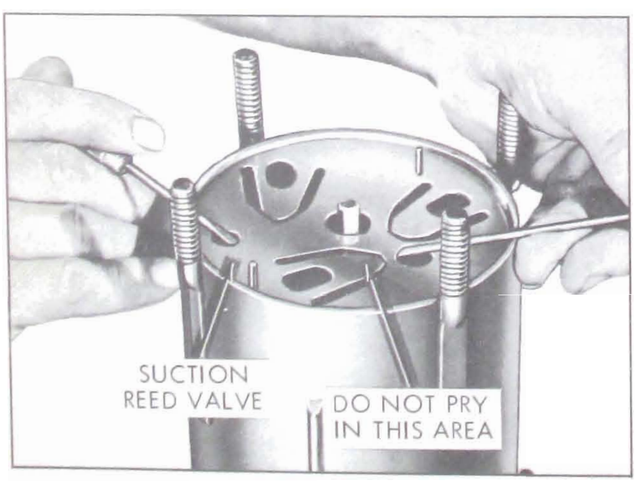


Figure 11-95—Removing Rear Suction Reed

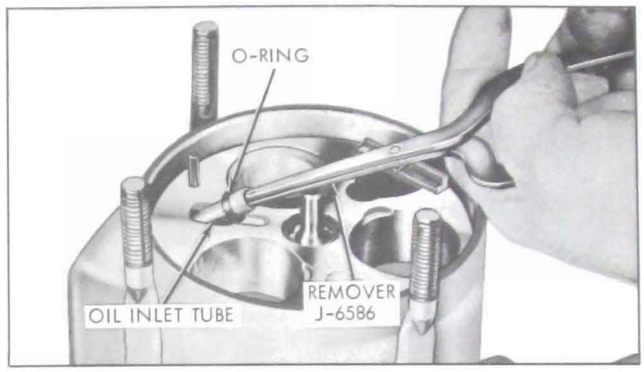


Figure 11-96—Removing Oil Inlet Tube

CAUTION: Do not hammer or use excessive force on end of shaft.

3. If the front discharge valve plate and suction reed valve were removed with cylinder mechanism, remove these parts from shaft before proceeding and examine for damage.

4. Examine cylinder mechanism for any obvious damage.

NOTE: If cylinder mechanism has sustained major damage, due possibly to loss of refrigerant and/or oil, it may be necessary to use the service cylinder assembly rather than replace individual parts.

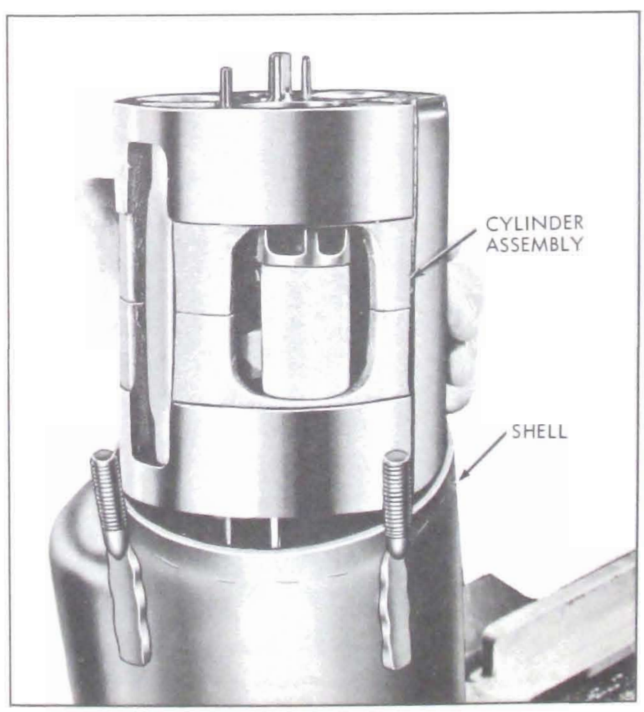


Figure 11-97—Removing Cylinder Assembly

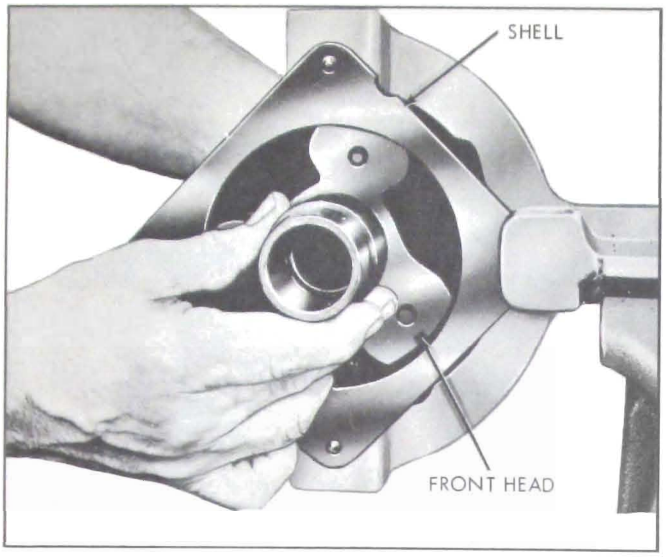

Figure 11-98—Removing Front Head

5. Remove compressor front head, using rubber mallet or wood block to unseat head from shell. See Figure 11-98. Care must be used to protect teflon surface on head from being damaged.

6. Remove and discard front head to shell O-ring seal.

7. Examine teflon sealing surface on front head for damage and/or deep scratches. Replace if necessary. See Figure 11-99.

NOTE: If compressor cylinder assembly is going to be replaced, omit sub. pars. c, d and e.

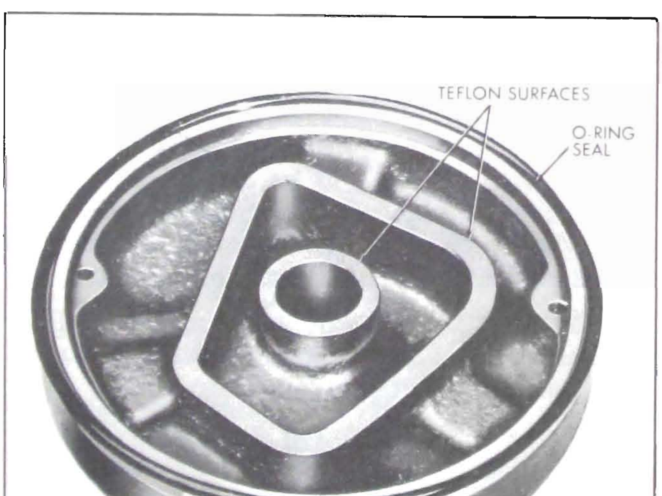

Figure 11-99—Front Head Teflon Sealing Surfaces

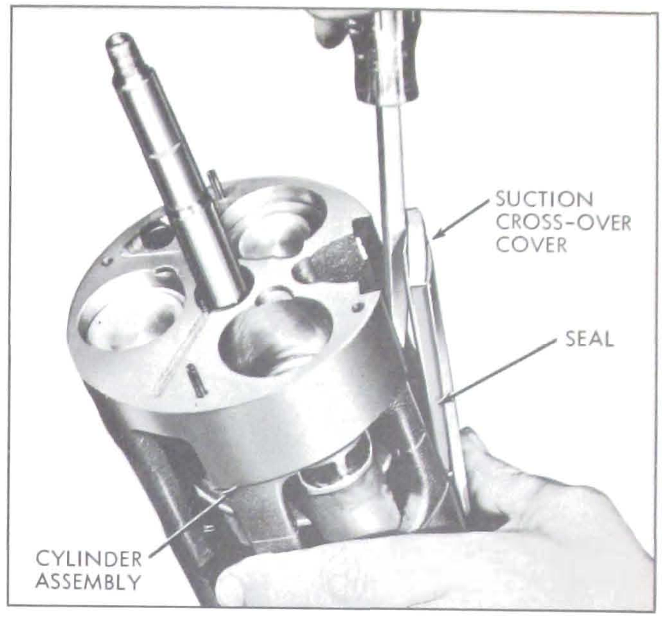

Figure 11-100—Removing Suction Crossover Cover

**c. Disassembly of Compressor Cylinder Assembly**

1. Remove suction crossover cover as shown in Figure 11-100 and discard seal on cover.

2. Place cylinder assembly in fixture as shown. Using a suitable punch, drive discharge crossover tube out of cylinder assembly toward

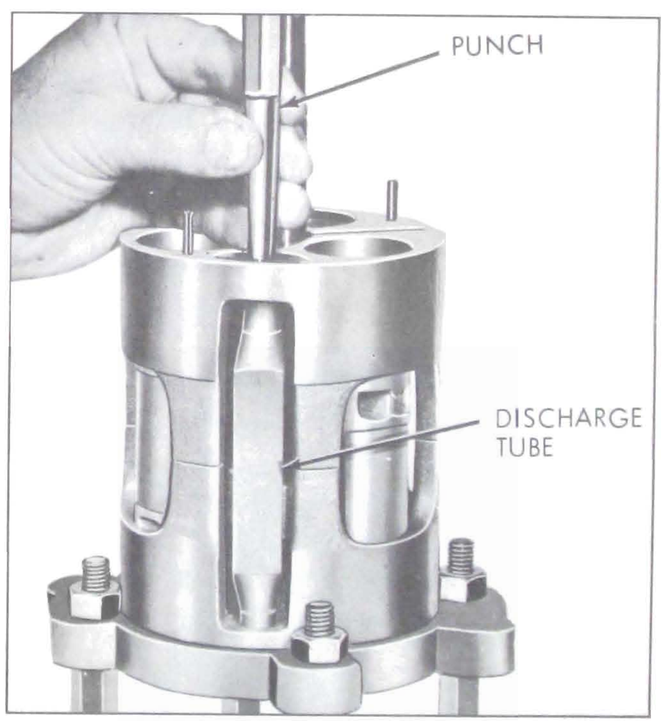

Figure 11-101—Removing Discharge Crossover Tube From Front Head

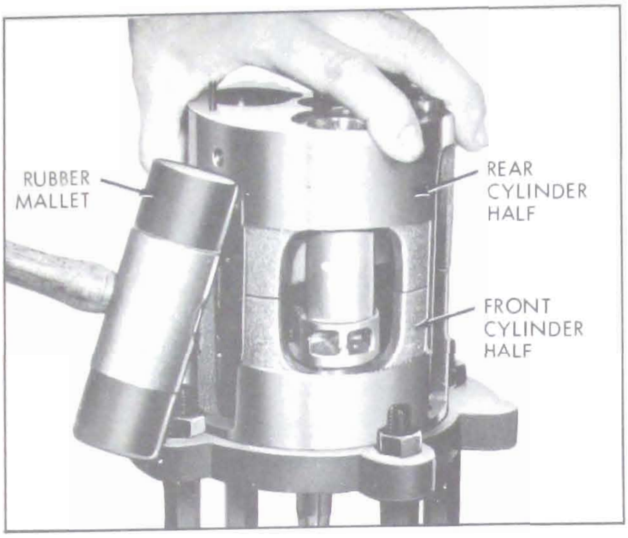


Figure 11-102—Separating Cylinder Halves

rear of compressor. See Figure 11-101. Use care not to damage cylinder half.

