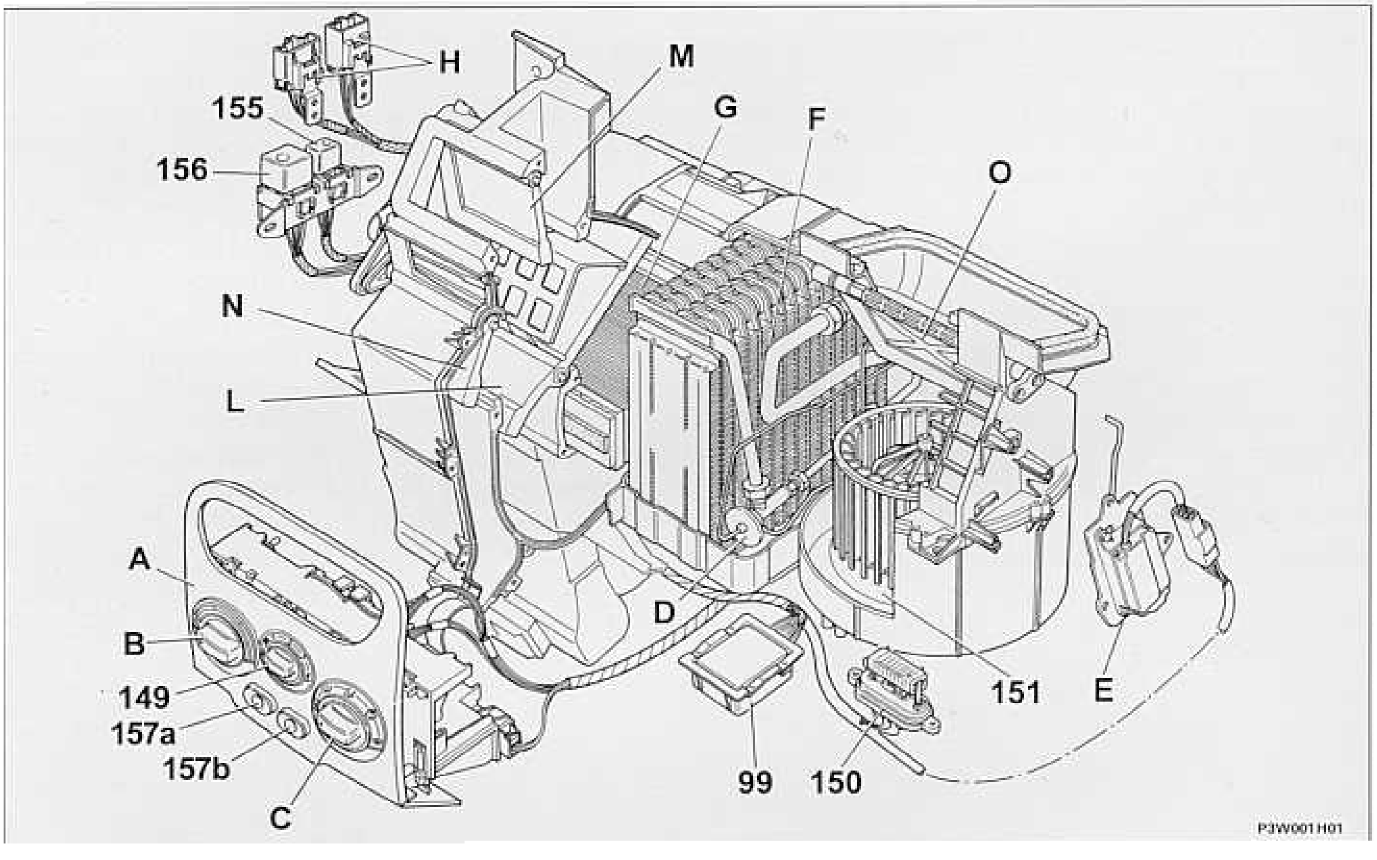
The temperature and humidity of air in the vehicle (with hood) may be altered or conditioned by means of one of the following systems:
- manual heater (fitted to car as standard);
- manual air conditioner (fitted as option to replace the first system).

AIR CONDITIONING SYSTEM WITH MANUAL CONTROLS

The evaporator - heater - distributor assembly, which represents the main component of the manual air conditioning system, is shown in the figure.
Mixer flap (L) turns to allow a variable amount of air to flow over the heater fins so that the required temperature can be achieved inside the passenger compartment. The flap is operated by a cable controled by knob (B), with the aid of two toothed sectors (one of which meshes with the knob shaft).
The two distribution flaps (upper (M) and lower (N)) are positioned by two toothed sectors. These mesh with a rack to allow mixed air to be distributed to outlets and diffusers located on the instrument facia or the lower side part of the central console as required by the user.



A. Air conditioner control panel
B. Air temperature regulation knob
C. Air distribution selection knob
D. Expansion valve
E. Recirculation flap control timer actuator
F. Evaporator
G. Heater radiator
H. Connectors
L. Mixer flap
M. Top distributor flap
N. Bottom distributor flap
O. Air intake flap

99. Compressor activation control unit
149. Fan speed selection switch (151)
150. Resistance divider for fan speed regulation (151)
151. Electric fan
155. Relay for first fan speed upon air conditioner activation
156. Fan circuit supply relay
157 a. Air conditioner activation key
157 b. Recirculation activation key

The rack is moved by a cable controled by knob (C) with the aid of a sector with toothed insert.

Mixed air flow may be adjusted using central knob (149), which acts directly on a switch. Through the resistance divider (150), this switch supplies four different voltages to fan (151), which forms an integral part of the main system assembly.

Two keys for another two switches are located on a control panel beneath the knobs described above. The left hand key (157 a), marked with a snowflake, inserts the compressor electromagnetic coupling, while the right hand key (157b) marked with a symbol representing a car passenger compartment activates electric actuator (E) with built-in timer. This positions air intake flap (O) horizontally via a link and lever to cut off outside air intake and allow air in the passenger compartment to recirculate.

When the second button is pressed, actuator (E) is re-activated to move air intake flap (O) to a vertical position, where it cuts off the recycled air flow and allows air to be taken in from outside.

The main component of the manual air conditioning system consists essentially of three separate units. These are connected in line and located in the middle of the passenger compartment beneath the instrument facia.

The unit (left) is made up of two casing halves which enclose a heater radiator (G). Mixer flap (L) and distribution flaps (upper (M) and lower (N)) are jointed to the radiator and can close two openings if required.

The right hand unit is made of a virtually cylindrical case containing fan (151) and air intake flap (O). The flap is able to close off one of the two upper openings (one vertical and one horizontal).

Evaporator (F) is located between the two units described above in a cube-shape box and communicates with both. The evaporator intake duct is connected to a self-regulator expansion valve (D), in turn connected to a dehydrating filter through a pipe. The output duct is connected, via a pipe, to the compressor intake.

Two connectors (H) for connection to the vehicle electrical system and two relays (156 and 155) are fastened to the left outer wall of the heater-distributor unit. The relays operate the fan (low speed only) when the compressor is active to prevent the evaporator freezing.

