PART 36-30 General Air-Conditioning Service

This part gives the basic principles and service procedures that apply to all Ford Air Conditioning systems both manual and automatic control for all vehicle lines. Each of the following parts (beginning with Part 36-31) covers only those procedures that are peculiar to the indicated vehicle system. **Reference both to this Part and to the Part covering the pertinent vehicle line is necessary for complete coverage of any given system.**

1 DESCRIPTION AND OPERATION

BASIC PRINCIPLES

Car Air Conditioning is the cooling or refrigeration of the air in the passenger compartment. Refrigeration is accomplished by making practical use of three laws of nature. These laws of nature and their practical application are outlined in the following paragraphs.

Heat Transfer

If two substances of different temperature are placed near each other, the heat in the warmer substance will always travel to the colder substance until both are of equal temperature. For example, a cake of ice in an ice box does not communicate its coldness to the bottle of milk standing nearby. Rather, in obedience to nature's law, the heat in the warm milk automatically flows into the ice which has a lesser degree of heat.

In order to determine the amount of heat that transfers from one substance to another, science has established a definite standard of measurement called the British Thermal Unit or BTU. One BTU is the amount of heat required to raise the temperature of one pound of water 1 degree F. For example, to raise the temperature of one pound of water from 32 degrees F. to 212 degrees F., one BTU of heat must be added for each degree rise in temperature or a total of 180 BTU's of heat. Conversely, in order to lower the temperature of one pound of water from 212 degrees F. to 32 degrees F., 180 BTU's of heat must be removed from the water.

Latent Heat of Vaporization

When a liquid boils (changes to a gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (changes back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

For example, place one pound of water at 32 degrees F. in a container over a flame. With each BTU of heat that the water absorbs from the flame, its temperature rises 1 degree F. Thus, after it has absorbed 180 BTU's of heat, the water reaches a temperature of 212 degrees F. Here the law of nature is encountered. Even though the flame continues to give its heat to the water, the temperature of the water remains at 212 degrees F. The water, however, starts to boil or change from the liquid to the gaseous state, and it continues to boil until the water has passed off into the atmosphere as vapor. If this vapor were collected in a container and checked with a thermometer, it also would show a temperature of 212 degrees F. In other words, there was a rise of only 180 degrees F. (from 32 to 212) in the water and vapor temperature even though the flame applied many more than 180 BTU's of heat. In this case, the heat is absorbed by the liquid in the process of boiling and disappears in the vapor. If the vapor were brought in contact with cool air,

the hidden heat would reappear and flow into the cooler air as the vapor condensed back to water. Scientists refer to this natural law as the latent (hidden) heat of vaporization.

Water has a latent heat of vaporization of 970 BTU's and a boiling point of 212 degrees F. This means that 1 pound of water at 212 degrees F. will absorb 970 BTU's of heat in changing to vapor at 212 degrees F. Conversely, the vapor will give off 970 BTU's of heat in condensing back to water at 212 degrees F.

This tremendous heat transfer, that occurs when a liquid boils or a vapor condenses, forms the basic principle of all conventional refrigeration systems.

Effect of Pressure on Boiling and Condensation

The boiling or condensation point of a material increases or decreases according to the pressure exerted on it. For example, water will change to vapor or the vapor will condense back to water at a temperature of 212 degrees F. only under normal atmospheric pressure at seal level. At pressures higher or lower than normal, the boiling and condensing can occur only at temperatures correspondingly higher or lower than 212 degrees F.

To illustrate with water as a refrigerant, place a bottle of milk at room temperature next to boiling water at 212 degrees F. (normal pressure). In this case, the heat flows from the water to the milk instead of from the milk to the boiling water, because the temperature of the boiling water is higher than the milk temperature. In order to cool the milk, the boiling point of the water would have to be reduced from 212 degrees F. to a temperature below that of the milk. This lowering of the boiling point would require such a tremendous reduction of pressure as to make water an impractical refrigerant.

In order to make practical use of the heat transfer that occurs when a liquid boils, chemists have developed a number of other liquids which boil at a very low temperature under normal pressure conditions. Refrigerant-12, which is used in Ford air conditioning systems boils at a sub-zero temperature under normal pressure.

Basic A/C System Operation

In any Ford air conditioning system, the evaporator (Fig. 1), is exposed to air flow from the passenger compartment. The expansion valve releases liquid refrigerant into the evaporator coils, the heat from the air is absorbed by the boiling refrigerant and disappears in the refrigerant vapor. The refrigerant vapor containing the hidden heat, is pumped out of the evaporator by a compressor and forced under high pressure to the condenser which is located outside the passenger compartment. In the condenser, the refrigerant vapor condenses back to liquid and the heat, that was absorbed from the passenger compartment and hidden in the vapor, now reappears and passes off into the outside air stream.

The liquid refrigerant under high pressure, now passes from the condenser to a receiver where it is stored for re-use. The liquid refrigerant will not boil while it is stored in the receiver, because it is under high pressure which maintains the boiling point of the refrigerant above the temperature of the surrounding air. Thus, no heat can transfer from the outside air to the refrigerant in the receiver.

The receiver is connected to the expansion valve in the evaporator where the cooling cycle starts over again. When the expansion valve is opened, the high pressure liquid refrigerant from the receiver passes through an orifice in the expansion valve which releases the refrigerant into the evaporator at a greatly reduced pressure. Thus, the temperature at which the liquid refrigerant will boil, is reduced below car air temperature. Now the liquid refrigerant, by absorbing heat from the car air, begins to vaporize.

It may seem difficult to understand how heat can be transferred from a comparatively cooler car passenger compartment to the hot outside air. The answer lies in the difference between the refrigerant pressure that exists in the evaporator and the pressure that exists in the condenser. In the evaporator, the expansion valve reduces the pressure and thereby reduces the boiling point below the temperature of the passenger compartment. Thus, heat transfers from the passenger compartment to the boiling refrigerant. In the condenser, the compressor raises the condensation point above the temperature of the outside air. Thus, the heat transfers from the condensing refrigerant to the outside air. The expansion valve and the compressor simply create pressure conditions that permit the laws of nature to function.

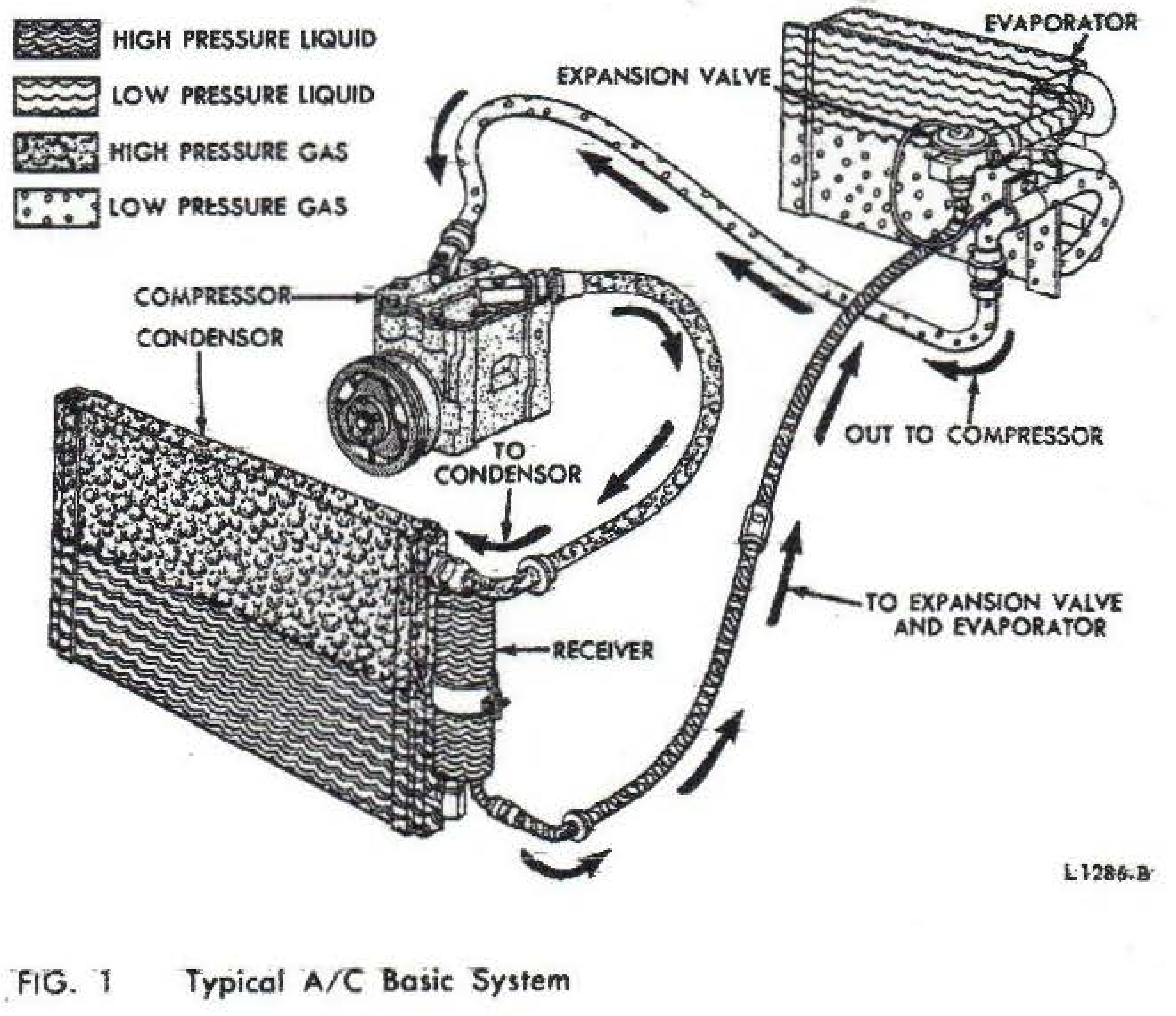


FIG. 1 Typical A/C Basic System

AIR CONDITIONER COMPONENTS

Receiver Unit

The air conditioning system stores the liquid refrigerant-12 under pressure in a combination receiver and dehydrator (Fig. 1). The pressure in the receiver normally varies from about 80 to 300 psi, depending on the surrounding air temperature and compressor speed.

The dehydrator serves the purpose of removing any traces of moisture that may have accumulated in the system. Even small amounts of moisture will cause an air cooling unit to malfunction. A fusible plug is screwed into the receiver. This will release the refrigerant before the refrigerant temperature exceeds 212 degrees F.

