1. CONSTRUCTION

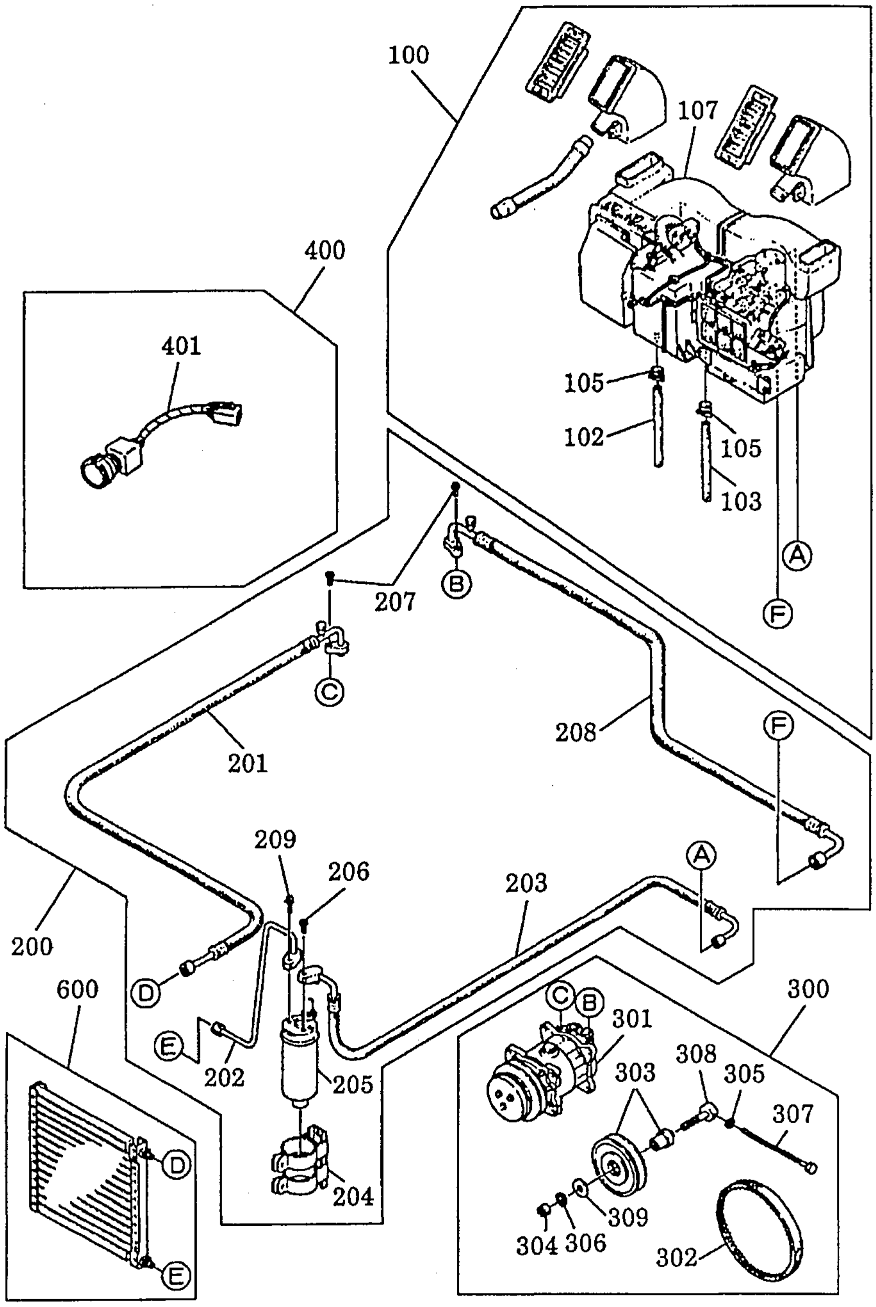

Fig. 1

No.	Part name	Q'ty	No.	Part name	Q'ty	No.	Part name	Q'ty
100	Cooler unit assy	1S	204	Bracket	1	304	Nut	1
102	Hose	1	205	Receiver	1	305	Lock washer	1
103	Hose	1	206	Sems bolt (M6)	1	306	Lock washer	1
105	Clamp	2	207	Capscrew (M8)	2	307	Bolt	1
107	Cooler unit	1	208	Hose	1	308	Shaft	1
	(Refer to par. 2.2.)		209	Sems bolt	1	309	Stopper	1
200	Air dryer assy	1S	300	Compressor assy	1S	400	Switch assy	1S
201	Hose	1	301	Compressor	1	401	Blower switch	1
202	Tube	1	302	V belt	1	600	Condenser	1
203	Hose	1	303	Pullery	1			