3. Number pistons (1, 2 and 3) and their cylinder bores so parts can be replaced in their original locations.

4. Obtain clean J-9402 assembly parts tray to retain compressor parts during disassembly.

5. Separate front and rear cylinder halves, using a wood block or rubber mallet. See Figure 11-102. Rotate swash plate so that discharge tube does not contact it. A 9/16" open end wrench may be used on the shaft seal area of shaft to rotate swash plate.

6. Remove rear cylinder half from pistons.

7. Rotate shaft until a piston is at its highest point. Push up on shaft and remove one piston

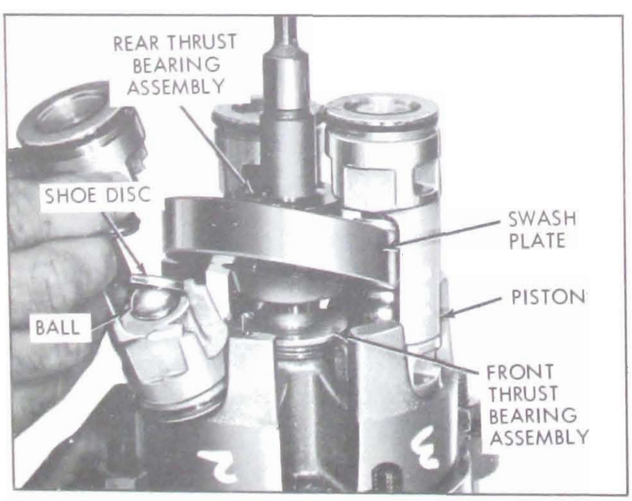


Figure 11-103—Removing Piston Assembly

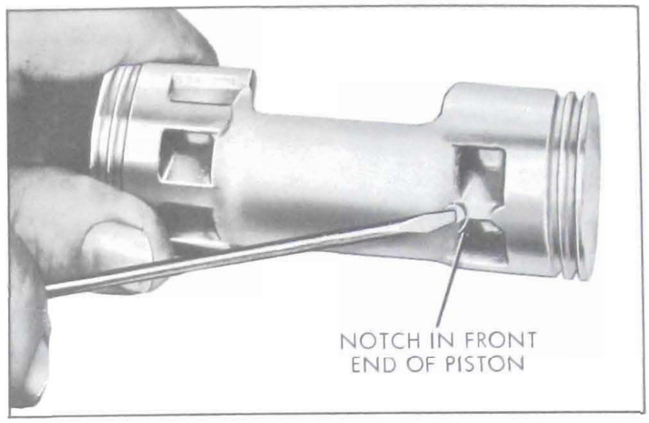


Figure 11-104—Piston Assembly

assembly at a time. See Figure 11-103. Place parts in parts tray to keep them separated.

8. Remove piston rings, balls and shoe discs. Discard the shoe discs. Examine piston balls, if satisfactory for reuse, place in parts tray with proper end of piston. The front end of piston has identifying notch in casting web. See Figure 11-104.

9. Remove rear combination of thrust races and thrust bearing. Discard all three pieces.

10. Push on shaft to remove shaft from front half cylinder.

11. Remove front combination of thrust races and thrust bearing. Discard all three pieces.

12. Drive discharge crossover pipe from front cylinder half, using punch.

13. Examine swash plate surfaces for excessive scoring or damage. If satisfactory, reuse. If necessary, replace main shaft and swash plate assembly.

14. Wash all parts to be reused in a tank of clean trichlorethylene, alcohol or similar solvent. Blow dry all parts, using a source of clean, dry air. If drive balls show any signs of damage, replace.

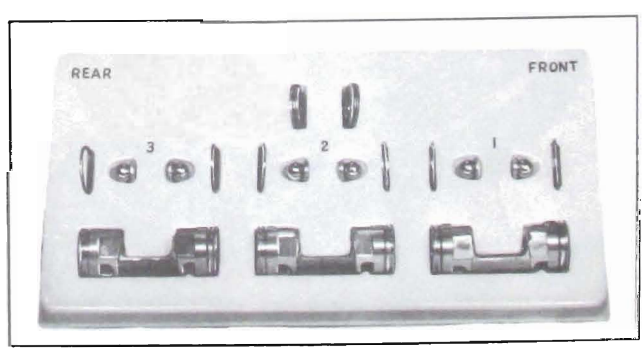


Figure 11-105—Parts Tray J-9402

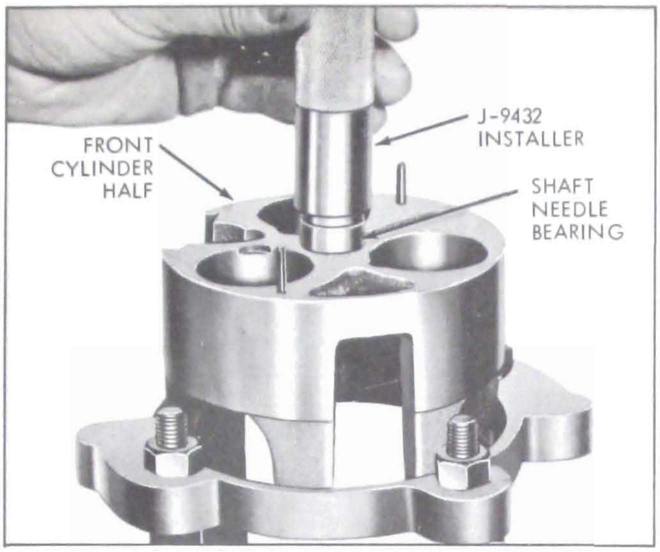


Figure 11-106—Installing Shaft Needle Bearing

15. Examine the front and rear cylinder halves and replace if cylinder bores are deeply scored or damaged.

16. Examine the shaft needle bearings. There is one in each cylinder half. If a bearing is damaged, remove bearing with a suitable socket or punch. Install new bearing with J-9432 so that lettering on bearing is toward outside of cylinder half. See Figure 11-106.

### d. Adjusting Compressor Shaft End Play and Piston Shoe Disc Clearance

IMPORTANT: The following operations are required when it is practical to replace an internal part or parts of the cylinder assembly. If the complete assembly is replaced, gauging of the shaft end play and shoe disc clearance is not required.

1. Secure four ZERO thrust races, three ZERO shoe discs and two new thrust bearings.

2. Apply clean petroleum jelly to a ZERO thrust race, a new needle thrust bearing and a second ZERO thrust race. Assemble this "sandwich" of parts to FRONT end of compressor main shaft.

3. Place FRONT half of cylinder on J-9397 fixture. Insert threaded end of shaft (with front thrust bearing assembly) through front cylinder half and allow thrust race assembly to rest on hub of cylinder. See Figure 11-107.

4. Place a ZERO thrust race, a new thrust bearing and a second ZERO thrust washer on REAR of compressor main shaft so it rests on hub of swash plate.

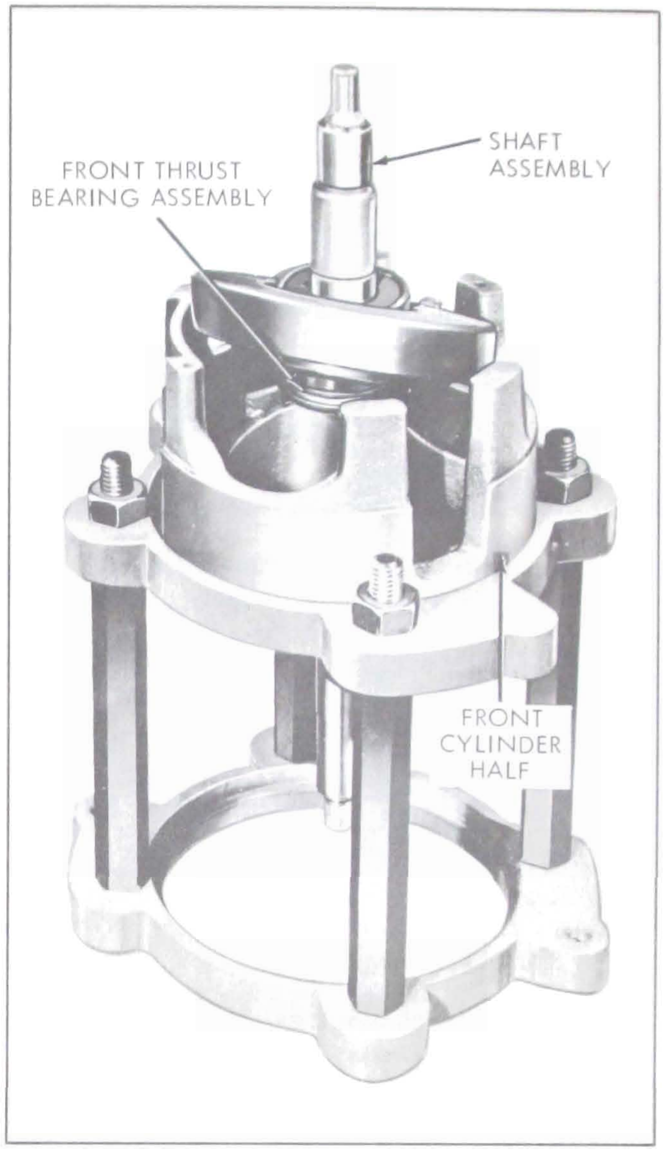


Figure 11-107—Shaft and Bearing Assembly In Front Cylinder Half

5. Apply a light smear of clean petroleum jelly to ball pockets of each of three pistons.

6. Place balls in piston pockets.

7. Apply a light smear of clean petroleum jelly to cavity of three new ZERO shoe discs.

8. Place a ZERO shoe over each ball in FRONT end of piston. Do not place shoes on piston rear balls.

NOTE: Do not assemble any piston rings on pistons at this time.