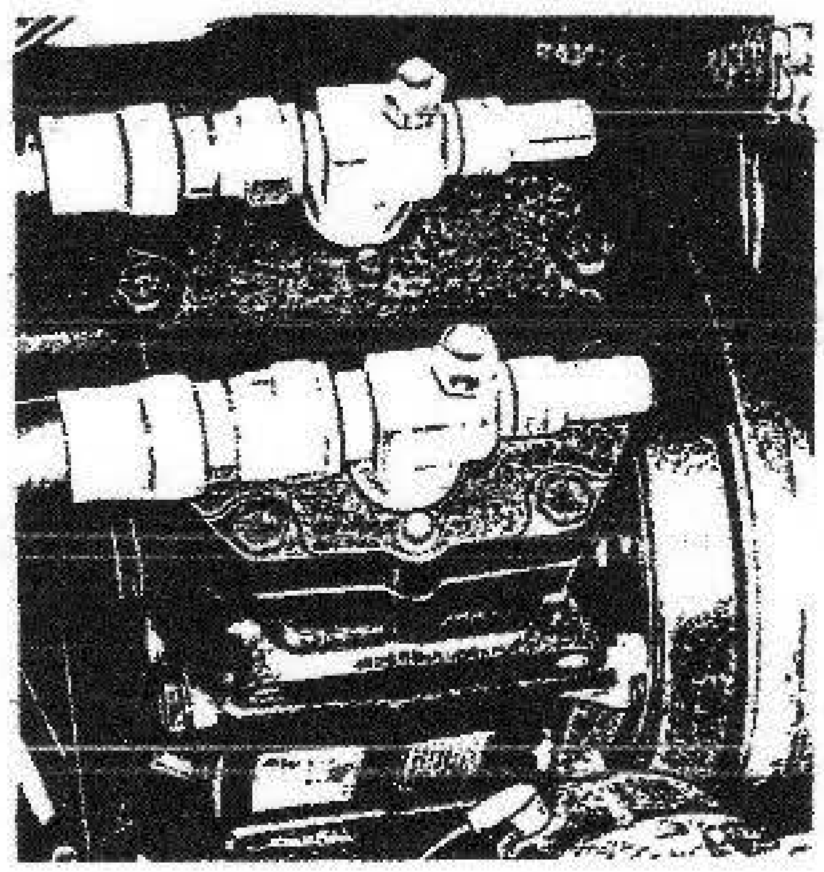
Evaporator Unit

When the cooling system is in operation, the liquid Refrigerant-12 flows from the combination receiver and dehydrator unit through a flexible hose to the evaporator (Fig. 1) where it is allowed to evaporate at a reduced pressure, to cool the evaporator. Air is blown through the evaporator fins and is thus cooled by the evaporator.

Expansion Valve

The rate of refrigerant evaporation is controlled by an expansion valve (Fig. 1) which allows only enough refrigerant to flow into the evaporator to keep the evaporator operating efficiently, depending on its heat load.

The expansion valve on all models except Torino and Montego consists of the valve and a temperature sensing capillary tube and bulb. The bulb is clamped to the outlet pipe of the evaporator. The expansion valve used on Torino and Montego is connected in line with both the inlet and outlet evaporator refrigerant lines. By use of internal passages leading to and from the underside of the valve diaphragm, the diaphragm senses the refrigerant temperature and pressure as it leaves the evaporator core. Thus the valve is controlled by evaporator outlet temperature.



L1287-A

FIG. 2 Compressor Installed

The restricting effect of the expansion valve at the evaporator causes a low pressure on the low pressure side of the system of 12 to 50 psi, depending on the surrounding air temperature and compressor speed.

Compressor Unit

The evaporated refrigerant leaving the evaporator (now in the form of a gas) at a pressure of 12 to 50 psi is pumped by the compressor, located on the engine (Fig. 2), into the top of the condenser, located in front of the radiator.

The compressor maintains a pressure on its high pressure side of from 80 to 300 psi, depending on the surrounding air temperature and compressor speed.

As the now heated and compressed refrigerant gas flows down through the condenser, it is cooled by air passing between the sections of the condenser. The cooled, compressed refrigerant then flows into the receiver.

Condenser

The air conditioning condenser, located in front of the radiator, receives heated and compressed refrigerant gas from the compressor.

As the refrigerant gas flows down through the condenser, it is cooled by air passing between the sections of the condenser. The cooled, compressed refrigerant gas condenses to liquid refrigerant which then flows into the receiver.

Liquid Sight Glass

A liquid sight glass is mounted in the high pressure refrigerant line between the receiver and the expansion valve (Fig. 1). The sight glass is used to check whether there is enough liquid refrigerant in the system.

Magnetic Clutch

It is necessary to control the temperature of the evaporator assembly. To accomplish this, the compressor is cut in and out of operation by an electrically operated magnetic clutch mounted on the compressor crankshaft. The magnetic clutch is controlled by the blower switch, a clutch switch which is a vacuum actuated electrical switch, and the icing switch.

Thermostatic (De-Icing) Switch

The thermostatic (de-icing) switch is connected in series with the blower

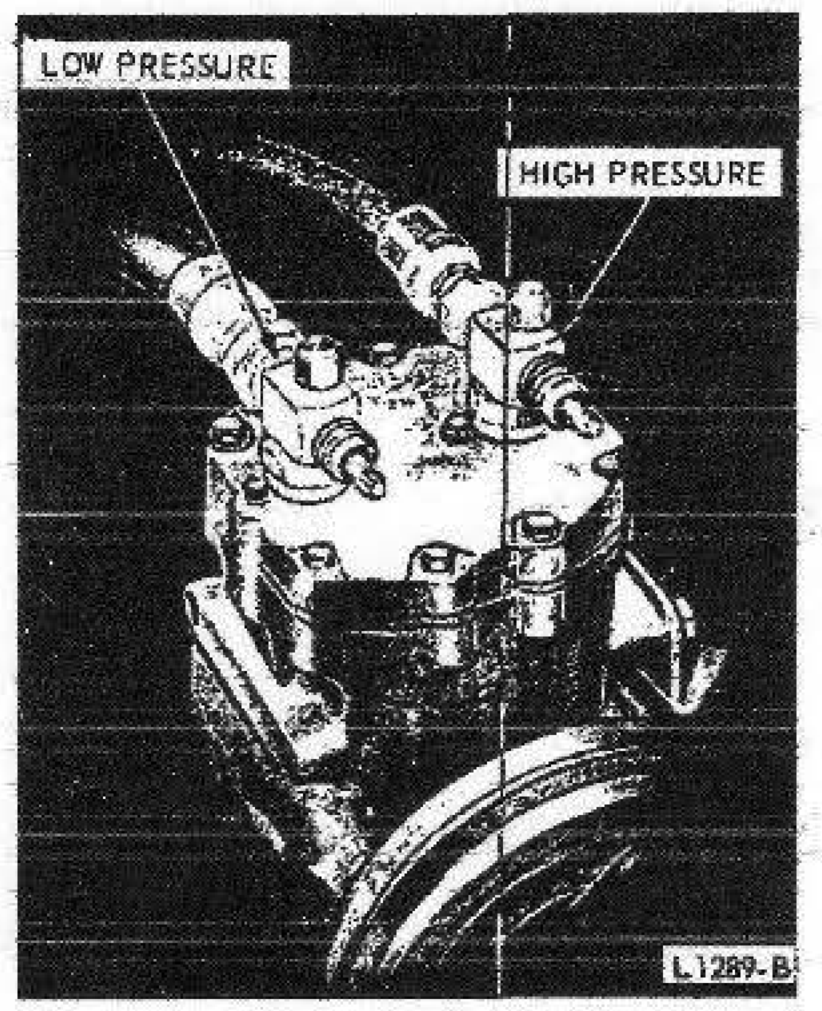


FIG. 3 High Pressure Service Valves

switch and the clutch switch and controls the operation of the compressor by controlling the compressor magnetic clutch. The temperature sensing tube of the switch is placed in contact with the evaporator fins. When the temperature of the evaporator becomes too cold, the switch opens the magnetic clutch electrical circuit, disconnecting the compressor from the engine. When the temperature of the evaporator rises, the thermostatic (icing) switch closes and energizes the magnetic clutch. This connects the compressor to the engine, and cooling action begins again.

When the blower switch is off or the functional control lever is **not** in an A/C position, the magnetic clutch cannot be energized for compressor operation.

When the blower switch is on and the functional control lever is in the cooling range, the magnetic clutch is controlled by the thermostatic (icing) switch which is controlled by the evaporator temperature.

Service Valves

The service valves on the compressor are used to test and service the cooling system (Fig. 3). The high pressure service valve, mounted at the outlet to the compressor, allows access to the high pressure side of the system for attaching a service hose with attached pressure gauge.

The low pressure valve, mounted at the inlet to the compressor, allows access to the low pressure side of the system for attaching a service hose with attached pressure gauge.

Both service valves may be used to shut off the rest of the system from the compressor during compressor service.

CODE NO.	DOOR VALVE	FUNCTION	ACTUATED BY	CONTROL LEVER
①	Outside Air Door (Ford Meteor, Mercury, and Lincoln Continental only)	Opens or Closes outside air inlet to the system	Vacuum Motor	Functional
②	Recirculating Air Door (Ford, Meteor, Mercury, and Lincoln Continental only)	Opens or closes inside air inlet to the system	Vacuum Motor	Functional
①②	Outside/Recirculating Combination Air Door (All except Ford, Meteor Mercury and Lincoln Continental)	Opens outside and closes inside air inlet, or Closes outside and opens inside air inlet to the system	Vacuum Motor	Functional
③	Restrictor Air Door (Not on A.T.C, system or Montego, Torino, Maverick Comet, Pinto)	Restricts flow of air through heater core during Cooling	Vacuum Motor	Functional
④	Heater Water Valve (All Models)	Opens or closes flow of hot water from engine through heater core	Vacuum Motor	Temperature and Functional
⑤	Temperature Blend Door (All Models)	Controls flow of air through and/or around heater core	Cable (Vac. Motor on A.T.C. systems)	Temperature
⑥	A/C-Heat Door-Mustang, Cougar Maverick, Comet and Pinto	Routes flow of discharge air either through floor outlets or to No. 7 Door	Vacuum Motor	Functional
⑥	A/C-Heat Door-Ford, Meteor, Mercury, T-Bird, Torino, Montego, and all A.T.C. systems.	Routes flow of discharge air either through A/C registers or to No. 7 Door.	Vacuum Motor	Functional
⑦	A/C-Defrost Door-Mustang, Cougar, Maverick Comet and Pinto	Routes flow of discharge air either through A/C registers or through defroster outlets	Vacuum Motor	Functional
⑦	A/C-Defrost Door-Ford, Meteor, Mercury, T-Bird, Torino, Montego and all A.T.C. systems	Routes Flow of Discharge air either through floor outlets or through defroster outlets	Vacuum Motor	Functional

CL1524-A

FIG. 4 Heater-A/C System Control Doors and Code Numbers

HEATER-A/C SYSTEMS CONTROL DOORS

With all Ford heater-A/C systems, outside air comes through an opening at the upper cowl and into the right end of the evaporator and blower assembly. All evaporator and blower assemblies contain:

(1) An evaporator core through which flows Refrigerant-12

(2) A heater core through which flows hot water from the engine

(3) A blower which forces air through the evaporator core, through and/or around the heater core, and out through various outlets.

(4) Several control valves or doors.

The control valves or doors determine the following functions:

(1) Whether outside air or inside (recirculating) air goes through the system.

(2) The amount of air that goes through and the amount that by-passes the heater core.

(3) The particular outlet(s) through which the air discharges.

The number of doors used and the manner in which they are actuated differ according to the particular vehicle model. Some doors are actuated by a vacuum motor; some by a cable. In all cases, the cables and motors are controlled by either one of two control levers (functional or temperature).

Each door or valve and the vacuum motor or cable that controls it has been assigned a code number which relates directly to its function in the system (Fig. 4). These code numbers are used in illustrations and procedures throughout this group to familiarize the reader with the function, control, and model application of each valve or door.

2 TESTING

SAFETY PRECAUTIONS

The refrigerant used in the air conditioner system is Refrigerant-12. Refrigerant-12 is nonexplosive, non-inflammable, non-corrosive, has practically no odor, and is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person who is working on the unit.

Use only Refrigerant-12. Do not use refrigerant that was canned for pressure operated accessories (such as boat air horns). This type is not pure Refrigerant-12 and will cause a malfunction.

Liquid Refrigerant-12, at normal atmospheric pressures and temperatures, evaporates so quickly that it has the tendency to freeze anything it contacts. For this reason, extreme care must be taken to prevent any liquid refrigerant from coming in contact with the skin and especially the eyes.

