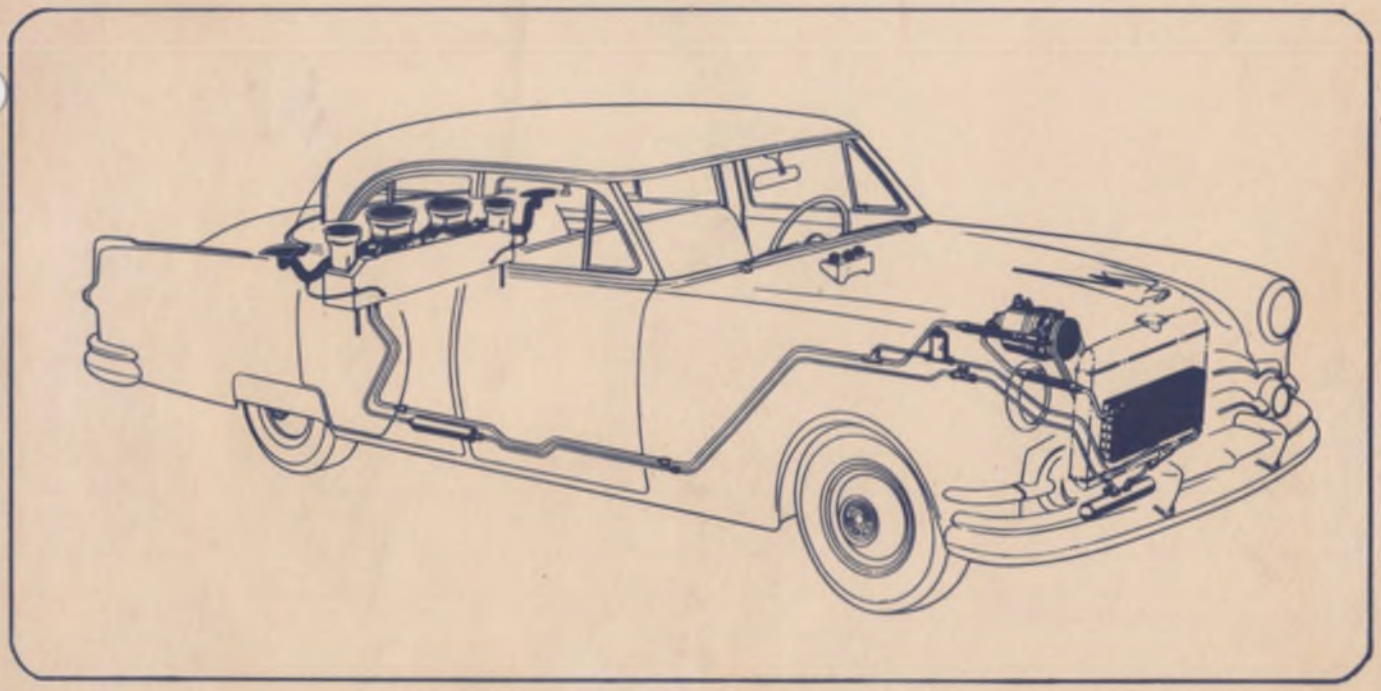
TRAINING PROGRAM

Serviceman's Training Book

PACKARD AIR CONDITIONING

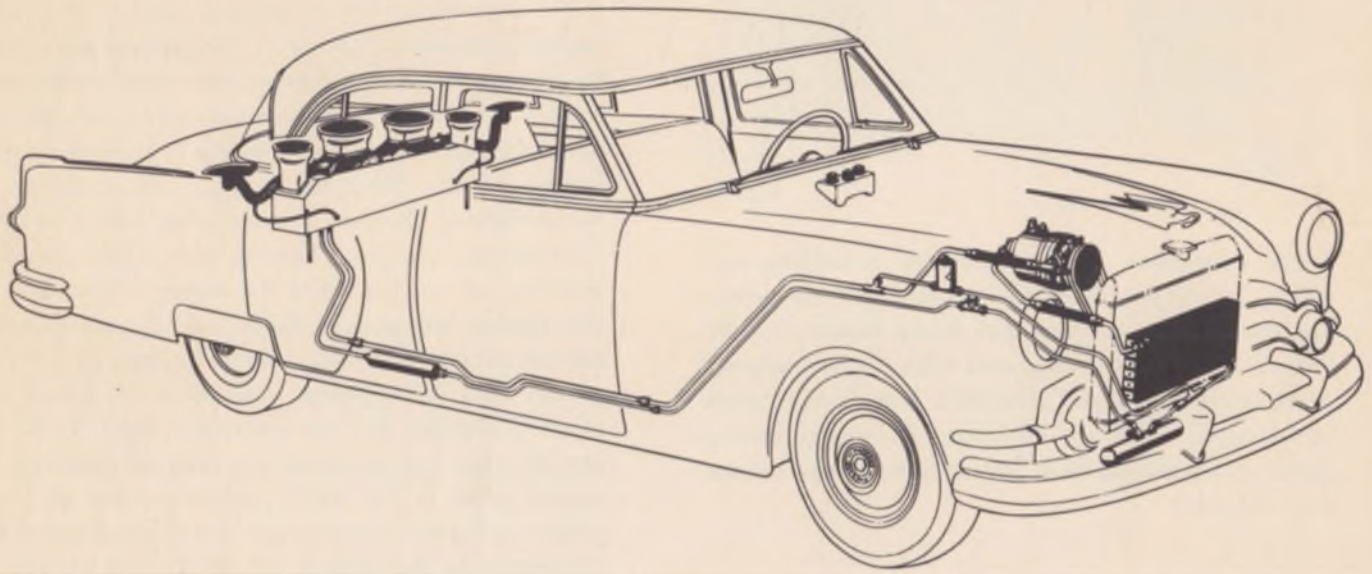


OCTOBER, 1953

PACKARD MOTOR CAR COMPANY

DETROIT 32, MICHIGAN

PACKARD AIR CONDITIONING
Part I
DESCRIPTION



The air conditioning system for the 26th Series "Packard Line" vehicles is basically a mechanical refrigeration system which provides comfort in the passenger compartment of the car by cooling the air while also removing moisture from the air.

While the cooling of the air may account for the reduction in actual temperature, the removal of moisture, or dehumidifying, may produce a greater cooling effect than the actual reduction of temperature. For example, if the temperature outside the car is 95° and the temperature inside the car is 80°, the cooling effect of dehumidification may make it feel the same as if the temperature were 70°.

Principles of Refrigeration

Among the basic principles on which a mechanical refrigeration system operates and the rules or factors that should be remembered are:

1. That heat always travels from the warmer to the cooler object or substance.
2. That when the liquid refrigerant absorbs enough heat it vaporizes and, in so doing, pulls heat from the surrounding area. In other words, it cools the area.
3. That when the refrigerant, in vapor form, is compressed and then cooled, it will give up the heat absorbed in the vaporization process and condense back into a liquid.

The Refrigerant

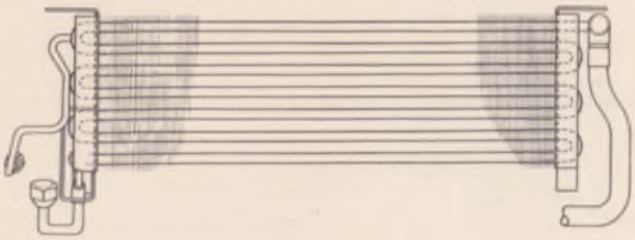
An important factor in selecting a liquid refrigerant is the boiling point or temperature at which rapid vaporization takes place. This is because a liquid can refrigerate effectively *only when it is changing from a liquid to a vapor.* After it becomes a vapor, it can no longer refrigerate.

The same applies when a solid changes to a liquid. For example, if ice did not melt, it could absorb but little heat from the objects around it and it would not be cooling or refrigerating effectively. Ice is refrigerating effectively only when it is changing to a liquid or, in other words, melting.

The refrigerant used in the Packard system is FREON 12 which has a boiling point of 21.7°F. below zero. This means that when FREON 12 vaporizes at room temperature, it is absorbing heat in great quantities thereby refrigerating very effectively.

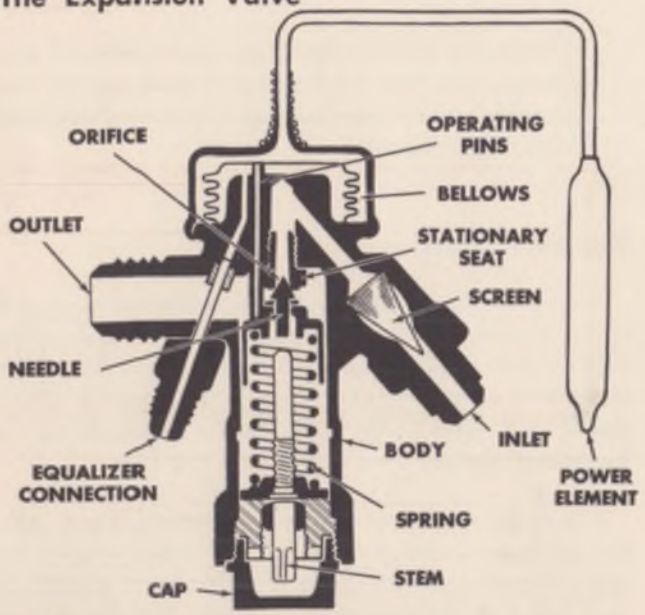
The Evaporator

COOLING COIL



The evaporator assembly contains a cooling coil which may be described as a container for refrigerant liquid and is so designed that it can readily remove heat from the surrounding area after the temperature of the refrigerant liquid is reduced. It is the only place in the system where the refrigerant is changed from a liquid to a vaporous state. This is done by the absorption of heat.

The Expansion Valve



The purpose of the expansion valve is to regulate the supply of liquid refrigerant according to the requirement of the cooling coil. Expressed differently, it supplies liquid refrigerant to the cooling coil at the same rate that vaporous refrigerant is removed from it.

The various parts which make up the expansion valve are the power element, the body, the operating pins, the stationary seat, orifice, needle carriage, adjusting spring and stem. A fine mesh screen is in the high pressure inlet which prevents dirt, filings or other foreign matter from entering the valve orifice. The small connection is called an equalizing line connection.

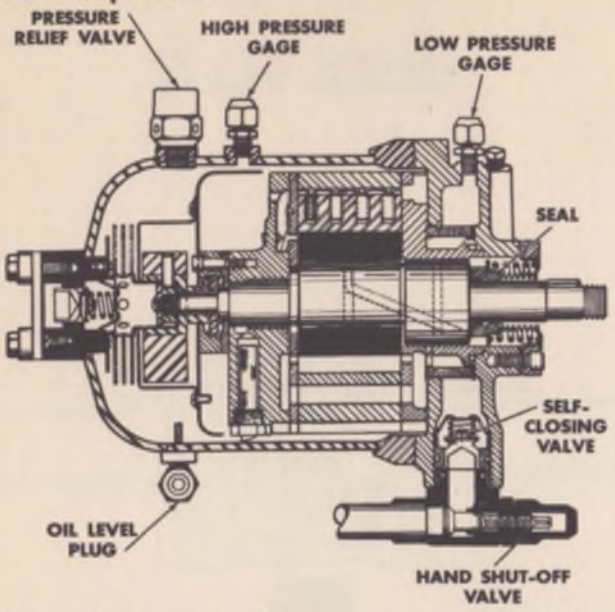
The power element contains a carbon dioxide vapor sealed in at the factory and operates similar to a car heater control thermostat.

The function of the expansion valve is to control opposing pressures produced by the spring and refrigerant pressures. For example, the pressure in the power element is trying to push the needle away from the seat while the adjusting spring is trying to force the needle toward the seat. When the system is not in operation, the refrigerant pressure in the cooling coil is helping the adjusting spring to close the valve. These opposing pressures are established in the design of the valve so that during idle periods the adjusting spring tension and the refrigerant pressure in the cooling coil is always greater than the opposing pressure in the power element. Therefore, the valve remains closed. The only way the valve can be opened is to turn the switch at the control panel to the "ON" position so that the compressor can reduce the pressure and temperature of the refrigerant in the cooling coil. When this pressure is reduced to a point where the vapor pressure in the power element becomes the stronger, the needle moves off the seat and liquid starts to flow through the valve orifice into the cooling coil. As long as the control switch is "ON," the thermostat calling for refrigeration, and the compressor operating, the valve will never close and completely shut off the supply of liquid.

The purpose of the power element is to help determine the quantity of liquid that is being metered into the cooling coil. As the temperature of the low pressure line changes at the bulb, the pressure of the vapor in the power element changes resulting in a change of the position of the valve needle. For example, if the cooling coil gets more liquid than is required, the temperature of the low pressure line is reduced and the resultant lowering of the bulb temperature reduces the pressure of the vapor in the power element allowing the needle to move closer to the seat. This immediately reduces the amount of liquid leaving the valve. Under normal operation, the power element provides accurate control of the quantity of refrigerant to the cooling coil.

The adjusting stem performs the same function as the idling screw adjustment on a carburetor. Turning the stem counterclockwise increases the flow; clockwise decreases it.

The Compressor



The compressor is of the rotary type which is high in efficiency and has few moving parts.

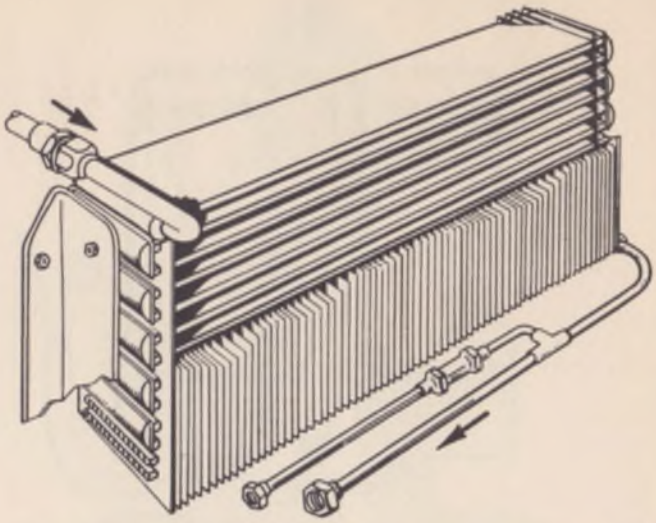
Self-closing valves in the low pressure and high pressure ports have a spring loaded seat that closes when the hand shut-off valves are removed for any reason.