9. Rotate shaft and swash plate until high point of swash plate is over piston cylinder bore, which has been identified as No. 1. Insert front end of No. 1 piston (notched end) in cylinder bore (toward the front of compressor) and at same time, place front ball and shoe and

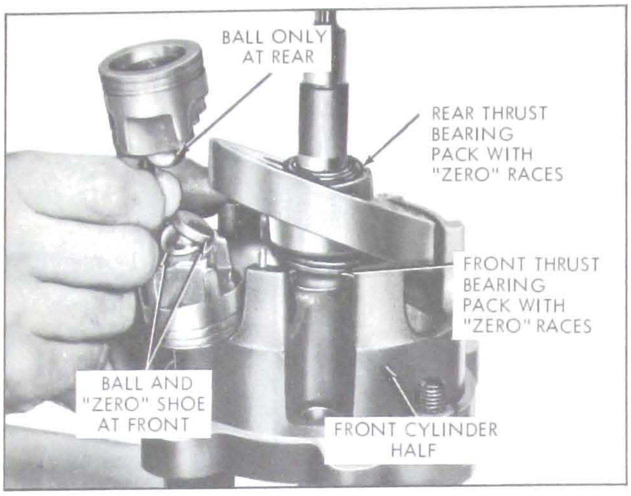


Figure 11-108—Installing Piston Assembly In Cylinder for Gauging

rear ball only over swash plate. See Figure 11-108.

IMPORTANT: It is necessary to lift shaft assembly when installing pistons. Hold front thrust bearing pack tightly against swash plate hub while lifting shaft.

10. Repeat this operation for No. 2 and No. 3 pistons. Balls and shoes must adhere to piston during this assembly.

11. Align rear cylinder half casting with bores, suction passage, discharge crossover holes, dowel pins, etc. Tap into place, using a wood block and mallet. See Figure 11-109.

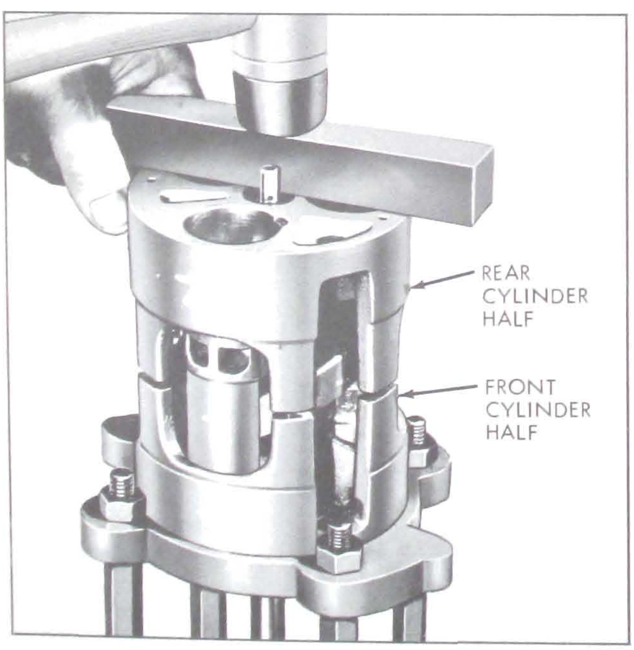


Figure 11-109—Assembling Rear Cylinder Half

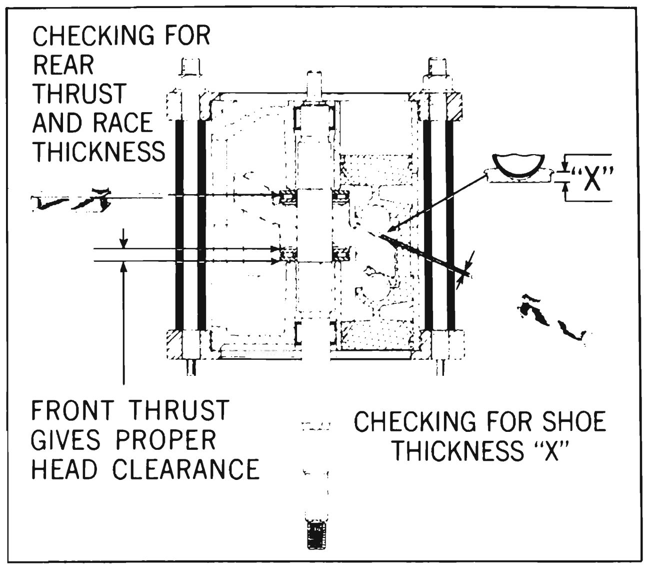


Figure 11-110—Checking Cylinder Clearances

12. Place cylinder assembly in J-9397 compressing fixture with front of compressor shaft pointing up, positioning discharge tube opening between fixture bolts. This will permit access for the feeler gauge. Assemble fixture head ring and nuts to the cage, tighten nuts evenly to 15 lb. ft. torque.

13. Use a leaf-type feeler gauge to check clearance between REAR ball and swash plate for each piston.

(a) Use a suitable combination of feeler gauge leafs until the combination will result in a satisfactory 'feel' between ball and swash plate. See Figure 11-111.

(b) Rotate the shaft approximately 120$^{o}$ and make a second check with feeler gauge between same ball and plate.

(c) Rotate shaft again approximately 120$^{o}$ and repeat check with feeler gauge between these same parts.

(d) From this total of three checks between the same ball and swash plate at 120$^{o}$ increments on swash plate, use the minimum feeler gauge reading to select a numbered shoe to correspond to this reading. See Example below.

Example:

| | Position 1 | Position 2 | Position 3 |
|---|---|---|---|
| Piston #1 | .019 | .020 | .019 |
| | Select and use a No. 19 Shoe | | |
| Piston #2 | .020 | .020 | .020 |
| | Select and use a No. 20 Shoe | | |
| Piston #3 | .021 | .020 | .021 |
| | Select and use a No. 20 Shoe | | |

SHOE DISC CHART

| Service *Part Number | Identification No. Stamped on Shoe Disc |
|---|---|
| 6557000 | 0 |
| 6556175 | 17-1/2 |
| 6556180 | 18 |
| 6556185 | 18-1/2 |
| 6556190 | 19 |
| 6556195 | 19-1/2 |
| 6556200 | 20 |
| 6556205 | 20-1/2 |
| 6556210 | 21 |
| 6556215 | 21-1/2 |

*Underlined numbers indicate identification No. on shoe discs.

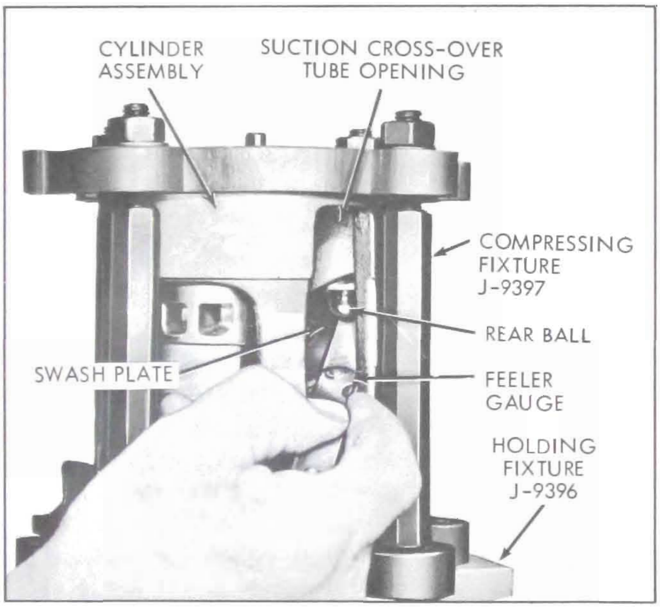


Figure 11-111—Gauging Clearance Between Rear Ball and Swash Plate

(e) Mark piston number (1, 2 or 3) on selected shoe package and place in corresponding position in parts tray.

(f) Repeat the above procedure on the other two pistons.

14. The next gauging operation is to determine space between REAR thrust bearing and rear outer thrust race.

(a) Use a suitable combination of feeler gauge leafs to get a satisfactory 'feel' between these two parts. See Figure 11-112.

(b) Select from stock a numbered thrust race that corresponds to feeler gauge reading. For example, if feeler gauge reading is .009", a race with a number 9 stamped on it should be selected and be installed in place of the rear outer race.

THRUST BEARING RACE CHART

| Service *Part Number | Identification No. Stamped on Race |
|---|---|
| 6556000 | 0 |
| 6556060 | 6 |
| 6556065 | 6-1/2 |
| 6556070 | 7 |
| 6556075 | 7-1/2 |
| 6556080 | 8 |
| 6556085 | 8-1/2 |
| 6556090 | 9 |
| 6556095 | 9-1/2 |
| 6556100 | 10 |
| 6556105 | 10-1/2 |
| 6556110 | 11 |
| 6556115 | 11-1/2 |
| 6556120 | 12 |

*Underlined numbers indicate identification No. of Race

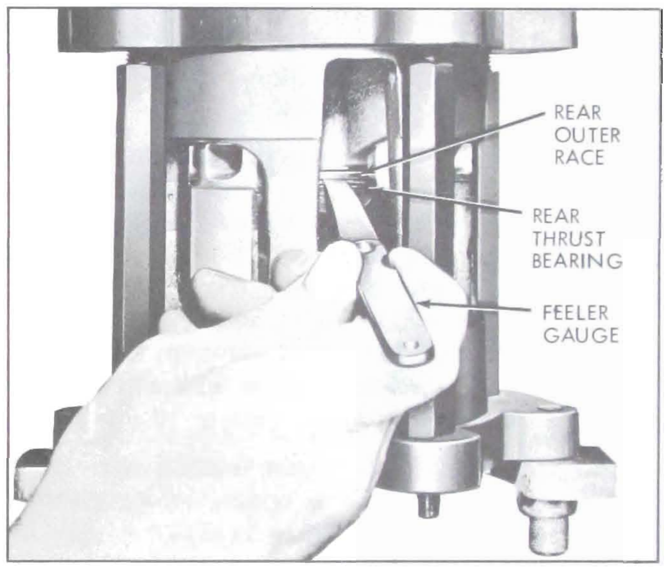


Figure 11-112—Gauging Clearance Between Rear Thrust Bearing and Rear Outer Race

(c) Mark the selected REAR thrust race or place it in the J-9402 assembly parts tray corresponding to its position.

