

## 8. Air conditioner system schematic diagram (12-10)

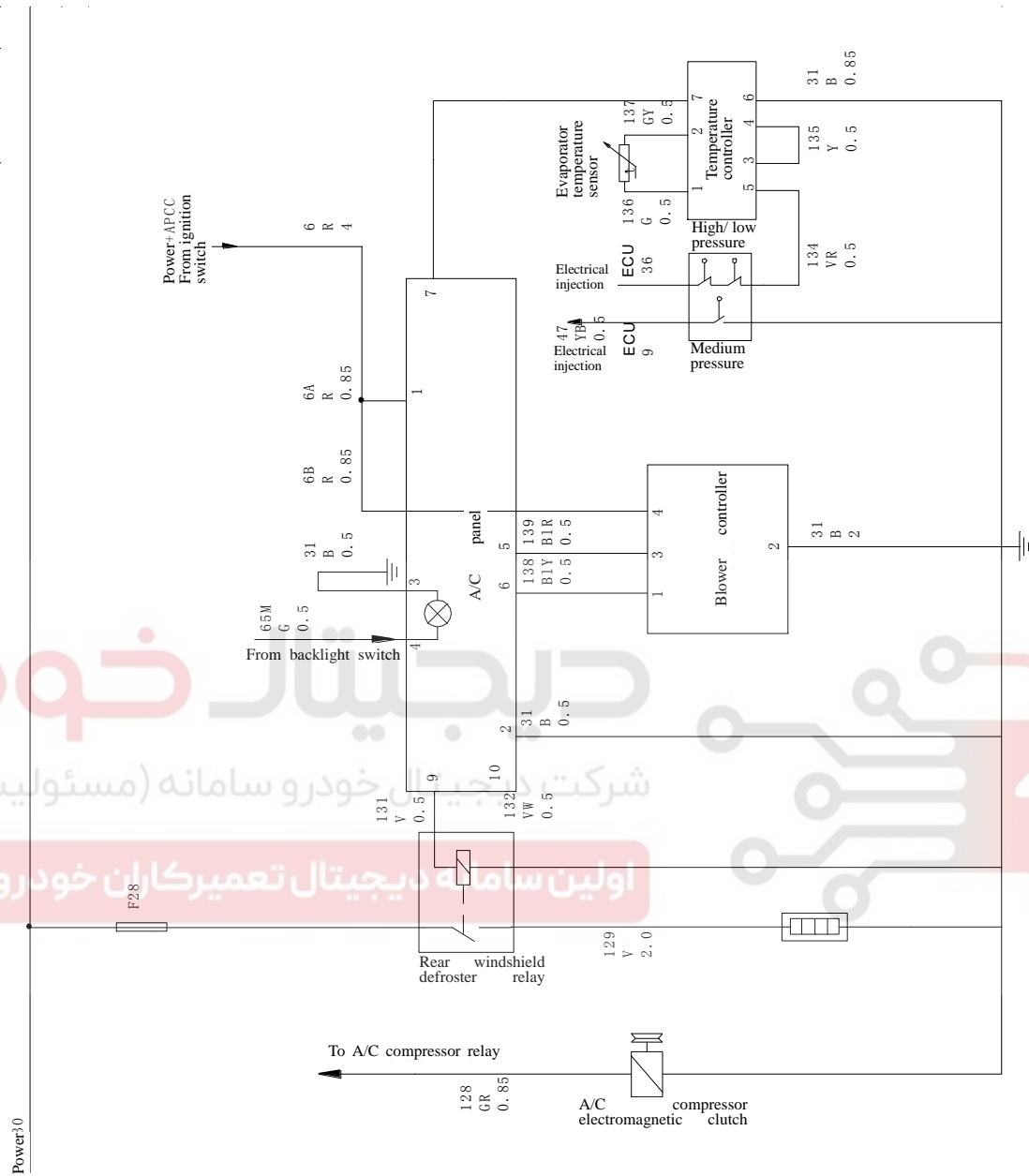


Figure 12-10 Air conditioner system schematic diagram

## Chapter IX Car A/C System

Air conditioner (A/C) is one of modernized marks of car, i.e. A/C refers to air control, and its meaning is control the temperature or humidity in a closed space. The basic function of modern car A/C is to improve the driver's working conditions and passenger's riding comfort under any weather and driving condition. The adjusted object of car A/C is any person in the car, so A/C lays upon the requirements of comfort. The comfort is determined by the feeling and response of passenger to the temperature, humidity, air flow rate, oxygen content, content of harmful gas, noise, pressure, odor, dust and bacterium or other parameter indices. Modern car A/C is used to adjust space environment in the car to the optimum state applicable for human body, create good labor conditions and working environment to increase the labor efficiency of driver and driving safety, and create a good environment in the car to protect the passenger's health, to the benefit of passenger's tourism, learning or rest. Therefore, modern car A/C system must have the functions described in Table 4-4 and devices required to complete these functions. These devices can be independently used or combined with other devices in completing the air control operation.

**Table 9-1 Functions of Car A/C System**

Purpose	Function	Device
Keep the passenger's comfortable environment	Keep appropriate temperature	Heating or cooling device
	Keep appropriate humidity	Dehydrating or humidifying unit
	Keep appropriate air flow	Air feeding device
	Keep clean air	Ventilator or air purifier
Keep eyesight clear	Prevent front or rear side window glass from frosting	Defroster (demister)

Lifan car A/C system is a full air-control system capable of cooling, heating and ventilation. In summer, A/C is used to reduce the temperature in the compartment, and A/C is used to heat and defrost the wind screen in winter.

## Section I Structural Principles of A/C System

### I. Refrigerating system

The refrigerating system of Lifan car mainly consists of compressor, evaporator, condenser, drying chamber, expansion valve, blower and control mechanism, etc, as shown in Fig. 9-1.

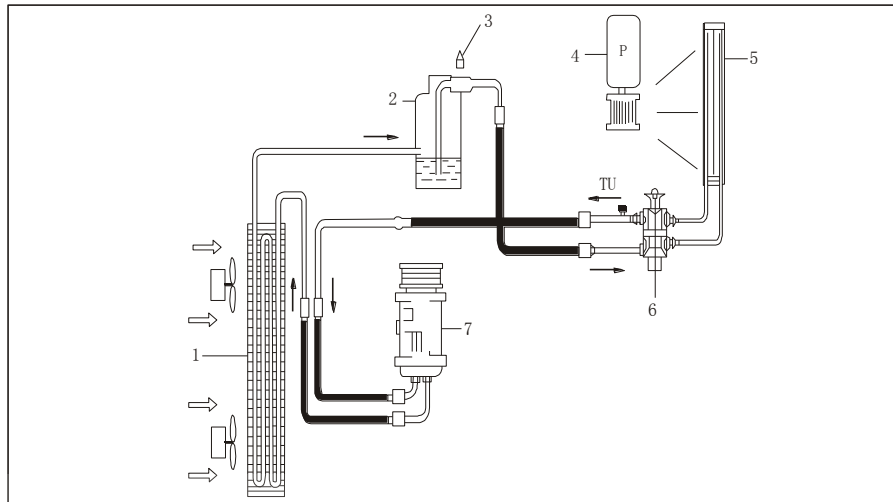


Fig. 9-1 Composition of Lifan Car Refrigerating System

1-Condenser 2-Drying chamber 3-Safety valve 4-Blower 5-Evaporator 6-Expansion valve 7-Compressor

The refrigerating principles of Lifan car refrigerating system are shown in Fig. 9-2. The compressor driven by the engine is used to draw the gaseous refrigerant out of evaporator, and pump it into the condenser. High-pressure gaseous refrigerant is liquefied and exchanges (releases) the heat through a condenser and the heat is taken away by the air outside the car. High-pressure liquid refrigerant reduces its pressure through the throttling action of expansion valve, low-pressure liquid refrigerant is gasified in the evaporator and exchanges the heat (absorbs the heat) with the hot air outside the evaporator, the hot air blown into a blower enters into the compartment after the evaporator cools the air (heat exchange). The gaseous refrigerant is also drawn by a compressor and pumped into the condenser, so as to make the refrigerant circulating in closed space, and drain the heat in compartment outside the car to reduce the air temperature in compartment to the appropriate temperature.