Coolant R 134 A is driven through the air conditioning system by a NIPPONDENSO vane type, variable displacement compressor. Output is adjusted automatically by a built-in pressure regulator.

Compressor operation and output regulation is described in detail in the following sections.

The gas used in this system is R134a (tetrafluoroethane), considered environmentally acceptable according to EEC law. **R134a gas cannot be used in systems designed for Freon.** This is because its different molecular structure makes non-metallic seals, gaskets and pipes permeable.

Because oil and coolant are incompatible, never use Freon 12 in systems designed for R 134 A.

Due to incompatibility between the two coolants and oils, the system must be charged/discharged using only specially-designed equipment (Cleaner 134 produced by ICF) as described in the relevant chapter at the end of this section.

HEATER WITH MANUAL CONTROLS

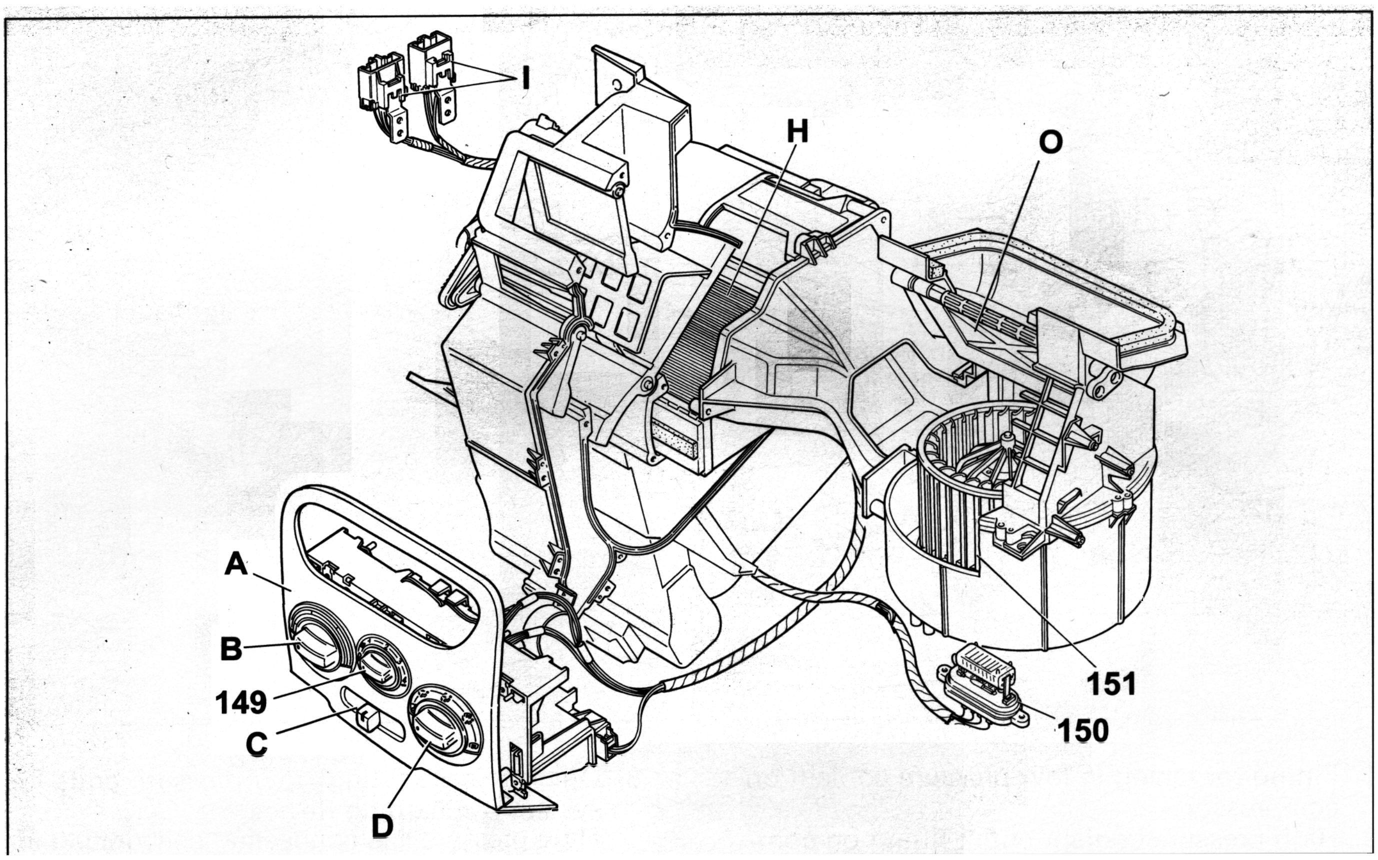
The assembly shown in the figure below forms the main component of the manual heater system. It is more or less the same as the system described previously.

The two assemblies differ only in the fact that the central evaporator unit is replaced by a duct which connects the other two units.

The air intake flap (O) of the fan unit is also no longer controlled by an electric actuator, but by a cable with two levers; one connected to cursor (C)

The system control panel differs in lacking two lower keys, which are replaced by a cursor key (C). This constitutes the end of the control lever for the air intake flap cable.

On this type of system, because air intake flap (O) can take up any intermediate position between the two limits, fan (151) may take up different proportions of exernal and internal (recycled) air