15. Remove cylinder assembly from J-9397 compressing fixture.

16. Separate cylinder halves. It may be necessary to use a fiber block and mallet.

17. Remove rear half cylinder.

18. Carefully remove one piston at a time from swash plate and front half cylinder. Do not lose relationship or position of front ball and shoe and rear ball. Transfer each piston, balls and shoe assembly to their proper place in the J-9402 assembly tray.

19. Remove REAR outer ZERO thrust race from shaft and replace it with selected numbered thrust race, determined in Step No. 14. Apply a LIGHT smear of petroleum jelly to thrust races to aid in holding them in place during assembly.

NOTE: This ZERO thrust race may be put aside for re-use in additional gauging and/or rebuild operations.

### e. Assembly of Compressor Cylinder Assembly

Be sure to install all new seals and O-rings and to lubricate all the parts generously with 525 compressor oil during assembly.

1. Assemble a piston ring, scraper groove toward the center of piston, to each end of the three pistons.

2. Apply a light smear of petroleum jelly to selected numbered shoes and place them over correct ball in rear of piston.

3. With front and rear thrust bearing assemblies on shaft and shaft installed in front cylinder half, rotate swash plate so high point is above cylinder bore No. 1. Carefully assemble No. 1 piston (complete with ball and ZERO shoe on FRONT end and ball and numbered shoe on REAR end) over swash plate. See Figure 11-113. Position piston rings so that the gap is toward center of cylinder.

Compress and enter piston ring into front half cylinder. Repeat this operation for pistons No. 2 and No. 3. See Figure 11-114.

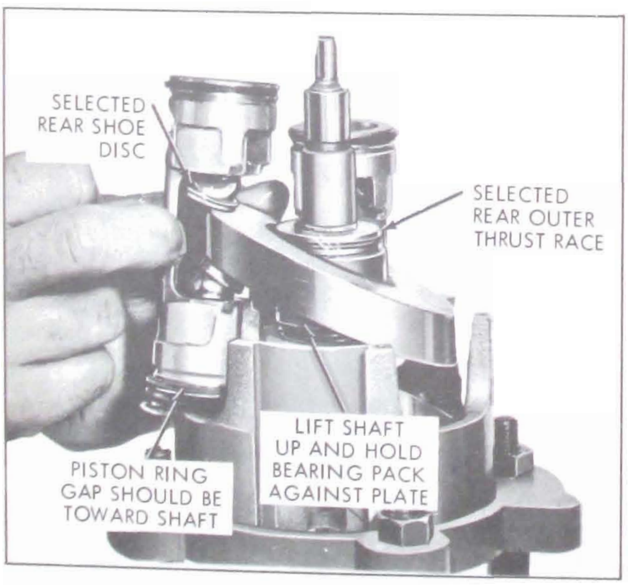


Figure 11-113—Installing Piston Assembly in Cylinder

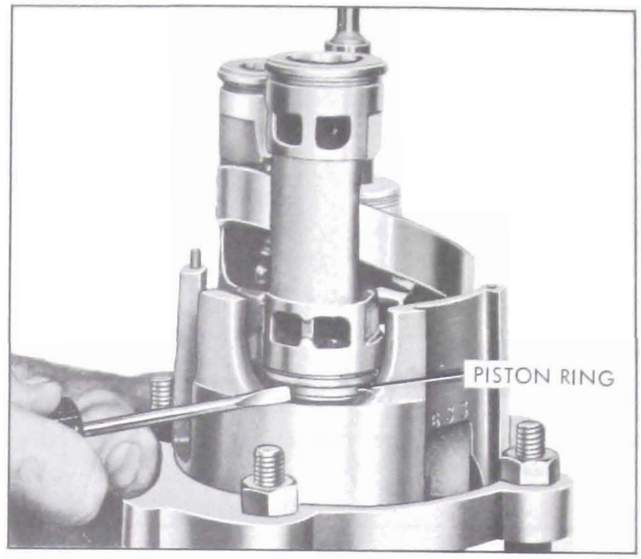


Figure 11-114—Compressing Front Piston Ring

4. Assemble one end of service discharge crossover tube into hole in front cylinder. See Figure 11-115.

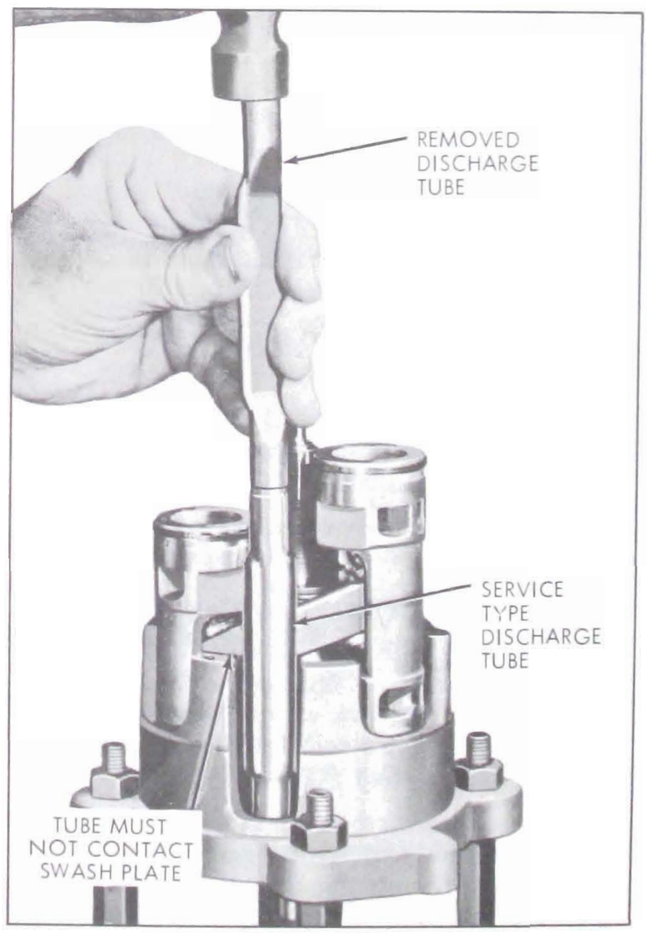


Figure 11-115—Installing Service Type Discharge Tube

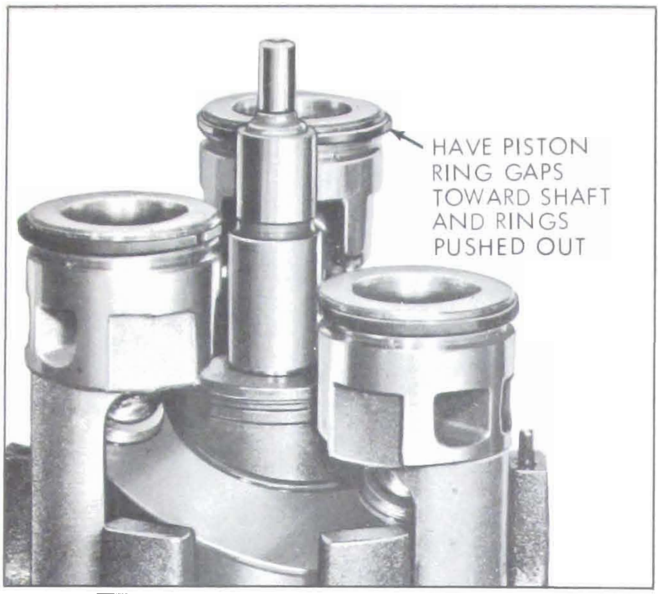


Figure 11-116—Front Cylinder Half Assembly

5. Rotate shaft to position pistons in a "stair step" arrangement. See Figure 11-116. Position piston ring gaps toward center of cylinder. Place rear half cylinder over shaft and start pistons into cylinder bores.

(a) Compress piston ring on each piston so as to permit its entrance into cylinder. See Figure 11-117. If ring is not properly compressed when installing rear cylinder half, ring will be broken.

(b) When all three pistons and rings are in their respective cylinders, align end of the discharge crossover tube with hole in rear half cylinder, making sure flattened portion of this tube faces inside of compressor for swash plate clearance.

(c) When satisfied that all parts are in proper alignment, tap with a fiber block and mallet to 'seat' rear cylinder over locating dowel pins.

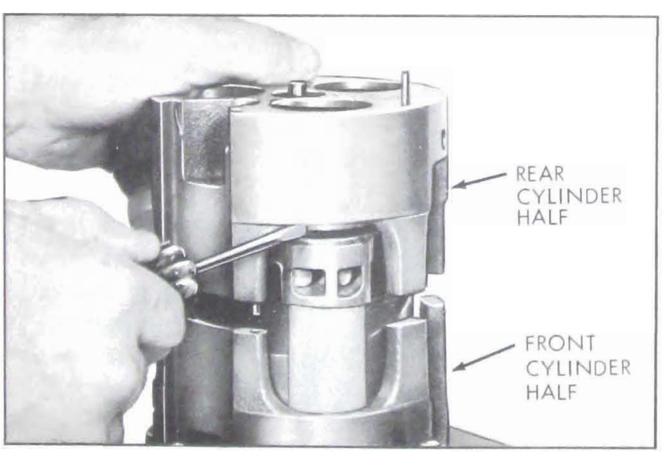


Figure 11-117—Compressing Rear Piston Ring

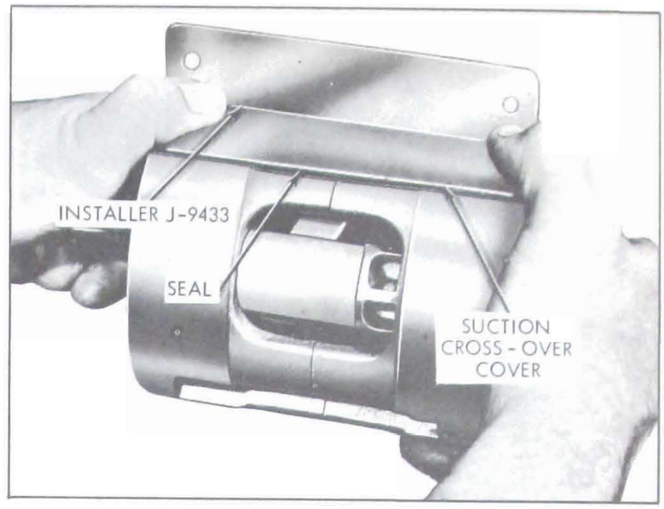


Figure 11-118—Installing suction cross-over Cover and Seal

6. Generously lubricate all moving parts with clean Frigidaire 525 viscosity oil. Check for free rotation of mechanism.

7. Assemble a new rectangular seal to suction crossover cover.

(a) Coat seal with clean 525 viscosity oil.