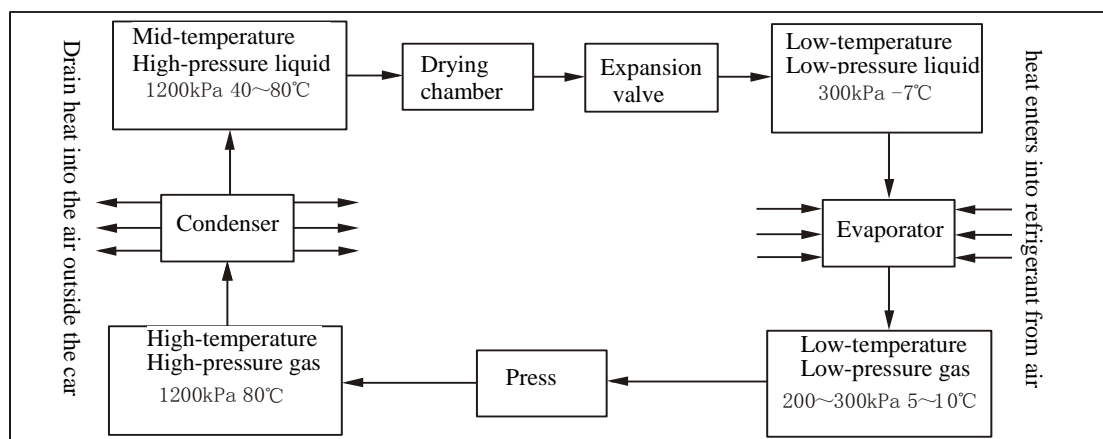


Fig. 9-2 Basic Refrigerating Principles

### 1. Compressor

#### (1) Functions of compressor:

The compressor is a heart part of refrigerating system capable of sucking, compressing the refrigerant and realizing its continual circulation.

1) Sucking function of compressor. The sucking operation of compressor (by combining the throttling action of expansion valve) makes the pressure of refrigerant in an evaporating tube reduced, realizes the conversion of refrigerant from liquid state to gas state, absorbs the heat by heat exchange, and take away the heat in the compartment.

2) Compressing function of compressor. The compressor is used to compress the low-pressure gaseous refrigerant, e.g. high-temp. high-pressure saturated gas, realizing the conversion of refrigerant from liquid state to gas state, and release the heat through a condenser to drain the heat outside the car.

3) Circulating pump function of compressor. The continual suctions and compressions of compressor make the refrigerant circulated, so the compressor is also a power source of circulating the refrigerant.

#### (2) Construction of compressor:

LF520 car A/C adopts a swinging-vane car A/C compressor and a scroll A/C compressor. The construction of scroll A/C compressor is shown in Fig. 9-3.

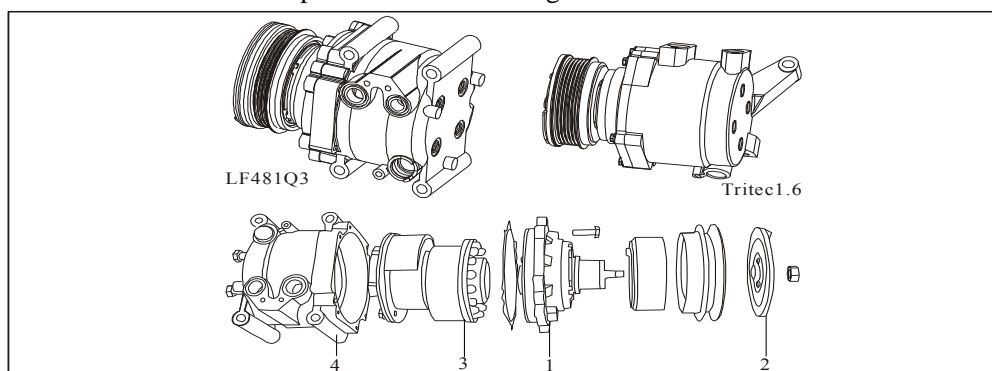


Fig. 9-3 Structure of Compressor

1-magnetic clutch 2-head cover 3-revolving body 4-shell

## 2. Condenser

### (1) Functions of condenser:

The condenser is used to release the heat of high-temp. high-pressure gaseous refrigerant drained by the compressor, and make the refrigerant converted into liquid state.

### (2) Structure of condenser:

The condenser is designed in full aluminum parallel stream structure, which is installed in front of engine radiator, and whose forced cooling is realized based on the radiator fan and adverse wind of car, as shown in Fig. 9-4.

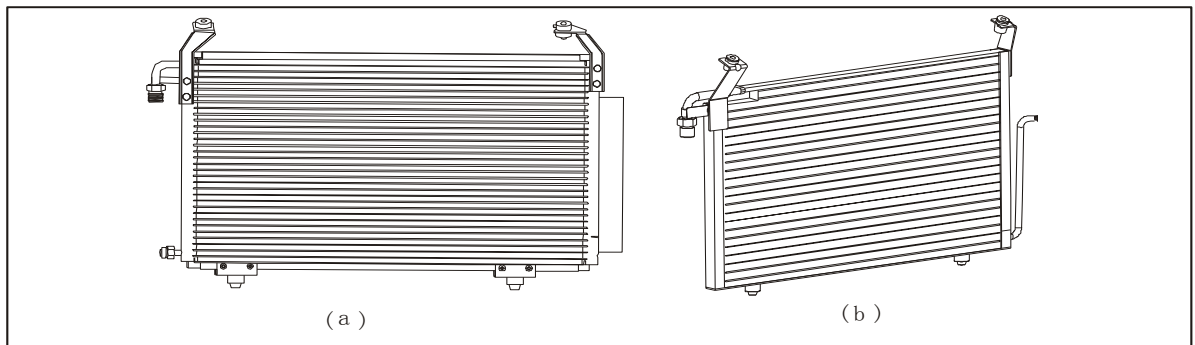


Fig. 9-4 Condenser

### (3) Operating process of condenser:

**The condensation process can be divided into three phases:**

1) Conversion from high-temp. high-pressure refrigerant steam into saturated steam. After the overheated refrigerant steam enters into a condenser tube, its temperature is rapidly reduced to saturation temperature through the heat dissipation of condenser tube.

2) Conversion from saturated refrigerant steam into saturated liquid steam. During this conversion, the temperature of refrigerant doesn't vary at all, but its liquification makes a great amount of heat released. Most of heat produced during the circulation of refrigerant is released in this phase.

3) Conversion from saturated liquid refrigerant into overcooled liquid refrigerant. The temperature of saturated liquid refrigerant is higher than the ambient temperature, so the saturated liquid in condenser tube will be further cooled.

## 3. Evaporator

### (1) Functions of evaporator:

The evaporator is used to make the low-pressure liquid refrigerant and part of refrigerant steam throttled and decompressed by expansion valve as well as the air in compartment reduce their temperatures and eliminate their humidity.

### (2) Construction of evaporator:

The construction of evaporator is similar to that of condenser. The evaporator of Lifan car is installed in the evaporator shell, as shown in Fig. 9-5.