2. CONSTRUCTION OF MAIN COMPONENTS

2.1 Intake Unit

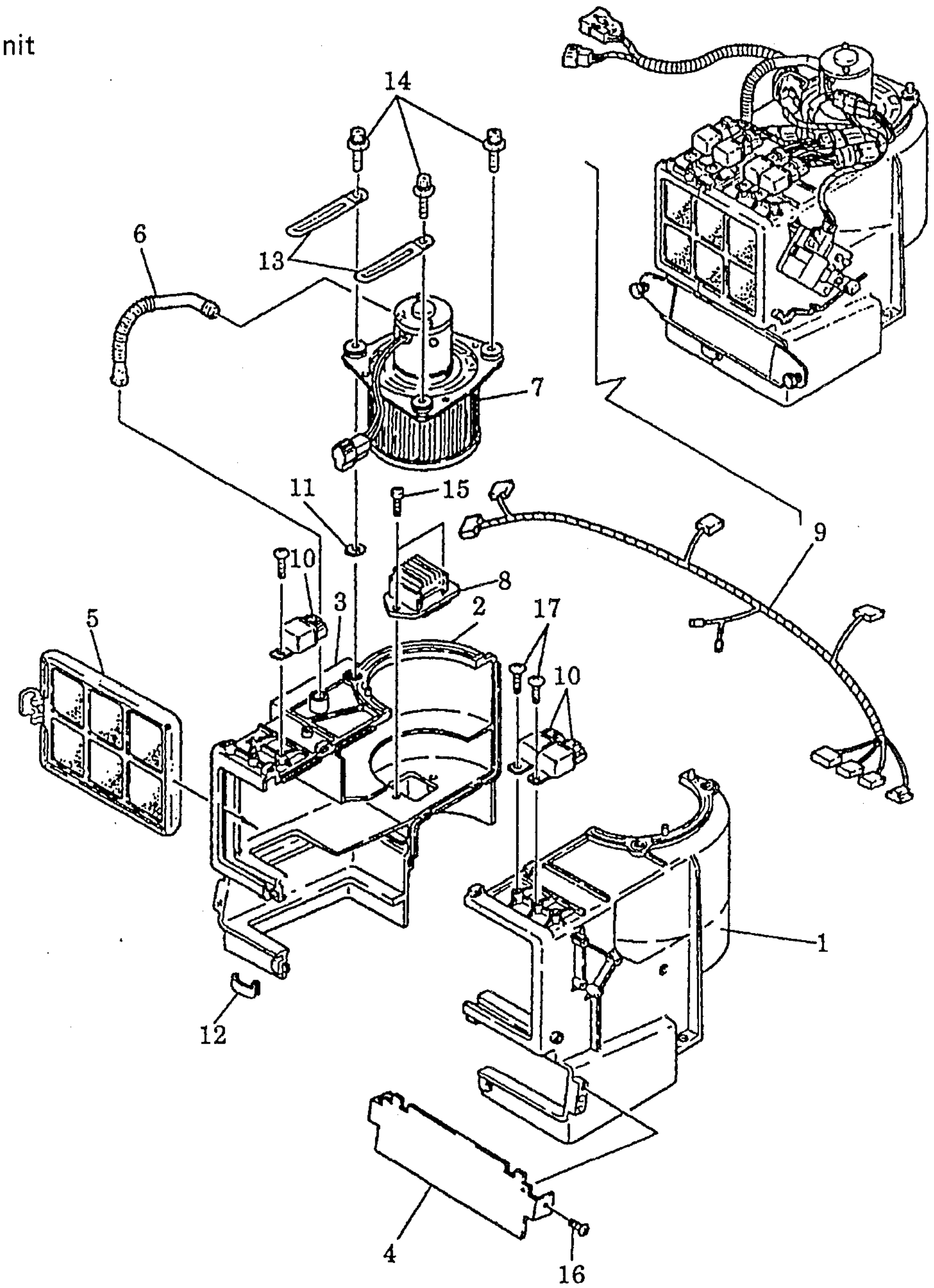

Fig. 2

No.	Part name	Q'ty	No.	Part name	Q'ty
1	Fan casing LH	1	10	Relay (24-4PA)	3
2	Fan casing RH	1	11	Washer	3
3	Connecting opening	1	12	Clamp	9
4	Fresh-air inlet closing plate	1	13	Clamp P	2
5	Inner air filter assy	1	14	Sems bolt (M6×18)	3
6	Cooling hose	2	15	Machine screw (N5×16)	2
7	Blower motor assy	1	16	Machine screw (T4×10)	2
8	Resister	1	17	Machine screw (T4×12)	3
9	Harness	1			