Refrigerant-12 is readily absorbed by most types of oil. It is therefore recommended that a bottle of sterile mineral oil and a quantity of weak boric acid solution by kept nearby when servicing the air conditioning system. Should any liquid refrigerant get into the eyes, use a few drops of mineral oil to wash them out, then wash the eyes clean with the weak boric acid solution. Seek a doctor's aid immediately even though irritation may have ceased.

Always wear safety goggles when servicing any part of the refrigerant system.

The Refrigerant-12 in the system is always under pressure. Because the system is tightly sealed, heat applied to any part would cause this pressure to build up excessively.

To avoid a dangerous explosion, never weld, use a blow torch, solder, steam clean, bake body finishes, or use any excessive amount of heat on or in the immediate area of any part of the air cooling system or refrigerant supply tank, while they are closed to the atmosphere whether filled with refrigerant or not.

The liquid refrigerant evaporates so rapidly that the resulting refrigerant gas will displace the air surrounding the area where the refrigerant is released. To prevent possible suffocation in enclosed areas, always discharge the refrigerant from an air cooling system into the garage exhaust collector. Always 'maintain good ventilation surrounding the work area.

Although Refrigerant-12 gas, under normal conditions, is non-poisonous, the discharge of refrigerant gas near an open flame can produce a very poisonous gas. This gas will also attack all bright metal surfaces. This poisonous gas is generated when the flame-type leak detector is used. Avoid inhaling the fumes from the leak detector. Make certain that Refrigerant-12 is both stored and installed in accordance with all state and local ordinances.

When admitting Refrigerant-12 gas into the cooling unit, always keep the tank in an upright position. If the tank is on its side or upside down, liquid Refrigerant-12 will enter the system and damage the compressor. In surrounding air temperatures above 90 degrees F., prolonged engine idle will result in excessively high compressor pressures.

VISUAL INSPECTION

Obstructed air passages, broken belts, disconnected or broken wires, loose clutch, loose or broken mounting brackets may be determined by visual inspection of the parts.

PROPER USE OF SERVICE VALVES

The service valves (Fig. 5) are used throughout the service procedures in this section and in the following Section 3.

When in the **Back-Seated** position, both valves are cut off from the gauge manifold; the low pressure valve is open between the suction side of the

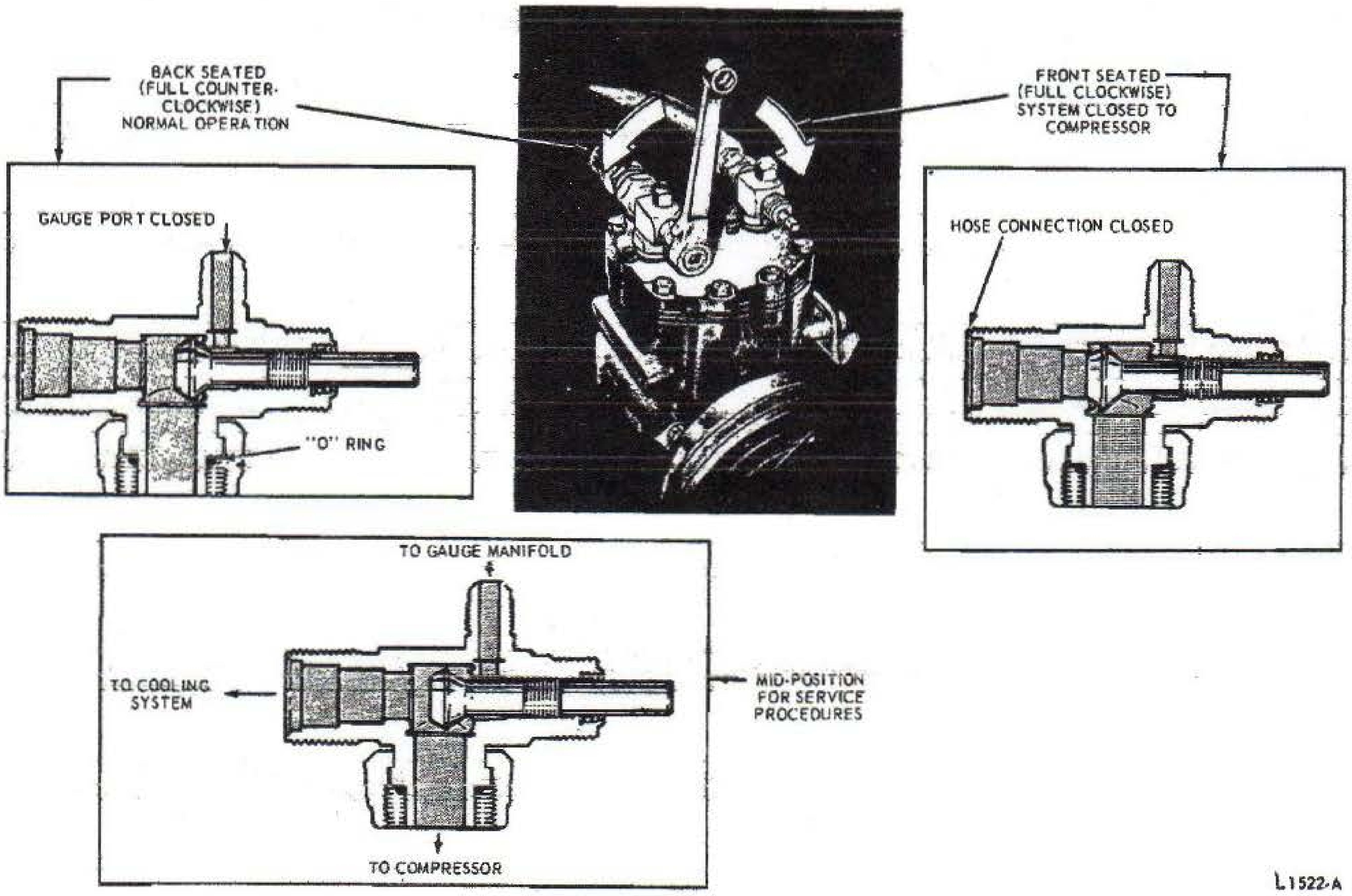


FIG. 5 Service Valve Positions

compressor and the evaporator; and the high pressure valve is open between the discharge side of the compressor and the condenser. This is the normal operating position.

In the **Front-Seated** position, the low pressure valve cuts off the suction side of the compressor from the evaporator; and the high pressure valve cuts off the discharge side of the compressor from the condenser.

In the **Mid-Position**, the valves are open between the gauge manifold, the cooling system, and the compressor. This is the position used in performing various tests and service operations.

COMPRESSOR TEST

1. Attach the manifold gauge set (Fig. 6). It will not be necessary to attach the Refrigerant-12 tank or the vacuum pump.

2. Set both manifold gauge valves at full clockwise (closed) position.

3. Turn the low pressure service valve to the Front-Seated (full clockwise) position, and turn the high pressure service valve to the Back-Seated (full counterclockwise) position (Fig. 5).

4. With the engine running at idle speed, set the A/C controls to maximum cooling (to engage the compressor clutch) **for 30 seconds only. Then, to avoid damaging the compressor, quickly disengage the clutch by returning the A/C controls to OFF.**

The low pressure (suction) gauge should reach 20 inches of vacuum within the 30 seconds of operation and should remain below zero psi for at least one minute.

If the compressor does not satisfy these two conditions after at least 3 cycles of clutch engagement, the compressor has either a blown head gasket or leaking valves. Remove the head and inspect the valve plate and gaskets for damage. Replace parts if necessary. Replace a compressor, if the cylinder walls are scored or pieces of metal are inbedded in the pistons.

CHECKING FOR LEAKS

Attach the manifold gauge set (Fig. 6). Leave both manifold gauge valves at the maximum clockwise position. Set both service valves at the center position. Both gauges should show approximately 60 to 80 pounds pressure at 75 degrees F. with the engine not running. If very little or no pressure is indicated, leave the vacuum pump valve closed, open the Refrigerant-12 tank valve, and set the low pressure (suction) manifold gauge valve to the counterclockwise position. This opens the system to tank pressure. Check all connections, and the compressor head gasket, oil filler plug, and shaft seal for leaks, using a flame-type leak detector (Fig. 7). Follow the directions with the leak detector. The smaller the flame the more sensitive it is to leaks. Therefore, to insure accurate leak indication keep the flame as small as possible. The copper element must be red hot. If it is burned away, replace the element. Hold the open end of the hose at each suspected leak point for two or three seconds. The flame will normally be almost colorless. The slightest leak will be indicated by a bright green blue color to the flame. Be sure to check the manifold gauge set and hoses for leaks as well as the rest of the system.

If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Good ventilation is necessary to prevent this situation. A fan, even in a well ventilated area, is very helpful in removing small traces of refrigerant vapor.

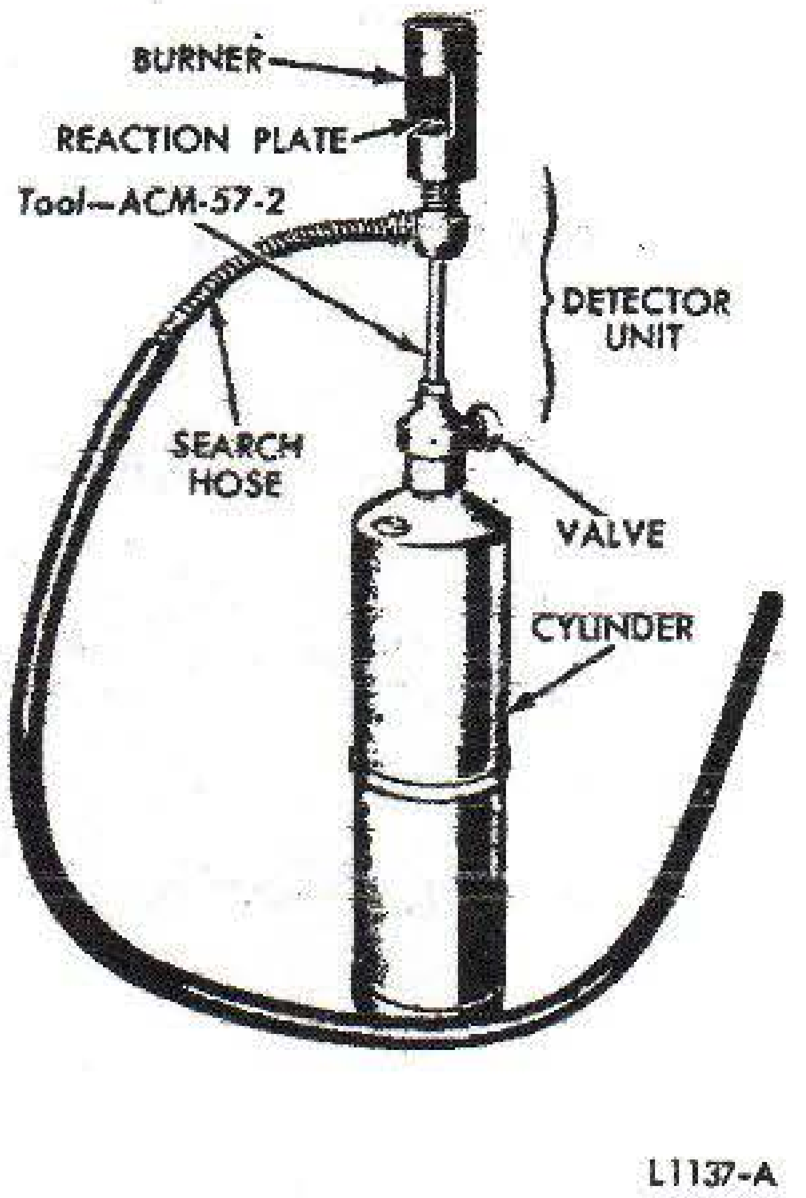


FIG. 7 Torch Type Leak Detector

USE OF SIGHT GLASS

Clean the sight glass before checking for a proper charge of refrigerant. Then, observe the sight glass for bubbles with the engine running at 1500 rpm and the A/C controls set at maximum cooling. A continuous or large amount of bubbles in the sight glass indicate an undercharge of refrigerant. If an undercharge of refrigerant is found, check the system for leaks. Repair any leaks, evacuate the system with a good vacuum pump, and charge the system with the proper amount of Refrigerant-12.