The hand shut-off valves are so constructed that when the valve body is bolted to the compressor housing, the hand valve depresses the spring loaded valve in the housing. This opens the housing valve seat in the compressor. When the hand valve body is removed from the compressor, the compressor housing valve closes. This arrangement prevents the loss of refrigerant and oil and tends to prevent dirt and moisture from entering the compressor when it is removed for any reason.

The compressor also incorporates gauge connections for determining both the high and low pressures, a valve for checking the oil level and a relief valve which opens automatically at approximately 375 pounds per square inch and closes automatically when the pressure is reduced to approximately 350 pounds per square inch. Any condition that causes this valve to open should be corrected.

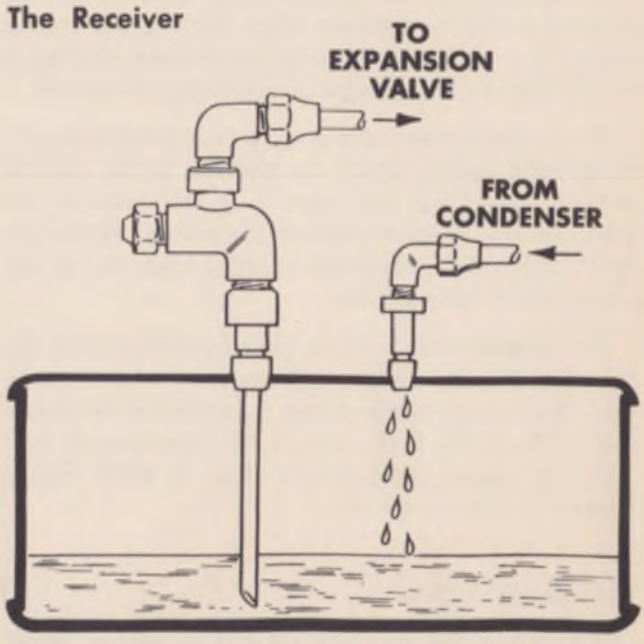
The Condenser

The condenser, as the name implies, condenses the high pressure refrigerant vapor that is discharged from the compressor. As this high pressure, high temperature vapor passes through the condenser, it is subjected to considerably cooler metal surfaces and it changes from a vapor to a liquid. This is based on two of the rules previously mentioned under "Principles of Refrigeration." The first rule states that heat always



travels from the warmer to the cooler substance. The second states that when enough heat is removed from a vapor, liquid is produced.

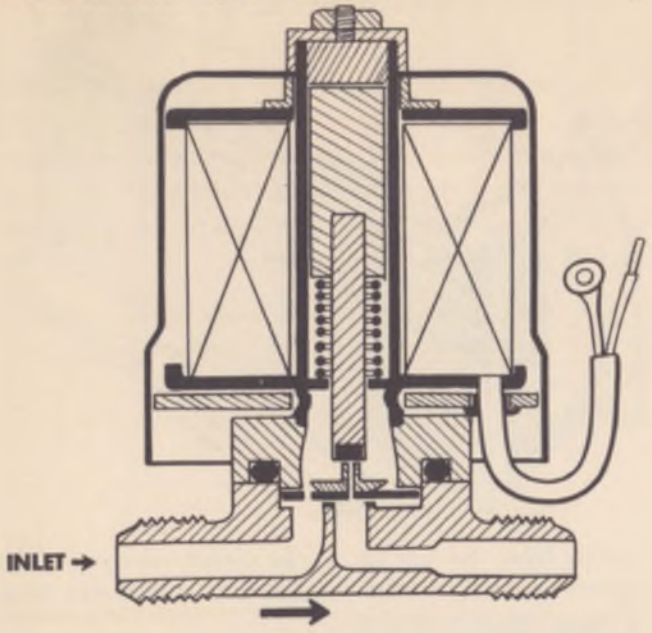
The Receiver



After the liquid is produced in the condenser, it enters the receiver which stores the liquid and maintains a supply which is more than that needed for normal operation.

The receiver is equipped with a hand shut-off valve with a tube extending from the valve to within a short distance of the bottom. As long as the amount of liquid is enough to cover the bottom of the tube, the system can operate normally. The high pressure produced by the compressor is also maintained on top of the liquid. This keeps the liquid from refrigerating in the receiver and also causes the liquid to be forced back to the expansion valve.

The Solenoid By-Pass Valve



The purpose of the by-pass valve is to relieve the pressure on the compressor when starting the engine and to by-pass the refrigeration cycle when cooling is not needed in the passenger compartment of the car.

When the by-pass valve is open (not energized), the compressor cannot reduce the pressure in the cooling coil due to the fact that there is no seal between the high and low pressure sides of the system. Therefore, the cooling coil temperature remains high and no refrigeration is taking place.

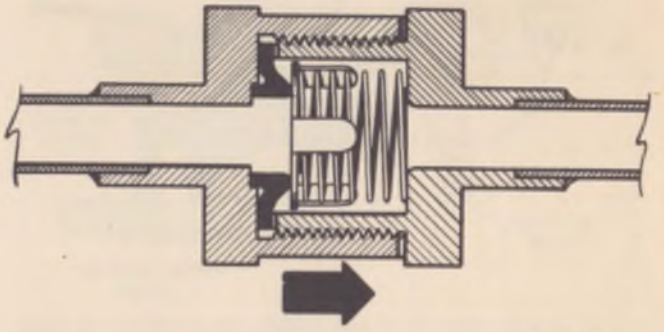
The by-pass valve is in the closed position when the coil is electrically energized. The valve is closed whenever the system is refrigerating. An arrow on the underside of the valve body denotes the direction of flow which is toward the cooling coil or, in other words, toward the rear of the car.

The Check Valve

The purpose of the check valve is to prevent liquid refrigerant from entering the by-pass and low pressure lines when the solenoid valve is open. This is a protection against possible damage to the compressor which might be caused by liquid entering the compression chambers of the pump.

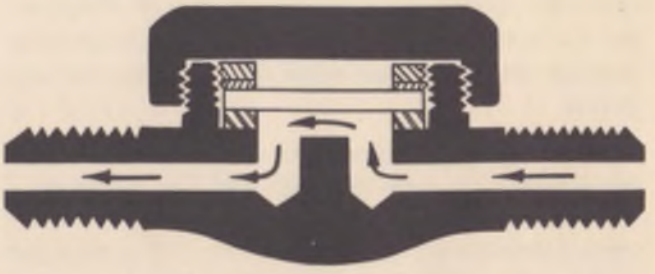
The valve incorporates a spring-loaded seat and operates by pressure differences between each end of the valve. When the system is refrigerating (by-pass valve closed), the check valve is open due to the fact that the pressure in the condenser is slightly higher than that in the receiver. When the system is not refrigerating (by-pass valve open), the pressure in the receiver becomes the higher pressure and the check valve closes.

CHECK VALVE



Arrows on the check valve body denote the direction of flow.

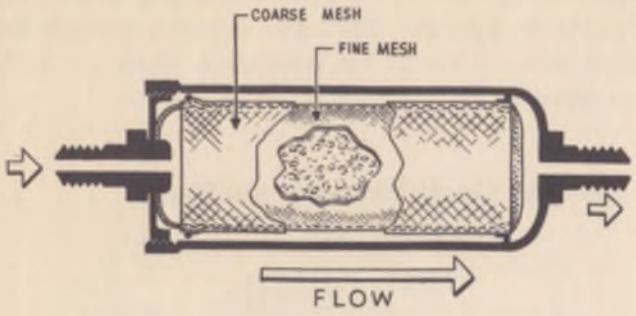
The Sight Glass



In reality, the sight glass has no function to perform and the system would operate just as well without it. It is incorporated in the high pressure liquid refrigerant circuit to provide a quick and sure way of determining whether or not the refrigerant charge is sufficient.

The refrigerant passes through two small holes in a small chamber which is covered with a sealed glass window. The design is such that a shortage of refrigerant in the receiver and liquid line will be indicated by the appearance of bubbles or foam beneath the glass. A screw-on metal cap protects the glass.

The Dehydrator-Filter



The most important function of the dehydrator-filter is to accumulate moisture that may not have been sufficiently removed during the installation of the system or which may have entered the system during service operations.

The second function of this unit is to trap foreign matter such as particles of dirt, copper filings and bits of solder which might accidentally remain in the system.

The dehydrating agent is small particles of acetate coated calcium sulphate contained within two screens, one within the other. The direction of flow through the dehydrator is marked with an arrow and the inlet connection is stamped with the word "IN." No service should be performed on the dehydrator-filter itself.

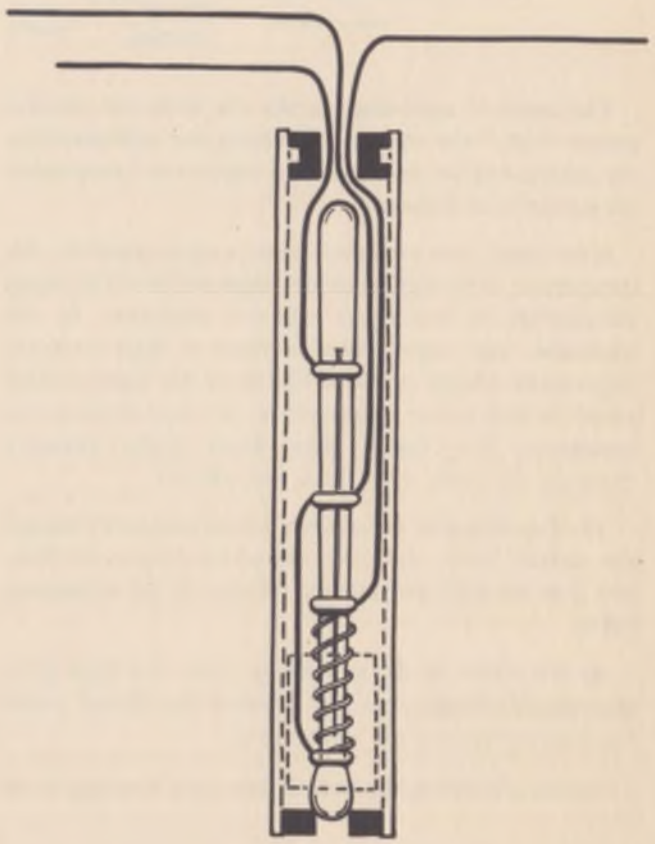
The Control Panel

The control panel permits the user to determine whether the system is to be "ON" or "OFF" and also determines the degree of cooling that is desired within the car.

The center knob controls a combination ON-OFF switch and rheostat. Turning the knob to the right (clockwise) to the "ON" position puts the system into operation. Turning it to the far right provides maximum coolness. Intermediate positions permit the driver to select the temperature preferred.

The outer knobs control the speed of the blowers. The blowers operate at maximum speed when the knobs are fully to the left; at slow speed when fully to the right; and at medium speed in the mid-position.

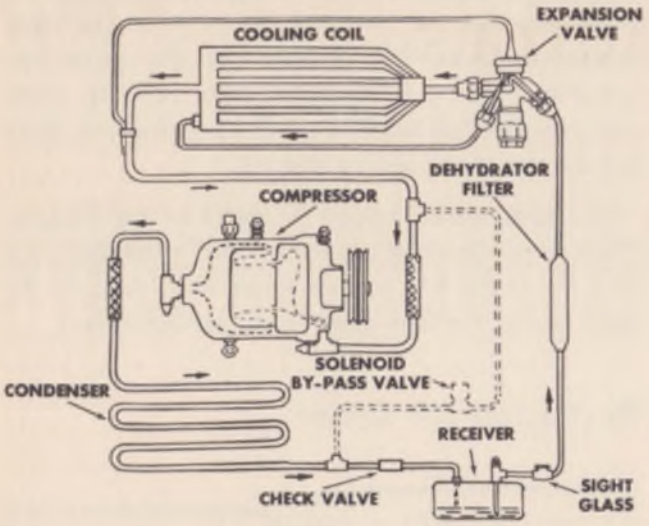
The Thermostatic Control



The thermostatic control is located in a return air inlet in the evaporator and is connected to the solenoid valve. The thermostat is constructed like a mercury thermometer and its function is to open and close the solenoid valve to maintain a constant temperature within the car. As the mercury column rises and falls with changes of temperature, wires inserted through the glass of the column give an electrical "make" and "break" point to energize and de-energize the solenoid.

CONTROL PANEL

Cycle of Operation—Full Cooling



The cycle of operation in the car with the control switch "ON," the thermostat calling for refrigeration, the solenoid valve closed and the engine and compressor operating is as follows:

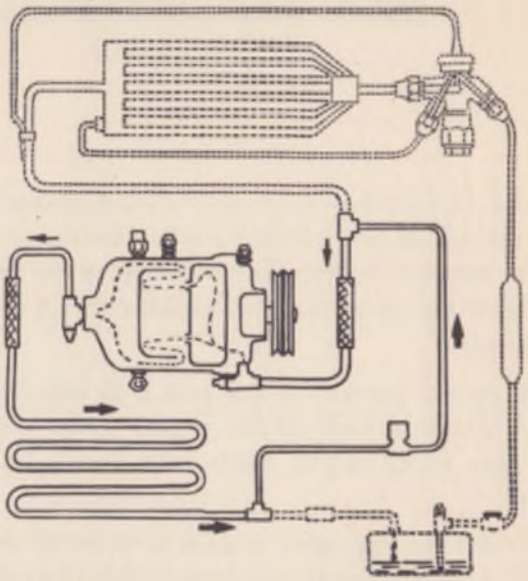
Heat laden, low pressure vapor is compressed by the compressor to be high pressure, high temperature vapor which then is discharged into the condenser. In the condenser the vapor changes from a high pressure vapor into a high pressure liquid as the heat is dissipated to the lower temperature air surrounding the condenser. The liquid then flows under pressure through the check valve into the receiver.

The liquid leaves the receiver under pressure through the shutoff valve, the sight glass, the dehydrator-filter and into the high pressure connection of the expansion valve.

At the orifice in the expansion valve, the high pressure liquid changes to a low pressure liquid and enters the cooling coil in the evaporator.