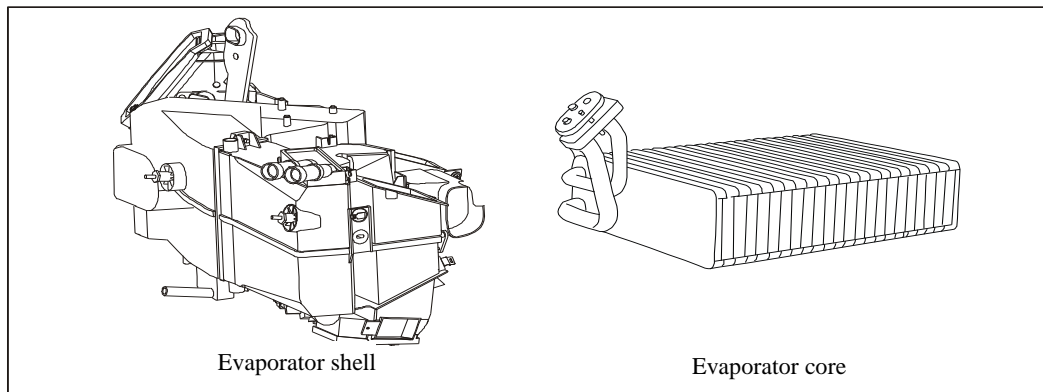


Fig. 9-5 Evaporator

### (3) Operating process of evaporator:

After the throttled refrigerant steam enters into the evaporator, the refrigerant steam absorbs the heat and gets boiled, and becomes saturated steam. The pressure of steam always keeps constant, and its corresponding evaporation temperature also keeps constant in this phase. The blower continually blows lower-temp. air on evaporator surface into the compartment and makes the temperature in compartment reduced.

### 4. Expansion valve

#### (1) Functions of expansion valve:

The throttling action of expansion valve makes the pressure of high-pressure liquid refrigerant reduced. It can adjust the flow of refrigerant automatically according to the temp. changes of refrigerant flowing to the compressor, and ensure that the refrigerant of compressor is gaseous.

#### (2) Structure of expansion valve: structure of expansion valve is shown in Fig. 9-6.

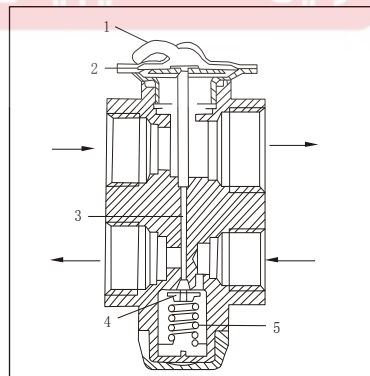


Fig. 9-6 Structure of Expansion Valve

1-Temperature sensitive element   2-Diaphragm   3-Ejector pin   4-Ball valve seat   5-Spring

### (3) Operating principles of expansion valve:

The expansion valve has two refrigerant channels, i.e. run-in channel and run-out channel. The ball valve under the run-in channel is used to control the flow of refrigerant, the spring force of ball valve makes the ball valve closed and refrigerant blocked, the ejector pin is driven by the diaphragm to move down to open the ball valve, and open the refrigerant channel.

When the temperature of evaporator outlet increases, the temperature sensitive element above the diaphragm expands to make the diaphragm bend down, and push the ejector pin move down to expand the opening of ball valve, thus the flow of refrigerant is also increased. As more refrigerant flows through the evaporator, its temperature is lower upon leaving from evaporator, the temperature sensitive element retracts, the pressure under the diaphragm is reduced, the opening of ball valve becomes smaller due to spring force, and the flow of refrigerant is also reduced.

#### 5. Drying chamber

Function of drying chamber: capable of absorbing the moisture, filtrating the impurities and storing the refrigerant for normal operation of compensating system. The structure of drying chamber is shown in Fig. 9-7.

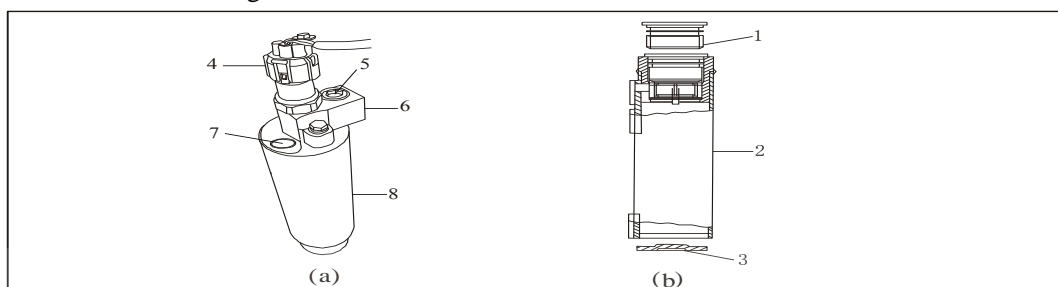


Fig. 9-7 Structure of Drying Chamber

a-Common type b-Overcooled type

1-Upper cover 2-Chamber body 3-Lower cover 4-Pressure switch 5-Inspection hole  
6-Connected to evaporator 7-Connected to condenser

The drying chamber and condenser are incorporated and non-removable.

#### 6. Muffler (common type)

When the refrigerant flows in the refrigerating system pipe, it can produce the noise due to pressure difference, temperature difference or bubble, etc. In order to remove the noise, the refrigerating system of Lifan 520 car is equipped with a muffler, as shown in Fig. 9-8.

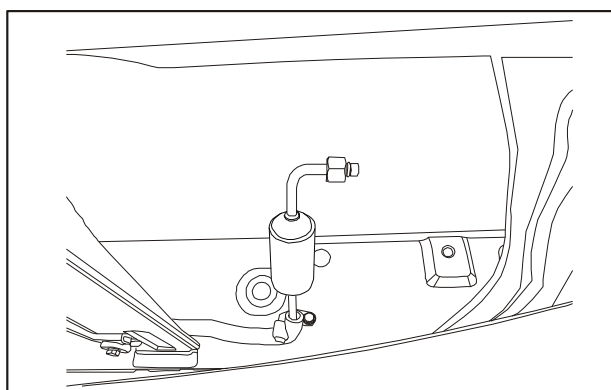


Fig. 9-8 Muffler

## II. Heating system

The heating system of Lifan two-compartment car is a water-heating system, which mainly consists of blower, wind guiding pipe, heat radiator, lower air duct and control mechanism, etc.



The shells of heater and evaporator are connected to each other and combined into one body, the blower and air duct, etc are shared with the refrigerating system, whose composition is shown in Fig. 9-9.

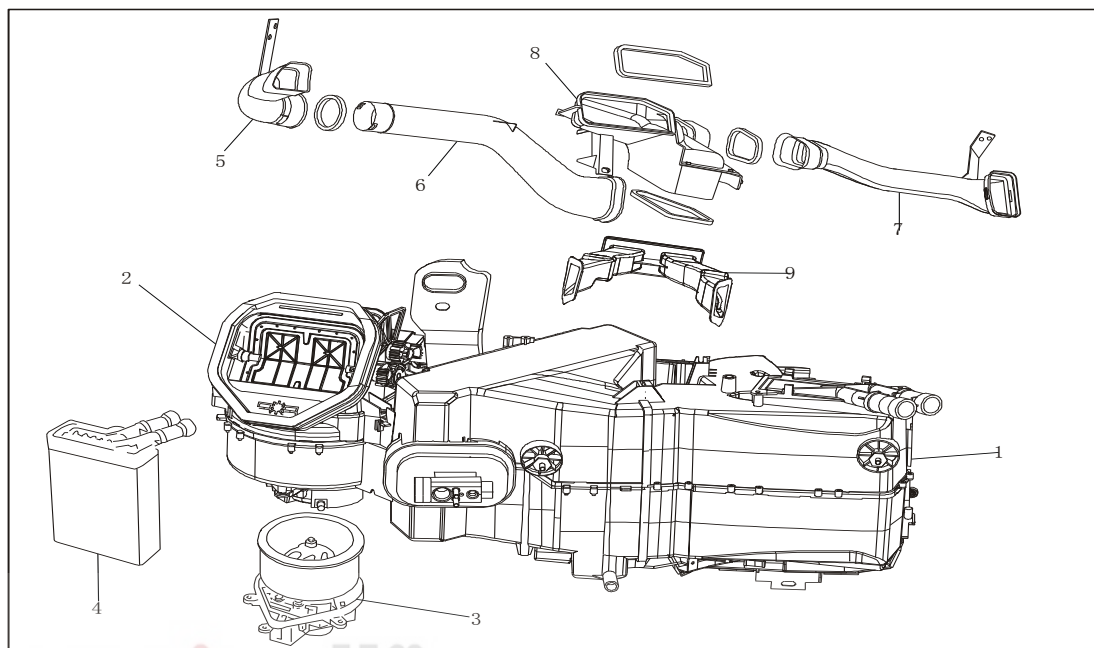


Fig. 9-9 Heating System

1-evaporator shell 2-Heater shell 3-blower 4-heat exchanger 5-left air duct 1

6-Left air duct 2 7-Right air duct 8-transition air duct 9-lower air duct assembly

The heater deflects the cooling water of engine into its inner heat radiator, and sends the heat released by the cooling water into the compartment or windscreen glass through a heater, so as to increase the temperature of compartment and defrosting capability.