(b) Start one side of seal and cover into "dove tail" slot in the cylinder.

(c) Use J-9433 suction crossover cover seal installer as a 'shoe horn', by placing it between the seal on opposite side and the 'dove tail' slot. See Figure 11-118.

(d) Center cover and seal with ends of cylinder faces.

(e) Press down on cover to snap it into place.

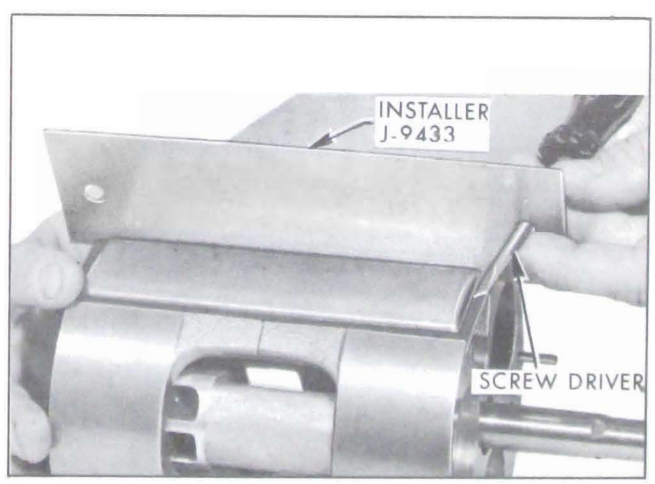


Figure 11-119—Removing Installer J-9433

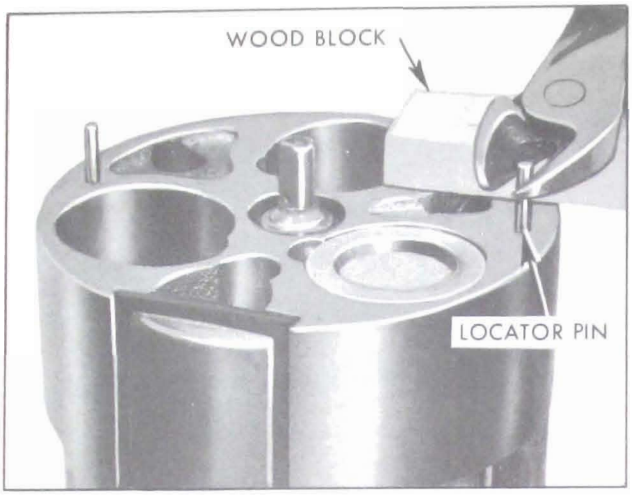


Figure 11-120—Removing Locator Pin

(f) Remove J-9433 installer as shown in Figure 11-119.

(g) Examine cover and seal to be sure cover is properly seated and seal is not damaged.

8. If necessary to replace a locator pin, use suitable pliers to remove pin, using care not to damage surface of cylinder. See Figure 11-120. Install new pin, carefully tapping it into place.

**f. Front Head and Cylinder Assembly Installation**

1. Install discharge crossover tube front O-ring and bushing. See Figure 11-121.

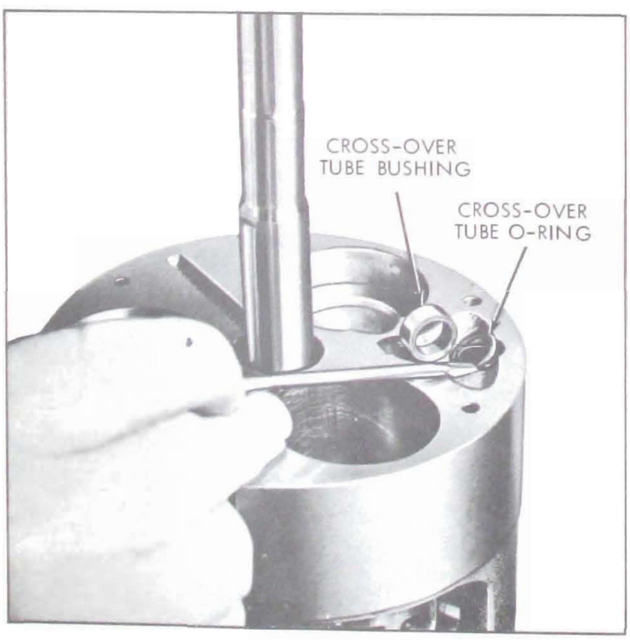


Figure 11-121—Installing Crossover Tube O-Ring

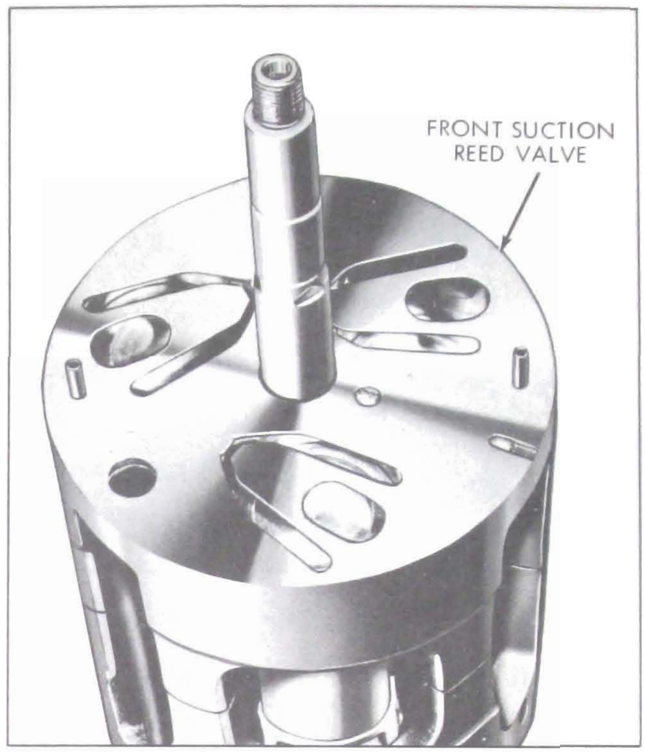


Figure 11-122—Front Suction Reed Valve Installed

2. Assemble suction reed valve to front end of cylinder. Align dowel pin holes, suction ports and oil return slot. See Figure 11-122.

3. Assemble front discharge valve plate,


Figure 11-123—Placing Front Head On Cylinder Assembly

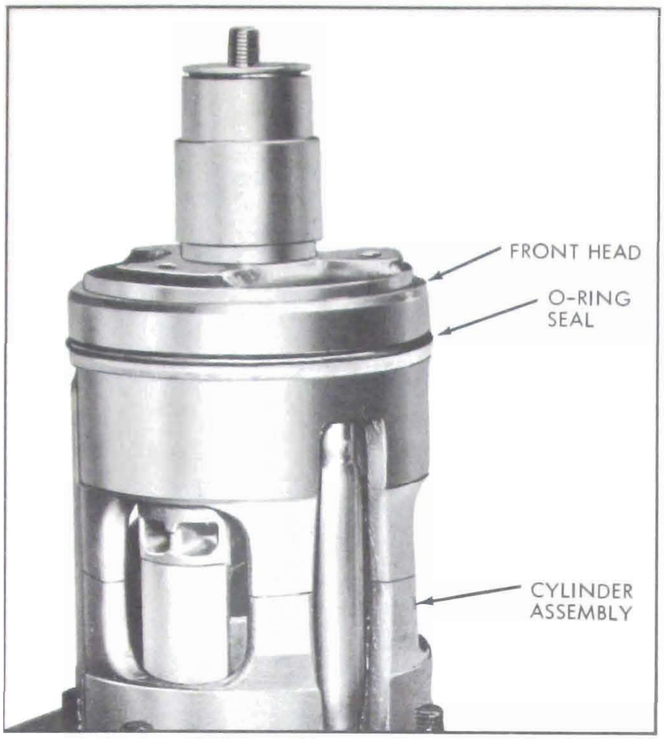


Figure 11-124—Cylinder and Front Head Assembly

aligning holes with dowel pins and proper openings in head. See Figure 11-123.

4. Coat teflon gasket surfaces on webs of compressor front head casting with clean 525 viscosity compressor oil.

5. Examine location of dowel pins and contour of webs and mark dowel location on head with pencil as shown. Rotate so as to position it properly over discharge reed retainers. Use care to avoid damaging teflon surfaces. See Figure 11-123. When in proper alignment, seat on front discharge plate with light mallet taps.

6. Place compressor shell with J-9396 holding fixture in vise so rear end of shell is up.

7. Install a new head to shell O-ring on shoulder at rear of front head. See Figure 11-124.

8. Apply 525 viscosity oil on the O-ring and surfaces of the front head.

9. Coat the inside machined surfaces of shell with clean 525 viscosity compressor oil. Line up oil sump with oil intake tube hole and lower mechanism into shell. Extreme care must be used to prevent large O-ring seal from being damaged. Maintain this alignment when lowering mechanism into place. See Figure 11-125.

10. Place O-ring on the oil intake tube; apply oil to cavity and O-ring. Insert tube and

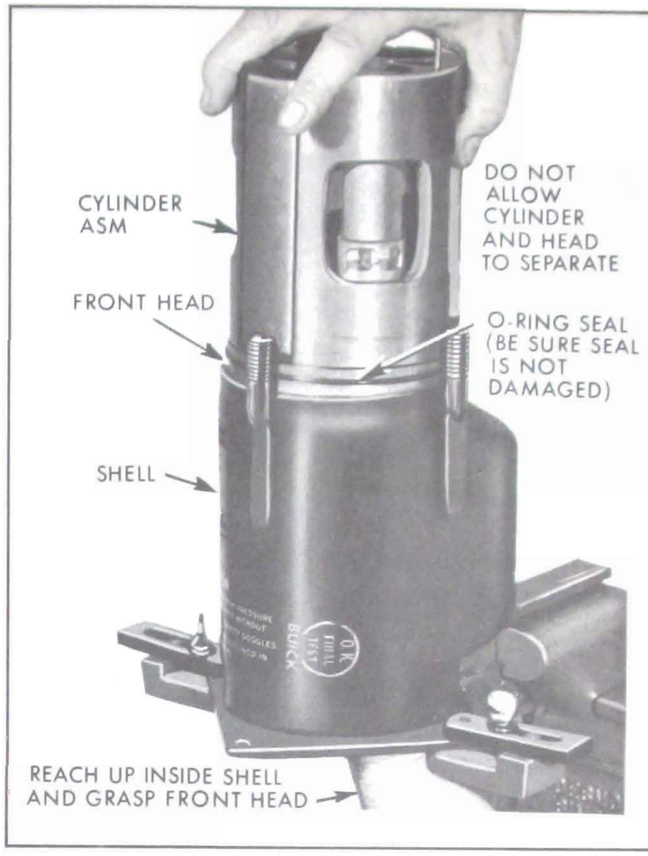


Figure 11-125—Inserting Cylinder Assembly in Shell

O-ring, rotating compressor mechanism as necessary and align tube with hole in the shell baffle. Be sure O-ring and intake tube are properly seated.