Warm air enters the evaporator unit housing from the passenger compartment and from the outside by the action of the blowers. Because the cooling coil is colder than the air, the heat from the air passes through the cooling coil into the liquid refrigerant, causing the liquid to vaporize. This vapor is drawn through the low pressure line to the compressor where the cycle is repeated.

Cycle of Operation—No Cooling



Foregoing paragraphs described the cycle of refrigeration when cooling was required in the car, under which conditions the solenoid by-pass coil was energized and the by-pass line was closed. If there is no requirement for refrigeration, the solenoid by-pass coil will be de-energized by either the "ON-OFF" switch or the thermostat and the by-pass line will be open. Opening of the by-pass line reduces the pressure on the inlet side of the check valve causing it to close. Thus, the refrigerant vapor is by-passed back to the compressor. This action stops refrigeration in the evaporator.

PACKARD AIR CONDITIONING
Part II
SERVICE FACTORS

Precautions in Handling Lines

Occasionally it may be necessary to replace all or portions of the refrigerant lines. The replacement lines should come out of stock completely sealed and dehydrated.

The lines should be free of kinks because kinks will cause restrictions in the flow of refrigerant. The refrigeration capacity of the entire system can be greatly reduced by a single kink in any line.

Inasmuch as the high and low pressure lines are installed close together, tubing clamps are used and these should be reinstalled if removed. The clamps keep the tubing separated which reduces vibration and the possibility of damage to the tubing.

The use of proper wrenches when making flare connections is important. If the wrench is too short, the flare may not be seated tight enough and a leak might develop. If the wrench is too long and heavy, the flare seat may be damaged. Wherever possible, the opposing fitting should be backed up with a second wrench to prevent distorting the connecting lines or parts.

In the event any line is opened to the atmosphere, the opening should be immediately capped or plugged to prevent the entrance of moisture and dirt.

Precautions in Handling Freon-12

All refrigerant drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for the same reason.

If it is ever necessary to transport or carry a drum of refrigerant in a car, keep it in the luggage compartment. The drum should not be exposed to the radiant heat from the sun for the resulting increase in pressure may cause the safety plug to release or the drum to burst.

For the same reason, the drum should never be subjected to high temperature when adding refrigerant to the system. In most instances, heating the drum is required to raise the drum pressure higher than the pressure in the system during the operation. It would be unwise to place the drum on a gas stove, radiator or use a blow torch while preparing for the charging operation, for a serious accident can result. Don't depend on the safety plug—many drums have burst when the safety plug failed. Remember, pressure can be a powerful force. A bucket of hot water, not over 125°F., or hot wet rags around the drum is all the heat that is required. If the occasion ever arises where it is necessary to fill a small drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. If the drum were completely full and the temperature was increased, hydraulic pressure would result and a tremendous force could be developed.

Discharging large quantities of Freon-12 into a room can usually be done safely as the vapor would produce no ill effects. However, this should not be done if the area contains a flame producing device such as a gas heater. While Freon-12 normally is nonpoisonous, heavy concentrations of it in contact with a live flame will produce a toxic gas. The same gas will also attack all bright metal surfaces.

The last precaution is one that is vitally important. Nature gives us only one pair of eyes and we are all concerned about keeping them. When working around a refrigerating system, one never knows when an accident may cause liquid refrigerant to hit the face. If the eyes are protected with goggles or glasses, no serious damage can result. Just remember, any Freon-12 liquid that you can touch or that touches you is at least 21.7°F. below zero. The eyes can't take much of this temperature.

If Freon-12 liquid should strike the eye, here is what to do:

Keeping calm in any situation which requires clear thinking is important.

When anything gets in the eye, the natural tendency is to rub it. *Above all—don't!* Splash the affected area with quantities of cold water to gradually get the temperature above the freezing point.

The use of mineral, cod, or an antiseptic oil is important in providing a protective film over the eyeball to reduce the possibility of infection.

As soon as possible, call or consult an eye specialist for immediate and future treatment.

Maintaining Chemical Stability

Whenever it becomes necessary to disconnect a refrigerant line, it should be immediately plugged or capped, depending on the type of connection. All air contains moisture and air that enters any part of the system will carry the moisture with it and the exposed surfaces will collect the moisture quickly. Capping the tubing will also prevent dirt and foreign matter from entering.

Tools should also be kept clean and dry. This includes the gauge set and replacement parts.

When adding oil, the container should be exceptionally clean and dry due to the fact that the oil in the container is as moisture-free as it is possible to make it. Therefore, it will quickly absorb any moisture with which it comes in contact. For this same reason the oil container should not be opened until ready for use and then it should be capped immediately after use.

When it is necessary to open a system, everything needed should be ready and handy so that as little time as possible will be required to perform the operation. The system should not be left open any longer than is necessary.

Finally, after the operation has been completed and the system sealed again, a vacuum pump should be used to remove any air that might have entered.

Refrigerant Pressure-Temperature Relationship

Without a basic knowledge of this, it will be impossible to make the proper diagnosis of certain difficulties which may occur in the system.

Each kind of refrigerant has a different pressure-temperature relationship than the others. The figures on the chart apply only to Freon-12.

The chart shows that every time the temperature of a quantity of Freon-12 is raised or lowered, the pressure on it is also raised or lowered. For example, at 70° the chart shows that the pressure is also 70 pounds. This is true only at 70°. However, if the temperature of the liquid in the cooling coil or the receiver is known, reference to the pressure-temperature chart will determine what the pressure should be.

The figures can also be used in a reverse manner. If the pressure at any point in the system is known, the temperature can be determined by referring to the chart.

PRESSURE-TEMPERATURE RELATIONSHIP OF FREON-12

(Pounds Per Square Inch)

Temp. °F.	Pressure	Temp. °F.	Pressure	Temp. °F.	Pressure	Temp. °F.	Pressure
—8	5.4	30	28.5	68	67.5	106	128.1
—6	6.3	32	30.1	70	70.0	108	132.1
—4	7.2	34	32.0	72	73.0	110	136.0
—2	8.2	36	33.4	74	75.5	112	140.1
0	9.2	38	35.2	76	78.3	114	144.2
2	10.2	40	37.0	78	81.1	116	148.4
4	11.3	42	39.0	80	84.1	118	153.0
6	12.3	44	41.0	82	87.0	120	157.1
8	13.5	46	43.0	84	90.1	122	161.5
10	14.6	48	45.0	86	93.2	124	166.1
12	15.9	50	47.0	88	96.4	126	171.0
14	17.1	52	49.0	90	99.6	128	175.4
16	18.4	54	51.0	92	103.0	130	180.2
18	19.7	56	53.0	94	106.3	132	185.1
20	21.0	58	55.4	96	110.0	134	190.1
22	22.4	60	58.0	98	113.3	136	195.2
24	23.9	62	60.0	100	117.0	138	200.3
26	25.4	64	62.5	102	121.0	140	205.5
28	27.0	66	65.0	104	124.0		

PACKARD AIR CONDITIONING
Part III
SERVICE DIAGNOSIS

The following diagnosis procedure outlines the method for diagnosing the complaint, but does not involve replacement or repair. These are covered in Part IV, Service Operations.

When diagnosing the complaint, all checks must be made with the car engine running at a speed approximating a 35 to 40 mph road speed and the control switch "ON" unless otherwise indicated.

Average operating pressures with the car engine running at 2,000 RPM and a fan directed into the radiator grille are:

Low Pressure 12-22 lbs., High Pressure 140-200 lbs. It must be remembered that the operating pressures change as the air temperature changes. In some localities where very high temperatures are reached, it is possible that these average pressures may be exceeded.

Blowers Operating—No Cooling

1. The first and easiest check is to determine whether the solenoid by-pass valve is open. This can be determined by feeling the temperatures of the by-pass line on both sides of the valve. If the valve is open, the by-pass line between the valve and the low pressure line should be considerably cooler than on the opposite side. If closed, the lines on both sides of the solenoid valve should be approximately the same temperature.

2. If the solenoid valve is closed, the next check is to determine whether a decided shortage of refrigerant is the cause of the difficulty. To determine this, remove the cap from the sight glass and, if it is full of foam or no liquid is seen at all, there is a shortage of refrigerant, which indicates a leak in the system. One of the first and most important places to test for a leak is at the compressor shaft seal. This, as well as all other leak checks, should be made with the leak detector. Since the seal is on the high pressure side of the system, a leak at this point will result not only in the loss of refrigerant, but also of the vital lubricating oil in the compressor. If the leak is large enough or continues too long, the result will be a stuck compressor. If the compressor sticks, the belts will wear excessively and soon break. This will result in the compressor becoming inoperative.

3. If the refrigerant supply is apparently normal, the next step is to check for a blown relay fuse which would cause the relay contacts to be open. Also the relay contacts may be open due to a mercury column separation in the thermostat or the relay contacts may be dirty. When the relay contacts are open, the solenoid coil is not energized and the by-pass is open. This prevents the system from cooling even though the conrol switch is "ON" and the blowers are operating.

   Check the solenoid valve for a bad coil, bad seat, stuck plunger or loose connections.

   Check the wiring for opens, accidental grounds or shorts.

4. If a check of the electrical control circuit did not reveal the difficulty, check the refrigeration system for restrictions. In order to check for restrictions in the system, connect the high and low pressure side of the gauge set to the gauge connections on the compressor housing. Note the operating pressure with the engine running at a speed approximating 35 to 40 mph road speed and control switch "ON." If the gauge reading is lower than normal on the low side, it indicates a restriction between the liquid outlet at the receiver and the low pressure side of the system through the compressor. This restriction may be caused by one of the following: Partially closed high pressure valve on the receiver, kinked or pinched high or low pressure refrigerant lines, clogged dehydrator-filter, dirty or clogged expansion valve inlet screen, expansion valve stuck shut, a partially closed low pressure hand shutoff valve at the compressor or a clogged filter in the compressor. A restriction at these points will be indicated by the presence of ice or frost at the point of restriction, with the exception of a stuck-shut expansion valve, partially

closed low pressure shutoff valve at the compressor or a clogged filter in the compressor.

5. Check the compressor for stuck divider blocks. To check this condition, remove the compressor belts and rotate the pulley by hand one complete revolution, noting that every 180° offers a resistance to turning. Rotate the pulley one complete revolution in the reverse direction, again noting a resistance to turning every 180°. The absence of resistance to turning at any point checked indicates a stuck divider block or possibly a broken high pressure discharge valve reed in the compressor.

Blowers Operating—Partial Cooling

1. First check for a shortage of refrigerant at the sight glass, indicated by bubbles in the refrigerant. A slight shortage of refrigerant results in the cooling coil getting only enough refrigerant to do a partial job of cooling.

2. If the refrigerant supply appears normal, check the solenoid by-pass valve for a leak past the valve seat. This check can be made by feeling the lines entering and leaving the solenoid valve. If there is a leak past the valve seat there will be a definite difference in temperature between the inlet and outlet lines of the valve. The leak past the seat may be caused by some foreign matter on the seat and may possibly be removed by opening and closing the "ON-OFF" control switch. Otherwise the valve must be replaced.

   If the refrigerant supply appears normal and the solenoid by-pass is okay, the difficulty may be due to the compressor working against a higher than normal high side pressure. Any condition that increases the normal high side pressure greatly reduces the ability of the compressor to remove the required amount of heat laden vapor from the cooling coil and produce the desired cooling effect.

3. Check the high side operating pressure by noting the high pressure gauge reading at engine speed approximating 35 to 50 mph road speed. If the reading is higher than normal, it could be caused by one of the following:

   A. Above normal engine temperature.

   B. Restricted air flow through the condenser.

   C. Overcharge of refrigerant.

   D. Air in the system.

Item "A"—Should be corrected by normal engine and cooling system maintenance as required. For instance, a shortage of water will cause the radiator to overheat and increases the heat radiated from the radiator to the condenser. This in turn increases the temperature of the condenser and raises the temperature and pressure of the refrigerant inside of it.

Item "B"—This can be corrected by using a stiff brush, compressed air or water to clean the condenser. Steam should not be used to clean it because it will cause excessive internal pressure. A dirty or clogged condenser does the same thing to the refrigerant temperature inside of it as blocking the air flow over a radiator does to the water temperature. Again, this increase of refrigerant temperature also increases the pressure.

Item "C"—If the high side pressure is still high with the engine temperature condition corrected and the condenser clean, the trouble may be caused by an overcharge of refrigerant. The high pressure is caused by too much of the condenser being occupied by liquid. This reduces the amount of condensing space and surface to such an extent that the heat cannot be dissipated as rapidly as it should, thus the increase in pressure. The excessive amount of refrigerant should be discharged until the operating high pressure is reduced to normal.

Item "D"—Air in the system produces the same symptoms and for the same reason, as an overcharge of refrigerant. No matter where or how air enters, it always ends up in the condenser. Air, in a system such as this, is considered to be a noncondensible gas. Therefore, it mixes with the refrigerant vapor in the condenser and occupies valuable condensing space.

The method of checking for either of these last two conditions will be covered in the "Service Operations" for "Purging Air or Refrigerant from the System."

4. Check the expansion valve: If the foregoing checks have not located the cause of the difficulty, check the expansion valve for proper adjustment. An expansion valve that is open too wide, allows more refrigerant to enter the cooling coil than it can hold, so the excess liquid enters the low pressure line. If the excess liquid is enough to prevent the compressor from reducing the pressure in the cooling coil, the temperature of the coil and passenger compartment will both be increased proportionately. A valve that is not open wide enough will cause only partial cooling because of the fact that

the cooling coil is not getting a sufficient amount of liquid to handle the heat load. A valve that is not open wide enough may be the result of improper adjustment, discharged power element, or an improperly clamped and insulated valve thermobulb. The proper adjustment of the valve stem is ten turns open from the fully closed position.

Too Cold

This can be caused by failure of the solenoid by-pass valve to open as a result of the solenoid plunger being stuck closed, relay contacts stuck closed or a faulty thermostat. Also refer to Air Conditioning Electrical Circuit Diagram and check the wiring.

Blowers Not Operating

If neither blower is operating, the cause can be a blown fuse, a broken wire or a loose terminal between the ignition switch and the common terminal of the blower motors. Also the contacts or mechanism in the control switch could be faulty. By point-to-point checks and visual inspection of the terminals, the difficulty can be located.