The heat exchanger of heater is installed in heater shell, its inlet tube receives hot cooling water from the engine, and its water outlet is connected to the water pump of engine. Hot cooling water circulates in the heat exchanger, the heat released by it is delivered into the compartment or windscreen glass through a blower and wind guiding pipe. The flow of water through heat exchanger is controlled by the thermostat at the water outlet of engine, and the temperature of air delivery temperature is controlled by a fan speed control switch and output temperature control switch.

Four valves are installed in a wind guiding pipe of heater set:

(1)An external circuit recirculation valve. It's used to control the fresh air and circulating air, and it's also capable of adjusting the temperature.

(2)A temperature control valve.

(3)Two compartment air distributing valves.

Four valves of wind guiding pipe are controlled by A/C control panel.



## Section II A/C Control System

### I. Basic composition of A/C control system

A/C control system includes power control circuit, compressor clutch control circuit and safety protection control circuit, A/C control system circuit layout and its circuit principles.

#### 1. Thermostat (temperature switch)

Thermostat is a temperature-control switching element of car A/C system, which is capable of sensing the temperature of evaporator surface, that of cooling water or air temperature, etc.

Water temperature switch is installed on a water tank of engine to sense the water temperature of engine, and prevent the water temperature of engine from overheating. When the water temperature exceeds a specified value, the switch is open to stop A/C compressor. When the water temperature is reduced below a certain value, the switch is automatically connected again, and A/C compressor works again.

#### 2. Pressure switch

A/C system of Lifan double-compartment car is equipped with a three-state pressure switch, i.e. high pressure protection, low pressure protection and intermediate pressure protection.

#### 3. Magnetic clutch

A/C system compressor influences main shaft of engine through a magnetic clutch, and the compressor is stopped or started by the magnetic clutch, so the magnetic clutch is an actuating mechanism of A/C automatic control system, which is controlled by temperature switch, pressure switch, speed relay, power switch, etc.

#### 4. Control device of A/C motor (blower)

A/C motor is controlled by two parts. First, it's controlled by A/C motor relay through an A/C switch to ensure the synchronization with the operation of system while starting A/C system, or start A/C motor first, and then activate A/C switch. Second, it's directly controlled by A/C motor switch, which can make the motor run at different speeds, while independently heating in case of not using any cooling air.

#### 5. Control device

A/C control device receives temperature, pressure, car speed or other signals, so as to control the compressor, cooling fan, blower and idling speed or rotating speed, etc.

#### 6. Idling acceleration solenoid valve

In case of activating the air conditioner of car at idling speed, the engine is stopped due to low speed of engine, little output power and incapability of activating A/C system. Moreover, when the engine runs at idling speed, the demands for electricity of A/C motor and compressor magnetic clutch can't be met due to little generating capacity, and the electric energy of battery will be consumed, which makes it difficult to start the engine. Therefore, an idling acceleration solenoid valve is installed in the position of T/P Throttle Body, which slightly opens the throttle to increase the speed of engine while A/C compressor works.

#### 7. Condenser fan relay

This relay is used to make the condenser fan automatically work while ensuring the connection of A/C switch, otherwise it will lead to overhigh condensing temperature and pressure of A/C system, resulting in the faults of refrigerating system. The fan relay is doubly controlled by cooling water temperature switch and A/C switch. So long as one of these switches is connected, the fan will rotate.

## II. Control of A/C

### 1. Temperature control

The temperature control consists of evaporator temperature sensor, A/C control box, magnetic clutch and relevant circuit. The evaporator temperature sensor is a negative-temperature thermostat. When the temperature of evaporator varies, the resistance of sensor is also varied, which makes A/C thermostat receive a voltage signal corresponding to the temperature. This signal is used to control the operation of magnetic clutch relay after being amplified by the amplifying circuit of thermostat.

In case of connecting the magnetic clutch relay, the compressor magnetic clutch is closed, the compressor works, and its temperature is reduced; when the circuit of magnetic clutch is open, the compressor magnetic clutch is loosened, the compressor stops, and its temperature is increased.

### 2. Pressure control

Pressure control is mainly used to protect the normal operation of system and installed on high-pressure circuit side of system, and it has the following control functions:

- (1) Low-pressure protection When  $P < 0.25$  MPa, the compressor is disengaged.
- (2) Overpressure protection When  $P > 2.45$  MPa, the compressor is disengaged.
- (3) Normal pressure When  $P$  is at least 0.25 MPa and no more than 2.45 MPa, control the idling speed of A/C.
- (4) High-pressure control When  $P > 1.7$  MPa, control the high-speed rotation of fan.

### 3. Control of engine cooling system (motor fan)

The control of engine cooling system consists of water-temperature sensor, water-temperature control box, high-/low-speed fan control relay, motor fan switching relay and relevant circuits. It has the following control functions:

- (1) When water temperature is  $92^{\circ}\text{C}$  to  $97^{\circ}\text{C}$ , the low-speed motor fan relay is switched on, and the low-speed motor fan rotates.
- (2) When water temperature reaches  $101^{\circ}\text{C}$ , the high-speed motor fan relay is switched on, and the high-speed motor fan rotates.
- (3) When water temperature reaches  $112^{\circ}\text{C}$ , disconnect the circuit of A/C compressor.
- (4) When water temperature reaches  $120^{\circ}\text{C}$ , the water temperature warning lamp will go on.
- (5) When A/C switch is closed, the motor fan rotates at low speed.
- (6) When the engine stops, if water temperature exceeds  $112^{\circ}\text{C}$ , the motor fan will rotate at low speed and start a 6 min-delay cooling.
- (7) When the pressure of refrigerating system is more than 1.7 MPa, the motor fan will rotate at high speed.
- (8) If the signal of water temperature is abnormal (damaged water temperature sensor), the temperature control box will think that the engine stays at heavy-load running state, and the motor fan rotates at high speed.

### Section III Diagnosis of R134a A/C System Faults

In case of R134a A/C system, check the faults of system with a multimeter after preheating the engine under the following special conditions: the temperature at air outlet is 30°C to 35°C, engine speed is 1550r/min, fan speed is set in "High Range", temperature control is set in "Coldest", and the exchange of repeated cycle/fresh air is set in "Repeated Cycle".

Under the above special conditions, read out the pressure value shown on the multimeter. In case of normal system, the pressure of low-pressure end is 0.15 MPa to 0.25 MPa, and that of high-pressure end is 1.37 MPa to 1.57 MPa.

If any moisture exists in the refrigerating system, the pressure of refrigerating system low-pressure end is sometimes vacuum or normal, while that of high-pressure end is sometimes high or normal, it appears intermittent refrigerated but fails to refrigerate at last. Its circulation will be temporarily ceased due to icing of moisture at expansion valve, and return to normal state after the ice is melted. The methods of fault remedy: usually eliminate the moisture by replacing the dryer or extracting the air in the system, and then refill in a proper amount of new refrigerant.