11. Install discharge crossover tube rear O-ring and bushing.

### g. Oil Pump and Rear Head Installation

1. Position rear suction reed valve to align with dowel pins, reed tips, and ports in head.

2. Position rear discharge valve assembly to align with dowel pins and ports and slide it into place over locator pins.

3. Assemble the inner oil pump gear over the "D" shaped flat on the shaft. Place outer oil pump gear over inner oil pump gear. If original gears are used, be sure gears are installed in their original positions.

4. Generously oil valve plate around outer edge where large O-ring will be placed. Oil valve reeds, oil pump gears, and area where teflon gasket will contact valve plate.

5. Coat new head-to-shell O-ring with oil and place it on valve plate in contact with shell.

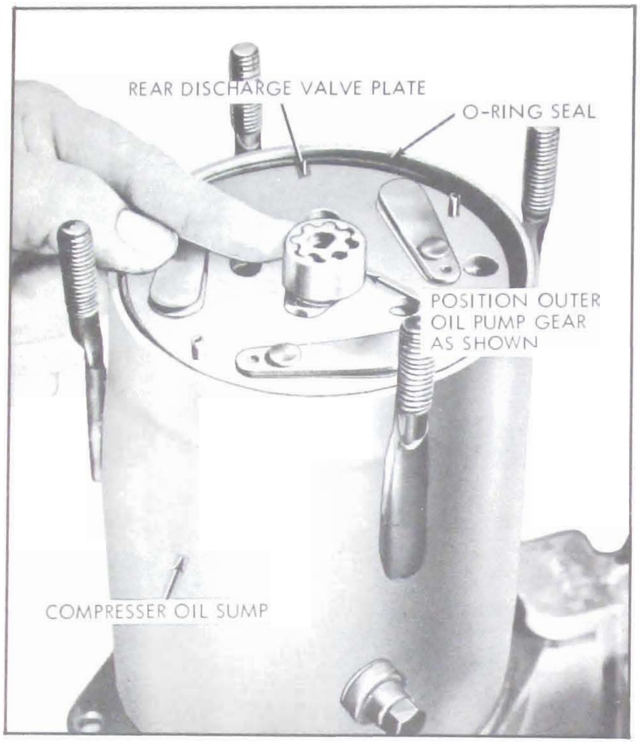


Figure 11-126—Positioning Oil Pump Outer Gear

6. Place suction screen in rear head if removed.

7. Position the oil pump outer gear as shown in Figure 11-126.

8. Assemble rear head to shell, using care not to damage the teflon sealing surfaces on head.

NOTE: If locator pins do not engage holes in rear head, grasp front head and slightly rotate cylinder assembly. See Figure 11-127.

9. Assemble new nuts to threaded shell studs and tighten to 20 lb. ft. torque.

10. Replace pressure relief valve, if removed, using new copper washer.

11. Place new O-rings on discharge and suction ports in compressor. Assemble charging line adapter plate J-9527 to compressor.

12. Invert compressor and compressor holding fixture in vise.

13. Install shaft seal assembly. Par. 11-17, Sub. par. h.

NOTE: When checking compressor for leaks as instructed in seal installation, it is also recommended to check for internal leaks as follows:


Figure 11-127—Installing Rear Head

With gauge set attached to compressor as shown, pressurize discharge side of compressor only. If the same pressure is immediately noted on the suction side gauge as on the discharge gauge, it indicates an internal leak such as head teflon sealing surface, discharge cross-over tube, head to shell O-ring seal or reed valves. Also observe the reading on the high pressure gauge with gauge shut-off valves closed. If gauge reading drops more than 10 pounds in 30 seconds, it indicates an internal leak in compressor.

14. Depressurize compressor and correct any leaks as necessary.

15. Remove charging line adapter plate from compressor and install end plate.

16. Refer to paragraph 11-16, sub. par. k for amount of 525 compressor oil to install in compressor. The oil is installed through oil drain screw opening.

17. Install compressor clutch coil and coil housing assembly. Par. 11-17, Sub. par. f.

18. Install compressor pulley and bearing assembly. Par. 11-17, Sub. par. d.

19. Install compressor clutch drive plate assembly. Par. 11-17, Sub. par. b.

## 11-19 EVACUATION, LEAK TESTING AND CHARGING OF AIR CONDITIONER

Tool J-8393 Portable Air Conditioner Service Station is a Kent-Moore unit designed specifically for servicing automobile air conditioners. J-8393 provides a means of measuring refrigerant without the use of scales. The unit also makes it possible to charge a system without heating the refrigerant tank. As complete instructions are printed on the control panel of J-8393 and the instructions differ from those used with conventional equipment, only conventional equipment will be considered in this paragraph.

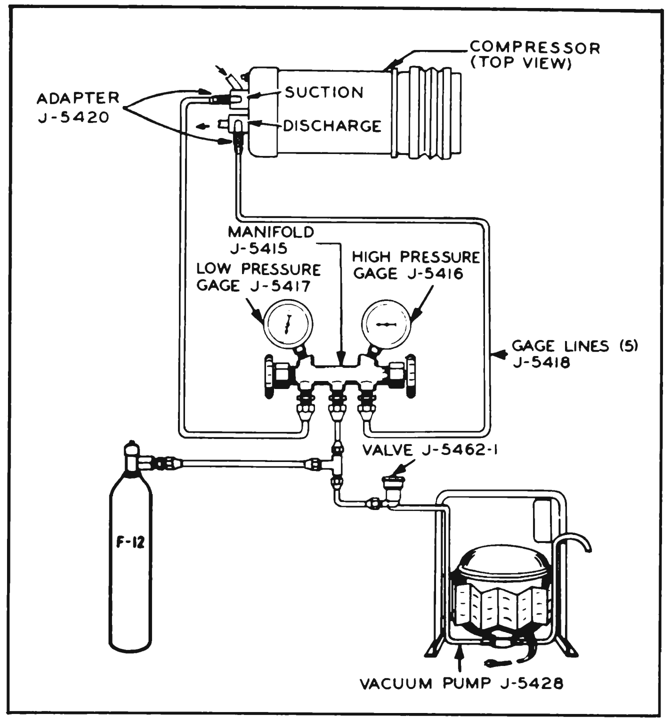


Figure 11-128—Service Gauge Hook-up for Evacuation and Charging System

### a. Evaluation and Leak Testing of System

1. Attach gauge lines, adapters and vacuum pump set-up as shown in Figure 11-128 and discharge any refrigerant that may be in system.

2. Start the vacuum pump, open both valves on gauge set, then slowly open the shut off valve on the vacuum pump. CAUTION: If valve on the vacuum pump is opened too quickly, oil may be forced out of pump.

3. Operate vacuum pump until at least 28 inches vacuum (at sea level) is registered on the "Low" pressure gauge, then continue to run pump for at least ten minutes.

NOTE: Allowance should be made for elevation when obtaining a vacuum. A vacuum of 28 inches of mercury at or near sea level is required. For higher levels, the required vacuum may be reduced by 1 inch of mercury for each 1,000 feet of elevation.

4. If a 28 inch vacuum cannot be obtained, close pump shut off valve and stop pump, then open the refrigerant-12 cylinder valve to charge the system at cylinder pressure. After closing the cylinder valve, leak test the complete system including gauge connections and correct any leaks found. Then re-evacuate system.

5. After 28 inches vacuum has been maintained for ten minutes, close the vacuum pump shut-off valve, stop the pump, and charge the system with refrigerant-12 at cylinder pressure.

6. With refrigerant-12 cylinder valve closed, again evacuate the system with pump at 28 inches of vacuum for ten minutes. This charging and second evacuation is for the purpose of removing any air or moisture that may have entered the system.

7. After maintaining the 28 inches of vacuum for ten minutes, close the vacuum pump shut-off valve and stop the pump. The refrigeration system is now ready for charging.

### b. Charging the System

1. With the vacuum pump, refrigerant-12 cylinder and gauge set connected to the compressor as shown in Figure 11-128, place the cylinder in a bucket of hot water which does not exceed 125°F.

CAUTION: Never heat refrigerant cylinder above 125°F. as tremendous hydrostatic pressures will develop, capable of rupturing cylinder. When there is a possibility of overheating cylinder, the cylinder must be opened to a suitable pressure relief mechanism at all times.

2. Place cylinder and bucket on a suitable scale and record the total weight.

3. Open the low pressure valve on the gauge set. (High pressure valve on gauge set closed.)

4. Wearing goggles to protect eyes, fully open the refrigerant-12 cylinder valve and allow refrigerant-12 vapor to flow into the refrigerating system.

5. Operate engine and compressor at slow idling speed until a total of 4-1/2 pounds of refrigerant-12 have been charged into the system. It may be necessary to reheat the water in bucket to maintain required pressure.

6. Close both valves on gauge set, close valve on refrigerant-12 cylinder, and remove cylinder from bucket of water.

7. Remove low pressure gauge line and adapter from suction line at rear of compressor and attach to schrader valve located on suction throttle valve. See Figure 11-129.

8. Perform functional test. See Figure 11-130.

9. After test is completed, remove gauge lines and replace protective caps over schrader valve fittings and tighten securely.

## 11-20 AIR CONDITIONER TROUBLE DIAGNOSIS

### a. Diagnosis of Components

Listed below are the air conditioner components and the possible conditions that could be encountered with each unit if defective.

1. COMPRESSOR - Compressor malfunction will appear in one of four ways: noise, seizure, leakage, or low discharge pressures. Even resonant compressor noises are not cause for excessive alarm; however, irregular noises or rattles are likely to indicate broken parts.