2.2 Cooler Unit

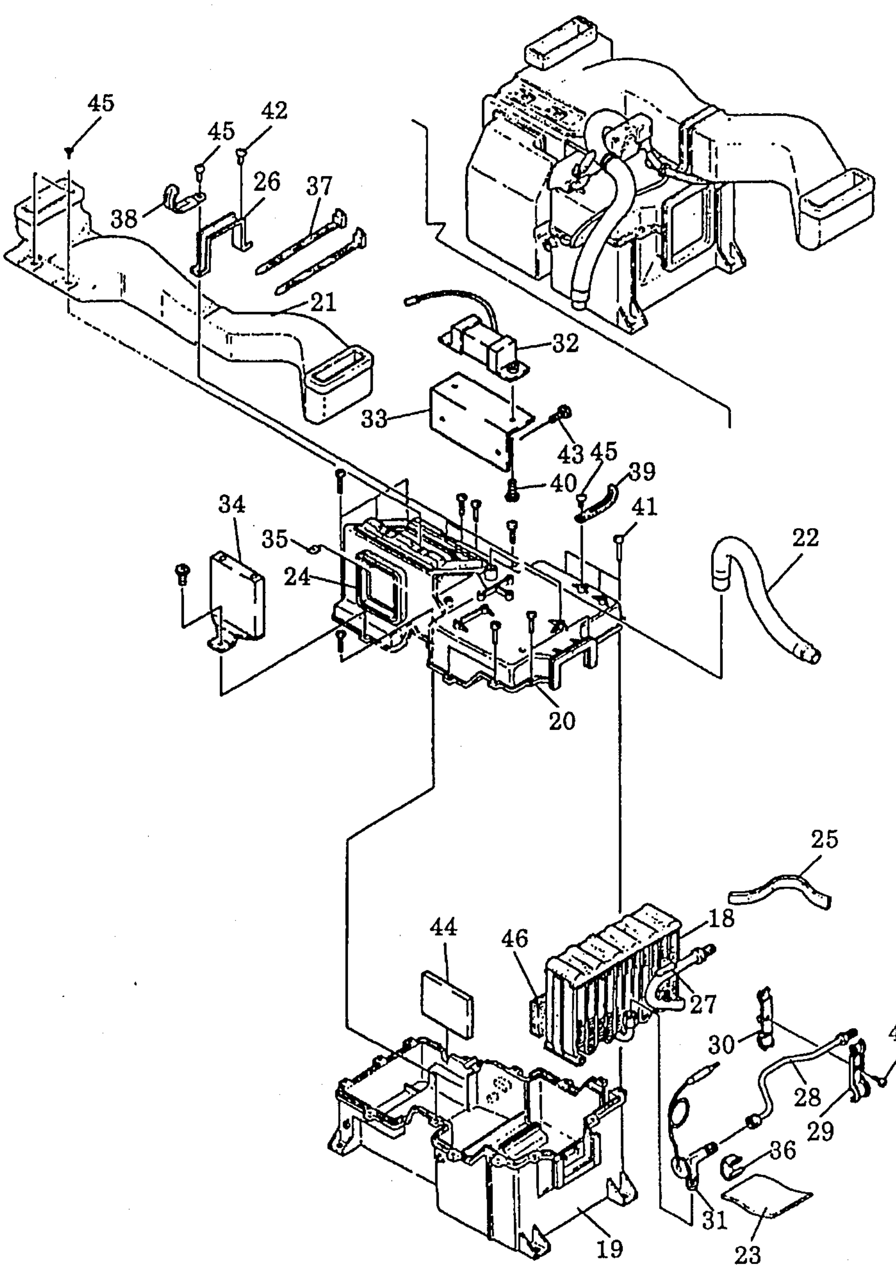

Fig. 3 (1/2)

No.	Part name	Q'ty	No.	Part name	Q'ty	No.	Part name	Q'ty
18	Evaporator	1	29	Pipe retainer A	1	40	Band screw (M4×8)	1
19	Unit casing lower	1	30	Pipe retainer B	1	41	Machine screw (N5×16)	15
20	Unit casing upper	1	31	Expansion valve	1	42	Machine screw (T5×10)	3
21	Upper duct	1	32	Gas type thermo	1	43	Machine screw (T5×12)	2
22	Duct hose	1	33	Gas thermo stay	1	44	Insulator	1
23	Heat insulator	1	34	Closing plate	1	45	Machine screw (M3×8)	2
24	Gasket (Lower duct)	1	35	Speed nut (T4)	2	46	Net	1
25	Gasket (Retainer B)	1	36	Thermo tube stay, E	1	47	Sensor holder	1
26	Duct retainer	1	37	Band (13A)	2	48	Bind screw (M4)	1
27	Thermo tube A	1	38	Clamp P	1			
28	Inlet pipe	1	39	Cord retainer CA	2			

2.3 Receiver Dryer

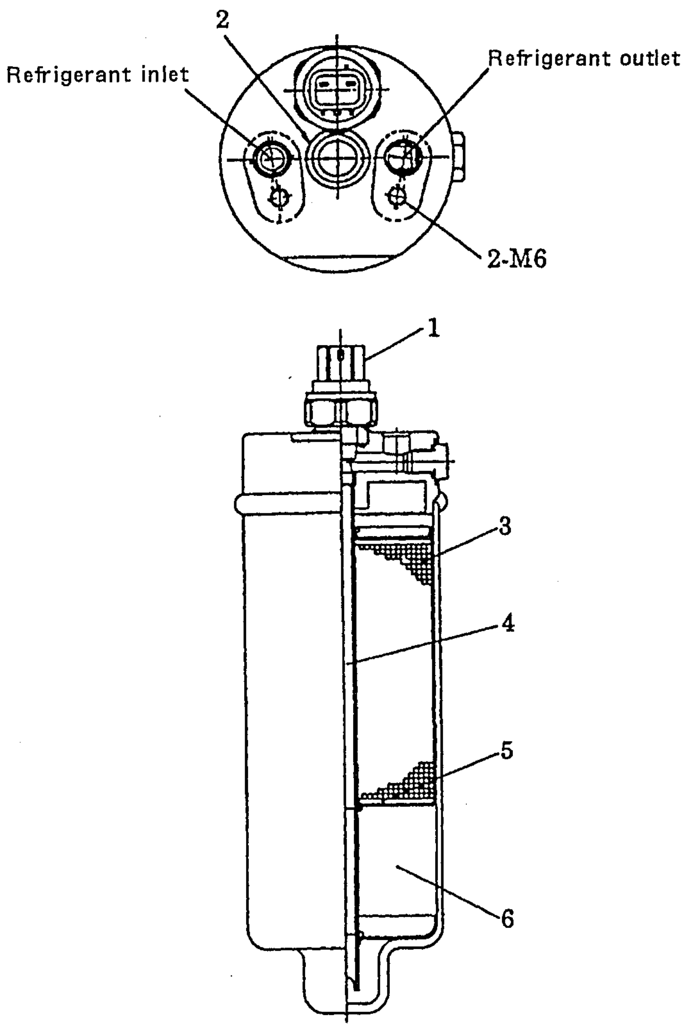

Fig. 4

No.	Part name	Q'ty
1	Pressure switch	1
2	Sight glass	1
3	Desiccant	1
4	Suction tube	1
5	Filter	1
6	Receiver tank	1

3. OPERATION

3.1 Cooling Circuit Mechanism

(1) The phase of refrigerant flowing through the cooling system changes from/to liquid to/from vapor repeatedly, and exchanges the heat from low temperature section (Inside of cab) to high temperature section (outside of cab).

1) Kinds of refrigerant

There are many kinds of refrigerants which act on the heat, but the following conditions must satisfied to employ them for general purpose.