If any poor refrigerating capacity occurs to the system, observe the pressure shown on the multimeter, and the pressure of high- or low-pressure end is lower (low pressure is 0.5 MPa through 0.1 MPa, and high pressure is 0.7 MPa to 1.0 MPa); when viewing the pressure shown in the sight glass, the continual air bubbles can be seen in the flow of refrigerant. This fault is usually caused by gas leakage or insufficient refrigerant of system. In order to remedy this fault, usually check the gas for leakage with a leak detector. In case of any leakage, remove it; in case of insufficient refrigerant, add in a proper amount of refrigerant. When connected to a measuring meter, if the pressure is approximate to zero, put the system at vacuum state after checking and repairing it.

In case of poor circulation of refrigerant, its refrigerating effect will be bad, and measure the high pressure with a multimeter. The pressures of low-pressure end are all lower (pressure of low-pressure end is zero or vacuum, the pressure of high-pressure end is 0.5 MPa to 0.6 MPa), and each pipe at the connection is frosted, which is mostly caused by the dirt in the receiver (the normal flow of refrigerant is blocked). Remove it by replacing the receiver.

If the refrigerant of system can't circulate or refrigerate, and measure the pressure of low pressure end is zero or vacuum, and that of high-pressure end is 0.5 MPa to 0.6 MPa or very low, the pipes before and behind expansion valve or receiver/dryer are frosted, which is usually caused by the moisture or dirt in refrigerant to block its normal flow, or the gas leakage of expansion valve heat-sensitive tube blocks the flow of refrigerant. In case of removing this fault, check the heat-sensitive tube and pressure regulator of evaporator, or blow off all the dirt of expansion valve; if invalid, replace the expansion valve and receiver, then remove the air and fill in a proper amount of refrigerant. If the gas leaks at the heat-sensitive tube, be sure to replace the expansion valve.

If the capability of refrigerating system is insufficient, when the pressure of high or low-pressure end is measured to be too high with a multimeter, and the engine speed is reduced to idling speed, no air bubbles can be seen in a sight glass, which is caused by excessive refrigerant in the system or insufficient cooling capability of condenser. In case of removing this fault, clean the condenser firstly and check the operation of fan motor, and check the amount of refrigerant. If the refrigerating effect of system is not good, when the pressure of high or low-pressure end is

measured to be too high with a multimeter, feel hot in touching the low-pressure pipe, and observe that obvious air bubbles exist in the sight glass during the flow of refrigerant, which indicates that the air has entered into the refrigerating system. In case of removing this fault, check whether the compressor oil is clean or insufficient firstly; if it's determined that the air has entered into the system, draw off the air and fill in new refrigerant.

If the system is poor in refrigerating capability, when the pressure of high or low-pressure end is measured to be too high (low pressure: 0.3 MPa to 0.4 MPa, high pressure: 1.95 MPa to 2.45 MPa) with a multimeter, and the pipe joints at low-pressure end are seriously frosted or dewed, this is mostly caused by the faults of expansion valve or improper installation of heat-sensitive pipe.

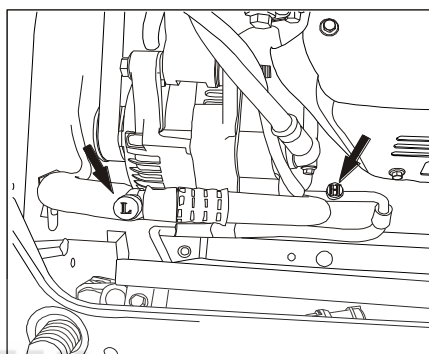


Fig. 9-10 High or Low-pressure Joint of A/C Pipe

L-Low-pressure joint H-High-pressure joint

In case of removing this fault, check the installation of heat-sensitive pipe; if this pipe is normal, check the expansion valve again; if this valve is damaged, replace it.

If the refrigerating system fails to refrigerate, measure the pressure of low-pressure end is too high (0.4 MPa to 0.6 MPa) and that of high-pressure end is too low (0.7 MPa to 1 MPa) with a multimeter, which indicates the leaks occur inside the compressor of system. It's required to repair or replace the compressor.

## Section IV Overhaul and Remedy of Faults of A/C System

### I. Operation and maintenance of A/C system

#### 1. Attentions for operation of A/C system

The refrigerating system of Lifan car is basically the same as that of any common car, and no specialties exist in its operating methods, and pay attention to the following keypoints for its operation:

(1) In case of adopting cold wind, when the internal car temperature is higher, open the car window, and then close the window after draining hot air in the car;

(2) In case of adopting cold wind, ensure the car doors or windows are closed to reach the desired temperature and reduce the consumption of energy as soon as possible;

(3) In case of using cold wind for a long time, in order to avoid the pollution of air in the car, open the windows for a short time or renew the air at vent opening;

(4) In case of using cold wind in driving, select at least the intermediate engine speed, beneficial to cooling or heat radiation;

(5) During the operation of refrigerating system, overload of engine and high temperature of cooling system are normal;

(6) During the long-term misuse of refrigerating system, keep on to start it once every week, and do so in winter to ensure normal lubrication of compressor and sealing components, and make the refrigerating system always at the optimum state;

(7) Regularly check the generator and ensure its good operation to avoid any premature damage caused by over discharge of battery.

#### 2. Maintenance of A/C system

##### (1) Daily maintenance:

In order to ensure the normal operation of refrigerating system and reduce the number of its faults, do well in the following daily maintenance work:

1) Check the conditions and tightness of compressor belt. The wear, partial fracture or insufficient tightness of compressor belt will not only influence the normal operation of compressor but also lead to the failure or insufficient refrigeration of refrigerating system. Upon finding the belt too loose or damaged, tighten or replace it in time.

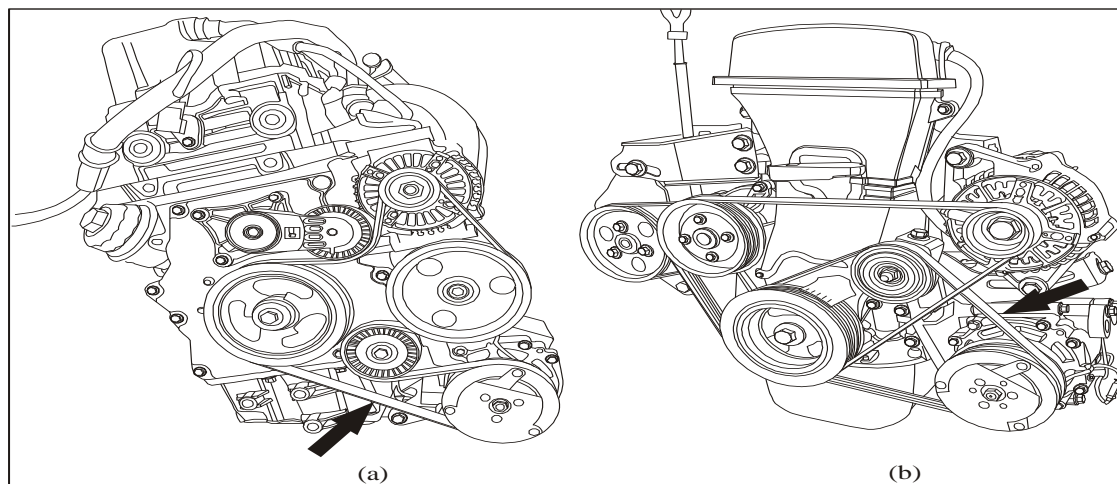


Fig. 9-11 Check of Compressor Belt Tightness

a-Tritec 1.6L b-LF479/481



2) Check the connection and contact conditions of harnesses and connectors. If the harnesses and connectors are short, open or poorly contacted, the normal operation of system is not only influenced, and even the system can't run. Upon finding any fault, repair or replace it in time.