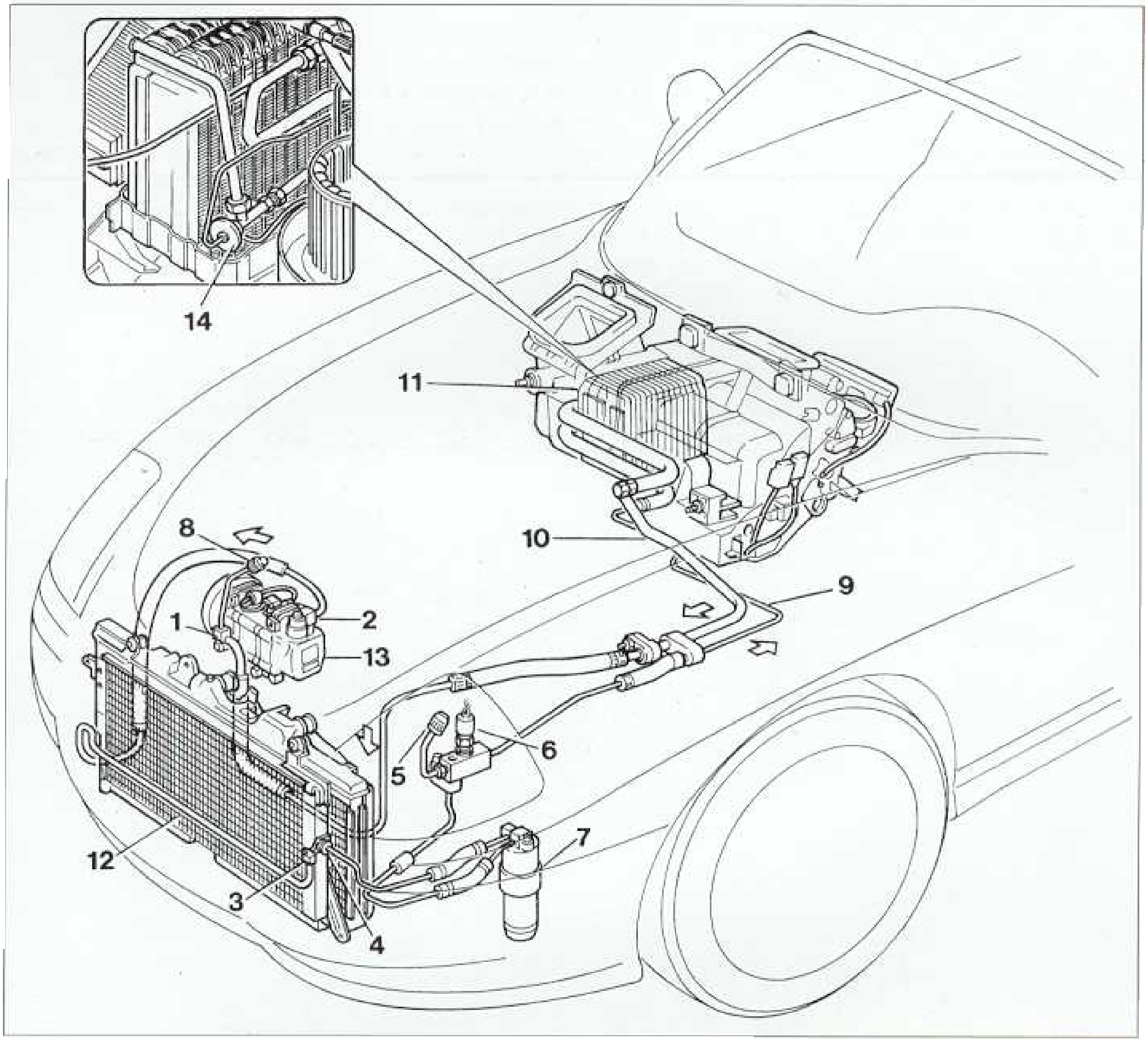
P3W003H01

A. Heater control panel
B. Air temperature regulation knob
C. Air intake selection cursor key
D. Air distribution selection knob
H. Heater radiator
I. Connectors
O. Air intake flap

149. Fan speed selection knob (]51)
150. Resistance divider for fan speed regulation (151)
151. Electric fan

50.

DIAGRAM SHOWING ARRANGEMENT OF AIR CONDITIONING SYSTEM COMPONENTS ON CAR



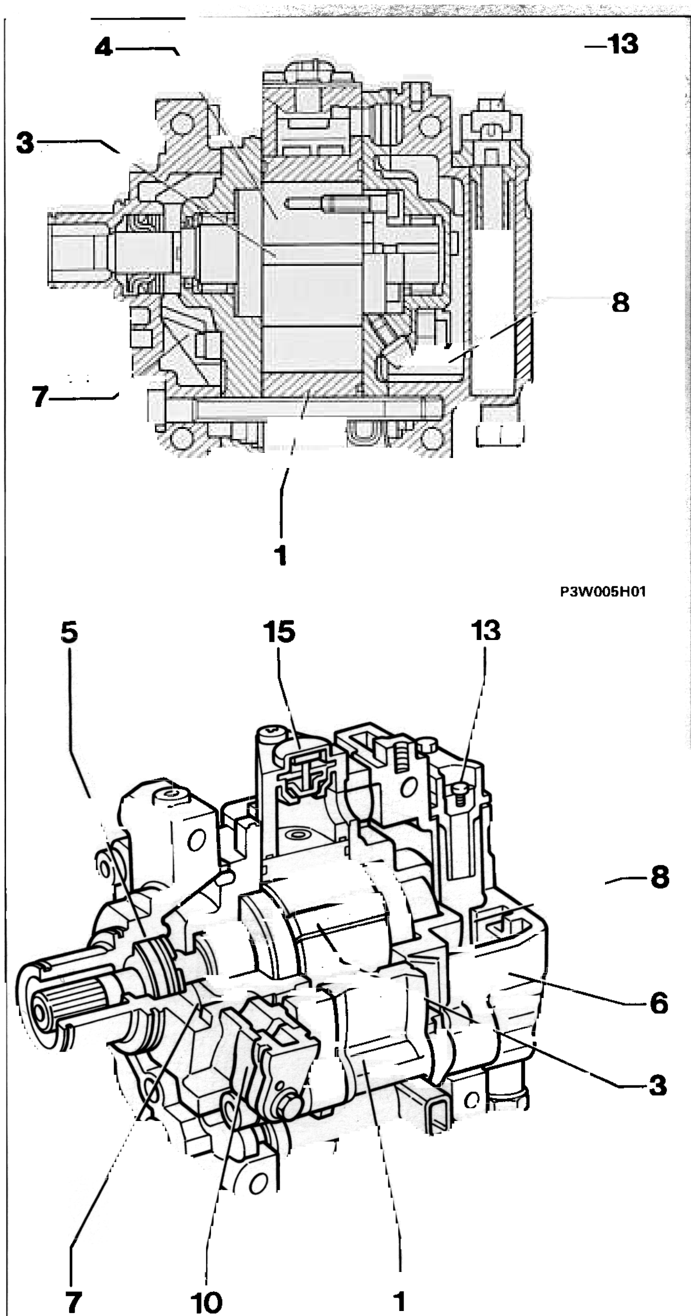
1. Fitting for taking in low pressure coolant on compressor
2. High pressure coolant outlet fitting on compressor
3. Condenser inlet fitting
4. Condenser outlet fitting
5. Quick-release fitting (high pressure end) for system charge/discharge device
6. Three stage pressure switch
7. Dehydrating filter
8. Quick-release fitting (low pressure end) for system discharging device
9. High pressure line connecting dehydrating filter and expansion valve
10. Low pressure pipe connecting evaporator and compressor
11. Evaporator
12. Condenser
13. Compressor (Nippondenso)
14. Expansion valve

Because expansion valve (14) is connected directly to the evaporator intake fitting, valve replacement involves removal of the evaporator - heater - distributor assembly from the vehicle.

COMPRESSOR

The Nippodenso compressor is vane type and equipped with a system that adjusts flow when evaporator temperature reaches values when freezing could occur. This situation is indicated by a drop in compressor intake pressure.
The compressor essentially consists of case (1), which contains chamber (2). Four vanes (3) turning inside the chamber are driven by hub (4), whose axis of rotation does not coincide with the theoretical chamber centre line. The geometrical configuration of the chamber ensures that the rotating vanes are always in contact with the inside surface of the chamber. The assembly thus allows the space between one vane and the next to be altered during rotation.
Two covers are secured to case (1), one at the front (5) and one at the rear (6). These contain an inlet or low pressure chamber (7) and a high pressure chamber (8). Gas is taken in through intake (10) on cover (5) and passes through low pressure chamber (7) and slot (11) on case (1).