If one blower will not operate, the difficulty could be stuck motor bearings, electrical failure inside the motor, a broken wire leading to the motor, a loose terminal, worn brushes or commutator, or faulty control.

PACKARD AIR CONDITIONING
Part IV
SERVICE OPERATIONS

In performing service operations and replacing parts, the system must be prepared and processed before and after the work is performed.

The following paragraphs will cover step-by-step procedures. These procedures will not be repeated in all operations which require them but only a reference will be made.

NOTE: The bumper and bonnet were removed from the car used for photographic purposes so that the equipment and parts involved could be clearly illustrated.

Pumping Down the System:

1. Assemble the gauge set and connect three lines to the gauge manifold. Cover the end of the center line with a cloth to prevent oil and refrigerant from contacting persons or objects.
2. Install the lines of the gauge set to the high and low pressure gauge connections on the compressor. See Figure 1.
3. Close the liquid line valve at the receiver, shown in Figure 2, using Valve Key J-5427.
4. Remove the cap from the low and high pressure hand shutoff valves on the compressor.
5. Purge air from the gauge lines by cracking open and then closing the hand shutoff valves on gauge set.

Important Note: Under some conditions of overcharge the receiver and condenser will not hold

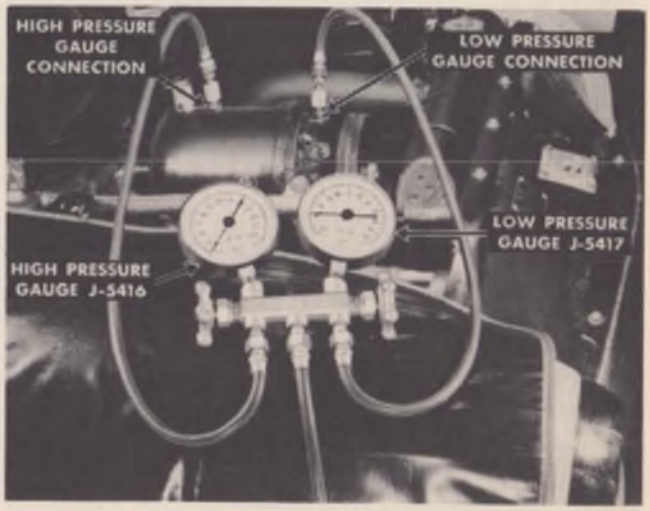


Fig. 1

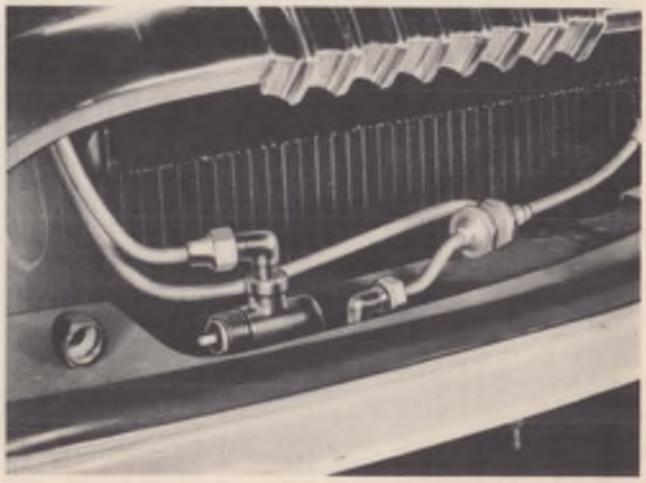


Fig. 2

the entire charge of refrigerant, therefore, it may be necessary to discharge some of it during the pump-down operation. If the high side pressure reaches 275 pounds, TURN THE ENGINE OFF. Then discharge refrigerant through the high pressure side of the gauge set to the atmosphere in sufficient quantity to prevent the pressure from exceeding this amount.

6. Energize the solenoid by connecting a wire from the hot (negative) side of the battery to the solenoid. See Figure 3.

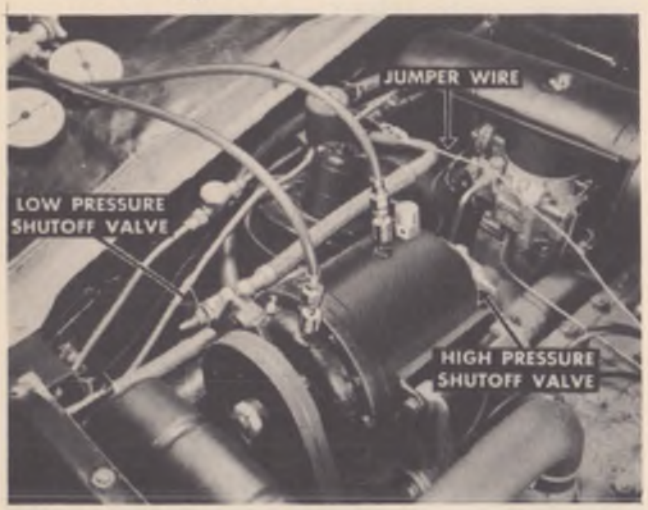


Fig. 3

7. Turn the control switch "ON" and operate car engine at *LOW* idling speed.

8. Watch both gauges and allow the compressor to operate until the low side pressure gauge reads 0 (zero) pounds. Then stop the engine and close the high pressure hand shutoff valve at the compressor using Valve Key J-5427. See Figure 4.

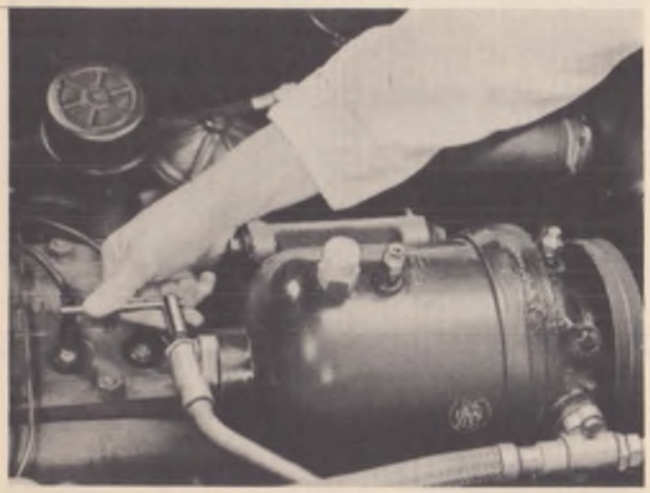


Fig. 4

9. Disconnect and tape one of the carburetor starter switch wires so that the engine cannot be started accidentally.

10. Purge the remaining refrigerant from the low pressure side through the low pressure side of the gauge set, allowing 1 or 2 pounds pressure to remain in the low pressure side of the system. Shut off the low pressure gauge for 5 minutes. If pressure builds up above 5 pounds, purge again. Then close the low pressure valve on the compressor using Valve Key J-5427.

Evacuating Low Pressure Side of System

To maintain chemical stability in the system one of the most important pieces of servicing equipment is the vacuum pump. Whenever the system is opened for performing service operations or repairs, it should not be put into operation again until it has been evacuated. This is necessary to remove air and moisture which will have entered the system when the system was opened to replace a part.

1. Hook up and install the equipment for evacuating or charging the system as shown in Figures 5 and 6.

2. Make certain the low pressure hand shutoff valve at the compressor is open.

Fig. 5

3. Energize the solenoid valve with a jumper wire from the hot (negative) side of the battery.

4. Close the high pressure hand shutoff valve at the compressor.

5. Close the hand shutoff valve at the receiver.

6. Open the low pressure gauge valve.

7. Start the vacuum pump.

8. Slowly open the shutoff valve at the vacuum pump to avoid forcing oil out of the pump.

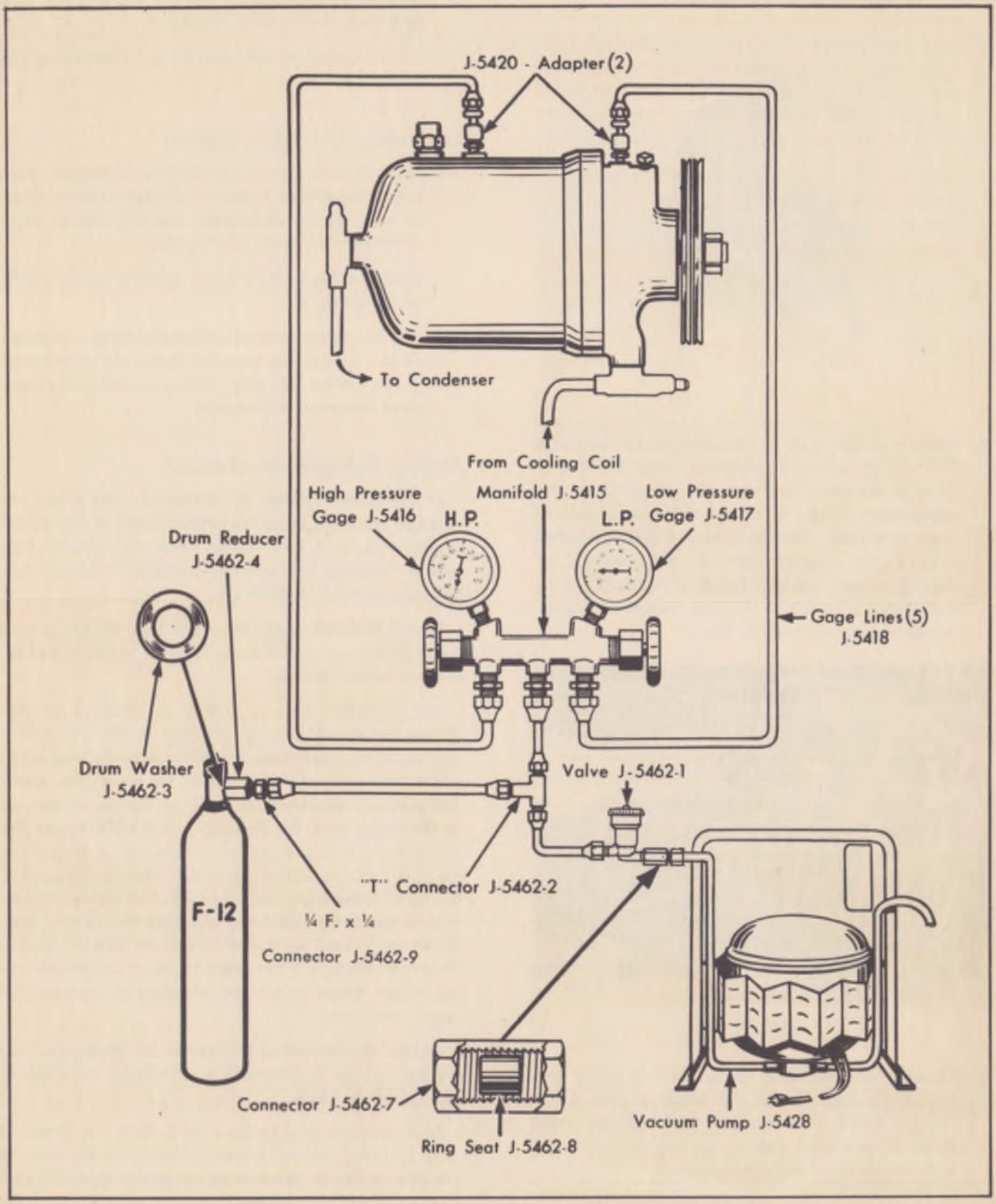

J-5420 - Adapter (2)
To Condenser
From Cooling Coil
High Pressure Gage J-5416
Manifold J-5415
Low Pressure Gage J-5417
H.P.
L.P.
Drum Reducer J-5462-4
Gage Lines (5) J-5418
Drum Washer J-5462-3
Valve J-5462-1
"T" Connector J-5462-2
F-12
¼ F. x ¼ Connector J-5462-9
Connector J-5462-7
Ring Seat J-5462-8
Vacuum Pump J-5428

Fig. 6

NOTE: If oil is blown from the pump it should be replaced with Frigidaire 75 viscosity oil (28 oz. full charge). See Figure 7.

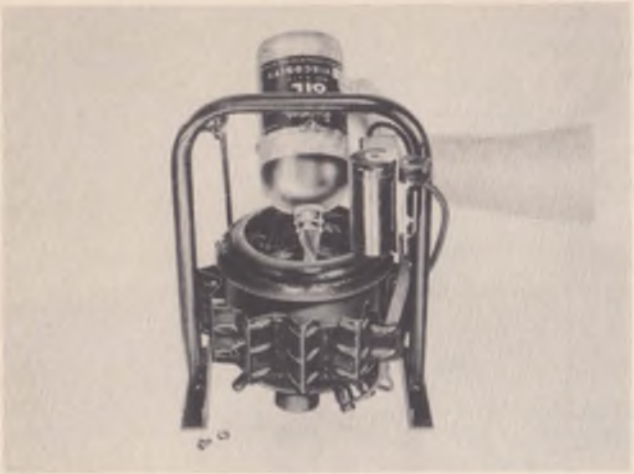


Fig. 7

9. Operate to obtain 28" vacuum for 10 minutes. If a 28" vacuum cannot be obtained, close the shutoff valve at the pump and stop the pump. Open the refrigerant cylinder valve and allow the system to come to cylinder pressure. Close the cylinder valve. Leak-test the complete low side of the system, including gauge hookup fittings, Figure 8, with leak detector J-5419. If the leak cannot be found, the vacuum pump may be faulty.

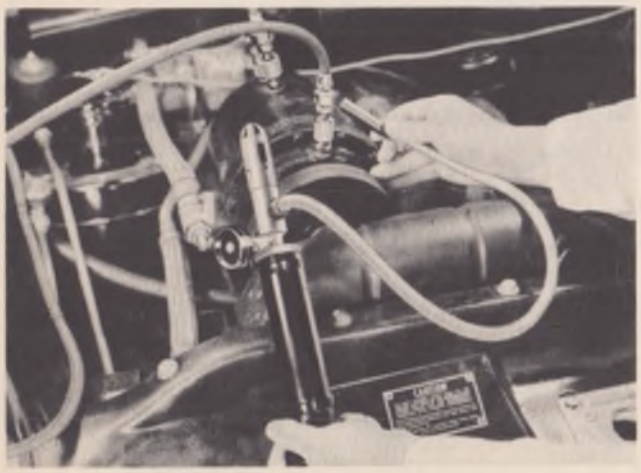


Fig. 8

10. Close the shutoff valve at the vacuum pump and stop the pump. Watch the gauge to see if the vacuum holds. If it will not hold, charge some Freon-12 into the system and leak-test. Fix the leak and pull the vacuum again.