- The latent heat of vaporization is to be high.
- Easily liquefied (High pressure is not required for condensation.)
- Easily vaporized (Even if the pressure is not low, be vaporized sufficiently to cool the object.)
- The specific heat is to be low. (The refrigerant is cooled by expansion valve to minimize the loss.)
- The critical temperature is to be high., and the freezing point is to be low.
- To be stabilized chemically, with no corrosion behavior or permeability
- No toxicity, offensive order, flammability, and explosivity, and high heat conductivity and electrical insulation
- Small specific volume
- Easy detection of leak

The refrigerant, which satisfies the above conditions and has the characteristics meeting the purposes for cooling unit use, is selected and used. If the non-specified refrigerant is used, poor cooling may be obtained, and the unit may be damaged. Take care not to use a non-specified refrigrerant.

Table 1 describes main characteristics of refrigerant R134a which is used for the unit on this machine.

(2) Characteristic (Refer to Fig. 5.)

Generally fluid (gas and liquid) has the following property.

1) By lowering the temperature of gas in certain pressure, the gas starts condensation at a temperature, and changes in phases to the liquid. Every material (fluid) has only one point of temperature under the specified pressure.

The temperature which is corresponding to that pressure is referred as a saturation temperature.

Table 1

Item	R134a
Chemical formula	CH_2FCF_3
Molecular weight	102.03
Boiling point	−26.19℃
Critical temperature	101.14℃
Critical pressure	4.065MPa{41.45kgf/cm²} ∗1
Critical concentration	511kg/m³
Concentration of saturate liquid	1206kg/m³
Specific volume of saturated steam	0.0310m³/kg
Latent heat of vaporization	197.5KJ/kg{47.19kcal/kg}
Combustibility	Non-combustible
Modules of ozone rupture	0

∗1 1MPa (Mega pascal) corresponds to (10.1972kgf/cm²).

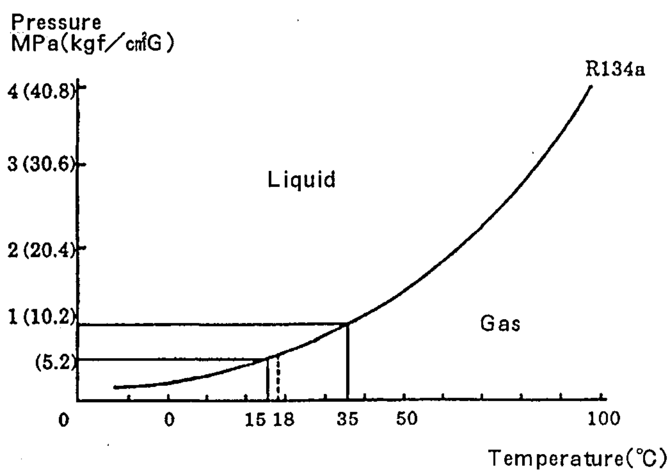

Fig. 5 R134a pressure—Temperature characteristic

2) Furthermore, the temperature can determine the pressure at which the gas starts condensation.
The Fig. 5. describes the refrigerant R134a which is used for air conditioner on which the advantage of the relation of saturation temperature and saturation pressure is utilized. In the Fig. 5, the refrigerant is in the gasesous phase under the temperature and pressure on the under right side, and in the liquid phase under the temperature and pressure on the upper left side.
Imagine that you are using the air conditioner in midsummer. When the refrigerant is vaporized, the heat of vaporization is absorbed from the air in the cab. So, to cool the inside of cab to 25 ℃ (77°F) or less, the refrigerant must change in phase from liquid to gas of a temperature lower than 25℃ (77°F). Fig. 5 shows that the refrigerant has sufficient ability to cool air in the cab under pressure higher than ambient pressure (If the refrigerant requiring pressure lower than ambient pressure to cool air to the required temperature is used, air is contaminated with refrigerant in the circuit lowering the ability of the unit.) And in the process of changing phase from liquid to gas, the refrigerant is cooled and condensed by the outside air of 35℃ (95°F) or higher. Therefore, the refrigerant can condense under pressure 10.2 kg/cm² (145psi) or higher as shown in Fig. 5.

3.2 Cooling Circuit

Fig. 6 shows the cooling circuit for the air conditioner. The cooling of air in the cab is performed by the evaporator shown in this schematic diagram. The cooling circuit has the advantage that the refrigerant takes in heat from the surrounding air for vaporization to cool the object while the refrigerant is being vaporized. The section where the refrigerant vaporizes is referred to as an evaporator. Air is continuously fed around the evaporator by blower fan, and simultaneously the liquid refrigerant (moist steam of low dryness) is supplied to the inside of the evaporator, resulting in a lowered temperature in the cab.
For example, to cool air to 15℃ (59°F), the refrigerant must be vaporized to a lower temperature than 15℃ (59°F) to take in the heat of vaporization from air. To obtain the temperature the pressure of refrigerant in the evaporator is to be 5.2 kg/cm² (74psi) or lower as described in Fig. 5. And to obtain effective cooling performance, the supply flow rate of refrigerant must be regulated so that all the refrigerant supplied to evaporator is vaporized in the evaporator, and changed in phase to dry steam.

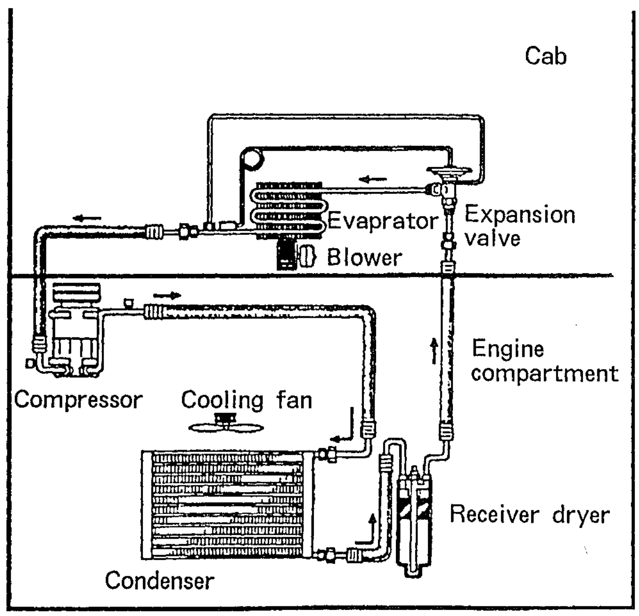

Fig. 6 Construction of cooling circuit

Therefore, the cooling circuit provides decreasing pressure in the evaporator and proper supply of refrigerant to the evaporator to enable the evaporator to cool the object (air) sufficiently.
The supply rate of refrigerant is regulated by expansion valve, and the evaporator inner low pressure is retained by the orifice of expansion valve and intake action of compressor. The compressor, which has a pumping function to recirculate the refrigerant, changes the refrigerant in the dry steam state to the liquid through compressing action of compressor and heat exchanger (heat release).