Compressed gas is expelled through duct (12) in high pressure chamber and admitted through fitting (13). Strip valve (14) prevents high pressure gas from flowing back into the compressor when it stops.
A thermal contact (15) on the top of the case is connected in line with the electromagnetic coupling. When the temperature reaches dangerous levels at about 180 °C, thermal contact (15) deactivates the electromagnetic coupling.



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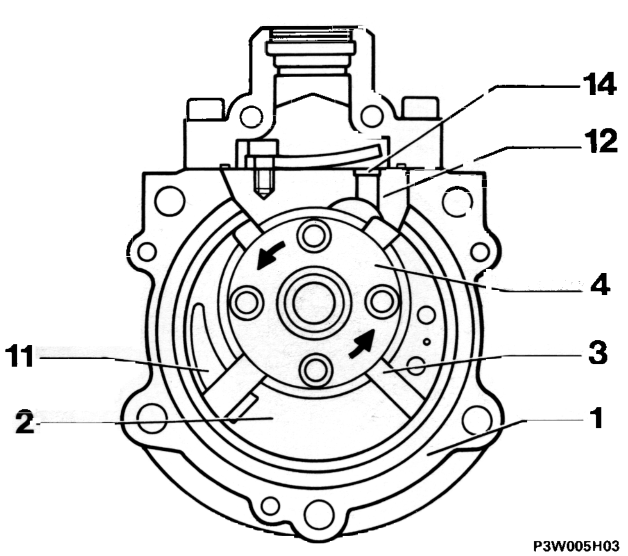

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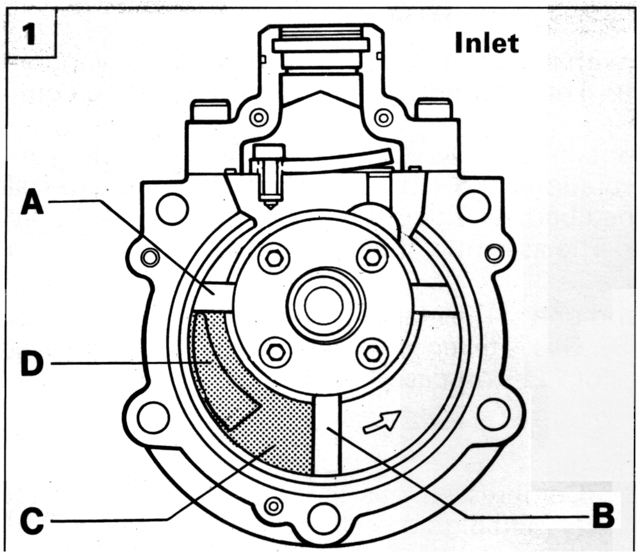

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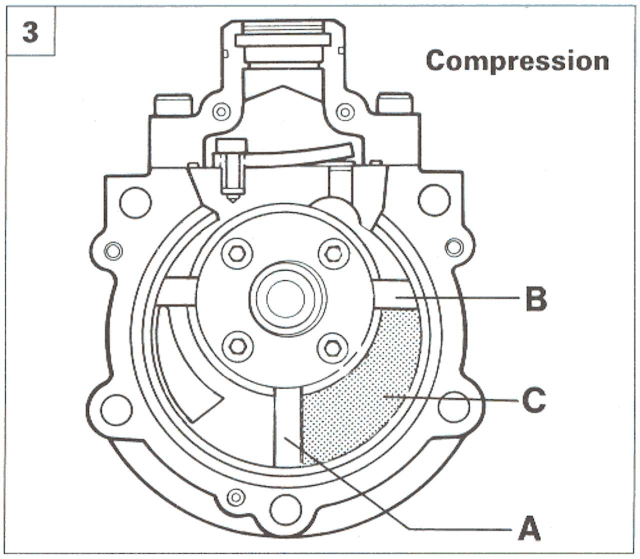

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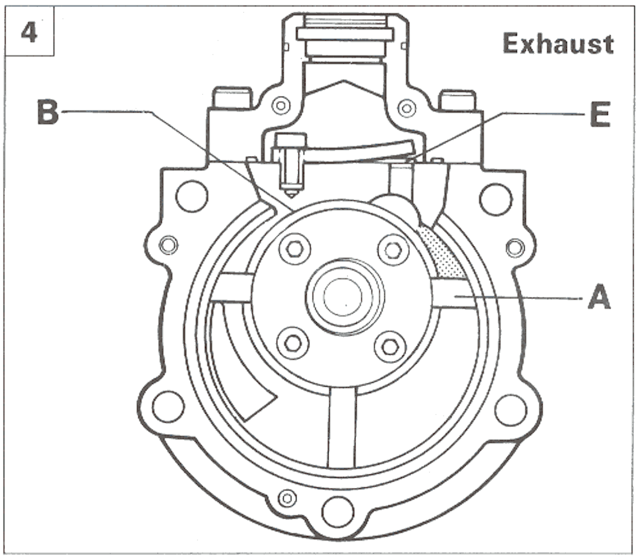

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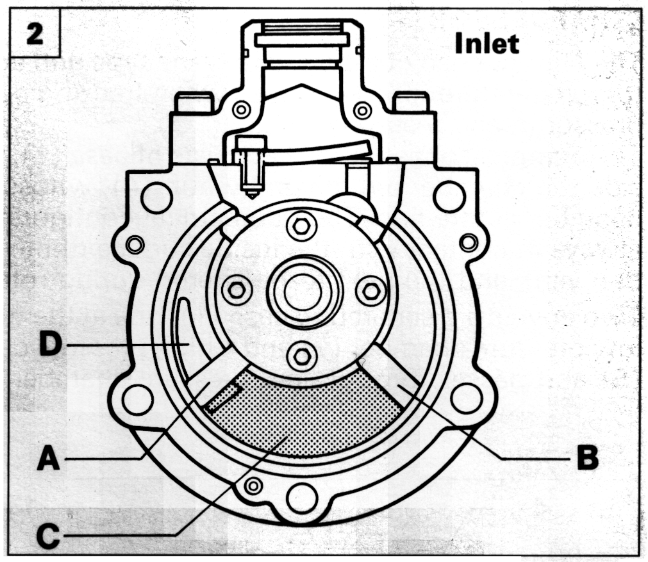
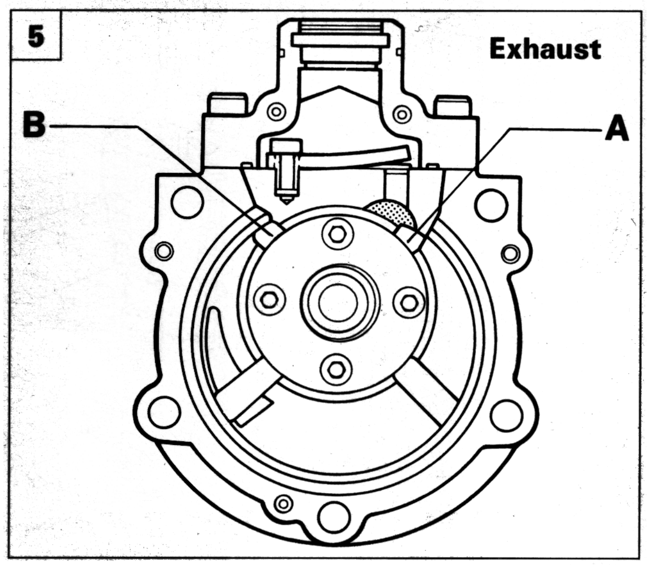


P3W006H02

OPERATION

1. Gas is taken in through slot (D) and then expands in compartment (C), which is delimited by vanes (A) and (B).
2. The new position of vanes (A) and (B) ensures that compartment (C) is at maximum volume. In particular, vane (A) cuts off communication between compartment (C) and slot (D) to complete the intake stage.
3. Compartment (C) reduces in volume and gas pressure increases: the compression stage thus begins.
4. Gas pressure increases further until strip valve (E) opens: at this moment the compression stage ends and the exhaust stage begins.
5. When vanes (A) and (B) take up the position shown in the figure, the exhaust stage is complete.