11. Open the refrigerant cylinder valve to charge the system to cylinder pressure. (Gauges should equalize.) Close the cylinder valve.

12. Evacuate the system again as previously described. This second charging and evacuating is for the purpose of picking up any air or moisture that may have remained in the system.

    The system is now ready for a partial charge of refrigerant.

Evacuating the Entire System

1. Make certain the low pressure hand shutoff valve at the compressor is open. The high pressure shutoff valve at the compressor and the shutoff valve at the receiver must also be open.

2. Open the high and the low pressure gauge valves on the gauge set.

3. Perform operations as outlined in steps 7 through 12 in "Evacuating Low Pressure Side of System."

   The system has now been prepared for a complete charge of refrigerant.

Adding Refrigerant—General

If the entire charge of refrigerant has been lost through accident, or in the replacement of any of the components, it will of course, need replacement. Procedure "Adding Refrigerant—Complete Charge" outlines the steps to be followed.

If the diagnosis indicated a shortage of refrigerant, Freon-12 is to be added as outlined in "Adding Refrigerant—Partial Charge."

An important rule to follow in charging is that refrigerant should always be added to the compressor in a vaporous state. Another important rule is never to add refrigerant until the system has been leak tested and properly processed. In order to charge refrigerant in the vapor state, the Freon-12 drum will require the use of heat. This can best be accomplished by placing the drum in a bucket of hot water. The temperature of the water should not exceed 125°F. Since the temperature of the water and drum will decrease, as the vapor leaves the drum, the water and drum will be cooled. This may result in a lowering of the drum pressure to the extent where it will be necessary to replenish or reheat the water.

So that the amount of refrigerant being charged into the system can be determined, it will be necessary to use a suitable scale.

If a platform-type scale is used, both the Freon-12 drum and the bucket of hot water should be placed on the platform with the drum in an upright position. Figure 9 shows the drum suspended from a spring-type scale. When the drum is suspended in this manner, it should not contact the bottom of the bucket. Note the scale

reading before opening the valve on the drum so it can be determined when the proper amount of refrigerant has been charged into the system.

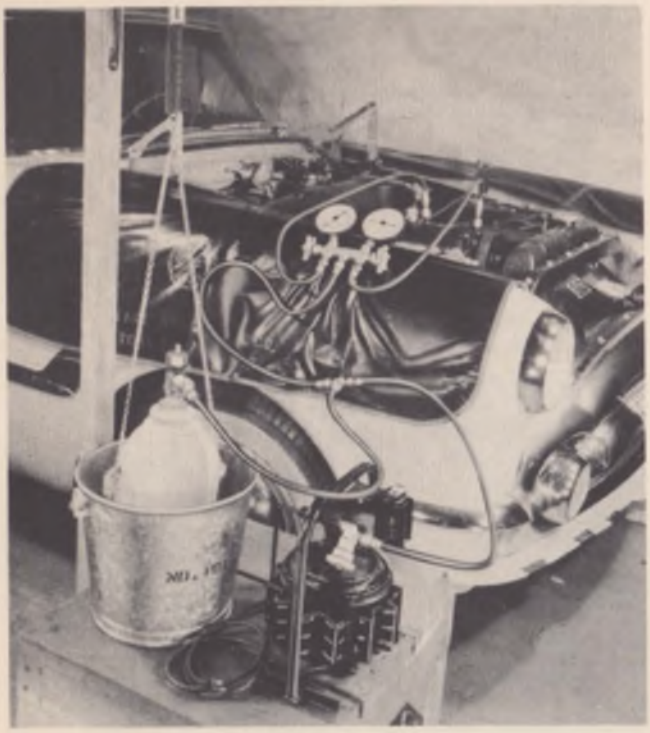


Fig. 9

NOTES: In all refrigerant charging procedures where the compressor is in operation, the following cautions should be observed:

1. The high pressure should not exceed 275 lbs.
2. The low pressure hand shutoff valve on the gauge manifold should be closed completely at frequent intervals to make certain the pressure in the low side of the compressor is always maintained above 12 pounds gauge pressure. When the low side hand shutoff valve on the gauge set is closed, the gauge will then indicate the low side pressure in the compressor. When the low side hand shutoff valve on the gauge set is open, the gauge indicates drum pressure.
3. The drum pressure should always be maintained at a minimum of 12 pounds and not exceed a maximum of 100 pounds.
4. Since the system would have been prepared by evacuating as recommended, the gauge manifold set would be connected as shown in Figure 5.
5. When adding refrigerant the solenoid valve should be energized by connecting a wire from the hot (negative) side of the battery to the solenoid.

Adding Refrigerant—Complete Charge

This operation is performed after the entire system has been evacuated.

1. Open both hand shutoff valves on the compressor.
2. Open the low pressure valve on the gauge set.
3. Make certain the solenoid valve is energized and closed.
4. Observe the reading on the scale and then open the drum valve wide.
5. Freon-12 vapor under pressure will flow into the system without operating the compressor. This amount should not exceed 7 pounds by weight.

   NOTE: If it is not possible to charge the total of 7 pounds by the method just described, it is premissible after 3 pounds has been forced into the system, to operate the engine and compressor at slow idling speed. The hand shutoff valve on the high pressure side of gauge set should be *CLOSED* all the way in. Continue in to operate the engine and compressor at slow idling speed until the 7 pounds is charged into the system.
6. Close off the low pressure shutoff valve on the gauge set.
7. Close the drum valve.
8. Remove the drum from the hot water.
9. The engine and compressor can be operated at a speed corresponding to 35 to 40 mph to observe the high and low pressure gauges as well as the sight glass and general performance of the system. When satisfied, stop the engine, remove the gauge line connections at the compressor and cap them tightly with flare nut and caps.

Adding Refrigerant—Partial Charge

This procedure is performed when an unknown amount of refrigerant is lost through a leak or when replacing some component in the system and after the low pressure side of the system has been evacuated.

The hookup of the charging equipment and the use of a scale and hot water will be the same as described in "Adding Refrigerant—Complete Charge."

1. With the compressor valves open, the receiver valve open, the gauge valves closed, and the sole-

noid energized, operate the engine and compressor at *slow* idle speed.

2. Open the low pressure valve on the gauge set.
3. Open the drum valve slightly.
4. Watch the sight glass until a solid column appears. See Figure 10.

Fig. 10

5. Note the scales and allow the compressor to operate until 1 additional pound of Freon-12 has been charged into the system.
6. Close the low pressure hand valve on the gauge set.
7. Close the drum valve.
8. Remove the drum from the water.
9. Make certain the compressor shutoff valves are open.
10. Operate the engine at a speed corresponding to 35 to 40 mph.
11. Observe the gauges, sight glass and the entire system for proper performance.
12. After 5 minutes of operation, if bubbles reappear at the sight glass, add 1 more pound of refrigerant.
13. When satisfied with the operation, remove the gauge connections on the compressor.
14. Cap the gauge connections with flare nuts and deadheads.
15. Make certain the compressor valves are open.

Purging Air or Refrigerant from the System

Air in the system can be easily differentiated from an overcharge of refrigerant. In order to check for this condition, the car engine and compressor must be stopped; then follow the procedure as outlined:

1. Connect the high pressure side of the gauge set to the high pressure gauge connection on the compressor.
2. Energize the solenoid valve by running a jumper wire from the hot (negative) side of the battery.
3. Open the valve on the high pressure side of the gauge set, allow vapor to exhaust slowly through the center connection on the gauge set for a few seconds, then close.
4. Clip the 5/8" thermo-well, J-5422, on the inlet tube of the condenser. Fill the well cavity with water and insert the thermometer, J-5421, in it. See Figure 11.

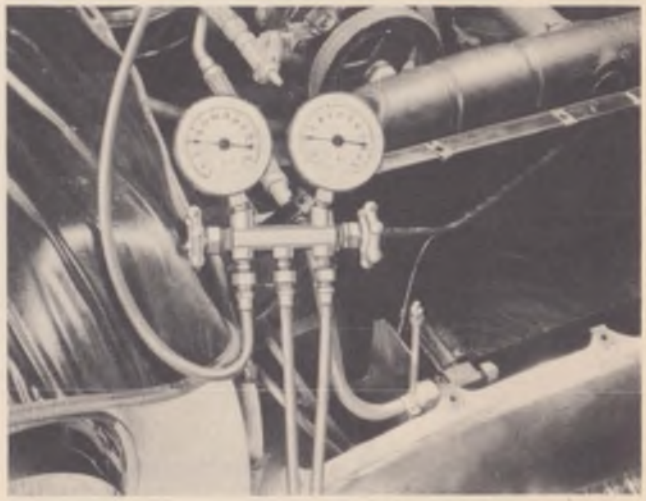


Fig. 11

5. Turn the control switch "ON" and operate the blowers at full speed.
6. Operate the engine and compressor at a speed approximately 35 to 40 mph for above five minutes. This will tend to concentrate any air or excessive refrigerant in the condenser.

   CAUTION: Do not allow the high side pressure to exceed 275 pounds pressure. See "Pump Down Procedure."

7. Stop the engine and close off the low side hand shutoff valve on the compressor and the hand shutoff valve on the receiver.
8. Allow the system to settle in temperature, observing the high pressure gauge and the thermometer. See Figure 12.

   If the high side pressure reduces as the condenser cools and conforms to the pressure-temperature relationship of Freon-12, the difficulty was due to an overcharge of refrigerant.

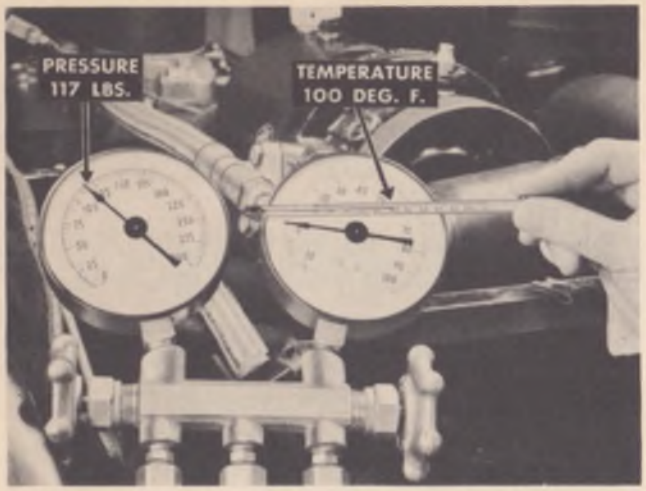


Fig. 12

On the other hand, if the pressure does not reduce as the condenser cools, there is air in the system, because air does not have the same pressure-temperature relationship as Freon-12. When either of these conditions are found, it will be necessary to purge the high side of the system.

9. Open the high side valve on the gauge set slowly and allow the vapor to exhaust at the center connection on the gauge set.

   CAUTION: Cover the connection with a cloth to prevent oil and refrigerant from contacting persons or objects.

10. This should be done at frequent intervals observing the pressure gauge and thermometer, until the two correspond to the correct Freon-12 pressure-temperature relationship.

    NOTE: Since an overcharge of refrigerant would already correspond to the Freon-12 pressure-temperature relationship, it will only be necessary to purge the excessive Freon-12 until the high side pressure does not build up rapidly when the engine is operating.

11. Open the low pressure shutoff valve on the compressor and the valve at the receiver.

12. Operate the engine at a speed corresponding to 35 to 40 mph.

13. Check the operating high side pressure and the sight glass.

14. When satisfied with the operation of the system, disconnect the gauge set, replace the flare nuts, and tighten all fittings.

Checking and Adding Oil

The compressor was originally charged with 18 to 22 ounces of 525 viscosity Frigidaire oil. During normal operation, because of the affinity of Freon-12 for oil, a certain amount of oil will circulate throughout the system along with the liquid and vapor.

To determine if the compressor has sufficient oil, an elbow fitting has been placed on the underside of the shell. It has a Schrader valve core, and is capped with a flare nut and deadhead.

Checking Oil Level

If a slight refrigerant leak is found which indicates some loss of oil, by the presence of oil around the leak, or when it is necessary to determine whether or not the compressor has a sufficient amount of oil in it, these steps should be followed:

1. The control switch should be turned to the "ON" position and the blowers operated at full speed.
2. Start the engine and operate at fast idle or a speed corresponding to 35 to 40 mph for ten minutes.

   NOTE: In order to maintain proper condenser operation, it is absolutely necessary that a 12 or 15-inch electric fan be placed in front of the radiator grille to direct a flow of air over the condenser.

3. Stop the engine.
4. Remove flare nut and deadhead from the oil test fitting.
5. Depress the Schrader core allowing the first surge of oil to escape. See Figure 13. If oil continues to escape with the Freon vapor, the oil level of the compressor is to be considered satisfactory.

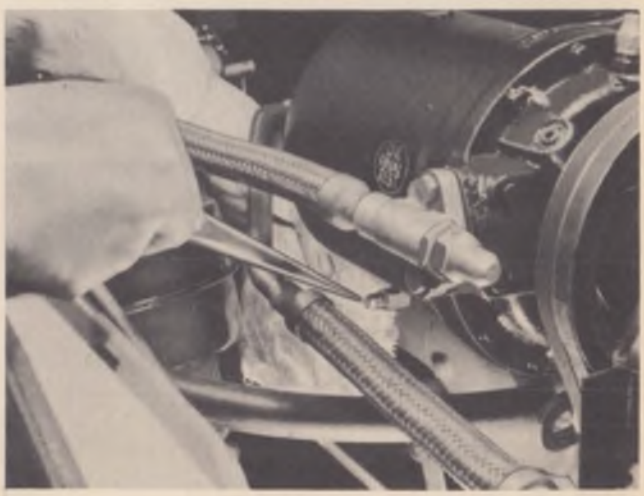


Fig. 13

NOTE: Allow the escaping oil and vapor to blow against a clean white cloth. The cloth should become oily.

6. If oil does not continue to escape from the test fitting, the oil is below the minimum level, and therefore, oil will have to be added.

Adding Oil—Minor Loss

If oil did not continue to escape from the test fitting when the oil level was checked, it is below the top of a small tube attached to the end of the elbow.