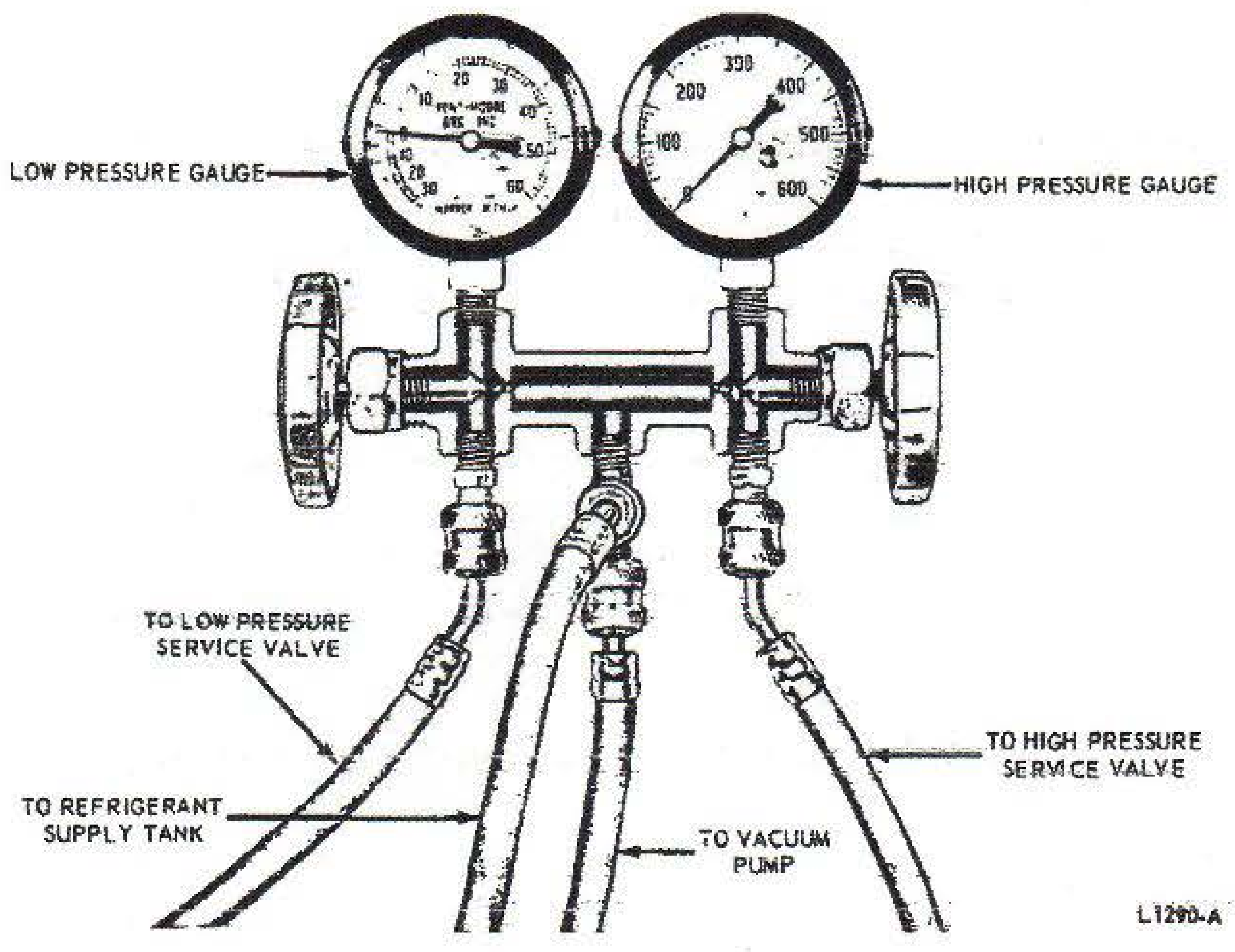


FIG. 6 Manifold Gauge Set

No bubbles in the sight glass indicate either too much refrigerant or a complete loss of refrigerant. While observing the sight glass, cycle the magnetic clutch off and on, with the engine running at 1500 rpm. If refrigerant is in the system, bubbles will appear while the clutch is off and disappear when the clutch is on. If no bubbles appear during the on and off cycle of the magnetic clutch, there is no refrigerant in the system. If there is no refrigerant in the system, it will be necessary to leak test, repair as required, and charge the system. **Under conditions of extremely high temperatures, occasional foam or bubbles may appear in the sight glass.**

AIR CONDITIONER PERFORMANCE TEST

The pressures developed on the high pressure (discharge) and low pressure (suction) side of the compressor indicate whether or not the system is operating properly.

Attach the manifold gauge set (Fig. 6). It will not be necessary to attach the Refrigerant-12 tank unless refrigerant is to be added to the system. Set both manifold gauge valves at the maximum clockwise, or closed, position. Set both service valves at the center position.

Check the system pressures with the engine running at 1500 rpm, all controls set for maximum cooling, and the front of the car at least 5 feet from any wall.

The actual pressures indicated on the gauges will depend on the temperature of the surrounding air and the humidity. Higher air temperatures along with high humidity, will give higher system pressures.

At idle speed and a surrounding air temperature of 100 degrees—110 degrees F., the high pressure may go as high as 300 pounds or more. If it becomes necessary to operate the air conditioner under these conditions, keep the high pressure down with a fan directed at the condenser and radiator.

Correct pressures for a normally operating system are shown on line (1) in the Refrigerant System Analysis Chart (Fig. 8): the low pressure gauge should indicate 10 to 20 psi; the high pressure gauge should indicate 180 to 225 psi. Lines 2 through 8 in Figure 8 show various abnormal pressure conditions and the possible problems that could be their cause.

THERMOSTATIC DE-ICING SWITCH TEST

Fill a container with crushed ice, salt and water. Put enough salt in the water so that the temperature of the solution is 25 degrees F. or lower.

Use a self-powered test light or ohmmeter connected to the switch terminals to check whether or not the switch is closed.

Place the sensing tube in the ice, salt and water solution. **Make certain that no salt water gets into the control.** The thermostatic (de-icing) switch contact points should open and remain open while the tube is in the solution. Remove the sensing tube from the solution. As the tube warms up, the switch contacts should close. If the switch contacts do not open and close as indicated, replace the switch.

An ohmmeter check of the contacts should show a resistance of less than an ohm. If a resistance of one ohm or more occurs, replace the switch.

RECEIVER—DRYER TEST

Operate the air conditioner for about five minutes; then, slowly move your hand across the length of the unit from one end to the other. There should be no noticeable difference in temperature. If cold spots are felt, it indicates that the unit is restricting the refrigerant flow, and the receiver-dryer must be replaced.

MAGNETIC CLUTCH TEST

Disconnect the magnetic clutch wire at the bullet connector, and connect it to the negative lead of an ammeter. Connect the positive lead of the ammeter to the battery positive terminal. The magnetic clutch should pull in with a distinct click and the current reading on the ammeter should be to specification.

BLOWER MOTOR TEST—EXCEPT LINCOLN CONTINENTAL

Disconnect the blower motor wire at the bullet connector, and connect it to the negative lead of an ammeter. Connect the positive lead of the ammeter to the battery positive terminal. The motor should operate and the reading on the ammeter should be to specification.

Low Press (Suction) Gauge	High Press (Discharge) Gauge	Problem
(1) 10-20 psi	180-225 psi	Normal
(2) Normal	Too High	Restriction in line. Plugged Condenser. } Look for frost ring. Radiator Overheating. Air in System. Engine fan too small - or Viscous fan (Fluid Clutch) Inoperative. Condenser Blower Not Operating (Trucks Only)
(3) Too High	Too High	Condenser Blower Not Operating (Trucks Only) Very hot shop, no auxiliary fan directed toward condenser. Restricted air flow through condenser. Overcharged system.
(4) Too High	Too Low	Compressor head gasket blown.
(5) Too Low	Too Low	Undercharged system.
(6) Vacuum	Normal	Expansion valve stuck closed. Plugged receiver (see Note). Iced up (Moisture in System).
(7) Too High	Normal	Capillary tube temperature sensing bulb uncovered and exposed to engine compartment heat.
(8) Normal (Complaint of Intermittent cooling)	Normal	Moisture in system, passes critical point and clears up but freezes again.

NOTE: If the condenser is hot from top to bottom and the receiver is hot but the receiver outlet line is cool, the receiver desiccant is restricted. Replace the receiver.

FIG. 8 Refrigerant System Analysis Chart

CL1521-A

3 ADJUSTMENTS

DISCHARGING THE SYSTEM

Discharge the refrigerant from the system before replacing any part of the system, except the compressor.

To discharge the system, connect the manifold gauge set to the system (Fig. 6). Do not connect the manifold center connection hoses to the Refrigerant-12 tank, or vacuum pump. Place the open end of these hoses in a garage exhaust outlet. Set both manifold gauge valves at the maximum counterclockwise or open position. Open both service valves a slight amount (Fig. 3) and allow the refrigerant to discharge slowly from the system.

Do not allow the refrigerant to rush out, as the oil in the compressor will be forced out along with it.

EVACUATING THE SYSTEM

Attach the manifold gauge set, a tank of Refrigerant-12 and a vacuum pump to the system (Fig. 6). Make certain that the Refrigerant-12 tank valve is tightly closed. Set both service valves to the midposition (Fig. 5). Open both manifold valves. Release any pressure in the system. Open the vacuum pump valve and run the pump until the low pressure gauge reads at least 25 inches, and as close to 30 inches of vacuum as possible. Continue vacuum pump operation for 20 to 30 minutes to boil any moisture out of the system. Close the pump valve. Turn off the pump.

MAKING A COMPLETE CHARGE

1. Evacuate the system as outlined in the foregoing procedure.

2. Leave both service valves at the midposition (Fig. 9) and the vacuum pump valve closed.

3. Leave the low pressure (suction) manifold gauge valve at the full counterclockwise or open position.

4. **Set the high pressure (discharge) manifold gauge valve at the full clockwise or closed position.**

5. Open the Refrigerant-12 tank valve to allow refrigerant to enter the system, and observe the gauges. When both gauges reach 60 to 80 pounds at approximately 75 degrees F., shut off the tak valve.

6. Perform the leak test with the leak detector as outlined in Section 2 of this Part.

7. Set both of the A/C controls to the maximum COLD position, and set the blower switch at HI speed.

8. Start the engine, and open the R-12 tank valve again to prevent drawing vacuum on the suction side. When the suction gauge shows pressure instead of vacuum, close the R-12 tank valve.

9. Run the engine at 1500 rpm for about ten minutes or until both gauge readings have stabilized. If the clutch disengages during the stabilization process, continue running the engine until the pressures again stabilize after the clutch re-engages.

10. With the engine still running, open the R-12 tank and charge the system until specified pressures are indicated on the manifold gauges: low pressure (suction) gauge—10 to 20 psi; high pressure (discharge) gauge—180 to 225 psi.

11. If the refrigerant will not enter the system due to low temperature, it may be necessary to place the Refrigerant-12 tank in a container of hot water at about 150 degrees F. This will increase the R-12 pressure and force the gas from the tank during charging. **Never heat the Refrigerant-12 tank with a torch. A dangerous explosion may result.**

12. During the charging, the high pressure (discharge) side may build up to an excessive value. This can be caused by an overcharge of refrigerant, or an overheated engine, in combination with high surrounding temperatures. Never allow the high pressure to exceed 240 pounds while charging. Stop the engine, determine the cause, and correct it.