3.3 Components

(1) Evaporator (See Fig. 7)

The evaporator is heat exchanger having the essential role of taking in heat of air in the cab, taking advantage of the latent vaporization of liquid refrigerant in low temperature and low pressure. Consequently, the evaporator is required to perform excellent heat transfer between the object and refrigerant. For this reason, the evaporator is equipped with a fin on the air intake side to make the heat transfer area larger, resulting in excellent heat transfer between refrigerant and air.
Also the cooling condenses the moisture in the air resulting in droplets, consequently the droplets stick on the outer surface of evaporator. The freezing of these droplets causes a reduction of cooling effect. Therefore the removal of water must be taken in the design.
In addition the refrigerant flow rate supplied to the evaporator is regulated by the expansion valve described later, but to regulate it accurately, the evaporator must make the pressure drop of refrigerant smaller. Therefore this is an important factor in making the pressure drop of refrigerant smaller, and also in drawing out the ability of the evaporator sufficiently.

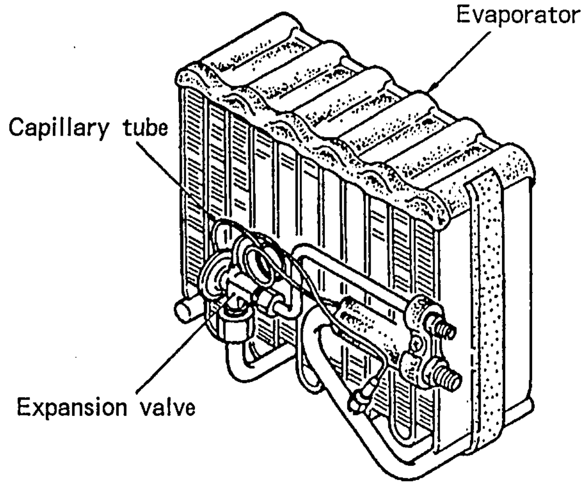

Fig. 7 Evaporator

(2) Expansion valve

The evaporator displays the full range of capacity by supplying the proper flow rate of liquid refrigerant in low pressure and low temperature. Where the flow rate is lower, the refrigerant in the evaporator is vaporized earlier than the specified time, consequently the cooling performance will be decreased. Conversely when the flow rate is higher, the remaining liquid refrigerant which is not vaporized in the evaporator returns to the compressor resulting in lowering the cooling performance, and damage to the compressor valve.

The expansion valve has the function of feeding the liquid refrigerant after reducing from high pressure and temperature to low pressure and temperature (Moist steam in low dryness), simultaneously regulating the supply flow rate of refrigerant.
Fig. 8 describes the construction of the heat sensing expansion valve. The temperature sensing tube described in the figure is fitted on the surface of the output tube of evaporator, and detects the refrigerant temperature at evaporator output section indirectly. As the temperature sensing tube and inside of capillary tube are ordinarily filled with R134a in saturation, the sensed temperature changes the inside pressure. Then the change of pressure is applied to the diaphragm.
The pressure of liquid refrigerant in high pressure and heat coming from the lever side lowers rapidly by passing through the valve. Then a portion of the refrigerant is vaporized by heat itself, resulting in low temperature, consequently moist steam refrigerant of low pressure and heat is fed to the evaporator.
The opening of the valve is determined by a balance between the evaporator side pressure (low) and control spring force, and diaphragm pushing power (refrigerant temperature at evaporator output where the temperature sensing tube senses).
And the refrigerant is kept to the proper degree of superheat (3 to 8℃) against evaporator inner pressure and the flow rate to the evaporator is automatically regulated. As this action senses the output side refrigerant temperature and regulates the refrigerant flow rate against the evaporator inlet pressure, if the pressure drop of refrigerant in the evaporator is increased, the regulation of degree of superheat, that is the regulation of refrigerant supply flow rate, is made more difficult. Therefore the small pressure drop is preferable for evaporation.
Using the temperature sensing expansion valve with external equalizing pipe, the pressure and temperature at evaporator outlet, and the degree of superheat of refrigerant and the supply flow rate to evaporator are positively regulated. The air conditioner on this machine is provided with the temperature sensing expansion valve with the externally-installed pressure equalizing pipe.

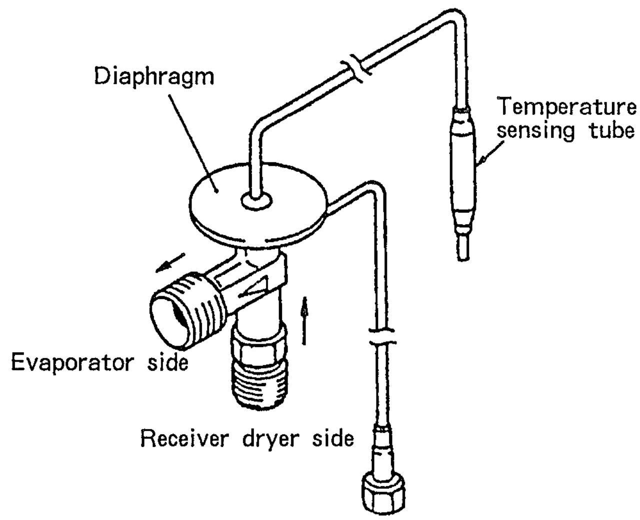

Fig. 8 Expansion valve

(3) Compressor (See Fig. 9.)
Compressor installed on the cooling system has the following three functions.