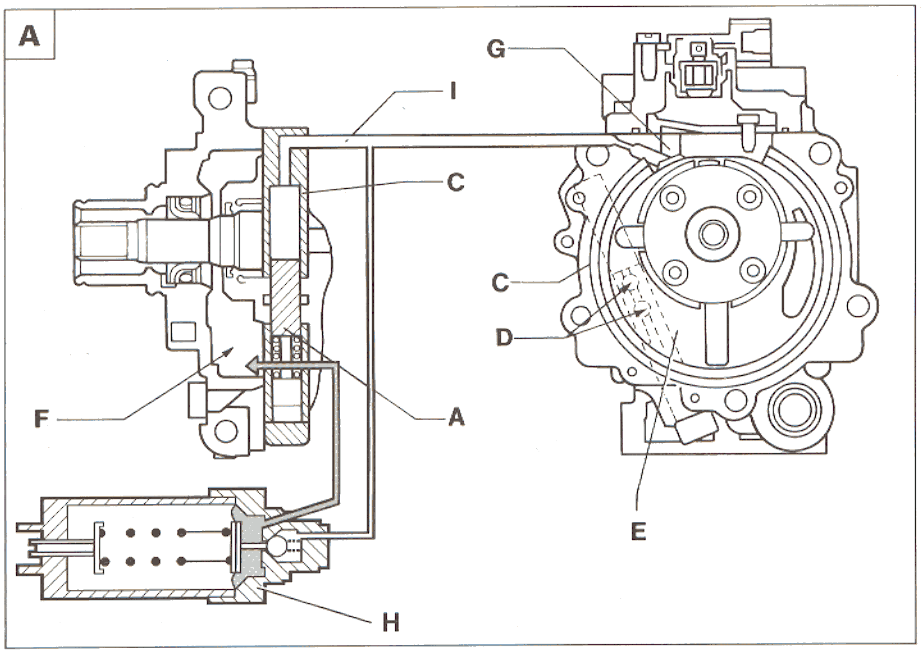
P3W006H05

Flow control

Flow control is achieved via an electropneumatic mechanism built into the compressor. This by-passes part of the gas in the compression stage to the intake, i.e. the low pressure chamber.When activated, this system, **allows compressor output to be reduced to about 17% of the total with the engine at 1000/min.**

The mechanism consists of a piston (A) that slides through cylinder (C) countered by spring (B). When the piston is positioned as shown in fig. A it blocks holes (D) that bring compartment (E; in which gas compression begins) into communication with low pressure chamber (F). Viceversa, when piston (C) is in the position in fig. B, holes (D) are in communication. The piston is operated by a small proportion of the gas under pressure, taken up by duct (I) that communicates with calibrated holes (G).

The mechanism is governed by automatic pressure regulator (H), which intervenes according to pressure in compressor low pressure chamber (F). This pressure is directly proportional to evaporator outlet fluid properties. High pressure in chamber (F) thus brings about high evaporator outlet temperature. Low pressure brings about low temperature.



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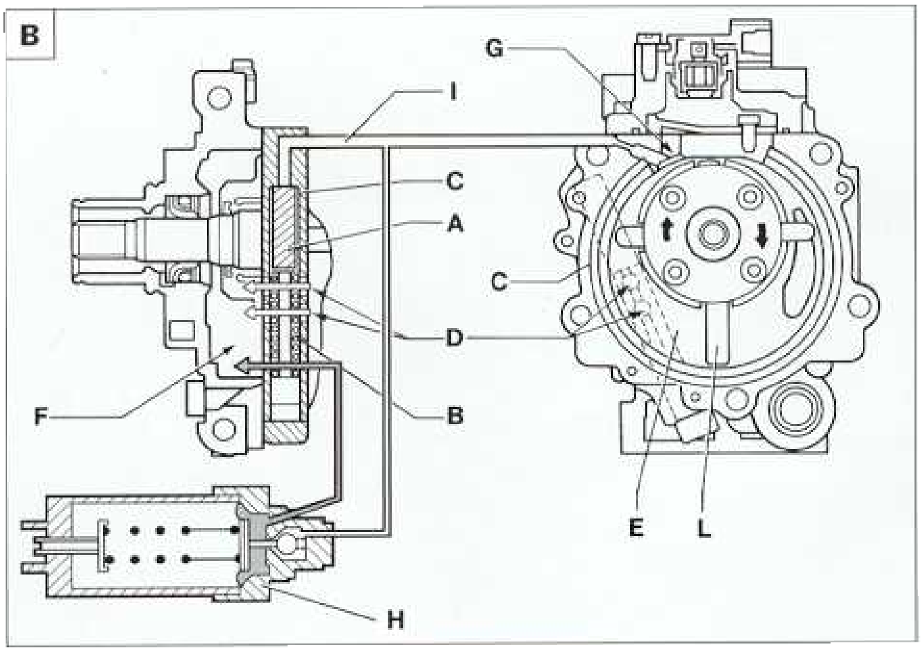


The pressure regulator consists of a ball valve controlled by reference pressure (chamber F), countered by a spring. When reference pressure is high, this overcomes spring load and the valve remains closed. Gas pressure acts on piston (A) to restore it to the position in figure A.

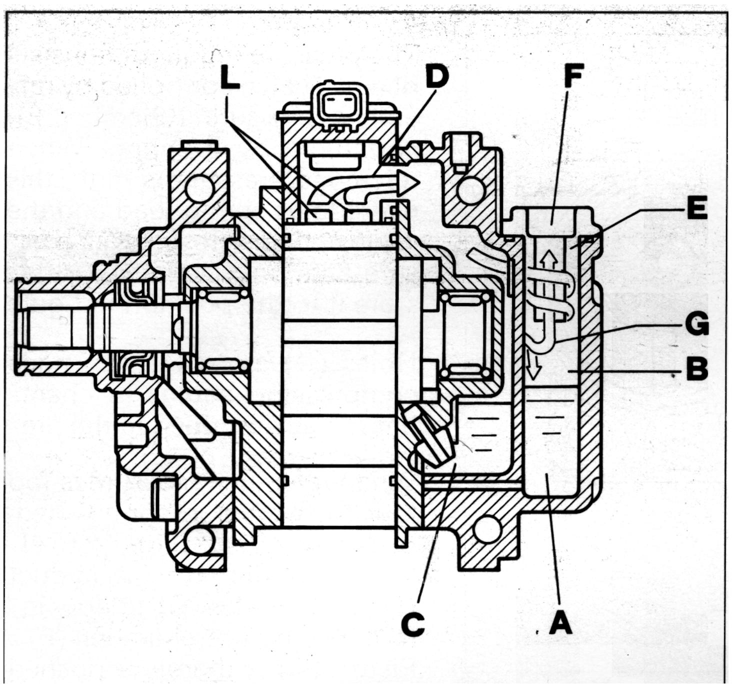
Holes (D) are cut off and gas compression begins in chamber (E) as described in the previous pages.