13. After the proper charge has been made, close the Refrigerant-12 tank valve, and check the system pressures for proper operation as described under Air Conditioner Performance Test in Section 2 of this Part.

14. After satisfactory operation has been achieved, set both service valves at the maximum counterclockwise (gauge port closed) position (Fig. 5). Remove the gauge set, and cap the service valve gauge ports and valve stems.

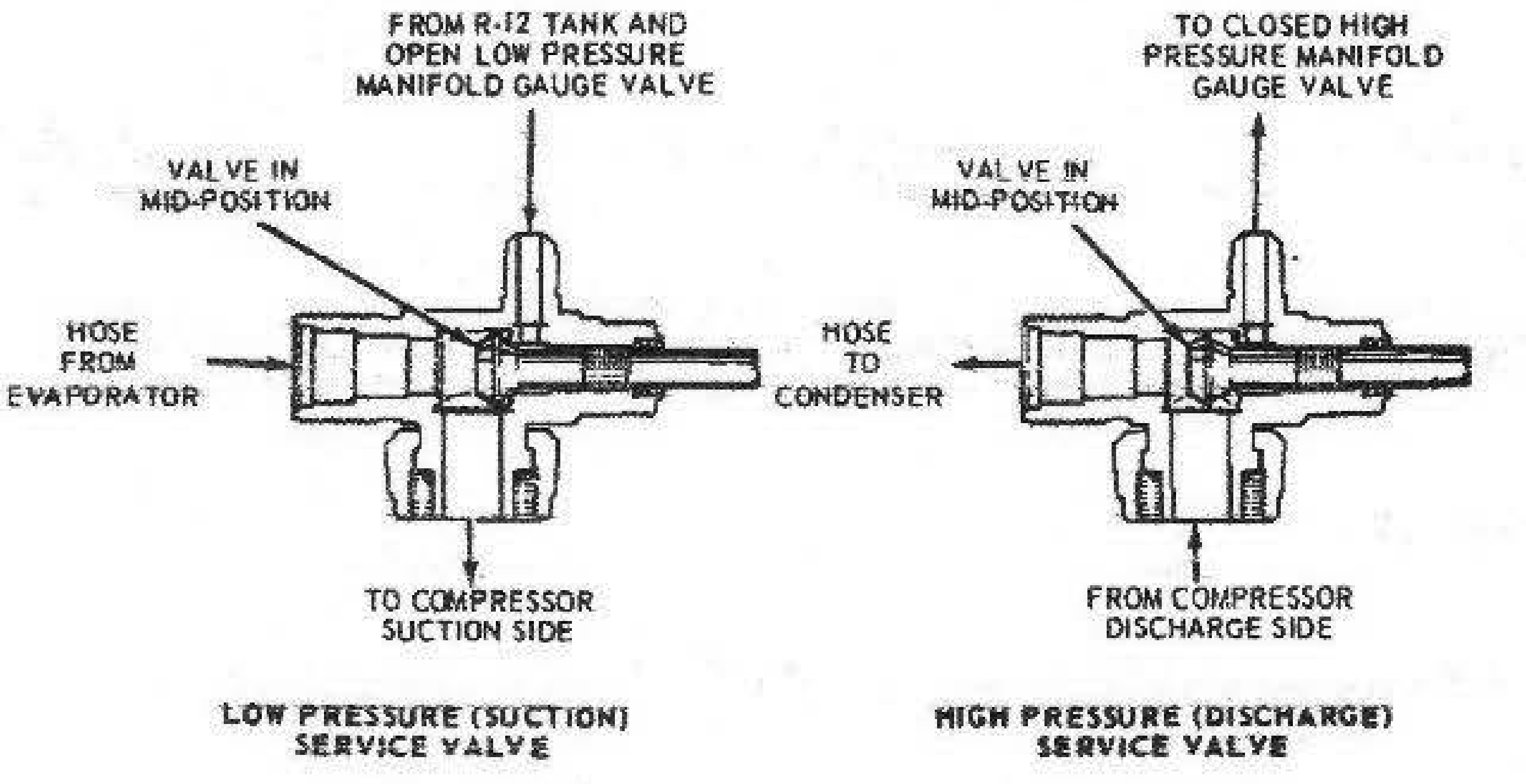


FIG. 9 Charging the Air Conditioning System

CHARGING FROM SMALL CONTAINERS

Refrigerant-12 is available in 15 oz. cans. **Do not open the high pressure (discharge) gauge valve on the manifold because the container can explode.**

1. A special valve and valve retainer is required for connecting the small can to the A/C system. Attach the valve retainer to the can by engaging the three tabs of the retainer to the lip at the top of the can. There is a sharp pointed tube on the threaded end of the valve assembly. Puncture the center of the can with the tube and turn the valve assembly into the threaded hole in the center of the valve retainer.

2. Connect the manifold gauge set to the system (Fig. 6). Connect the hose (normally connected to the large R-12 tank) to the special valve on the small can. **Make sure that the valve is closed (full clockwise position).**

3. For a complete charge, discontinue this procedure, and follow the steps in the foregoing procedure. For a partial charge, continue with this procedure.

4. Set the service valves and the manifold gauge valves as indicated in steps 2, 3, and 4 of the foregoing procedure. Making a complete charge.

5. Set both of the A/C controls to the maximum COLD position, set the blower switch at HI speed, and start the engine.

6. With the engine running at 1500 rpm, open the valve on the R-12 can to admit refrigerant into the system. Keep the can in an upright position. Allow refrigerant to be pumped into the system only in the amount necessary to achieve specified operating pressures (low pressure gauge, 10 to 20 psi; high pressure gauge, 180 to 225 psi). When these pressures are indicated on the gauges, the system will have been charged with the approximately correct amount of refrigerant. Close the valve on the can.

If the can is empty (no frost showing) before the specified pressures are reached, close the valve and remove the empty can. Connect a new can and open the valve again.

7. Back-seat both service valves (full counterclockwise) for normal operation (Fig. 5).

8. Remove the gauge set and cap the service valve stems and gauge ports.

COMPRESSOR OIL LEVEL CHECK

Under normal conditions, when the air conditioning system is operating satisfactorily, the compressor oil level need not be checked. There is no place for the oil to go except inside the sealed system. When the engine is first started, some of the oil will be pumped into the rest of the refrigerant system. After several minutes of operation, most of the oil is returned to the compressor crankcase.

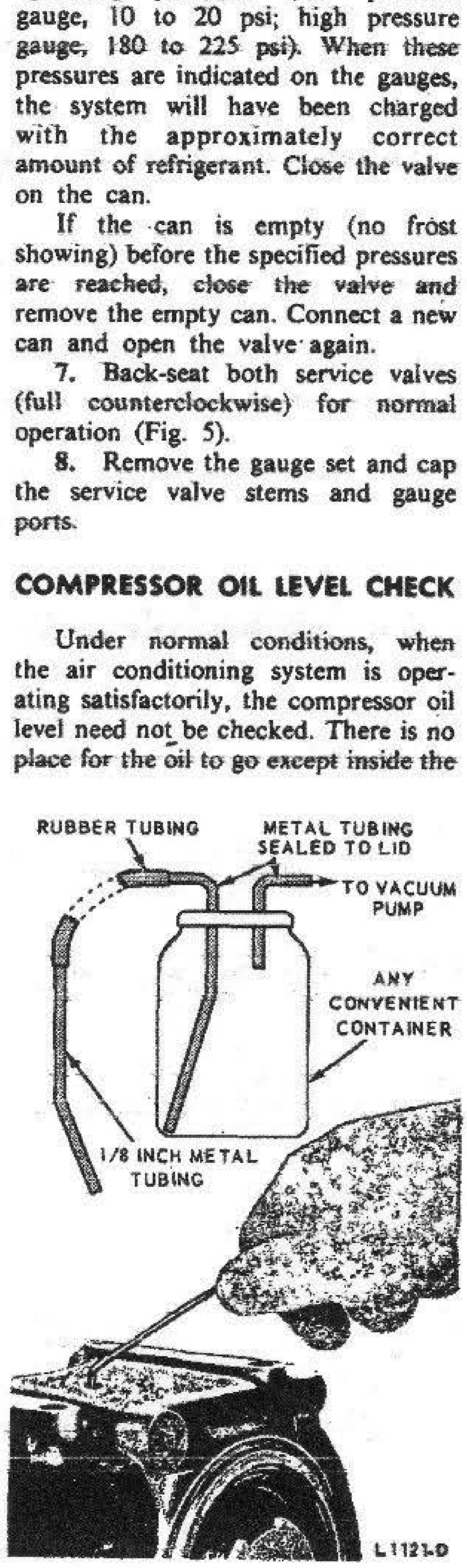


FIG. 10 Compressor Oil Level Check and Oil Trap

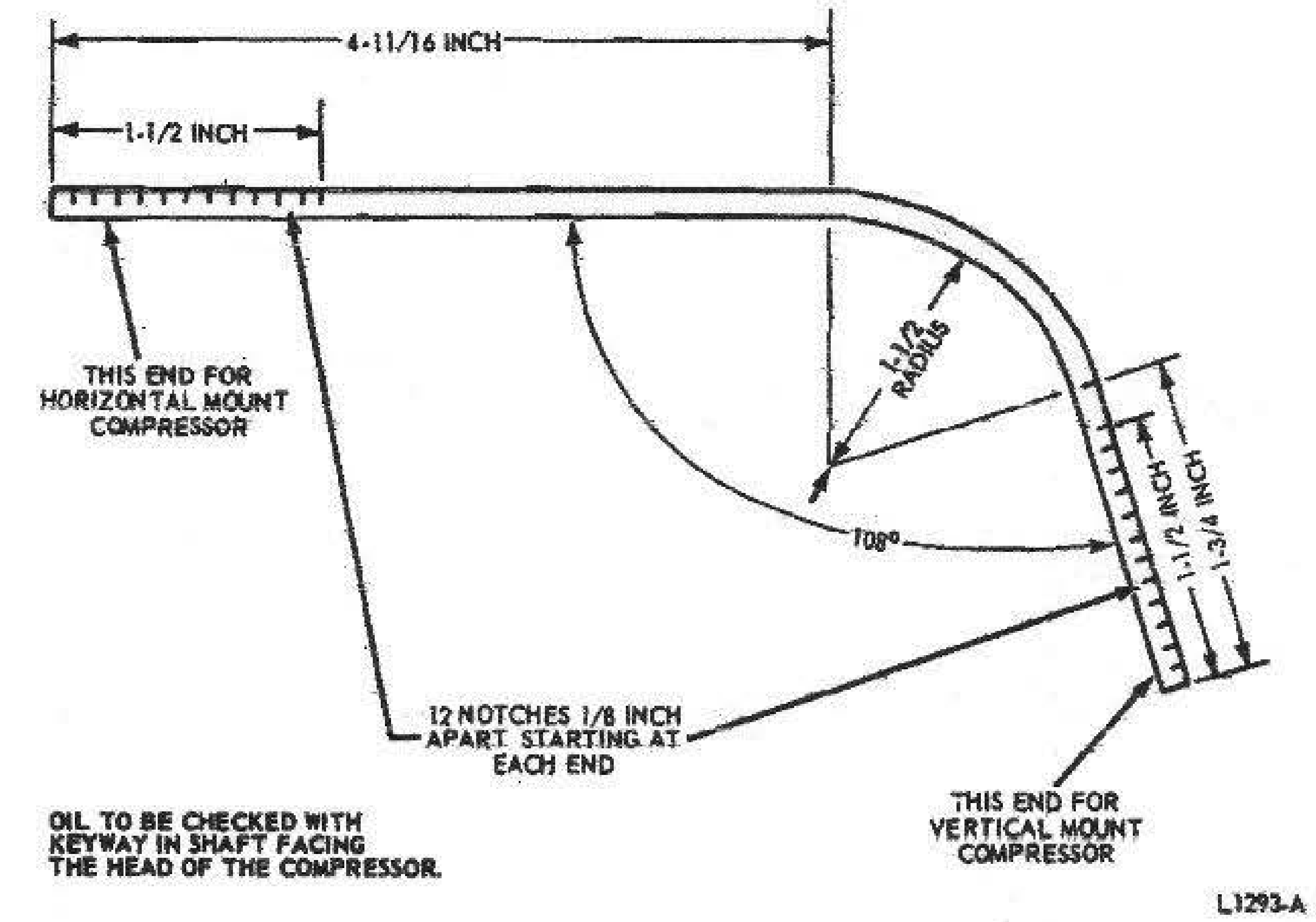


FIG. 11 York Compressor Oil Level Dipstick

Check the compressor oil level only if any portion of the refrigerant system is being replaced, or if there was a leak in the system and the refrigerant is being replaced.