1) Suction
2) Pumping
3) Compression

1) The suction function lowers the refrigerant pressure in the evaporator in combination with the orifice function. And this enables the refrigerant to be vaporized at a low temperature to cool the object.
2) The pumping function circulates the refrigerant in the cooling system. And this enables continuous cooling.
3) The compression function returns the vaporized refrigerant to the liquid in combination with the condenser described later.
As the pressure rises, the saturation temperature rises. For example, the refrigerant can be cooled and liquefied with outside air of temperature 35℃ (95°F). The compression function of compressor changes the pressure of steam refrigerant from low to high, and the subsequent condenser cools the refrigerant. And since this compression function is accomplished in a short time, the heat exchange of refrigerant hardly takes place. In a word, since the functioning form is similar to an adiabatic compression, the refrigerant discharged from the compressor vaporizes in high pressure and temperature, and is sent to the condenser.

(4) Condenser (See Fig. 10.)
This condenser is used to cool the steam refrigerant in high pressure and temperature by the outside air and to condense the refrigerant. The heat flows from the refrigerant to air, in reverse direction of evaporator. The fin is also installed on the air side to make the heat transfer higher. Where the refrigerant in the condenser is not sufficiently cooled, the evaporator can not cool air in the cab sufficiently. To obtain sufficient cooling, the ventilation required to cool refrigerant must be ensured.

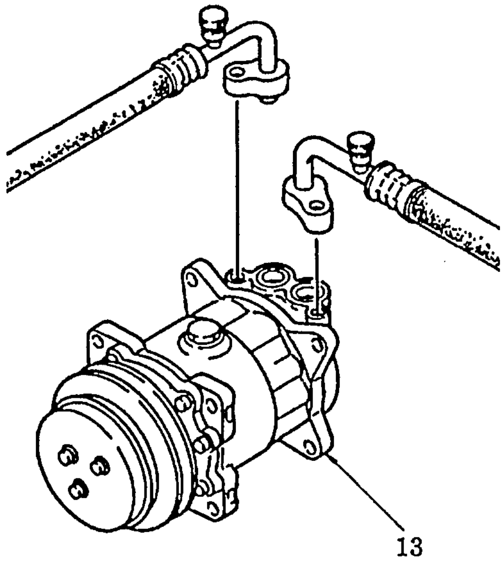

Fig. 9 Compressor

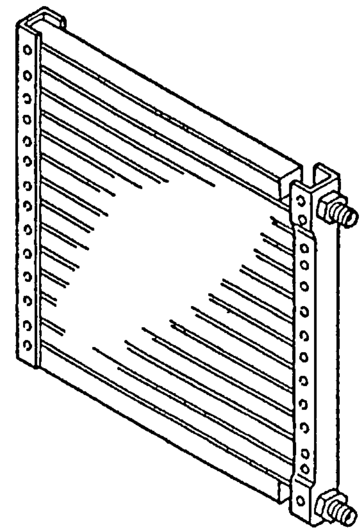
Fig. 10 Condenser

(5) Receiver dryer (See Fig. 11.)

1) Receiver tank

The air conditioner provides large variation of compressor revolution, resulting in the variation of proper quantity of refrigerant in the cooling system. The variation is caught by the receiver tank, and the remaining refrigerant, when the cooling circuit does not require so much refrigerant, is temporarily stored, and conversely when much refrigerant is required, this stored refrigerant is supplied to the system. This also has a role in protection against infiltration and leak of refrigerant through rubber hose.

2) Dryer

Moisture contamination of the refrigerant in the system causes defects, such as deterioration of compressor valve and oil, corrosion of metallic parts installed on the system, and clogging of circuit due to the freezing in the expansion valve, etc. In the cooling system, the moisture contamination of the refrigerant must be held to 30 ppm or less. The air conditioner uses a molecular sieve as a desiccant suitable for the system to absorb, moisture entering into the system while fitting or charging refrigerant.

3) Sight glass

This is an inspection hole to check the system for refrigerant level, enabling the operator visually confirm the inside of system.

4) Filter

5) Pressure switch

This machine is provided with a pressure switch in high and low pressure types. When the pressure is abnormally raised (32 kgf/cm², 455 psi or more), this switch cuts the power to the compressor to protect the system from damage. And when the circuit pressure lowers to 2 kgf/cm² (28 psi) or less due to the leakage, this switch cuts the pressure to the compressor to detect the leak of refrigerant.