3) Check each pipe and connection for leakage. The regeneration failure or insufficient regeneration of system is internally caused by leakage of any pipe or connection and insufficiency of refrigerant. In case of finding out any leakage, handle it in time to avoid any adverse influence on the normal operation of system.

4) Observe whether abnormal noises are produced during the operation of system. Any abnormal running noise is mostly produced from the compressor or clutch, the refrigerating effect will be adversely influenced, and even the system will be stopped. In case of hearing any abnormal noise, check its cause, and handle it in time.

(2) Maintenance before the usage season:

1) Observe whether there is dust or dirt on the surface of condenser or evaporator. If more dust or dirt is left, flush it in tap water after cleaning it, and then blow it dry with compressed air.

2) Check whether the operation of switch or electronic control system is normal. If any fault, repair or replace it.

3) Check the connections and fasteners for damages or loosening. If poor, replace or tighten them.

4) Start to run, and check the amount of refrigerant by adopting the following methods:

a. Observe the conditions in the inspection window. In case of continual flow, elimination or similar mist flow of air bubbles, it indicates serious insufficiency of refrigerant; if air bubbles appear interruptedly within 1s-2s, it indicates the insufficiency of refrigerant; when the engine speed quickly varies, and air bubbles appear sometimes, it indicates the proper amount of refrigerant; if no air bubbles are always seen, it indicates the overcharge of refrigerant.

b. Check the temperature of high- or low-pressure pipe side. The temperature difference of both sides of high- or low-pressure pipe, it indicates serious insufficiency of refrigerant; if the high-pressure side is warm and low-pressure side is colder, it indicates that the refrigerating capability is insufficient; if the high-pressure side is hot and low-pressure side is cold, it indicates that the amount of refrigerant is appropriate; abnormal heat of high-pressure side indicates the overcharge of refrigerant.

c. Check the pressure of high- or low-pressure side. If the pressure of high-pressure side is abnormally low, it indicates the serious insufficiency of refrigerant; if the pressure of high- or low-pressure side is a little lower, it indicates the insufficiency of refrigerant; if the pressure of high- or low-pressure side is normal, it indicates the appropriate amount of refrigerant; if the pressure of high- or low-pressure side is overhigh, it indicates the overcharge of refrigerant.

(3) Maintenance after the usage season:

1) Check the leakage with a leak detector. If any leakage, find out the cause, repair it, and then refill the refrigerant.

2) Check the compressor belt and belt pulley bearing. In case of any damage or abnormal noise, replace them.

3) In order to prevent the belt from aging, loosen the belt properly, but don't remove it to avoid any deformation.

## II. Check of A/C system

## (I) Visual inspection

A/C system fails to work or can't work normally, etc, it's more effective to determine the faults with eyes, hands or ears. It's very helpful to remove the faults correctly and rapidly by understanding the visual inspection method, because this method is easy and time-saving.

1. Observe and check the faults with eyes.

(1) Observe the appearances of refrigerating system parts:

**Observe the pipes for eyes, and check the surfaces of condenser and evaporator for cracks or oil dirt. If oil dirt exists in a certain position of condensers, evaporators or their pipes, the refrigerant may be leaked in this position. Confirm its leakage or not by adopting the soap bubble method, the key parts checked for leakage include:**

- 1) Each pipe joint and valve connection.
- 2) Hose and hose joint.
- 3) Rear cover plate of compressor shaft seal, sealing gasket or oil filler plug, etc.
- 4) Scratches and deformations in the surface of condenser or evaporator, etc.
- 5) Check the electric circuit. Check the relevant circuit for disconnection carefully.

2. Check the faults by feeling.

(1) Touch the pipe and parts at high-pressure end of A/C system by hands. From compressor outlet, condenser, drying chamber to expansion valve inlet, feel from warm to hot by hands. If the middle position is felt to be very hot, it indicates poor radiation; if these parts get cool, it indicates that A/C system may be blocked or refrigerant-free, the compressor fails to work or is poor in operation, etc.

(2) Touch the pipe and parts at low-pressure end of A/C system by hands. From drying chamber outlet, evaporator to compressor inlet, feel from cool to cold by hands. If not cool or a certain part is frosted, it indicates that the refrigerating system is abnormal.

(3) Touch both ends of compressor inlet by hands. Obvious temperature difference exists between the high- or low-pressure ends of compressor. If this difference is not obvious or doesn't exist, it may be caused by none or insufficiency of refrigerant.

(4) Check whether the connection of lead connectors is good. Each connector of A/C system circuit shall not be loose or heated. If the connector is loose or its surface feels hotter (heated) by hands, it indicates that internal poor contact of connector leads to the failure or abnormal operation of A/C system.

3. Check the faults with ears.

Listen to the compressor carefully for abnormal noise and whether the compressor works to judge whether the refrigerating failure of poor refrigeration of A/C system is caused by the fault of compressor or its control circuit.

## (II) Temperature check of refrigerating system

The temperature check is used to judge the operation of A/C system is normal by adopting the following methods:

1. Conditions of temperature measurement

(1) After heating the engine, increase its speed up to 3000r/min, and close the engine hood tightly.

(2) Turn on A/C control switch.

(3) Open the blower to its maximum ventilation quantity, and open all the vent openings.

2. Check conditions



After the refrigerating system works for 3min, determine the temperature ( $T_a$ ) of central vent opening and external temperature ( $T_b$ ) with a thermometer, and then judge whether these temperatures are normal. If the checked intersection point of  $T_a$  and  $T_b$  is not within the normal area shown in Fig. 4-24, it indicates that the temperature of refrigerating system is not normal, as shown in Fig. 9-12.

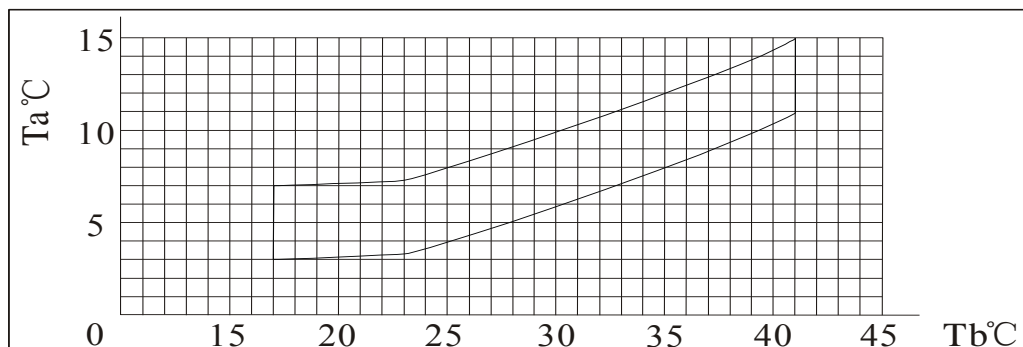


Fig. 9-12 Check of Vent Opening Temperature and External Temperature

### (III) Check of refrigerating system pressure

Check the pressure of high- or low-pressure side of refrigerating system to judge the faults of refrigerating system.

#### 1. Check conditions

- (1) The speed of engine is 1500 r/min.
- (2) The speed of blower stays at high-speed state.
- (3) The temperature control switch is set in the coldest position.

#### 2. Analysis of check results and methods of fault remedy

Normal pressure: low-pressure side: 0.15 MPa to 0.20 MPa, high-pressure side: 1.3 MPa to 1.5 MPa. Possible causes and remedy methods for abnormal pressure of refrigerating system high- or low-pressure side are shown in Table (4-6).

### (IV) Check of compressor

Check whether the compressor driving belt is correctly installed in the belt trough, tension the detector with a driving belt to check the tension of driving belt, which should be 250N.

### (V) Check of refrigerant leakage

The first check of refrigerant leakage is visual check. Check it with a detector if necessary.