This tube projects into the compressor housing. If the oil level is to the top of the tube, it is at the minimum safe level.

If the check shows the oil level to be below this point, the condition should be corrected by performing the following operations:

1. Shut off the high and low pressure hand shutoff valves on the compressor.
2. Using a gauge adapter on the high pressure test connection, purge off Freon until the escaping vapor produces only a low audible hiss. Wait a few minutes and repeat the purging.
3. Remove the high pressure relief valve.
4. Pour 4 ounces of 525 viscosity Frigidaire oil from a graduated bottle or container into the high pressure relief valve opening. See Figure 14.

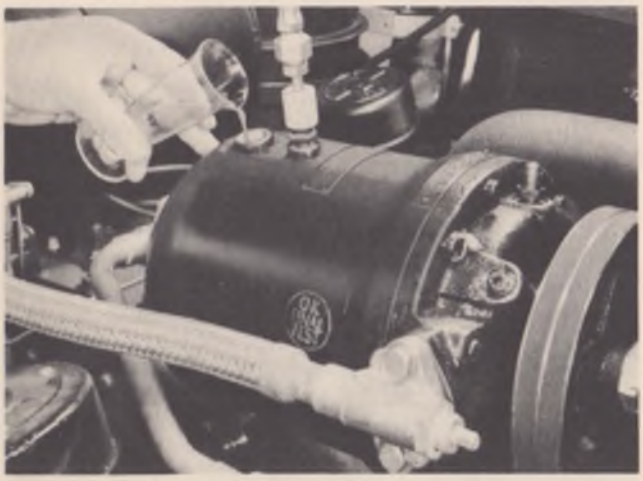


Fig. 14

5. Replace the high pressure relief valve using a new copper gasket.
6. Open the high pressure hand shutoff valve.
7. Purge the compressor. Use a gauge adapter on the high side gauge connection of compressor.
8. Recheck the oil level as indicated in Step 5 "Checking Oil Level."
9. If the oil is still below the minimum level, continue to add 4 ounces at a time by following the foregoing steps until satisfactory level is reached.
10. When the satisfactory level is reached, make certain both high and low pressure shutoff valves are open, then replace the protective caps over the valve stems.
11. Replace the flare nuts and deadheads on both the oil test fitting and high side gauge fitting connections.
12. Leak test all connections which have been disturbed.

Adding Oil—Major Loss

If a major loss of oil has occurred, such as a seal leak, line breakage, etc., this procedure should be followed. It is to be carried out after making necessary repairs, evacuating and recharging the system.

1. Close both the high and low pressure hand shutoff valves on the compressor.
2. Using a gauge adapter on the high side gauge connection, purge the pressure until the escaping vapor produces only a slight hiss. Repeat if necessary to be sure pressure is at a minimum.
3. Remove the shutoff valve flange bolts, and remove the valves from the compressor. See "Removing and Installing Compressor—Engine Maintenance."
4. Remove the belts and the compressor from the mounting bracket, transfer the compressor to the work bench.
5. Remove the high pressure relief valve.
6. Invert the compressor and drain the oil into a clean container.

   NOTE: Examine the condition of the oil to determine whether or not it is contaminated with any foreign material, such as metal chips, water sludge, etc. This oil should be discarded and new oil used. If any amount of water is found, install a new liquid dehydrator-filter.

7. Pour 16 ounces of 525 viscosity Frigidaire oil from a graduated bottle into the compressor at the high pressure relief valve opening.
8. Reinstall the high pressure relief valve using a new copper gasket.
9. Reinstall the compressor to engine mount, then connect the high and low pressure hand shutoff valves using new "O" rings and valve flange gaskets; reinstall the belts.

10. Open the high pressure hand shutoff valve and, by using the gauge adapter on the high pressure gauge connection, purge the compressor.
11. Open the low side hand shutoff valve.
12. Leak test all connections which have been disturbed or repaired.

Adjusting the Expansion Valve

If the expansion valve is acting as though it is out of adjustment by either starving the cooling coil of refrigerant or by flooding liquid into the low pressure line, it should be adjusted.

If the expansion valve is open too wide, it may cause a frosting of the low pressure suction line and a higher than normal operating suction (low) pressure.

If the expansion valve is not open enough, the suction (low) pressure may be lower than normal. A partially filled cooling coil will result in lowered efficiency and partial cooling.

After removing the evaporator housing rear panel to gain access to the expansion valve, remove the hexagonal cap from the end of the expansion valve, being careful to give support to the valve with another wrench. This will prevent damage to the lines or valve mounting.

In this system, the expansion valve can best be adjusted by first closing the stem completely (clockwise) and then opening it (counterclockwise) 10 complete turns using Valve Key J-5426. See Figure 15. If this does not produce satisfactory operation it is suggested that the valve be replaced.

NOTE: Always replace the hexagonal cap after checking the setting.

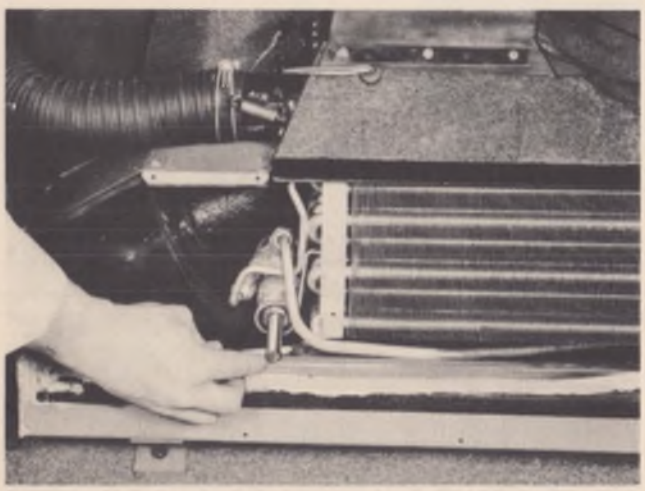


Fig. 15

Replacing the Expansion Valve

Before replacing the expansion valve, make certain the liquid inlet screen is not clogged. A discharged power element caused by a broken capillary line or broken tip is cause for replacement. A stuck shut or stuck open needle caused by corrosion is also reason for replacement.

1. Remove the rear cover from the evaporator.
2. Install the gauge set and pump the system down as previously described.
3. Remove the power element bulb from the suction line.
4. Remove the equalizing, low pressure, and high pressure line flares in that order at the valve. Remove the valve clamp and valve.
5. Install the new valve by connecting the lines and clamp the power element of the new valve to the top or side of the low pressure line.
6. Crack the low pressure valve on the compressor and the high pressure valve on the receiver until full condenser pressure (about 35 pounds) is produced in the cooling unit. Then close both valves.
7. Check the three newly made connections carefully for leaks.
8. Evacuate the low side of the system as previously described.
9. Add refrigerant to replace that lost in the operation.
10. Replace the evaporator cover and check the operation of the system.

Replacing the Solenoid Valve

If the solenoid valve coil is open, shorted, grounded or burnt, it should be replaced.

If the valve fails to close and hold properly when energized, or fails to open when de-energized, it will be necessary to replace the entire valve.

In order to replace the valve, proceed as follows:

1. Connect the gauge set to both gauge connections on compressor. (Do not operate the compressor.)
2. Close the hand shutoff valve at the receiver.
3. Discharge the high and low sides of the system through the gauge set, to a pressure of not more than 5 pounds. Because the hand shutoff at the receiver is closed and there is a check valve in the line from the condenser to the receiver, the re-

frigerant that is in the receiver will remain there. This is based on the supposition that the check valve is working properly.

4. Disconnect the wiring leads from the solenoid and remove the solenoid valve from the line by disconnecting the flare nuts.
5. Install a new solenoid valve, being certain that the direction of the arrow on the valve body is pointing in the correct direction for flow which is toward the rear of the car. Reconnect the wiring to the valve.
6. Open the hand shutoff valve at the receiver. Allow the system to build up pressure to between 35 and 40 pounds. Close the valve and test for leaks.
7. If no leaks are found, leave the receiver valve closed and evacuate the system. Follow the instructions given in "Evacuating Low Pressure Side of System."
8. Open the hand shutoff valve on the receiver and recharge the system with refrigerant. Follow the instructions given in "Adding Refrigerant—Partial Charge."

Replacing Dehydrator—Filter or Sight Glass

Since the dehydrator-filter and sight glass are both in the high pressure liquid line, the procedure for replacing either one will be the same.

The dehydrator-filter should be replaced if it has been damaged through an accident, leaks, becomes restricted or clogged. It is attached to the right frame side rail as shown in Figure 16.

If at any time when examining the compressor oil, moisture is found or there is an indication of moisture at the expansion valve needle, the dehydrator-filter should be replaced.

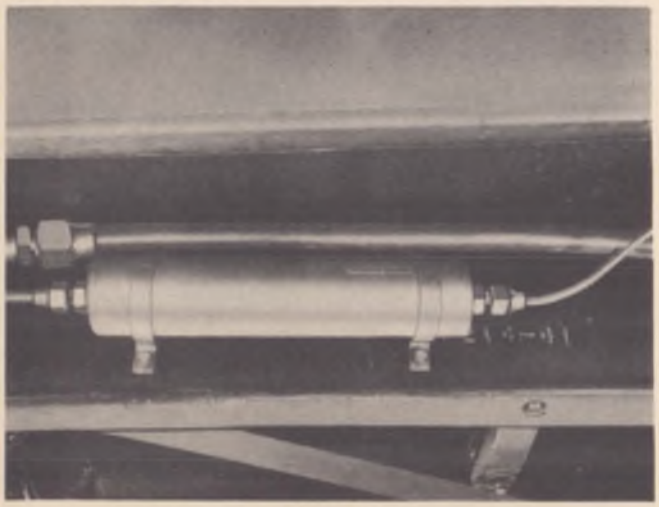


Fig. 16

If a compressor fails during operation and it is necessary to replace it, the dehydrator-filter should also be replaced.

In order to replace either the dehydrator-filter or sight glass the following operations should be performed:

1. Pump down the system as previously described.
2. Disconnect the flare fittings at the dehydrator or sight glass and remove.

   NOTE: Do not uncap the new dehydrator until the exact time it is to be installed as it will quickly pick up moisture from the air and ruin its efficiency in the system.
3. Install the new dehydrator or sight glass making certain that the refrigerant flow through the dehydrator will be in the direction of the arrow on the label or the stamp "IN" on the inlet fitting. The direction of flow is toward the rear of the car.
4. Before evacuating the low side, apply sufficient drum pressure to the low side to obtain a good leak test.
5. Evacuate the system as described under "Evacuating Low Pressure Side of System."
6. Add refrigerant to replace that lost in pumping down.
7. Check the performance of the system.
8. Remove the processing and charging equipment and recap the gauge connections.
9. Make certain all hand shutoff valves are OPEN.

Replacing the Compressor Shaft Seal

If a shaft seal leak has been found as a result of leak testing and diagnosing, a completely new seal kit should be installed.

The new seal assembly will be in a unit package, consisting of the bellows, Nitralloy and synthetic rubber seal and lead gasket. The lead gasket is to be clamped between the bellows flange and the boss on the compressor casting.

In opening the package and subsequent handling of the parts, use extreme care so as to avoid scratches, nicks or even finger printing the surfaces of the seal faces. Such care is necessary because these surfaces must prevent the leaking of the high pressure vapor.

In order to assure a satisfactory seal, it is important to follow carefully the procedure described.

1. With the car engine off, close the low and high pressure shutoff valves on the compressor.

Fig. 17

2. Use a gauge adapter on the high pressure fitting and purge until the escaping vapor produces only a slight hiss.
3. Remove the compressor from the mounting bracket and move it to a work bench. See "Removing and Installing Compressor—Engine Maintenance."
4. Remove the pulley from the compressor shaft.

   CAUTION: Care should be exercised in removing the pulley. Do not hammer it off the shaft.
5. Remove the seal retaining plate as shown in Figure 17.
6. Remove the bellows seal as shown in Figure 18.
7. Remove the Nitralloy ring from the shaft using the Seal Centering Tool J-5425. See Figure 19.
8. Remove any paint or corrosion from the shaft. Flush and clean the seal cavity with new 525 Frigidaire oil, and wipe the surface of the shaft and shoulder with a clean lint-free rayon cloth, until they are clean and dry.
9. As a final cleaning operation, wet one of the cleaning tissues included in the replacement seal package with lighter fluid, then allow the tissue to dry until no liquid fluid is present. Wipe the shaft and the shaft shoulder with the tissue so as to remove any remaining trace of oil.
10. Remove the Nitralloy seal ring from the protective foil and insert the seal ring in the seal centering tool so that the synthetic rubber is visible. *Care should be taken not to handle the polished surfaces of the Nitralloy seal ring.* Tighten the setscrew in the centering tool.
11. Apply a good grade of lighter fluid to the cleaning tissue which is packed in the unit package.
12. Using the wetted tissue, wipe the entire rubber surfaces (including inner diameter and radius) of the seal until all the protective oil coating is completely removed and the rubber is completely clean and dry.
13. Install the new Nitralloy ring on the compressor shaft making certain the neoprene rests evenly and firmly against the shaft shoulder. This can be done by loosening the setscrew and reversing the tool so that the small tubular end is pressed firmly by hand against the inner ring of the synthetic rubber. This will assure a better contact between the radius of the seal and the shaft shoulder.
14. Apply clean Frigidaire 525 viscosity oil to the Nitralloy ring in the compressor cavity and to the seat and first three turns or convolutions of the bellows seal.
15. Using the special seal centering tool, install the new bellows seal and gasket. See Figure 20. Install the retainer plate and tighten the bolts alternately

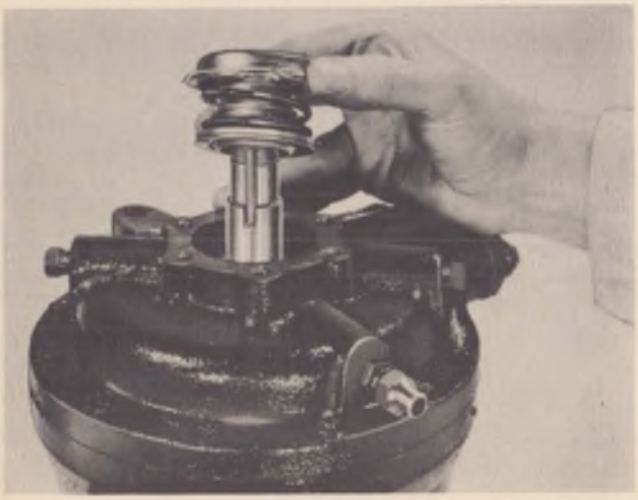


Fig. 18

Fig. 19

Fig. 20

to insure even pressure against the seal. See Figure 21. Do not remove the centering tool until all bolts are tight.