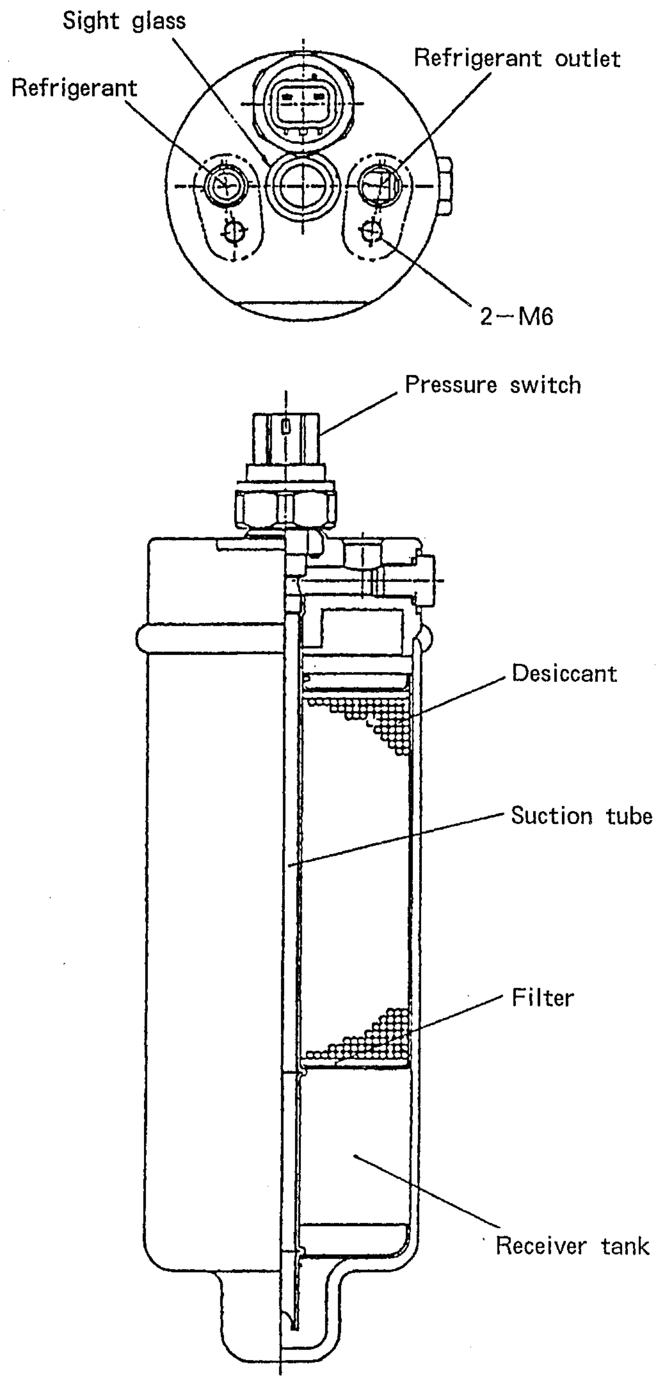

Fig. 11 Receiver dryer

4. DISASSEMBLING AND ASSEMBLING

4.1 Precautions

(1) Special refrigerating machine oil
This air conditioner uses special purpose refrigerating machine oil which is suitable for new refrigerant R134a. Other oil than SP20 can not be used. And as the SP20 has features such as easily absorbing moisture, attacking painting and resin, etc. Pay attention to the following points.

1) All the connections of the new compressor and components of refrigerating machine should be plugged. (Valve and cap at the connections of compressor are to be removed immediately before connecting pipes. Where the connection is disconnected for repairing, both connections are to be plugged or capped, etc., immediately.)

2) Care should be taken to keep the painted surface and resin applied section free from SP20. Should SP20 adhere on those surfaces, wipe them immediately.

(2) Since the receiver dryer is provided with the desiccant sealed to absorb moisture in the system, the valve installed at the connection of pipe must be removed immediately before connecting pipes.

(3) Tightening torque

1) Joint of pipe (See Fig. 2.)
Prior to connecting the joint of pipe, apply special purpose oil (SP20) to O-ring. And tighten bolts and nuts to the specified torque using two spanners.

2) Screw them to the specified torque shown in the table.

(4) Oil quantity of compressor (See Table 4.)
The compressor SD7H (HD type) is provided with oil 240 cc (15 cuin) sealed. The low oil level may cause seizing at high speed and decrease of life, and conversely the excess oil quantity causes the drop of cooling capacity.
By starting operation of air conditioner once, the oil is distributed in the freezing current to a certain extent.
Therefore, the oil level should be adjusted to the specified level shown in the table to replace parts described in Table 4.

(5) All work must be carried out in the state where all the power supply for air conditioner and relevant are turned off.

(6) After completing each work, check that all trouble is repaired completely while operating air conditioner.

Table 2 Unit: kgf•cm

Pipe tightening part	Tightening Torque
D hose and compressor (M8 bolt)	200 to 250
D hose and condenser	200 to 250
L hose and condenser	120 to 150
L hose and receiver dryer (M6 bolt)	80 to 120
L hose and air conditioning unit	120 to 150
S hose and air conditioning unit	300 to 350
Expansion valve inlet	120 to 150
Expansion valve outlet	200 to 250
Expansion valve pressure sensing portion	70 to 90

Table 3 Unit: kgf•cm

Screw size	Tightening Torque
N4, T4 machine screw, M4	8 to 12
N5, T5 machine screw, M5	20 to 25
M6 (L hose joint attaching part)	80 to 120
M6 (Other than L hose joint attaching part)	100 to 120
M8 (S, D hose joint attaching part)	200 to 250
M8 (A/C unit attaching part)	100 to 120
M8 (Other than the above)	120 to 160
M10	400 to 550

Table 4

Spare parts	Refilling
Evaporator	40 cc (0.24 cuin)
Condenser	40 cc (0.24 cuin)
Compressor	Discharge oil from the new compressor in quantity equal to the remaining oil in the compressor replaced.

4.2 Disassembly and Reassembly of Unit Casing (See Fig. 12 and 13.)

The figures in parentheses after the part names correspond to those in the structural drawings.

(1) Dismantling Upper Duct
Remove two T4 machine screws (45) and two T5 machine screws (26). Then separate duct retainer (11) and upper duct (5).

(2) Desmantling the Upper Casing of Air-Conditioner Unit.

1) Dismantle the upper duct according to para. (1) above.

2) Remove two T4 machine screws (45) and one T5 machine screws. The separate blowoff hole cover.

3) Remove fifteen N5 machine screws (41) and then separate casing upper (4).

(3) Mounting
Mounting should be done in the reverse order of dismantling.