When reference pressure is too low to overcome spring load, ball valve opens (Fig. B) to allow gas under pressure in duct (I) and cylinder (C) to flow into low pressure chamber (F) . Piston (A) is therefore pushed into rest position by spring (B) to open up by-pass holes (D). In this way, part of the gas in chamber (E -at the compression stage) is able to flow into the low pressure chamber (F), until vane (L), has passed holes (D).

By reducing the quantity of gas in chamber (E), compressor output is also be reduced to about 17%.

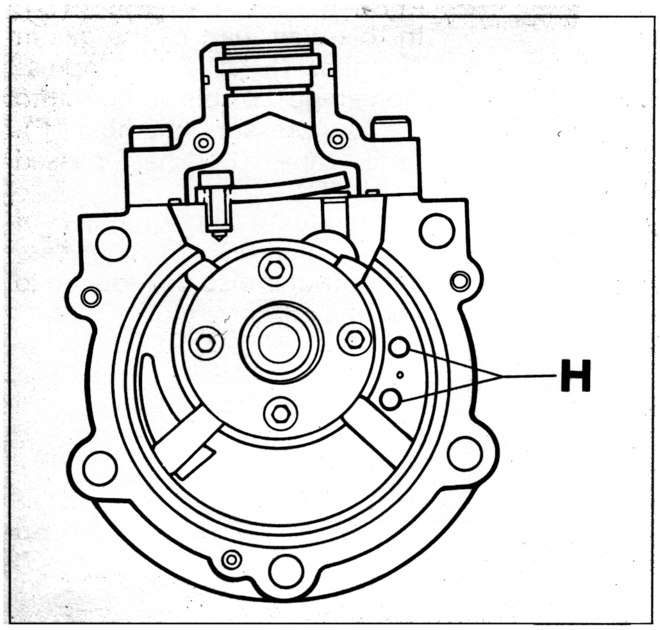
Lubrication

Lubrication oil (A) is contained in the high pressure chamber (B). When the compressor is working, the high pressure in chamber (B) forces oil through calibrated hole (C) to the moving parts inside.
Oil mixed with gas (D) is expelled through strip valve (L) to the high pressure chamber.
A separator device (E) installed in gas outlet fitting (F) separates the gas from the oil that falls under the force of gravity to the bottom of chamber (B) while the gas emerges from fitting (F).
This device minimises the amount of oil entering the system and thus increases thermal efficiency.
The compressor is also fitted with two safety valves (H) that discharge any excess pressure in compression chambers (I).
The valves open when the pressure difference between chamber (I) and chamber (B) exceeds 4 bar.



P3W008H01

To prevent the oil in the compressor from flowing into the compression chamber or the upper part of the chamber and a possible momentary loss of lubrication to the moving parts, it is essential that the compressor is always positioned with the cover turned up as shown in the figure on page 10 when not installed.



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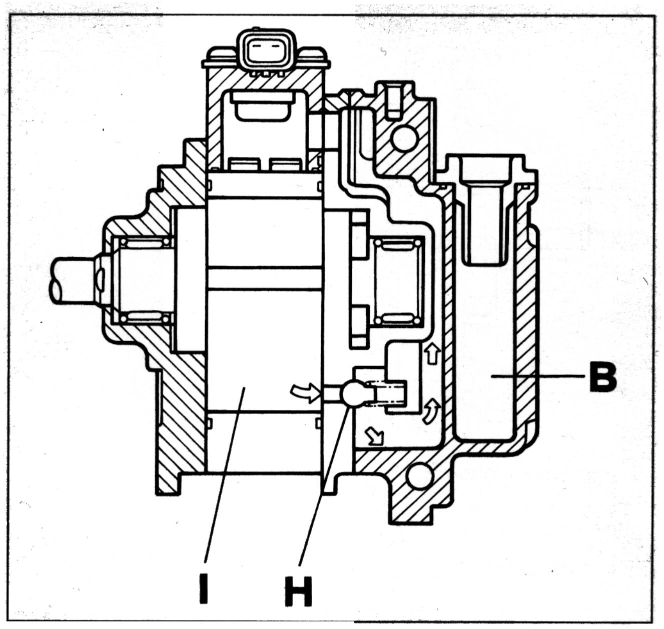


P3W008H03

MAINTENANCE AND SERVICE OPERATIONS

Lubricant oil

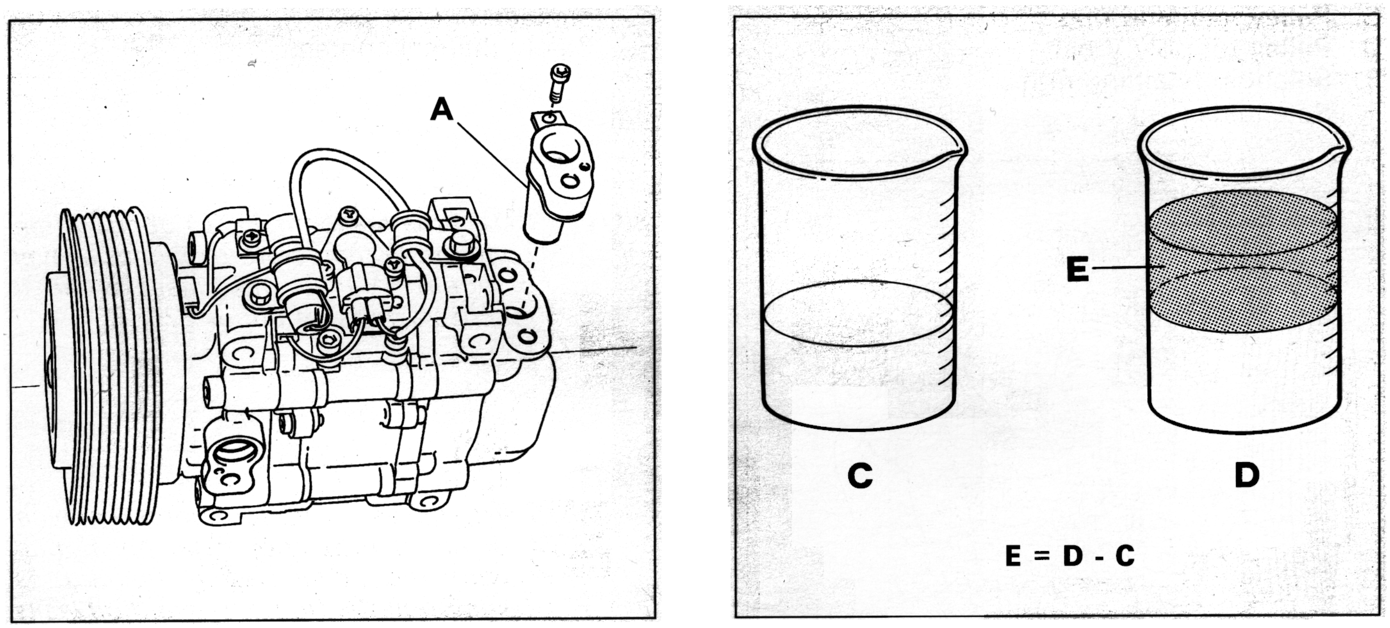
> ⚠ *The compressor is lubricated with 150 ± 20 cc of oil type ND9. Use only oil type ND9 for topping up or changes.*