1. After the system has been charged, operate the system for about ten minutes or until the pressures have been stabilized in a surrounding temperature of 60 degrees or above.

2. Stop the engine and isolate the compressor as outlined in the following procedure. Isolating the compressor.

3. Remove the oil filler plug from the compressor. Insert a flattened 1/8-inch diameter rod (Fig. 10) in the oil filler hole until it bottoms. The rod or dipstick fashioned for the particular compressor (Figs. 11 or 12) should be used. **The dipstick must be wiped completely clean before insertion.** If necessary, **slightly** rotate the compressor crankshaft by hand so that the dipstick will clear the crankshaft.

On horizontally mounted compressors, the oil check hole is located on the side of the crankcase that faces up. On the opposite or downward side, there is a corresponding boss provided on the inner wall as an al ternate oil check hole for a different mounting. When checking the oil level on such a compressor, angle the dipstick so that it bottoms against the lower side of the crankcase and not against the boss.

4. Pull out the dipstick, and check the oil indication. It should show at least the minimum amount of oil as indicated in Figs. 11 and 12.

If the oil level is low, add ESA-M2C31-A (Ford Part No. CAZ19577-A) oil.

If too much oil is indicated proceed as follows:

(a) Draw out all of the oil using a trap similar to that shown in Fig. 10, or remove the compressor from the vehicle and pour the oil out of the crankcase.

(b) Add approximately 4 oz. of oil to the crankcase, and replace the filler plug. Reinstall the compressor, if it was removed.

5. Evacuate the compressor with the vacuum pump (both service valves front-seated (Fig. 5) and both manifold gauge valves open).

6. Connect the compressor back into the system by turning both service valves to the back-seated (full counterclockwise) position.

7. Operate the system again for another 10 minutes as in step 1, and recheck the oil level as in steps 3 and 4.

8. Replace the oil filler plug. Evacuate and connect the compressor back into the system.

9. Operate the system again for five minutes and make a final oil level check.

It is necessary to recheck the oil level a second time to be sure that all the oil has returned to the compressor.

10. Replace the oil filler plug. Evacuate and connect the compressor back into the system.

11. Check the compressor filler plug area for leaks with a leak detector.

ISOLATING THE COMPRESSOR

This procedure is used when checking the compressor oil level and when it is desired to replace the compressor without losing the refrigerant charge.

To isolate the compressor from the system, turn both the high and the low pressure service valves to the extreme clockwise (front-seat) position (Fig. 5). Loosen the cap on the high pressure service valve gauge port, and allow the gas to escape until the compressor is relieved of refrigerant pressure.

Loosen the cap a small amount only, and do not remove it until the pressure is completely relieved.

To connect the compressor back into the system, evacuate the compressor with a vacuum pump at both service valve gauge ports, close the vacuum pump valve, turn both service valves to the maximum counterclockwise (back-seat) position, and cap the high pressure service valve gauge port and service valve stems.

4 REMOVAL AND INSTALLATION

COMPRESSOR

All compressor removal and installation operations, except belt replacement, can be performed only after the unit has been isolated from the rest of the system. (See Adjustments, Section 3 in this part).

To reduce the amount of time to make a comprssor replacement, the service compressors are dehydrated and filled with refrigerant (R-12) and the proper amount of the specified refrigerant oil is in the crankcase when received.

When replacing a compressor, the oil level in the old compressor should be checked. Then oil should be removed from the new compressor is the same as that in the old compressor. This keeps the amount of oil in the system a constant. Failure to use this procedure is the most common reason for excessive oil in the crankcase. Refer to Compressor Oil Level Check, Adjustments Section 3.

Removal

1. Isolate the compressor. Refer to Adjustments Section 3, and disconnect the two service valves and hoses from the compressor (Fig. 13). Energize the clutch and loosen and remove the clutch mounting bolt.

2. Install a 5/8-11 bolt in the clutch drive shaft hole. With the clutch still energized, tighten the bolt to loosen the clutch from the shaft. Disconnect the clutch wire at the bullet connector.

3. Loosen the idler pulley or alternator and remove the drive belt and the clutch and then remove the mounting bolts and the compressor.

Installation

Before installing the compressor, carefully remove any burrs or dirt that may be on the compressor shaft. The shaft must be dry and brightly polished.

1. Mount the clutch on the shaft and install the mounting screw and washer finger-tight. Place the compressor on the mounting bracket and install the four mounting bolts finger-tight.

2. Connect the clutch wire, energize the clutch and torque the clutch mounting bolt to specification. Tighten the compressor mounting bolts to specification.

3. Install the belt and adjust and tighten the idler pulley.

4. Install the service valves on the compressor using new seals. **Be certain to remove the rubber shipping plugs first.** Tighten the service valve nuts to specification. Do not over tighten. The new ROTOLOK service valves can be rotated slightly on their seat without breaking the high pressure seal. This is not an indication of a loose valve. Leak test the compressor, then evacuate it and connect it back into the system.

5. Check the oil level in the compressor, and add or remove oil if necessary (Section 3).

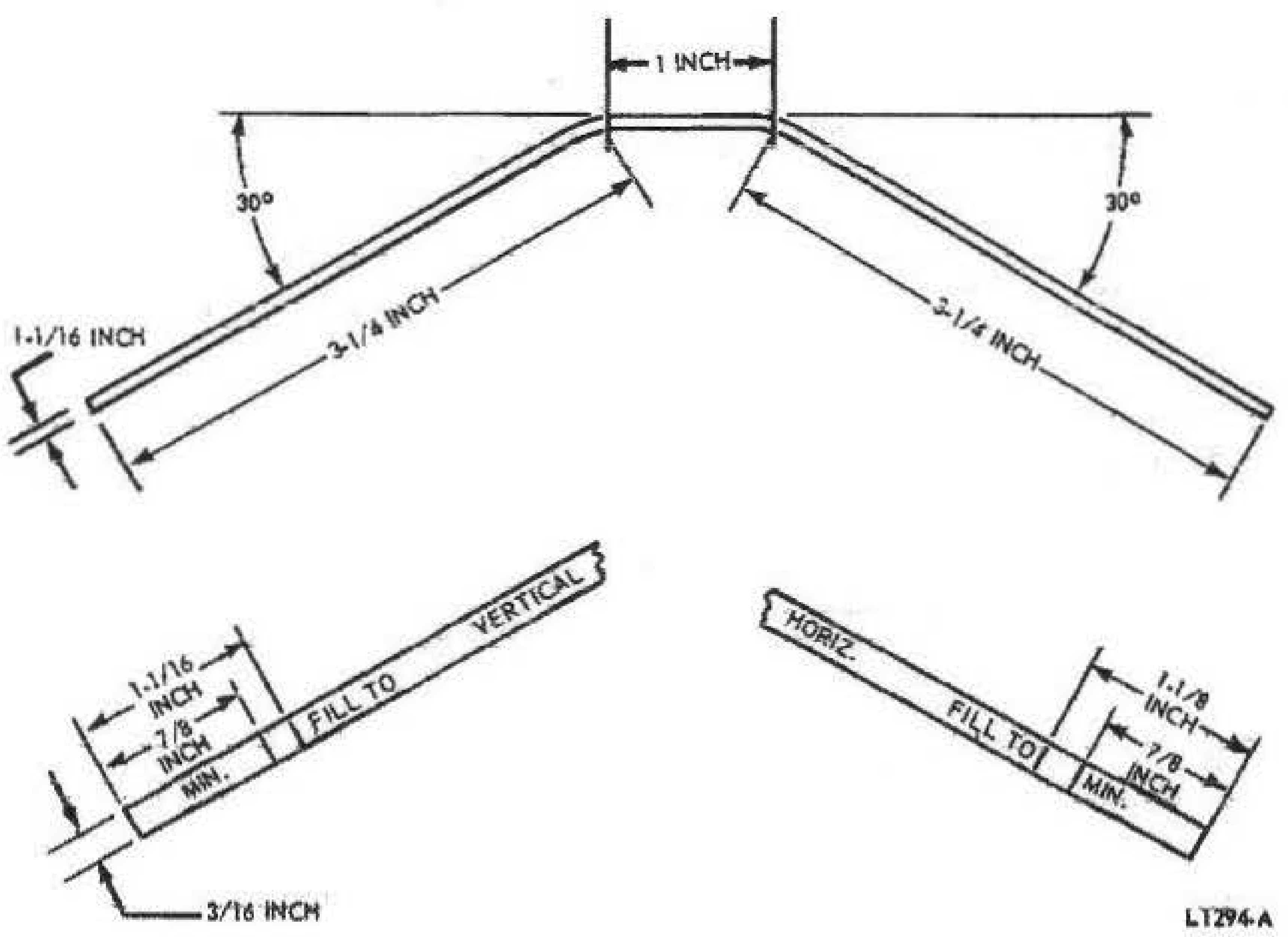


FIG. 12 Tecumseh Compressor Oil Level Dipstick

VALVE PLATE AND HEAD GASKET

The procedure for replacing a blown head gasket is identical to the procedure for replacing the valve plate except that the old valve plate is used. If a worn valve plate has caused the cylinder walls to become scored or has imbedded pieces of metal in the pistons, the compressor should be replaced.

Removal—All Compressors

1. Isolate the compressor (Section 3 in this Part), and disconnect both service valves. Place a clean drip pan under the horizontally mounted compressor.
2. Remove the cylinder head bolts.
3. Remove the valve plate and cylinder head from the compressor by tapping upward with a fiber hammer on the overhanging edge of the valve plate.
4. Remove the valve plate from the cylinder head by holding the head and tapping against the valve plate.
5. Remove the drip pan from under the horizontally mounted compressor. Then, remove all particles of gasket, dirt and foreign material from the surface of the cylinder head and cylinder face.

Be extremely careful not to scratch or nick the mating surfaces or any edges.