Seizure will be indicated by the failure of the compressor to operate, if the clutch is in good

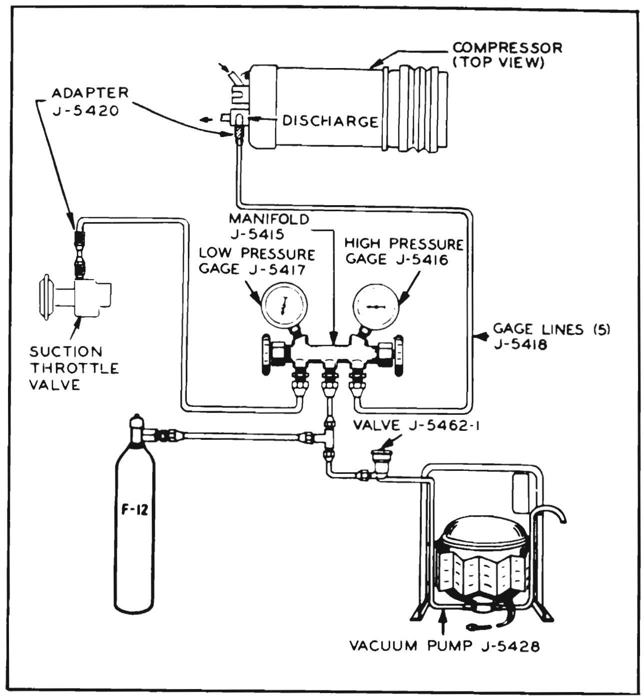


Figure 11-129—Service Gauge Hook-up for Functional Testing and Adjusting Suction Throttle Valve

operating condition and there is no break in the electrical continuity of the system. Continued operation of a seized or partially seized compressor will result in damage to the clutch. To check for seizure, de-energize the clutch and attempt to rotate the compressor by using a wrench on the compressor shaft. If the shaft will not turn, the compressor is seized. Leakage of compressor refrigerant may be detected through routine leak detection.

Low discharge pressures may also be caused by insufficient refrigerant or a restriction elsewhere in the system. These should be checked out prior to compressor servicing.

2. COMPRESSOR CLUTCH - IF the compressor is inoperative, the electrical lead to the clutch should first be checked. If there is current to the clutch and the compressor is not seized, the clutch is defective and should be repaired.

3. CONDENSER - There are two types of possible condenser malfunction. The condenser may leak, resulting in loss of refrigeration and low system pressures, or the condenser may have a restriction, resulting in excessive compressor discharge pressures and inadequate cooling. If a restriction occurs and some refrigerant passes the restriction, icing or frost may occur on the external surface of the

Test Conditions

1. Car doors and hood open.
2. Air Conditioner "Cool" and "Air" levers set at maximum cooling position (down).
3. Gage set connected to Schrader valve fittings as shown in Figure 11-129.
4. Heater defroster and ventilators in "Off" position.
5. Test should be conducted in area with above 70°F. ambient temperature.
6. Ambient air temperature should be measured in immediate test area toward front of car.
7. A fan should be used in front of radiator grille to insure minimum differential between temperature of air passing over condenser through radiator grille and evaporator through body cowl screen.

Test No. 1:

Set engine speed at 1600 rpm.

The following table lists ambient temperature, evaporator and head pressures and right air outlet temperatures that can be expected from a normally-functioning unit.

NOTE: If evaporator pressure is not correct for indicated ambient temperature, adjust suction throttle valve following procedure in par. 11-16, sub-par. d.

NOTE: The lower outlet temperature can be achieved on dry days, and the higher on humid days.

| Ambient Temperature | Evaporator Pressure PSIG | Head Pressure PSIG | Rt. Outlet Temperature |
|---|---|---|---|
| 70°F | 27-29 | 140-180 | 36-42°F |
| 80°F | 27-29 | 160-200 | 38-43°F |
| 90°F | 27-29 | 190-230 | 42-49°F |
| 100°F | 27-29 | 220-260 | 44-55°F |
| 110°F | 28-31 | 280-310 | 47-58°F |

At temperatures above 100° with very high humidity, engine speed should be increased by approximately 500 rpm.

Test No. 2:

This should be run on cars which will pass Test No. 1, but do not perform satisfactorily on the road. In this test the engine speed should be adjusted to the ambient temperature and humidity.

| Ambient Temperature | Humidity | Engine R.P.M. | Evaporator Pressure | Head Pressure | Right Outlet |
|---|---|---|---|---|---|
| 70°F | Dry | 500-525 | 34 | 140 | 40 |
| 70°F | Humid | 600-625 | 34 | 160 | 45 |
| 80°F | Dry | 500-525 | 34 | 160 | 46 |
| 80°F | Humid | 625-650 | 34 | 190 | 49 |
| 90°F | Dry | 550-575 | 34 | 160 | 49 |
| 90°F | Humid | 850-875 | 34 | 210 | 55 |
| 100°F | Dry | 700-725 | 34 | 235 | 51 |
| 100°F | Humid | 1050-1100 | 34 | 260 | 59 |
| 110°F | Dry | 1050-1100 | 34 | 270 | 62 |
| 110°F | Humid | 1600-1650 | 34 | 290 | 67 |

The pressures and outlet temperature should be equal to or lower than those tabulated above.

NOTE: Head pressures in excess of maximum on chart may indicate:

1. Air in system.
2. Overcharge of refrigerant.
3. Restriction in high pressure side.
4. Defective receiver dehydrator.

Evaporator pressure higher than on chart may indicate:

1. Defective suction throttle valve.
2. Defective expansion valve.
3. Defective compressor.

Figure 11-130—Air Conditioner Functional Test Chart condenser in the area of the restriction. Also if the air flow through the condenser is restricted or blocked, high discharge pressures will result. It is important that the external fins of the condenser and radiator core are not plugged with bugs, dirt, etc.

4. THERMOSTATIC EXPANSION VALVE - If malfunction of the valve is suspected, make sure the power element bulb is in proper position, tightly attached, and well insulated from outside air temperatures.

If this valve fails, it usually fails in the power element and thus the valve remains closed. This will be indicated by low high side or discharge pressures. Also the inlet screen could be plugged. The screen may be cleaned with liquid refrigerant.

5. EVAPORATOR - Dirt or other foreign matter on the core surface or in the evaporator case will restrict air flow. A cracked or broken case can result in leakage of cold air and can result in insufficient air or warm air delivered to the passenger compartment.

6. REFRIGERANT LINES - Restrictions in the refrigerant lines may be indicated as follows:

High pressure liquid line - low head pressure, no cooling.

Suction line - low suction pressure, low head pressure, little or no cooling.

Discharge line - compressor blow-off

7. RECEIVER DEHYDRATOR - Leakage of refrigerant indicates a defective unit. The desiccant cannot easily be checked, but if it, or the system has been exposed to outside air for a considerable length of time, the unit should be replaced.

Restrictions in the receiver-dehydrator can also cause system malfunction. If the inlet tube is blocked, it is likely to result in high head pressure. If the outlet tube is blocked, head pressure is likely to be low and there will be little or no cooling.

8. SUCTION THROTTLE VALVE - If the STV is defective it may cause evaporator pressure to be too high (air outlet temperature too warm) or it could cause the evaporator pressure to be too low (air outlet temperature too low which may cause icing of the evaporator core). Also if the vacuum diaphragm of the STV is defective, there would be no means of setting the STV to change (increase) the air outlet temperature. Refrigerant leakage of STV may be detected through routine leak detection.

Before servicing the suction throttle, it should be determined that the STV is actually the cause of the complaint by following adjustment procedure in Paragraph 11-16, sub. par. d (item #2). If evaporator pressure remains too high when checking and adjusting STV, the low pressure gauge line should be attached to the schrader valve located on the compressor suction line. If compressor suction pressure is also high, compressor or thermostatic expansion valve may be the cause of the trouble.

If tests indicate STV is defective, it should be removed, disassembled and repaired following procedure in Paragraph 11-16, sub. par. e and f.

### b. Use of Receiver Sight Glass for Diagnosis

A clear sight glass will indicate a properly charged refrigeration system. The occurrence of slow moving gas bubbles or a broken column of refrigerant for momentary periods during normal operation should not be considered an indication of refrigerant shortage if sight glass is generally clear and performance is satisfactory. The tendency of the sight glass to indicate refrigerant shortage when the system is under light load should be considered.

If the sight glass consistently shows foaming or a broken liquid column, it should be observed after partially blocking the air to the condenser. If under this condition the sight glass clears and the performance is otherwise satisfactory, the charge shall be considered adequate.

In all instances where the indications of refrigerant shortage continues, additional refrigerant shall be added in 1/4 lb. increments until the sight glass is clear. An additional charge of 1/2 lb. shall be added as a reserve.

In no case shall the system be overcharged.

**c. Trouble Diagnosis Chart**

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| 1. Insufficient Cooling | |
| (a) Low air Flow | (a) Check blower operation. Check for obstructions in air distribution system. Check for clogged evaporator. If iced, de-ice core and check adjustment and operation of suction throttle valve. Par. 11-16, sub. par. d. |
| (b) Defective heater temperature control valve | (b) Check operation of valve. Adjust or replace as necessary. |
| (c) Heater controls or ventilator control not in the "off" position | (c) Advise operator of correct operation of controls. |
| NOTE: If none of the above items are cause of complaint of insufficient cooling, perform functional test on car. See Figure 11-130. If car does not pass test see items 2, 3, 4 and 5 on this chart. | |
| 2. Compressor Discharge Pressure Too High | |
| (a) Engine overheated | (a) See Par. 2-13 for possible cause. |
| (b) Overcharge of refrigerant or air in system. | (b) Systems with excess discharge pressures should be slowly depressurized. (1) If discharge pressure drops rapidly, it indicates air (with possibility of moisture) in the system. When pressure drop levels but still indicates in excess of specifications shown in the FUNCTIONAL TEST CHART, slowly bleed system until bubbles appear in the sight glass and stop. Add refrigerant until bubbles clear, then add one-half pound of refrigerant. Recheck operational pressures. If system pressures still remain above specifications, and the evaporator pressure is slightly above normal, then a restriction exists in the high pressure side of the system. (2) If discharge pressure drops slowly, it indicates excessive refrigerant. If pressures drop to specifications and sight glass remains clear, stop depressurizing and recheck operational pressures. If pressures are satisfactory, depressurize until bubbles appear in the sight glass, stop depressurizing, then add one-half pound refrigerant. Recheck operational pressures. (3) If discharge pressure remains high after depressurizing the system, continue depressurizing until bubbles appear in the sight glass. If evaporator pressures also remain high, there is a possibility of a restriction in the high pressure side of the refrigeration system or the STV may require adjustment. See EVAPORATOR PRESSURE TOO HIGH. |