In the case of service operations that involve the replacement of certain system components such as the condenser or evaporator, add 40 cc of oil for each part replaced.
If the compressor is replaced, new compressors are supplied with the required amount of oil. For this reason, prior to installation on the vehicle, remove a quantity of oil corresponding to the amount remaining in the system. To do this:

> ⚠ *New compressors are supplied pressurised with nitrogen to prevent the entrance of moisture and impurities. When fitting, therefore, remove the inlet and outlet fitting plugs slowly and with the compressor positioned exactly as shown in the figure below (with the cover facing upward).*

1. Remove the oil separator device (A) secured close to the compressor outlet fitting, which must be replaced.
2. Pour the quantity of oil in the compressor into graduated burette (C) taking care to drain the contents well.
3. Remove the oil separator device (A) from the new compressor and pour the quantity of oil contained into a graduated burette (D), taking care to drain the contents properly.
4. Remove the excess quantity of oil (E) corresponding to the difference between the quantity of oil in burette (C) and burette (D) (E=D-C).

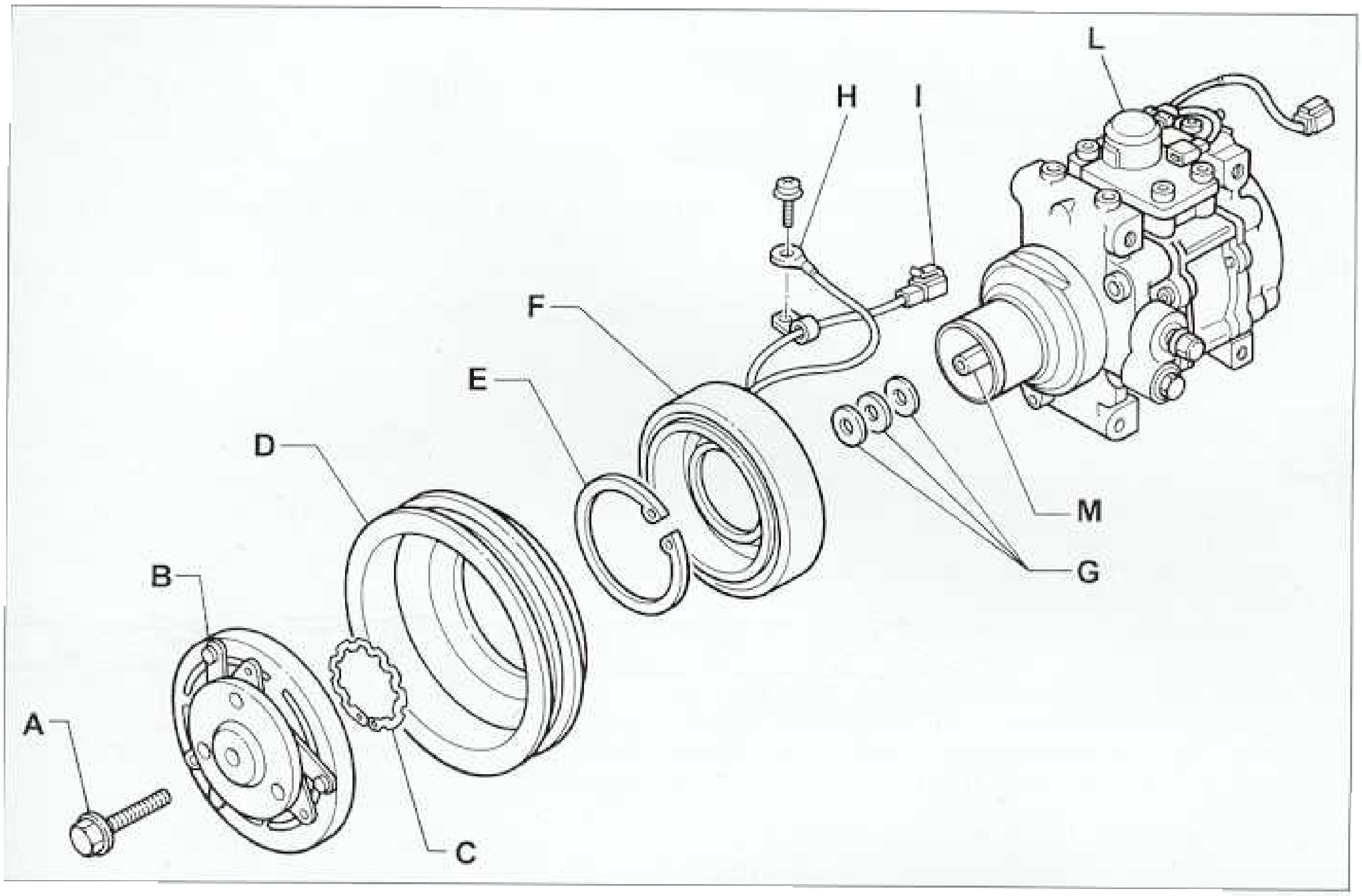
> ⚠ *The oil is highly hygroscopic: avoid leaving the tins open. Avoid leaving the compressor or any other part detached from the system for longer than necessary.*
> *Do not overturn or tilt the compressor when the oil separator device (A) is not fitted.*



P3W009H01

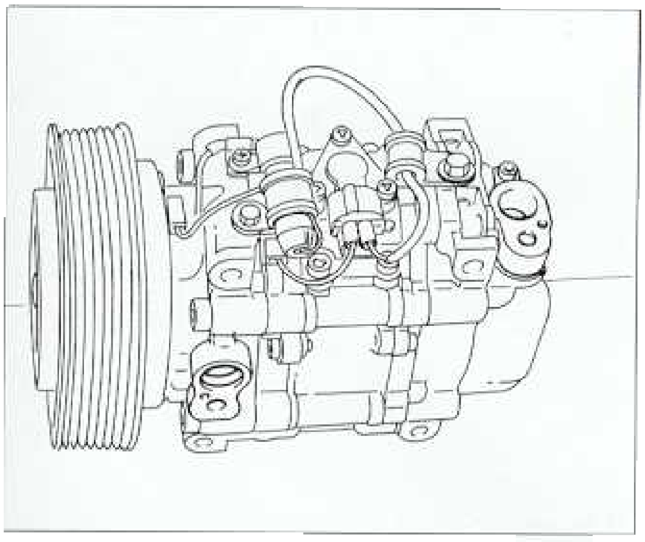
Calculating the quantity of lubricant oil to be added to compressor.