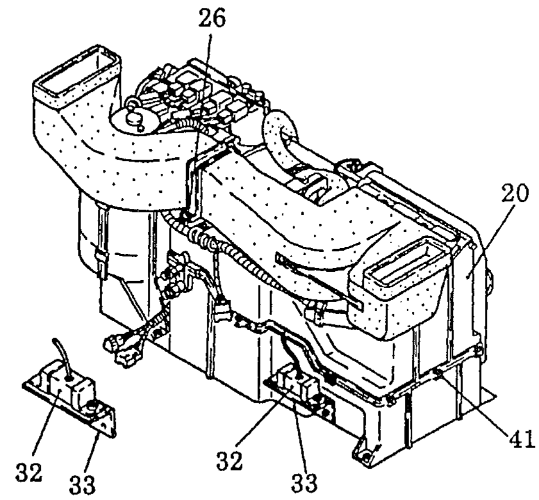

Fig. 12 Air-conditioner unit

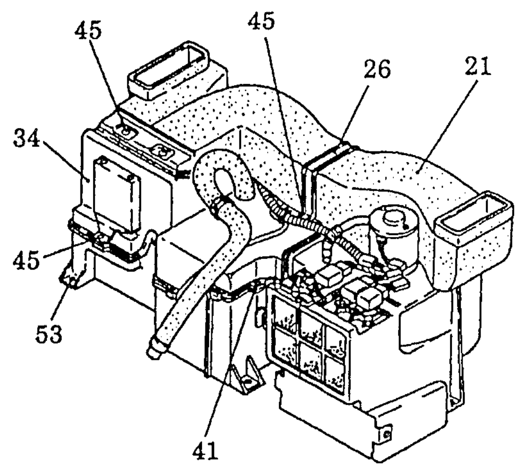

Fig. 13 Air-conditioner unit

4.3 Replacing Gas type Thermo (32) (See Fig. 14.)

(1) Dismantling

1) Dismantle the casing upper of the cooler unit according to para 4.2.(2).

2) Remove gas type thermo (32) from gas type thermo bracket (33) mounted on unit casing lower (19).

3) Separate gas type thermo probe (32) from groove (a) of the unit casing upper.

4) Draw out sensor holder (47) from evaporator (18).

5) Remove thermo probe (32) from sensor holder (47).

(2) Mounting
Mounting is done in the reverse order of dismantling.

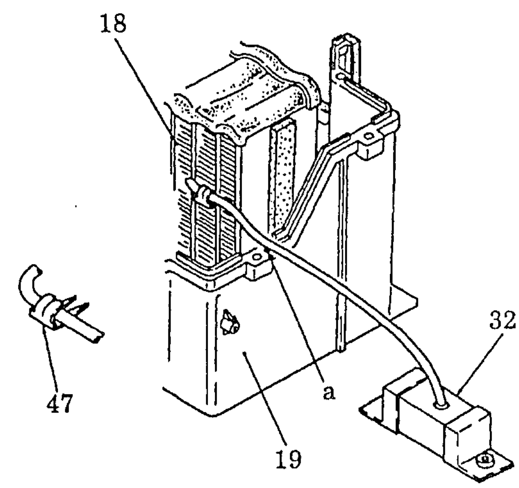

Fig. 14 Replacing gas type thermo (32)

4.4 Replacing Evaporator and Expansion Valve (See Fig. 15 and16.)

(1) Dismantling Expansion Valve.

1) Remove the casing upper of the air-conditioner unit according to para. 4.2 (2).

2) Dismantle the assembly of evaporator (46) and expansion valve (31) from the casing, as shown in Fig.15.

3) Peel off thermal insulation material (23) of the temperature sensing part and separate thermo tube stay (36). (See Fig. 16.)

4) Loosen nuts (a), (b) and (c) and remove each of the pipes.

(2) Dismantling Evaporator

1) Perform Para. (1) above.

2) Remove M4 screw (48) and separate retainer (30).

(3) Mounting

Mounting should be done in the reverse order of dismantling, with attention paid to the following.

1) Install thermo tube (36) as shown in the cross-sectional drawing (A-A).

2) Round off extra length of capillary (31-2) to about ϕ20 (0.8in) beforehand.

3) When installing the assembly of the evaporator and the expansion valve to the casing, place them so retainer (30) is fixed to the casing.

4) Since thermal insulation material (23) can not be re-used, replace it with the expansion valve at the same time.

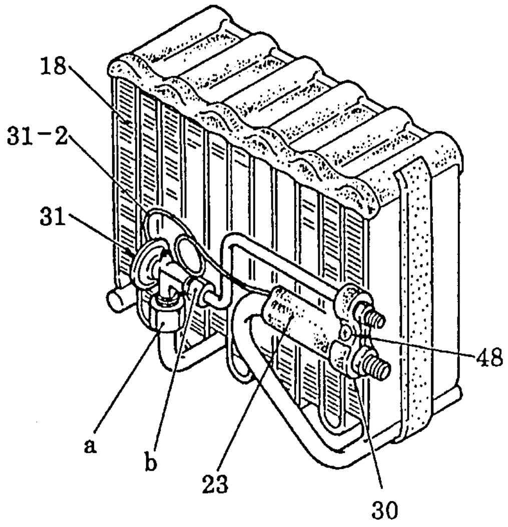

Fig. 15 Replacing expansion valve

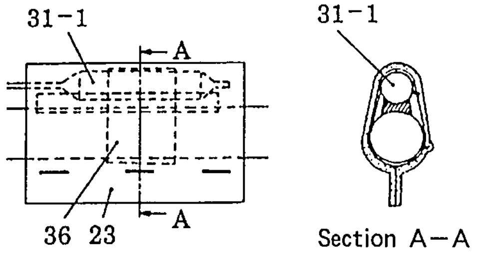

Fig. 16