Fig. 21

16. Install the pulley and rotate the compressor by hand several times.

    NOTE: The pulley is marked "Compressor Side." Be sure this side is next to the compressor.

17. Install the compressor and the belts. Using Belt Tension Adjuster J-5577 and a 0-100 ft. lb. torque wrench, tighten the belts to 58 ft. lbs. See Figure 22. Tighten all compressor to mounting bracket bolts while maintaining this 58 ft. lb. torque.

18. Install the low pressure and high pressure valves using new valve flange and "0" ring gaskets and then open the high pressure shutoff valve.

19. Using the gauge adapter on the high pressure gauge connection, purge the compressor.

20. Open the low side hand shutoff valve. Then operate the engine at a speed equivalent to 35 to 40 mph road speed for 15 minutes and repeat the purging operation at the high pressure gauge connection. This will remove the air that was introduced into the seal cavity during the seal change.

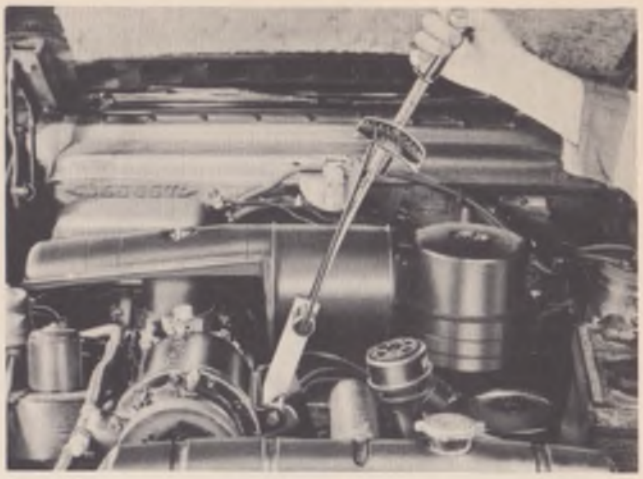


Fig. 22

21. Recap the high pressure gauge connection and leak-test the compressor shaft seal and all other connections which were disturbed.

22. If a leak is found at the seal at this time, repeat the run-in as described in Operation 20. If a leak is found on the second test, it will be necessary to install another seal kit.

Removing and Installing Compressor—Engine Maintenance

1. Shut off the high and the low pressure valves at the compressor using the Valve Key J-5427.

2. Loosen the bolts on the hand shutoff valves on the compressor about $\frac{5}{16}$". Then tap the valve to free it from the "0" ring and flange opening. The valve should come back firmly against the bottom of the bolt heads. See Figure 23. A momentary release of

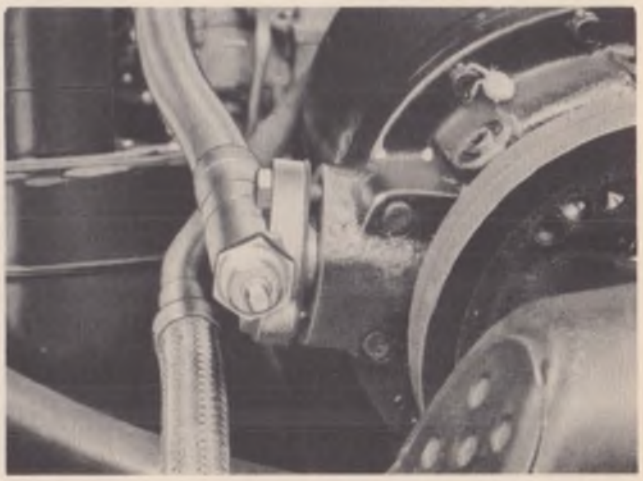


Fig. 23

vapor should be expected as the "0" ring leaves the boss on the casting. If vapor continues to escape, it would indicate one of two things; either the shutoff valve is not tight or the spring loaded automatic valve in the body is not seating properly.

In the latter case, it will be necessary to purge the compressor body at the high side gauge connection, by use of a gauge adapter.

3. Complete the removal of bolts and valves from the compressor. Cover the openings in the compressor and the hand shutoff valves.
4. Loosen the belts and remove the compressor to the work bench.
5. After making maintenance repairs on engine, reinstall the compressor.
6. Install the belts. Using Belt Tension Adjuster, J-5577 and a 0-100 ft. lb. torque wrench, tighten the belts to 58 ft. lbs. See Figure 22. Tighten all compressor to mounting bracket bolts while maintaining this 58 ft. lb. torque.
7. Before attaching the shutoff valves to the compressor, install new "0" rings and valve flange gaskets. Apply Frigidaire 525 oil to the "0" rings and valve flange gaskets before fitting the valve into the opening sleeves in the compressor. This will permit easier installation.
8. Leak test.

CAUTION: *Make sure all valves are open before starting engine.*

Replacing an Inoperative Compressor

An inoperative compressor is one that will not turn over, has stuck divider blocks, broken discharge reeds or some internal difficulty which prevents the compressor from operating properly.

When such a difficulty is encountered, not only will the compressor need replacement, but additional processing of the system will be necessary.

1. Install a gauge set to the high and low pressure gauge connections on the compressor. (Do not operate the engine or the compressor.)
2. Close the high pressure hand shutoff valve at the compressor. Also close the high pressure hand shutoff valve at the receiver.
3. Energize the solenoid valve by running a jumper wire from the negative side of the battery.
4. Discharge the low pressure side of the system through the low pressure side of the gauge set.
5. Close the low pressure hand shutoff valve at the compressor.
6. Disconnect the dehydrator-filter in the liquid line and remove.
7. Disconnect the gauge set from the compressor. Disconnect the high and low pressure valves from the compressor. Then remove the compressor from the mounting bracket. See "Removing and Installing Compressor-Engine Maintenance."
8. Open wide the hand shutoff at the receiver and allow the refrigerant in the high side of the system to discharge at the connection where the dehydrator-filter was connected. (Place rags or a bucket at the end of the line where the dehydrator-filter was connected so that refrigerant and oil does not splash on the car or floor.)

   NOTE: If the system has been completely discharged of refrigerant because of the compressor difficulty, it is necessary to use liquid Freon-12 from a drum to do this flushing job. This can be accomplished by following these instructions:

   a. Remove the core from the self-closing valve installed in the header of the condenser.
   b. Install a charging line to this connection and to a Freon-12 drum, containing at least 5 pounds of Freon-12.
   c. Invert the drum and open the drum valve wide, allow approximately 5 pounds of the liquid Freon-12 to flush through the condenser, the receiver and out of the liquid line at the point previously mentioned.
   d. Close the drum valve, disconnect the charging line from the drum.
   e. Disconnect the charging line from the condenser fitting and replace the core in the self-closing valve.
9. Install a new dehydrator-filter in the liquid line.
10. Remove the cone screen from the liquid inlet of the expansion valve and install a new cone screen in the valve.
11. Install the new compressor on the engine.
12. Install the high and low pressure hand shutoff valves on the compressor using new "0" rings and valve flange gaskets.
13. De-energize the solenoid valve and remove the wire.

14. Install the gauge set on the compressor gauge connections and open the hand shutoff valves on the compressor.
15. Evacuate the system and leak-test as described under "Evacuating the Entire System" or "Evacuating Low Pressure of System" as required.
16. Recharge the system with refrigerant as outlined under "Adding Refrigerant—Complete Charge" or "Adding Refrigerant—Partial Charge" as required.

Replacing the Condenser

If the condenser becomes damaged through accident or collision, or develops a leak, it should be replaced.

Since the condenser is on the high side of the system, it will be necessary to discharge any remaining refrigerant.

1. Connect the low and high pressure line of the gauge set to the low and high pressure gauge connection on the compressor.
2. Close the low pressure hand shut-off valves on the compressor and the high pressure hand shut-off valve at the receiver.
3. Energize the solenoid valve by running a jumper wire from the battery.
4. Discharge the condenser through the high pressure side of the gauge set. (The check valve should hold the refrigerant in the receiver and the solenoid valve should keep the refrigerant in the low side.) Be sure the pressure in the condenser is discharged to below 5 pounds gauge pressure. Close the compressor high pressure hand shut-off valve.
5. Disconnect the condenser from the high pressure line flared connection at the condenser header, and from flared connection at the outlet of the condenser.
6. Remove the condenser mounting bolts and remove the condenser.
7. Install and evacuate the new condenser and recharge the refrigerant lost as outlined under "Adding Refrigerant—Partial Charge."
8. Test for leaks.

Replacing the Receiver

If the receiver develops a leak because of a collision or is damaged in any other way, it is best to replace it.

Since it is on the high pressure side of the system, the entire charge of refrigerant must be released to the atmosphere.

1. Install the high and low side gauge set to the connections on compressor.
2. Open the high side valve on the gauge set and discharge vapor through the center connection. When the pressure is reduced to within readable range (under 100 pounds) on the low pressure gauge, then open the low side shutoff valve.
3. Continue discharging until all refrigerant has been released or the pressure does not exceed 5 pounds.
4. Disconnect the high pressure inlet line flare at the receiver.
5. Disconnect the high pressure line from the valve on the receiver.
6. Remove the receiver mounting bolts and remove the receiver.
7. Transfer the fittings from the old receiver to the new receiver.
8. Install the new receiver by reversing the procedure for removing it.
9. Evacuate the system as outlined under "Evacuating the Entire System" and recharge as described under "Adding Refrigerant—Complete Charge."
10. Test all joints which have been disturbed for leaks.

Replacing the Cooling Coil

The cooling coil is located in the evaporator unit in the trunk compartment.

If a leak develops in any of the tubes or solder joints, or if one becomes damaged, it should be replaced.

1. Pump down the system as described under "Pumping Down Low Pressure Side of System."
2. Disconnect and remove the expansion valve. Remove the valve bulb from the low pressure line.
3. Remove the drain elbows.
4. Disconnect all of the air ducts from the grilles.
5. Disconnect the blower motor leads.
6. Disconnect the refrigerant line connections at the evaporator unit housing.
7. Remove the evaporator unit mounting bolts and remove the unit from the luggage compartment.
8. Remove the panels from the unit housing, including the blower assemblies.
9. Remove the cooling coil and install the new one by reversing the procedure for removing it.
10. Evacuate as described under "Evacuating Low Pressure Side of System."

11. Add refrigerant to replace that lost in pumping down the system as outlined under "Adding Refrigerant—Partial Charge."
12. Test for leaks.

Replacing a Blower Motor

If one or both of the fan motors fail to operate and it has been determined that the motor is defective, replacement is necessary.

1. Disconnect the blower motor electrical lead.
2. Remove the evaporator rear cover and disconnect the flexible conduit at the air shutoff valve.
3. Remove the screws which hold the blower assembly to the evaporator housing and lift it partially out of the housing. See figure 24. This will permit access to the rubber air duct retaining plate screws.

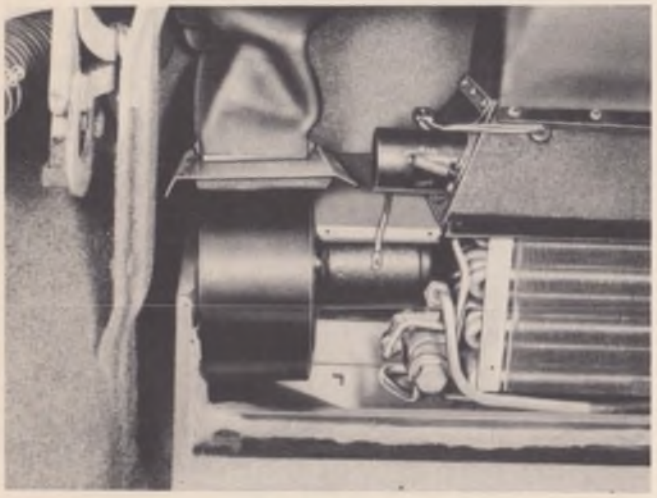


Fig. 24

4. Remove the retaining plate screws and plates, slide the lower end of the duct upward and then remove the blower assembly as shown in figure 25.

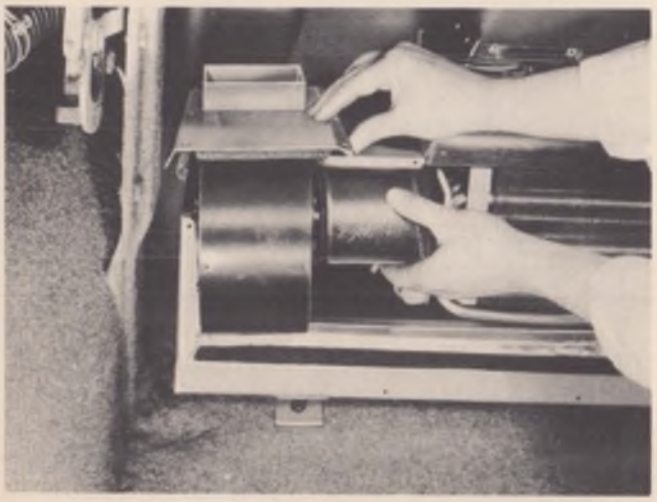


Fig. 25

5. Remove the blower wheel from the motor shaft and install it on the new motor, making certain that the blower wheel is in the corresponding position on the new shaft.
6. Install the new motor and its assembly by reversing the procedure for removing it.

Replacing the Thermostat

The thermostat is supported in clips in the left return air duct. If for any reason it is necessary to replace the thermostat, proceed as follows:

1. Disconnect the wires at the connector above the evaporator and remove the three duct retaining plate screws. See arrows in figure 26.