Installation (York Compressor—Fig. 14)

1. Apply a thin film of clean refrigeration oil to each side of the valve plate gasket (Fig. 14).

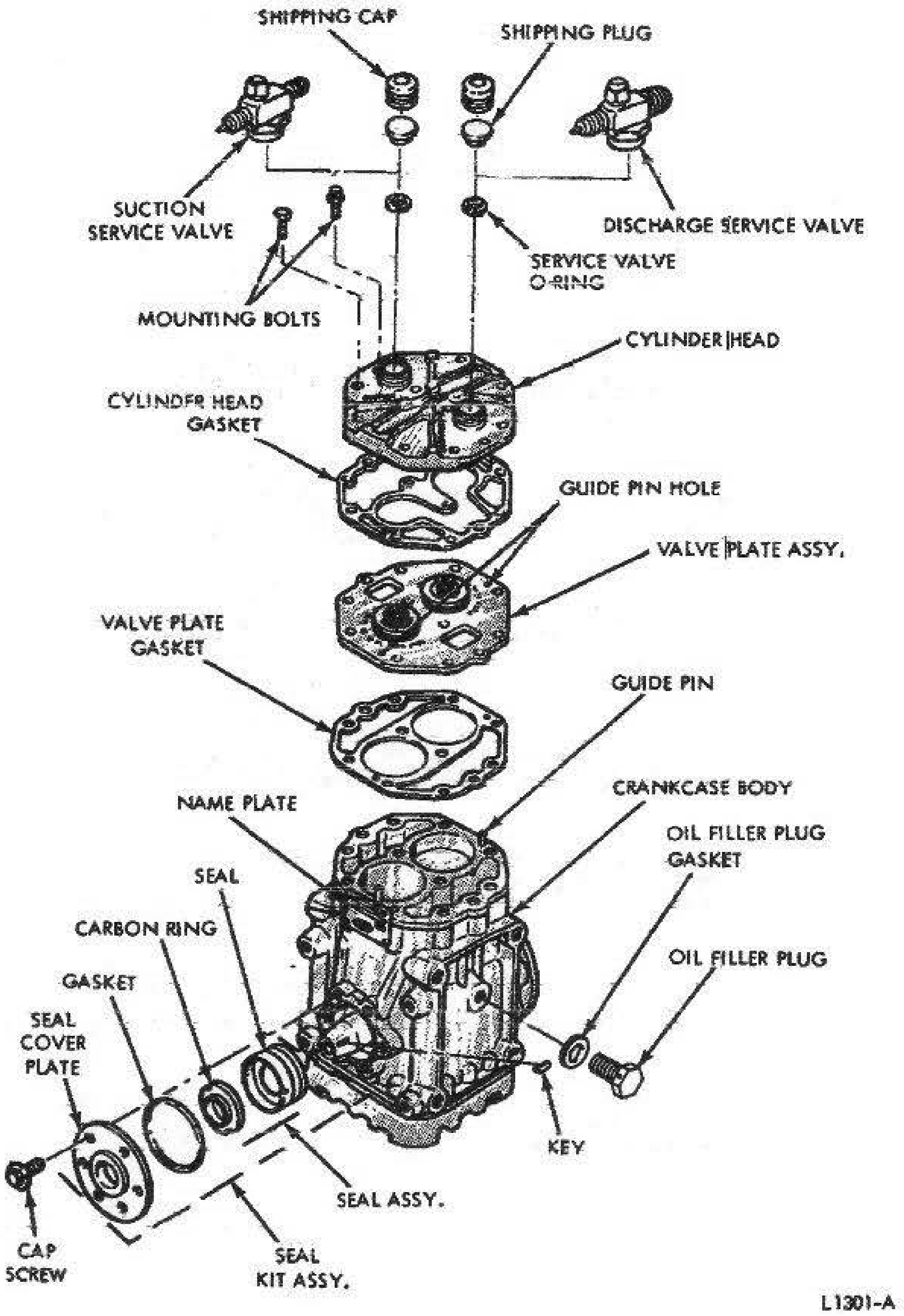


FIG. 14 York Compressor—Disassembled

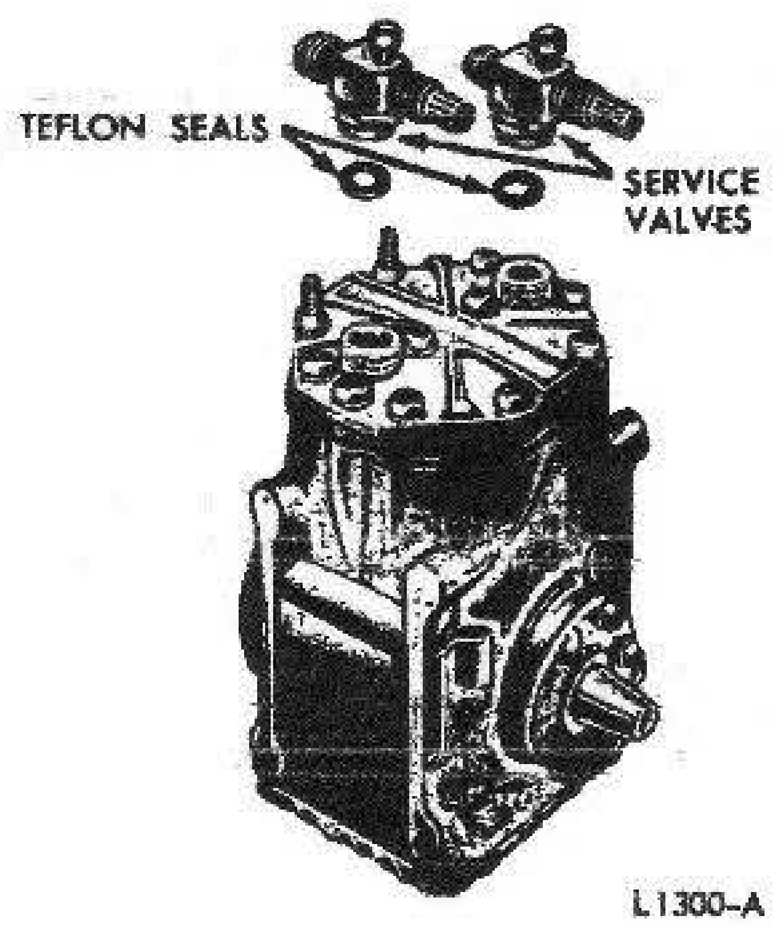


FIG. 13 Compressor Service Valves Removed

2. Place the new valve plate gasket in position on the crankcase so that the crankcase dowel pins go through the dowel pin holes in the gasket (Fig. 14).
3. Place the valve plate in position on the cylinder so that the dowel pins go through the dowel pin holes (Fig. 14).
4. Apply a light film of clean refrigeration oil on each side of the cylinder head gasket. Then, place the gasket and cylinder head on the cylinder with the dowel pins inserted into the dowel pin holes in the gasket and head.
5. Insert the two longer cap screws in the two center holes of the cylinder head. Then, insert the remaining cap screws in the holes around the edge of the cylinder head. The four 12 point head screws should be inserted into the four holes closest to the service ports.
6. Tighten all head cap screws until they contact the head. Then, torque the two center screws to 15-23 ft-lb.
7. Tighten the remaining cap screws in a pattern so that the cap screws diagonally opposite each other are evenly tightened to 15-23 ft-lbs. After the cylinder head has been installed 1/2 hour, retorque the head bolts to 15-23 ft-lbs.
8. Inspect the top of the cylinder head service valve ports to be sure that they are free of nicks and imperfections. Connect the service valves with new O-rings to the correct compressor ports and torque to specification. Then, check the compressor oil level

and add or remove oil as required. (See Compressor Oil Level Check in Section 3). Evacuate the compressor and connect it back into the system.

Installation (Tecumseh Compressor—Fig. 15)

1. Apply a thin film of clean refrigeration oil to each side of the valve plate gasket (Fig. 15).

2. Place the new valve plate gasket on the crankcase cylinder face and align the bolt holes.

3. Place the valve plate on the valve plate gasket so that the letter S (stamped on the valve plate) is on the same side of the crankcase as the word SUCTION. Align the bolt holes.

4. Apply a thin film of clean refrigeration oil on each side of the head gasket.

5. Place the head gasket on the valve plate with the largest hole of the gasket over the largest hole of the valve plate. Line up the holes of the gasket with those of the valve plate.

6. Position the cylinder head on the compressor. **The word SUCTION on the head must be up and on the same side as the word SUCTION on the compressor crankcase.**

7. Align the bolt holes of the cylinder head, gaskets and valve plate with the holes in the compressor crankcase.

8. Install the cylinder head attaching bolts in the bolt holes. The four 12 point head bolts must be inserted in the four holes nearest the head service ports.

9. Tighten the bolts until they contact the top surface of the cylinder head. Then, tighten the head bolts in a sequence so that the bolts diagonally opposite each other are evenly tightened to a torque of 20-24 ft-lbs.

After the cylinder head has been installed 1/2 hour, retorque the head bolts to 20-24 ft-lbs.

10. Inspect the top of the cylinder head service valve ports to be sure that they are free of nicks and imperfections.

Connect the service valves with new O-rings to the correct compressor ports and torque to specification.

11. Check the compressor oil level and add or remove oil as required. (See Compressor Oil Level Check in Section 3). Evacuate the compressor and connect it back into the system.

CRANKSHAFT SEAL

Removal—All Compressors

1. Isolate the compressor, loosen and remove the belt.

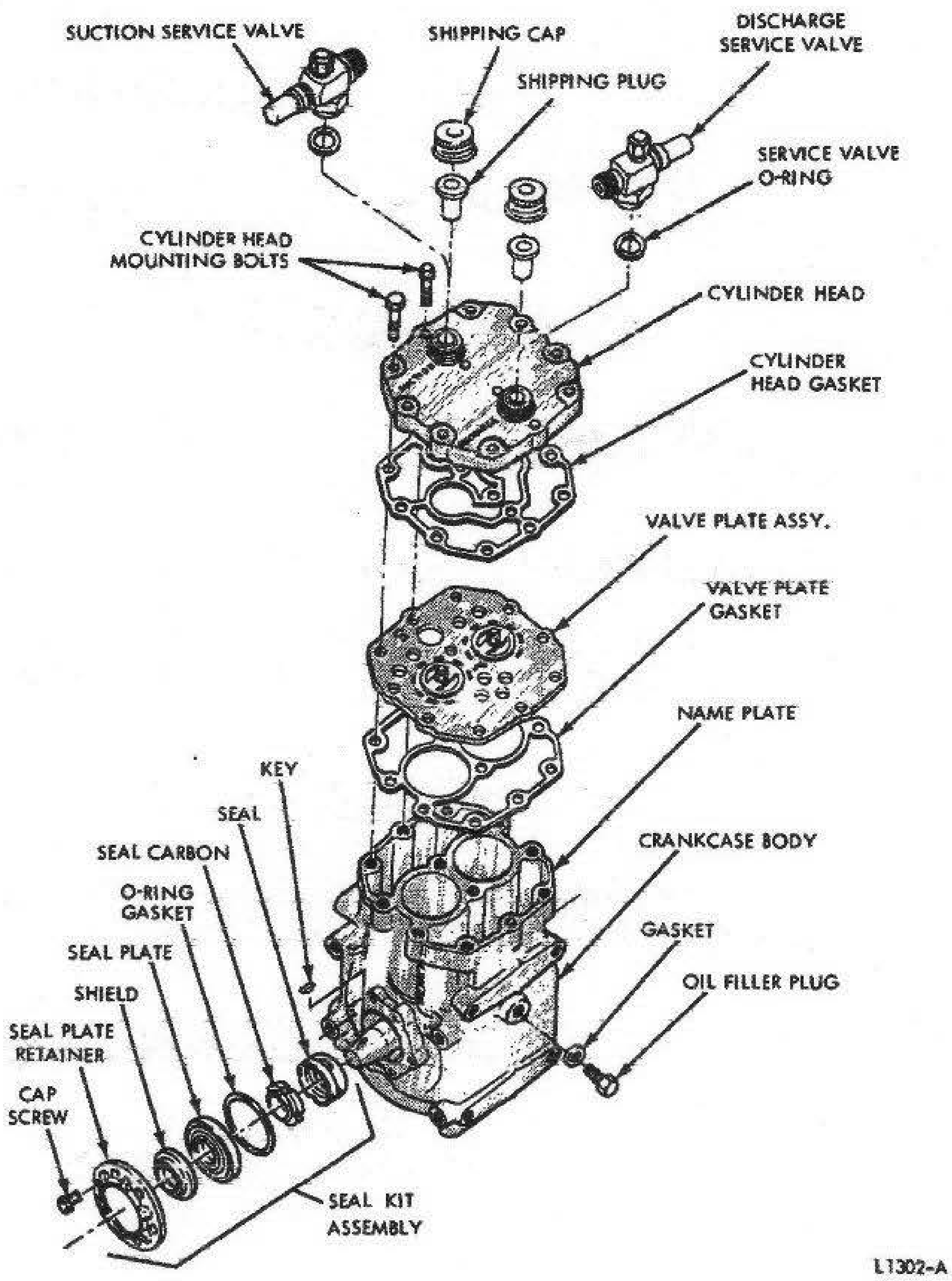


FIG. 15 Tecumseh Compressor—Disassembled

2. Remove the clutch and remove the Woodruff key. Carefully remove the secondary dust shield so as to avoid marring the shaft.