#### 1. Check of refrigerant leakage

- (1) Check the compressor firstly. Check the engaging parts of compressor body and magnetic clutch by touching or wiping with white-line gloves to determine its leakage.
- (2) Check the clutch and O-ring for disengagement or leaks.
- (3) Check the compressor cylinder cover for leaks and compressor cylinder body for damages.

Table 9-2 Possible Causes and Check of Abnormal Pressure of Refrigerating System

Measured Pressure	Operation of system	Possible cause	Remedy of fault
Pressure of low-pressure side is normal or vacuum sometimes during the operation.	Intermittent refrigeration	Moisture in refrigerant	Remove the moisture through repeated drawing of air, and then refill the refrigerant.
Too low pressure of high- or low-pressure side	Air bubbles on sight glass	Insufficient refrigerant	Check the leakage, and refill the refrigerant.
	Frosting of section from drying chamber to unit pipe	Flow of refrigerant is not smooth due to the dirt in drying chamber.	Replace the drying chamber.
Too high pressure of high- or low-pressure side	Insufficient refrigeration	Insufficient cooling of condenser	Clean the condenser, and check the operation of fan motor.
		Too much refrigerant is filled.	Check the total amount of refrigerant, and drain the redundant refrigerant.
		Air exists in the system.	Check the compressor oil for dirt or insufficiency, drain the air in the system, and refill the refrigerant.
	Frost or a lot of dew on the pipes on low-pressure side	Improper installation of expansion valve	Check the expansion valve. If poor, replace the expansion valve.
Pressure of low-pressure side indicates vacuum, and that of high-pressure side is very low.	Failure of refrigeration or intermittent refrigeration, frost or dew on the pipes before and behind the fluid reservoir or expansion valve.	Circulation of refrigerant is stopped.	Remove the expansion valve, clear off the dirt from the expansion valve with compressed air. If impossible, renew the valve. After draining the air, refill the refrigerant.
Indicated pressure of low-pressure side is too high, while that of high-pressure side is too low.	Failure of refrigeration	Insufficient compression or excessive refrigerating fluid.	Repair or replace the compressor.
Too high pressure of high-pressure side, or too low pressure of low-pressure side	Insufficient refrigeration	Too much refrigerating fluid.	Drain the refrigerant until air bubbles appear, and then refill the refrigerant until air bubbles disappear.
		Bad cooling effect of engine or dirt of condenser radiator	Check the operation of motor fan, and clean the condenser radiating fin.
Overhigh pressure of high-pressure side, or overlow pressure of low-pressure side.	Frost on output pipe of drying chamber or condenser	Blockage of pipe	Remove the blockage of pipe.
Normal pressure of high-pressure side, but overhigh pressure of low-pressure side.	Intermittent refrigeration	Damages of evaporator sensor or A/C controller	Check and replace the damaged parts.

(4) Check the filling plug on compressor cylinder and O seal ring of repair hole for leaks.

(5) Check each pipe joint for leaks.

2. Check the leaks of refrigerant with a leak detector.

(1) In case of checking the leakage with an electric leak detector, the detector probe shall be as near to the suspected leak-detecting point as possible, which should be within 3 mm. The speed of probe movement shall be slow and below 30 mm/s. Ensure the operating reliability of leak detector during the use, correct power voltage and clean probe, otherwise all of them may be invalid.

(2) In case of checking the leakage with a flame leak detector, especially ensure that the leakage should be checked in a well-ventilated environment because the combustion of substances can produce toxic gases.

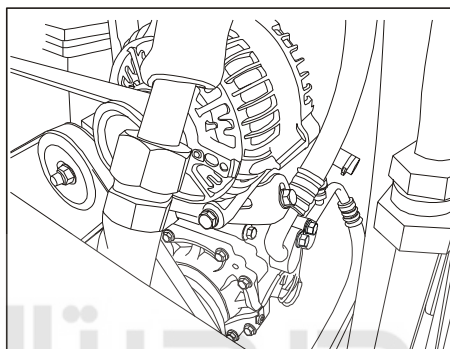


Fig. 9-13 Connector of A/C Compressor

### III. Repair methods of A/C system parts

#### 1. Condenser and evaporator

If the condenser or evaporator is bent or broken, flatten it with a thick wood board or weld the broken part. If the radiating pipe is broken, remove some of radiating fins for the conveniences of welding, which has a slight influence on the refrigerating effect. As the condenser is mostly made of aluminum alloy, it's difficult to weld, and slight leaks can't be avoided after welding, therefore, grind the welds clean, stop up the leaks with a bonding agent, so the condenser can be installed and used after 24 hours.

#### 2. Pipe and joint

(1) The breakage of metal pipe leads to the leaks, but it can be welded and repaired.

(2) When the rubber tube is damaged, if the damaged area is not large and the length of rubber tube is allowed, cut off the damaged part. Insert a connector into the rubber tube of two ends (paint the bonding agent) and fasten it; in case of larger damaged area, no allowance is provided for the length of rubber tube, cut it, and connect another rubber tube with the same specifications as per the above methods; if the mode of connecting the rubber tube and metal joint is an extrusion mode, and the connection is also damaged, saw off the metal outer circle, cut off the damaged rubber tube, remove the rubber tube on central circle of metal joint, apply a little of bonding agent to central circle, then insert it into a rubber tube, and fasten it with a lead wire.

#### 3. Compressor

Most moving parts of A/C system are on the compressor, so the compressor is required to repair. During the repair of compressor, pay attention to the following matters:

(1) In case of replacing the compressor, flush the whole system with refrigerant;

(2) In case of repairing and removing the system, clean the filter screen on the compressor or inlet joint with a solvent;

(3) All the sealing elements like O ring, cylinder gasket and valve plate, etc shall be lubricated with a refrigerant oil before assembling, but any cylinder gasket shall not be soaked in the oil;

(4) After installing the compressor, turn the driving disc several cycles by hands, remove the refrigerant oil accumulated on the cylinder cover, and avoid any fault between the spring plates after starting the compressor.

#### IV. Check and remedy of compressor's common faults

##### 1. Failure of refrigeration

Symptom: in case of starting the air conditioner under the engine's idling conditions, the refrigerating system fails to work and has no refrigerating function.

Cause:

(1) The engine stops in case of running A/C, and the engine has no idling speed;

(2) The compressor belt pulley fails to rotate;

(3) The compressor belt pulley rotates, but the engine can't run at high idling speed;

(4) Leakage of system and no refrigerant.

Remedy:

(1) Check high-idling speed control of electronic control injection to ensure that the engine can run at high idling speed.

(2) Check the compressor belt pulley and driving belt, and adjust the tightness of belt to make the belt pulley normally rotate.

(3) The compressor belt pulley normally rotates, but check the compressor relay in case of refrigerating failure, and replace the compressor relay to activate the magnetic clutch when necessary, if the magnetic clutch of compressor can't be activated in case of its poor contact or damage.

(4) In case of damages to magnetic clutch, the joint of solenoid is broken or its internal circuit is short. Disassemble and check the magnetic clutch if necessary.

(5) In case of damages to compressor, disassemble and check the compressor if necessary.

(6) Check the refrigerating system, and determine no leaks of refrigerant.

##### 2. Excessive noise or noise change of compressor

Symptom: during the rotation of compressor belt pulley, its excessive noise can be obviously heard, or its running sound becomes suddenly bigger or smaller.

Cause:

(1) Loosening of compressor mounting support;

(2) Loosening of compressor mounting bolt;

(3) Fault of magnetic clutch;

(4) Fault of compressor.

Remedy:

(1) Check the installation of compressor support, and tighten it;

(2) Check the mounting bolt of compressor, and tighten it;

(3) Check the magnetic clutch, observe the sucking disc of clutch for deformations or other faults, repair or replace the sucking disc if necessary;

(4) Check the bearing of magnetic clutch, and adjust the clutch clearance to ensure normal operation of clutch;

(5) If the covibration occurs to A/C system, change its position properly, and fix its connection part;

(6) In case of insufficient refrigerant, fill the refrigerant;

(7) In case of insufficient refrigerant oil, add it in up its normal level.