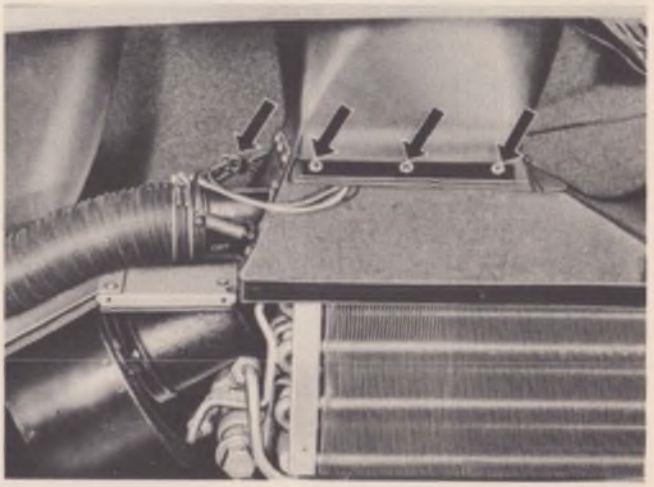


Fig. 26

2. Lift up the lower edge of the duct or boot and slide out the air filter. See figure 27.

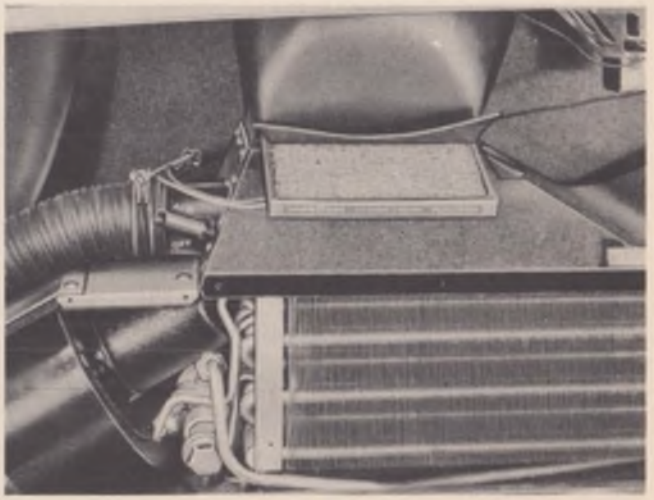


Fig. 27

3. Remove the left return air grille and retainer from the top of the rear compartment package tray.

4. Pull the thermostat out of its retaining clip, disconnect the ground wire working through the opening in the package tray and then remove the thermostat. See figure 28.

Fig. 28

5. To install the thermostat, reverse the procedure used in removal.

Replacing the Relay

The relay is mounted behind the instrument panel on the lower flange above the parking brake handle.

To replace the relay, first detach it from the flange. This will permit lowering the relay enough to transfer the wires over to the new unit. After the wires are connected, the new relay then should be attached to the panel flange.

Collision Procedure

Whenever a car equipped with air conditioning is involved in a collision or wreck, it should be inspected as soon as possible.

Prolonged exposure of any part of the air conditioning system to atmosphere results in the entrance of air, moisture and dirt. This causes internal damage which cannot be seen readily.

The following steps should be taken:

1. Remove the drive belts; cut them off, if necessary.
2. Close both the high and low side hand shutoff valves at the compressor.
3. Inspect the condenser, receiver, compressor, mounting brackets, dehydrator-filter, evaporator unit, all connecting lines, and all controls to determine the extent and nature of the damage.

   a. Because of the construction of the condenser, no repairs should be attempted, such as soldering, welding or brazing. If the vapor passages in the horizontal tubes or return headers or manifolds have been damaged in any way the condenser should be replaced with a new one.

   b. The receiver should be replaced if there is any evidence of its having sustained sufficient damage to fracture any of the welded joints. It should also be replaced if it is damaged so as to disturb the internal liquid tube outlet, which extends nearly to the bottom of the receiver shell.

   c. The compressor should be removed from the mounting bracket and tested by turning it over by hand. Examine the pulley before using to be sure there are no cracks. This can be done quickly by tapping it with a small hammer. It may be possible to re-use the compressor, if it does not show evidence of external damage and is free to be turned over by hand, and provided the following steps are first performed:

      (1) Release any pressure remaining in the compressor.

      (2) Remove the high pressure relief valve.

      (3) Pour out the oil into a clean glass container and examine it for any foreign substance such as dirt, water, metal particles, etc. If any of these are present, the compressor should be replaced.

      (4) If the oil is clean and free of any harmful substances, replace the oil with 16 ounces of 525 viscosity Frigidaire oil.

      (5) Evacuate the compressor by following the Evacuating Procedure. Introduce Freon-12 vapor at cylinder (room) temperature and pressure. Leak test all fittings, connections and give special attention to the shaft seal to make certain it does not leak.

4. The dehydrator-filter should be replaced if any lines were broken or the system was exposed to the atmosphere for an undetermined period of time.
5. The evaporator unit in the trunk compartment should be examined for damage if the wreck involved the rear or either side of the car. It may be necessary to remove and replace or process the entire unit if it has been damaged or exposed to the atmosphere.

6. All connecting lines and flexible joints should be examined throughout their entire length for damage. If they are damaged in any manner, replace them with new lines. Do not attempt any straightening or repairing.

7. Check all controls and connecting wires for damage, replace with new parts where needed.

   The extent of damage to any or all of the components and the length of time the system has been exposed to the atmosphere will determine the replacement of parts and processing that will be required.

The greater length of time that the system has been exposed to atmosphere, the greater will be the chances for air, moisture, and dirt to enter and damage the system.

Every case may be entirely different so it is not possible to establish a hard and fast procedure to follow each time. Good practices and good judgement must be used to determine just what steps should be taken in each specific instance.

New parts should be used wherever needed so as to be assured of the proper operation of the system.

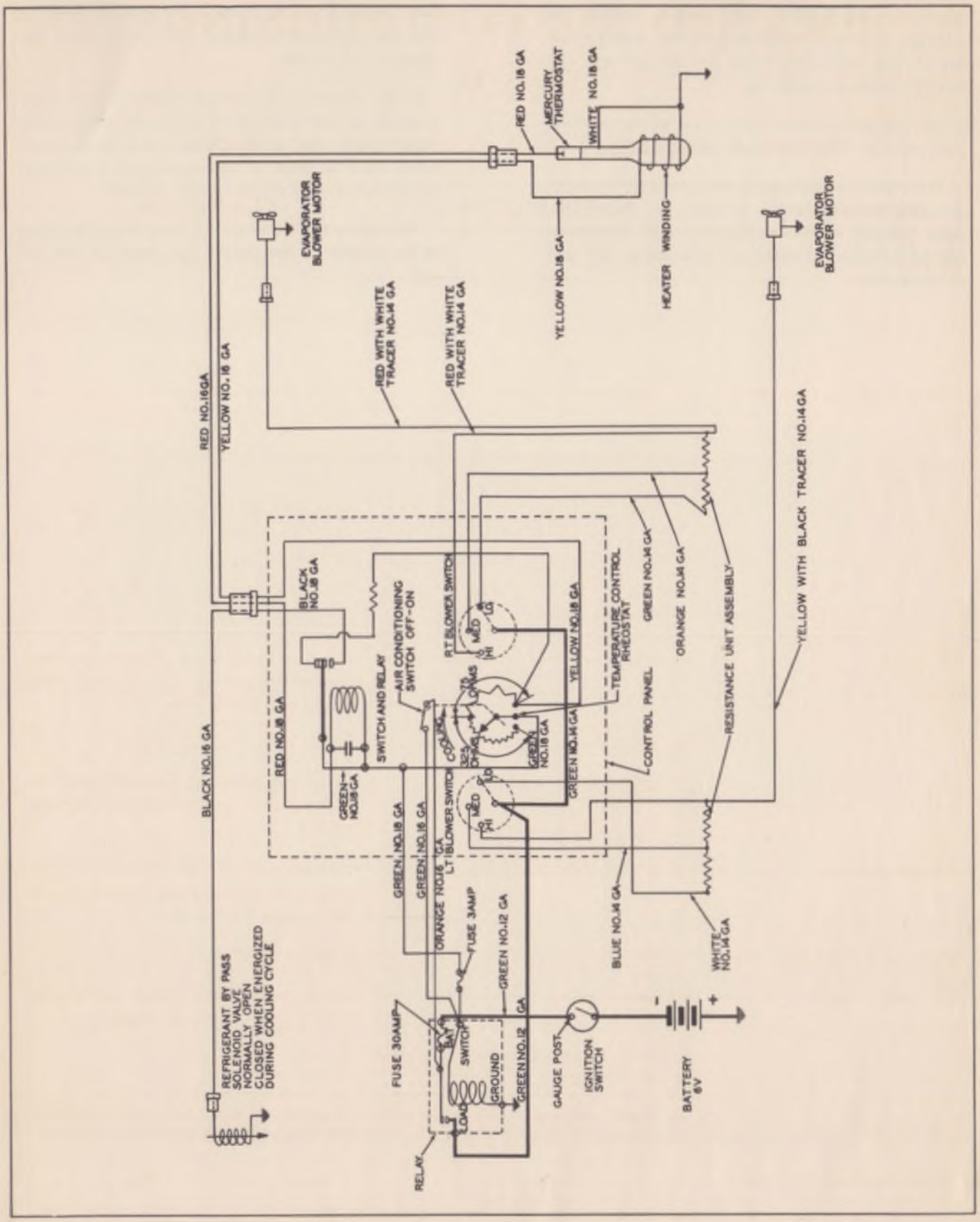


Fig. 29. Air Conditioning Electrical Circuit Diagram

PACKARD AIR CONDITIONING

Part V

TROUBLE SHOOTING AND CORRECTIVE MEASURES

CONDITION	POSSIBLE CAUSE	CORRECTION
1. Drafty.	(a) Air to cold.	Check thermostat for mercury separation.
		Check position of thermostat in return air duct.
2. Not enough cold air out of grilles.	(a) Restricted air flow.	Check for restriction of free air flow through cooling coil in evaporator.
		Check for dirty air filters in return air ducts.
	(b) Low fan speed.	Check voltage at battery and at blower motor. A slight line drop can be expected.
	(c) Blower motor running in wrong rotation.	Replace motor with one of proper rotation.
3. Air noise.	(a) Sharp projecting item in air stream.	Check ducts and air distribution system for sharp projections or rough surfaces and smooth out.
	(b) Small slits or openings in ducts.	Fill or close all holes or slits.
	(c) Obstructions in outlets.	Check for loose air direction vanes in outlet grilles. Remove objects covering outlets.
4. Scraping noise.	(a) Blower fan hitting housing.	Adjust fan to turn free. Check for noisy blower motor bearings. Tighten motor mountings
5. Rattle and vibration noises.	(a) Loose air filters.	Tighten filters.
	(b) Loose tubing.	Check and tighten clamps and inserts. Reform lines to prevent chafing.
	(c) Cooling coil mounting bolts loose in evaporator.	Tighten bolts.
	(d) Blower fans out of balance or loose on shaft.	Tighten if shaft is not worn from loose fan. Replace if damaged.
6. Water leaking into trunk.	(a) Drip pan stopped up.	Clean pan and drain holes.
	(b) Evaporator housing sweating.	Check for proper insulation in housing.
	(c) Deformed drain pan.	Straighten pan.

TROUBLE SHOOTING AND CORRECTIVE MEASURES—Continued

CONDITION	POSSIBLE CAUSE	CORRECTION
7. Hissing noise at expansion valve.	(a) Shortage of refrigerant shown at sight glass.	Locate and repair leak. Add refrigerant.
	(b) Restriction in high pressure line.	Check for dirty filter screen in expansion valve. Check for restriction in dehydrator-filter. Check all lines for kinks or restrictions.
8. Poor cooling, partial frosting and sweating of cooling unit.	(a) Shortage of refrigerant.	Locate and repair leak. Add refrigerant.
	(b) Expansion valve improperly adjusted.	See "Adjusting the Expansion Valve."
	(c) Solenoid by-pass valve sticking partly open.	Turn control switch on and off a few times to free valve. If still stuck, repair or replace valve.
	(d) Restricted or clogged liquid line.	Check expansion valve filter screen and dehydrator-filter for restriction. Check lines for kinks.
9. No cooling.	(a) Solenoid by-pass valve open.	Repair or replace solenoid as required.
	(b) Discharged power element in expansion valve.	Replace valve.
	(c) Stopped up liquid line.	Check for stoppage. Repair or replace line.
	(d) Faulty thermostat.	Repair or replace thermostat.
	(e) No refrigerant in system.	Locate and repair leak. Process system and add refrigerant.
	(f) Blower inoperative.	Check electrical circuit.
	(g) Insufficient air.	Clean air filters.
	(h) Cooling coil clogged with dirt (outside coil surface).	Clean coil.
	(j) Frozen expansion valve due to moisture in the system.	Evacuate and recharge system.
10. Too cool.	(a) Faulty thermostat.	Repair or replace thermostat.
	(b) Solenoid by-pass valve stuck closed.	Turn control switch on and off to free valve. If still stuck, repair or replace as required.
11. High gauge reading at high pressure gauge connection.	(a) Inaccurate gauge.	Check gauge and fittings.
	(b) Air in system.	Purge air from system.

TROUBLE SHOOTING AND CORRECTIVE MEASURES—Continued

CONDITION	POSSIBLE CAUSE	CORRECTION
	(c) Air blocked off through condenser or high engine temperature.	Clean condenser (do not use steam). Correct cause of high engine temperature.
	(d) Overcharge of refrigerant.	Check refrigerant charge and remove excess.
12. Low gauge reading at high pressure gauge connection.	(a) Inaccurate gauge.	Check gauge and fittings.
	(b) Leaking divider blocks in compressor.	Replace compressor.
	(c) Leaking solenoid by-pass valve.	Repair or replace valve.
	(d) Shortage of refrigerant.	Locate and repair leaks. Add refrigerant.
13. High gauge reading at low pressure gauge connection.	(a) Expansion valve overfeeding cooling coil.	Check for proper expansion valve bulb contact on low pressure line. Check expansion valve setting. See "Adjusting the Expansion Valve."
	(b) Compressor divider blocks or reeds sticking open.	Replace compressor.
14. Low gauge reading at low pressure gauge connection.	(a) Restriction in system.	Check lines for kinks. If kinked, replace line. Check for dirty expansion valve screen or restricted dehydrator-filter. Check expansion valve setting. See "Adjusting the Expansion Valve."
	(b) Shortage of refrigerant.	Locate and repair leak. Add refrigerant.

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