3. Carefully remove all accumulated dirt and foreign material from the seal plate and surrounding area of the compressor, and position a small drain pan beneath the seal plate.

4. Remove the seal plate cap screws, and gently remove the plate and gasket. Do not mar or scratch the sealing surfaces, or the polished shaft surface.

5. Remove the carbon seal ring and seal housing assembly from the crankshaft. A disassembled view of the crankshaft seal assembly is included in Figs. 14 and 15.

6. Clean all old gasket material from the seal plate and the compressor. Make certain that the shaft, the seal plate and the compressor gasket surfaces are completely clean.

7. Check the face of the crankshaft front bearing journal in the seal housing to make certain that there are no nicks or burrs. Check the crankshaft surface to be sure it is not damaged. Check all parts of the seal assembly to be sure that they are not damaged.

8. Inspect the compressor internal components for damage.

Installation—Tecumseh Compressor

1. Wash the new seal assembly components in clean refrigeration oil.

2. Coat the exposed surface of the crankshaft with clean refrigeration oil.

3. Place the seal (Fig. 15) over

the compressor shaft with the end that fits the carbon ring facing out.

4. Position the carbon ring over the shaft and to the seal. The raised rim of the carbon ring must face outward.

5. Insert the O-ring in he crankcase mating surface for the seal plate.

6. Position the seal plate, shield and seal plate retainer to the compressor crankcase and align the cover attaching screw holes. Push the seal plate retainer against the mating surface of the crankcase and install the six attaching screws. Torque the screws in a circular sequence to 54-78 in-lb.

7. Rotate the shaft by hand 15 to 20 revolutions to seat the seal.

8. Make certain that there are no burrs or dirt on the compressor shaft. Install the key and magnetic clutch on the shaft.

9. Install the belt and adjust the tension to specifications.

10. Check the compressor oil level (Section 3).

Installation—York Compressor

1. Wash the new seal assembly components in clean refrigeration oil.

2. Position the seal over the end of the shaft with the carbon ring retainer facing out. Move the seal in and out on the shaft a few times to insure a good seal between the seal and the shaft.

3. Push the seal all-the-way on the shaft. Be sure that the seal drive ring slots engage the drive pins on the shaft bearing journal face.

4. Place the carbon ring (Fig. 14) over the shaft and in the seal ring retainer. The polished surface of the carbon ring must face out and the lugs must engage the ring retainer and be fully seated.

5. Apply a light film of clean refrigeration oil on the matching faces of the crankcase and seal cover plate. Then, place the gasket in position on the crankcase face.

6. Place the seal cover plate in position (Fig. 14), with the polished side facing the carbon ring. Then, install the cap screws. Tighten the cap screws evenly while turning the crankshaft. Be sure that the clearance between the crankshaft and the hole in the seal cover plate is even all around the shaft. If the clearance is not equal all around the shaft, gently tap the seal face into position until the clearance is equal. Then, tighten diagonally opposite cover plate cap screws evenly to 7-13 ft-lb.

7. Make certain that there are no burrs or dirt on the compressor shaft. Install the key and magnetic clutch on the shaft.

8. Install the belt and adjust the tension to specification

9. Check the compressor oil level (Section 3).

CLUTCH

1. Loosen and remove the belt.

2. Energize the clutch and loosen and remove the clutch mounting bolt.

3. Install a 5/8-11 bolt in the clutch drive shaft hole. With the clutch still energized, tighten the bolt to loosen the clutch from the shaft, then remove the magnetic clutch.

4. Carefully remove any burrs or dirt that may be on the compressor shaft. The shaft must be dry and brightly polished. Install the clutch, the clutch mounting bolt, and the washer.

5. Energize the clutch, and torque the bolt to specification.

6. Install and adjust the belt.

CLUTCH BEARING

When installing a new bearing, extreme care must be taken to support the bearing and the clutch assembly so as not to place any pressure on the balls of the bearing.

The following procedure should be rigidly adhered to during bearing replacement. Any exceptions due to clutch design are noted. Refer to Fig. 16.

Removal

1. Remove the clutch assembly from the compressor shaft as outlined in the foregoing procedure.

2. With the clutch assembly face down, remove the external bearing retainer from the drive plate shaft.

3. Support the clutch, face down, by the outer edge so as to clear the drive plate. Insert a 5/8-11 inch bolt through the drive plate shaft and hand tighten the bolt.

4. Smoothly apply enough pressure on the bolt to free the shaft from the bearing inner race and then remove the drive plate assembly. Before preceeding, check the drive face plate for any excessive warping or breakage. Replace the entire clutch assembly if any damage is evident.

5. Remove the internal bearing retainer from the pulley assembly. Support the pulley assembly, face up, by the bearing bore making certain that there is no interference when the

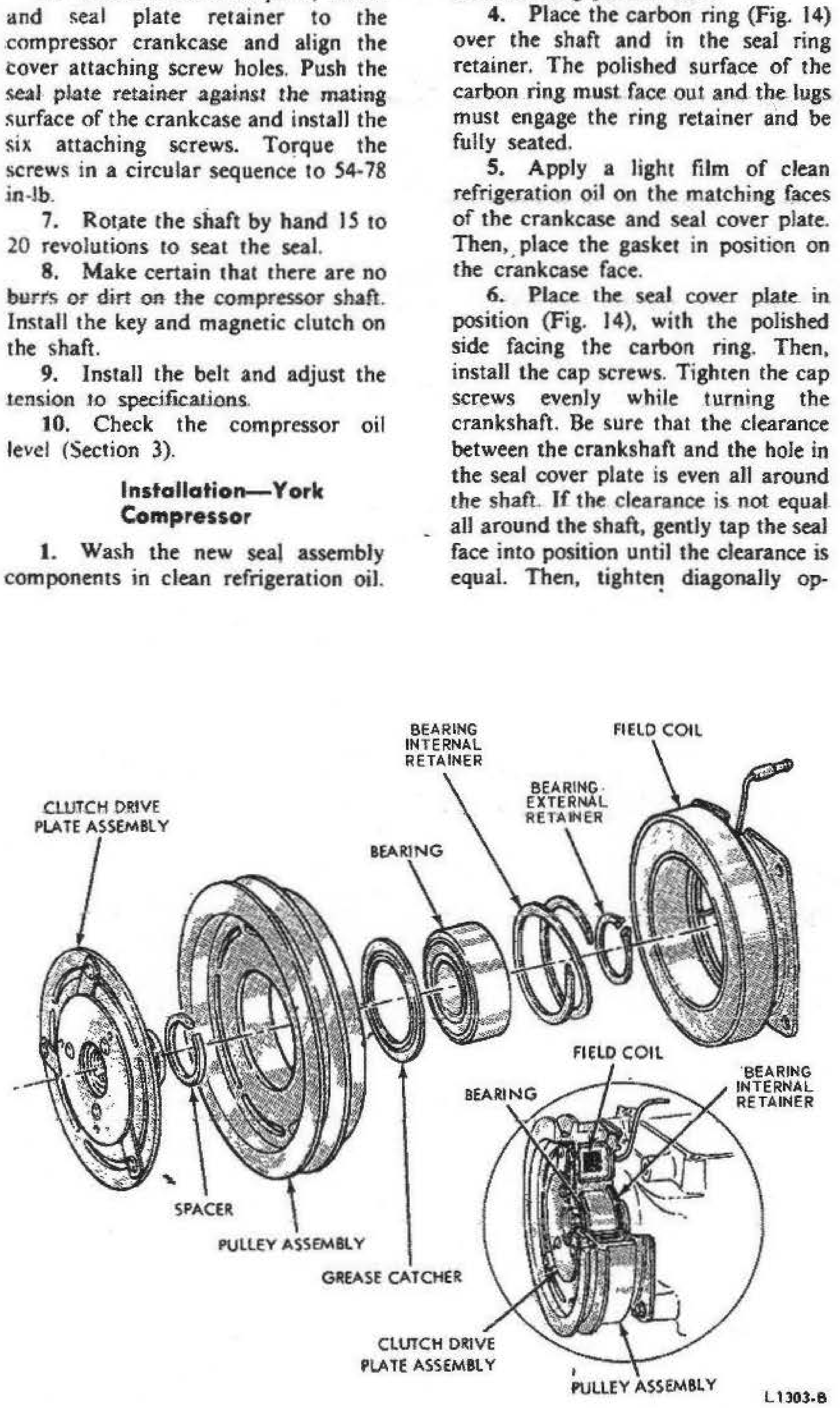


FIG. 16 A/C Clutch Assembly

bearing is pressed out. With a suitable plug, force the bearing out of the pulley assembly by the inner race. **The plug should clear the metal grease catcher, but do not remove the grease catcher from the pulley assembly.**

Installation

Before installing the bearing, be sure that all bearing contact surfaces are clean.

1. Support the pulley assembly face down, near the bearing bore but do not support it by the sides of the pulley grooves as this may bend the pulley assembly.
2. Press a new bearing into the bearing bore by the outer race. **Do not press the bearing in by the inner race.** Pressure should be uniform and in line with the axis of the bearing bore. Replace the **internal** bearing retainer.
3. Support the pulley assembly, face up, by the bearing inner race. Insert a 5/8-11 inch bolt into the front of the drive face plate and carefully press the shaft into the bearing inner race, exerting pressure on the bolt. Be certain that the shaft is in line with the axis of the bearing bore.
4. Replace the **external** bearing retainer onto the drive plate shaft. Rotate the pulley relative to the drive plate to make certain that there is free rotation and that there is no looseness of the assembly before installing the clutch onto the compressor.
5. Install the clutch assembly on the compressor shaft.

DRIVE BELT

All Except Maverick

Adjust the belt by repositioning the idler pulley if so equipped. Otherwise, follow this procedure.

1. Loosen the bolts securing the compressor to the compressor mounting bracket. On a Lincoln Continental, first remove the bolts securing the compressor to the support bracket that is attached to the cylinder head.
2. Install the belt tension gauge (Tool T63L-8620-A) on the compressor clutch drive belt. Move the compressor toward or away from the engine until the specified belt tension is obtained. Remove the gauge. Tighten the compressor-to-support bracket bolts. Install the tension gauge and check the belt tension.

Maverick

Adjust the belt by repositioning the idler pulley if so equipped. Otherwise, follow this procedure.

1. Loosen the alternator-to-brackets attaching bolts.
2. Install the tension gauge on the compressor clutch drive belt. Move the alternator toward or away from the engine until the specified belt tension is obtained. Remove the gauge. Tighten the alternator bolts. Install the tension gauge and check the belt tension.