#### V. Check and remedy of refrigerating system's common faults

Repair tool of refrigerating system is mainly composed of filling valve, high- and low-pressure meter set and electronic leak detector, etc, which shall be fully used for any check and repair.

##### 1. Flow of no cooling air

Symptom I: the operation of refrigerating system is normal, and the flow of blower's cooling air is high. In case of low speed, it can't rotate, and there is no cooling air in the car.

Cause:

(1) Poor contact or damages of blower motor relay;

(2) Damages or seizure of blower motor;

(3) Fault of circuit;

(4) Burning of circuit fuse.

Remedy:

(1) Replace the blower relay, and use a good spare part for blower relay;

(2) Repair or replace the blower motor, and remove the seizure causes;

(3) Check the circuit of blower motor to activate the circuit;

(4) Replace the burnt fuse to activate the motor.

Symptom II: the operation of refrigerating system is normal. The blower can rotate at high speed and can't rotate at low speed. No flow of cooling air.

Cause:

(1) The control resistor of blower motor is damaged;

(2) Fault of circuit.

Remedy:

(1) Replace the control resistor of blower motor;

(2) Check and repair the circuit.

##### 2. Insufficient flow of cooling air

Symptom: the rotation of blower is abnormal, and the flow of cooling air is insufficient.

Cause:

(1) Fault of blower motor;

(2) Low voltage of battery, the generator fails to generate;

(3) Poor connection of battery to motor circuit;

(4) Poor contact of blower relay, which is sometimes broken or connected.

Remedy:

(1) Repair the blower motor, and renew the motor if necessary;

(2) Check the charging circuit of generator and battery to ensure the normal voltage of motor circuit of whole car;

(3) Check the circuit of generator to ensure normal operation of motor;

(4) Check the blower relay, and renew the blower relay if necessary.

##### 3. Defective coldness of cooling air temperature

Symptom I: the rotation of blower is normal, the flow of cooling air is normal, but its temperature is not low enough.

Cause:

- (1) Fault of temperature control device;
- (2) Incorrect direction of air flow.

Remedy:

- (1) Check the temperature control device and air throttle, and ensure their normal operation or renew them.
- (2) Check the ventilation duct and vent hole, and ensure correct direction of air flow.

Symptom II: normal running of blower, normal running of compressor, and abnormal pressure of refrigerating system.

Cause:

- (1) High pressure of high-pressure side/high pressure of low-pressure side;
- (2) High pressure of high-pressure side, overflow pressure of low-pressure side;
- (3) Lower pressure of high-pressure side, overflow pressure of low-pressure side;
- (4) Normal pressure of high-pressure side, high pressure of low-pressure side;
- (5) Low pressure of high-pressure side, overflow pressure of low-pressure side.

Remedy:

- (1) Overhigh pressure of high- or low-pressure side. It's caused by the overcharge of refrigerant, which can be removed by draining a proper amount of refrigerant. Air exists in refrigerating system which can make the operation of system normal by draining the refrigerant, vacuum-pumping of system and refilling the refrigerant.

The condenser of refrigerating system is insufficient in cooling capability, the surface of condenser radiating fin is filled with dirt, the radiating fin is blocked by foreign materials or it can't radiate due to its compression deformation, the speed of condenser fan isn't enough, or the fan can't radiate sufficiently, any of these faults can be recovered by checking the control mechanism and control circuit of fan, e.g. the damaged fan shall be replaced.

- (2) Overhigh pressure of high-pressure side. Overflow pressure of low-pressure side is mainly caused by the blockage of refrigerating system pipes. Feel the pipe temperature by hands, the temperature difference of blocked section is larger before and after the operation. Knock the pipe with a nylon gentian, and make the pipe unblocked by vibrating it. If failed, repair the system, including replacement of pipe, re-vacuuming of system and refilling of refrigerant.

- (3) The pressures of high- and low-pressure sides below the normal value are mainly caused by insufficient refrigerant and system leakage, so this fault can be removed by finding out and repairing the leaked parts, and filling the refrigerant.

- (4) Overhigh pressure of low-pressure side is mainly caused by high temperature around evaporator inlet of refrigerating system, so the flow of air shall become normal by checking the ventilation duct and vent hole. Any faulted compressor shall be checked and repaired.

- (5) Pressure of high- or low-pressure side below the normal value is mainly caused by the leakage of refrigerant. The operation of system can become normal by finding out and repairing the parts subject to refrigerant leakage and vacuum-pumping of system.

4. Large noise of engine compartment



Symptom I: when the engine runs at idling speed or high speed, the large noise of engine compartment can be felt after opening the engine hood, but you don't know where the noise comes from, and sometimes think that the noise comes from the engine itself.

Cause:

- (1) Large idling noise of engine;
- (2) Low voltage of battery or generator;
- (3) Damages of cooling fan.

Remedy:

(1) In case of suspecting large idling noise of engine, turn off A/C, and listen to the noise of engine. If the noise is obviously reduced, increase the speed of engine, and then listen to its noise, so as to find out the cause of large engine noise and remedy it.

(2) Low voltage of battery causes the abnormal power supply of electric equipment and production of its noise. Check the voltage of circuit, and renew the battery. In case of too loose driving belt of generator makes the belt slipped, low rotating speed of generator, low power generation and unstable voltage, the electric equipment will produce the noise, and the generator itself will increase its noise, too. Thus, the noise of generator itself can disappear by adjusting the tightness of belt after removing its faults.

(3) In case of damages to the cooling fan, or large scraping noise of fan blade and any part or foreign material, check the fan, and remove the causes of large noise. Symptom II: when the engine runs at idling speed or high speed, the large noise of engine compartment can be heard after opening the engine hood, the noise around the engine compartment or instrument panel front wall can be heard inside the car.

Cause:

- (1) Damages of blower;
- (2) Damages of blower motor;
- (3) Low voltage of battery or generator.

Remedy:

(1) Check the blower blades and bearings for damages. If any, repair or replace them;

(2) Check the blower motor. In case of any damage, repair or replace it;

(3) Check the voltages of battery and generator to make the voltages of whole car circuits normal.

#### 5. Leakage of liquid separator

The liquid separator is also called as a drier receiver, installed at the evaporator outlet, and used to separate the moisture from refrigerant. After the long-time use of liquid separator, it will leak and lose the function of liquid separation. Due to the leakage of refrigerant, the refrigerating system can't refrigerate, so no cooling air is produced in the car.

Symptom: abnormal operation of refrigerating system, and no cooling air is produced in the car; normal running of refrigerating system, insufficient cooling air in the car, and the frost appears on the evaporator.

Cause:

- (1) The refrigerant leaks out of liquid separator due to high temperature and pressure of refrigerating system. No cooling air in the car is caused by no refrigerant in the system;
- (2) The damages to the filter screen of liquid separator and external leakage of drying agent loses its drying function, resulting in moisture contained in refrigerant and icing in the evaporator.



Remedy:

(1) In case of normal operation of refrigerating system, replace the liquid separator once every 2 to 3 years, and replace it when ready to adopt any refrigerating system at the beginning every summer.

(2) If the refrigerating system can't refrigerate due to the liquid separation, replace the liquid separator immediately.

(3) If the parts and assemblies of refrigerating system are normal, icing of evaporator indicates that the moisture exists in refrigerating system. Therefore, the liquid separator shall be replaced.

(4) In case of refrigerant leakage, check high or low pressure at the high or low switch, and check whether the closing and opening pressures of high pressure switch conform to the specified requirements. If the pressure of refrigerating system is below the closing value of low pressure switch, it indicates that the pressure of refrigerating system is too low, i.e. leakage of refrigerating system. Add in refrigerant after checking and repairing the system. If the above system pressure is above the closing value of low pressure switch, it indicates that the switch is damaged, so it shall be replaced.

دیجیتال خودرو

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