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| **2. Compressor Discharge Pressure Too High (Cont'd.)** | |
| (c) Restriction in condenser or receiver liquid indicator. | (c) Remove parts, inspect, and clean or replace. |
| (d) Condenser air flow blocked. | (d) Clean condenser and radiator core surfaces as well as the space between the condenser and radiator. |
| (e) Evaporator pressure too high. | (e) See EVAPORATOR PRESSURE TOO HIGH. |
| **3. Compressor Discharge Pressure Too Low** | |
| (a) Insufficient refrigerant | (a) Check for presence of bubbles or foam in liquid indicator. If bubbles or foam are noted (after five minutes of operation), check system for leaks, if no leaks found refrigerant should be added until sight glass clears, then add an additional 1/2 lb. |
| (b) Low suction pressure. | (b) See EVAPORATOR PRESSURE TOO LOW. |
| (c) Defective compressor and/or broken compressor reed valves. | (c) Repair compressor. |
| **4. Evaporator Pressure Too High** (This will be accompanied by air outlet temperature at outlet too high.) | |
| (a) Thermostatic expansion valve capillary tube bulb not tight to evaporator outlet tube. | (a) Check for tightness. |
| (b) Thermostatic expansion valve improperly adjusted or inoperative. | (b) Replace valve. |
| (c) Suction throttle valve adjusted improperly or defective. | (c) Check operation of STV, Par. 11-16, sub. par. d. Repair valve, if necessary. |
| (d) Vacuum modulator defective. | (d) There should be no vacuum to STV when "Cool" lever on instrument panel is at maximum on position. Replace vacuum modulator if defective. |
| NOTE: If compressor suction line from STV is extremely colder than STV inlet line from evaporator, this indicates that STV outlet pressure is much lower then inlet pressure and STV may be defective. | |
| **5. Evaporator Pressure Too Low** | |
| (a) Thermostatic expansion valve capillary tube broken, inlet screen plugged or valve otherwise failed. | (a) Replace valve or clean inlet screen of valve. |
| (b) Restriction in system tubes or hoses. | (b) Replace kinked tube or restricted hose. |
| (c) Suction throttle valve adjusted improperly or defective. | (c) Check operation of STV, Par. 11-16, sub. par. d. Repair if necessary. |

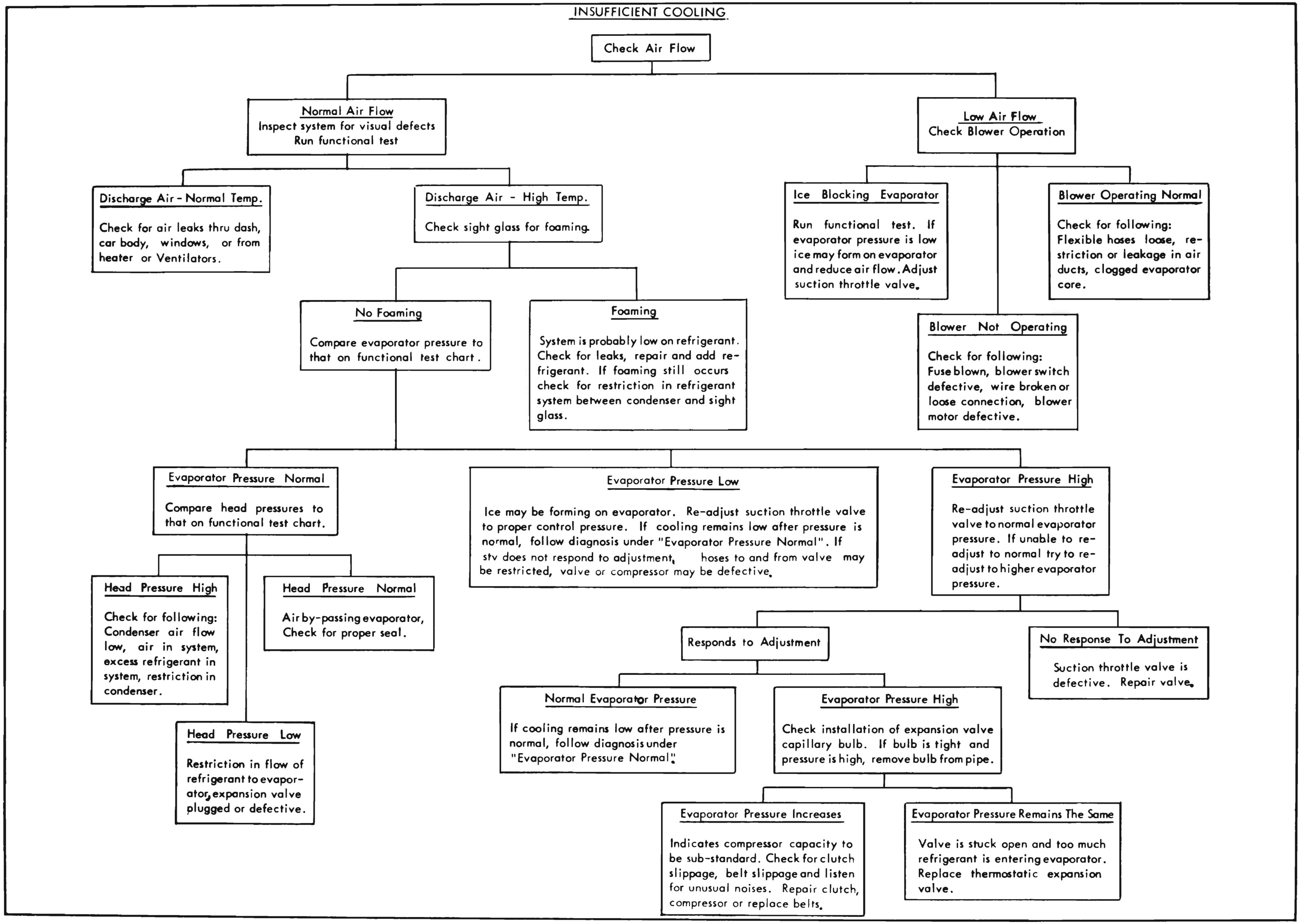


Figure 11-131—Air Conditioner Trouble Diagnosis Chart

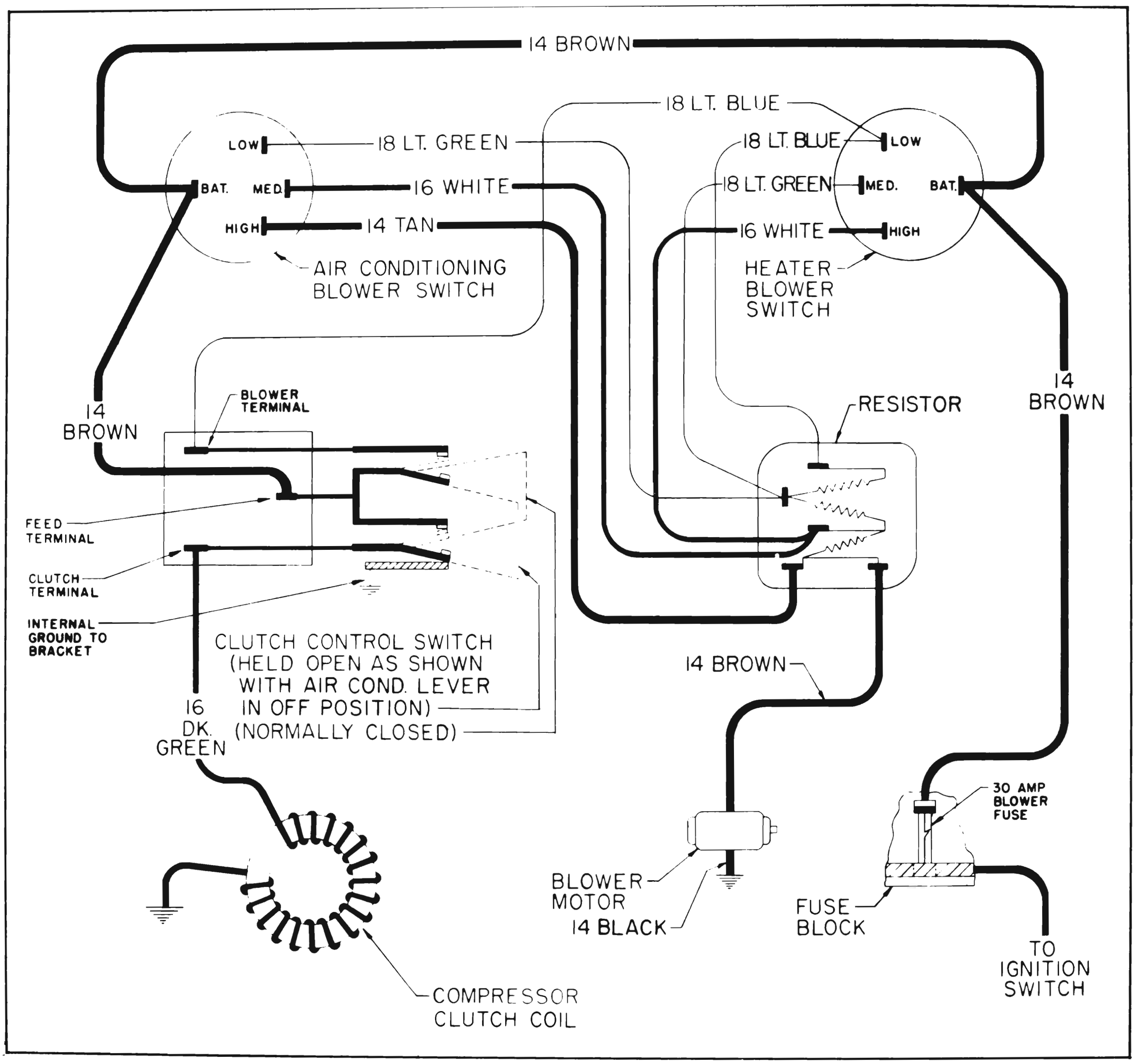


Figure 11-132—Wiring Schematic-Air Conditioner and Heater