Pulley electromagnetic coupling



Parts of pulley electromagnetic coupling

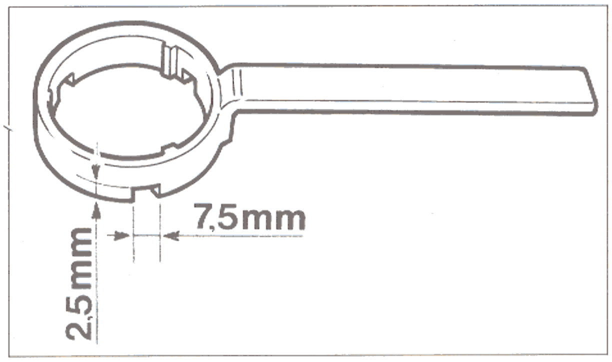
A. Screw retaining electromagnetic coupling assembly to shaft (M) of compressor
B. Hub with rubber coupling
C. Pulley retaining ring
D. Pulley for poly V belt
E. Solenoid retaining ring
F. Solenoids
G. Clutch clearance adjustment shims
H. Solenoid earth lead
I. Lead connected in line to safety thermal contact
L. Safety thermal contact



NOTE *Safety thermal contact (L) opens when compressor temperature reaches a level of about 180 °C and closes when it reaches a value of about 120 °C.*

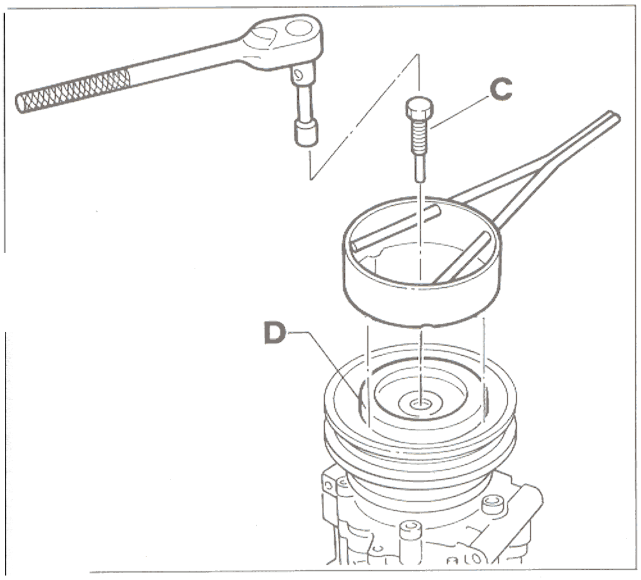
⚠ *Whenever the compressor is removed or handled, it should be positioned with the cover facing upward as shown in the figure to avoid oil leaks and the compressor becoming contaminated.*

Removing-refitting electromagnetic clutch components



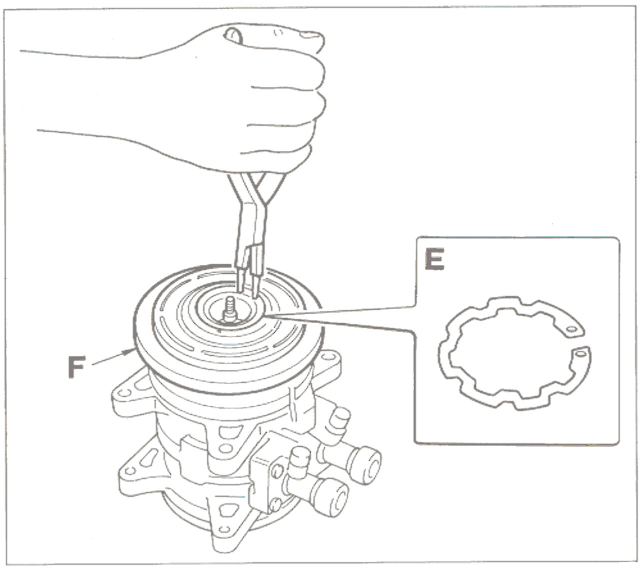
P3W011H02

Make three equidistant millings at the distances shown in the figure on tool 1860494000.
Secure hub with tool 1860494000 and remove the retaining nut.



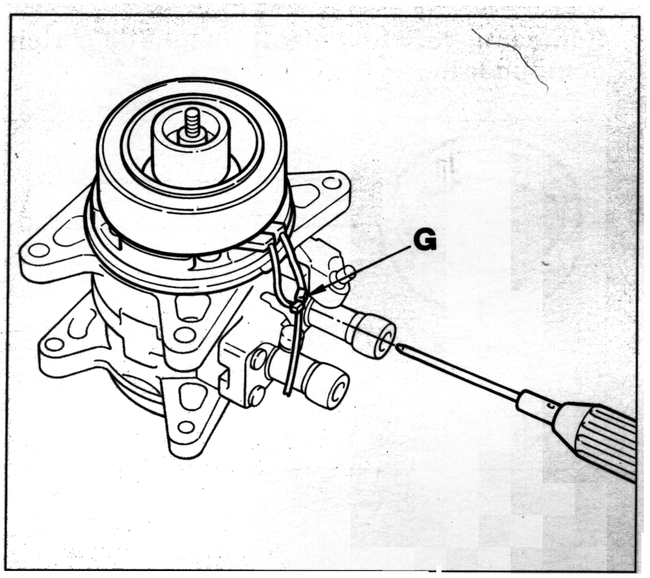
P3W011H03

Fit extractor (C) and remove (D)



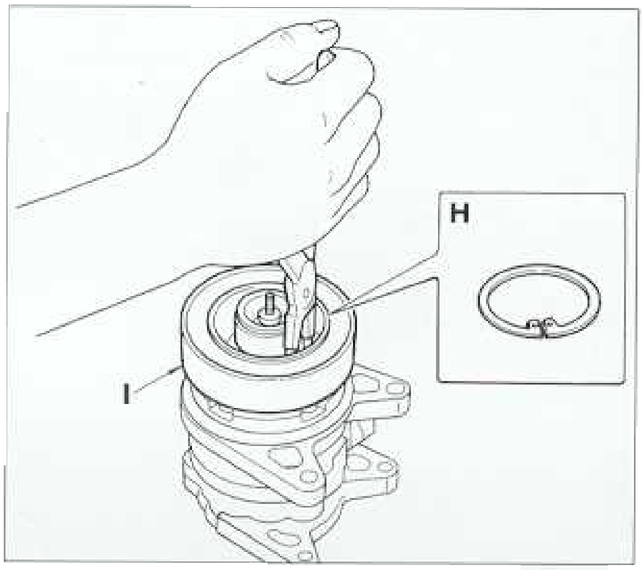
P3W011H04

Use round-nosed pliers to remove pulley retaining ring (E) and take off pulley (F).



P3W012H01

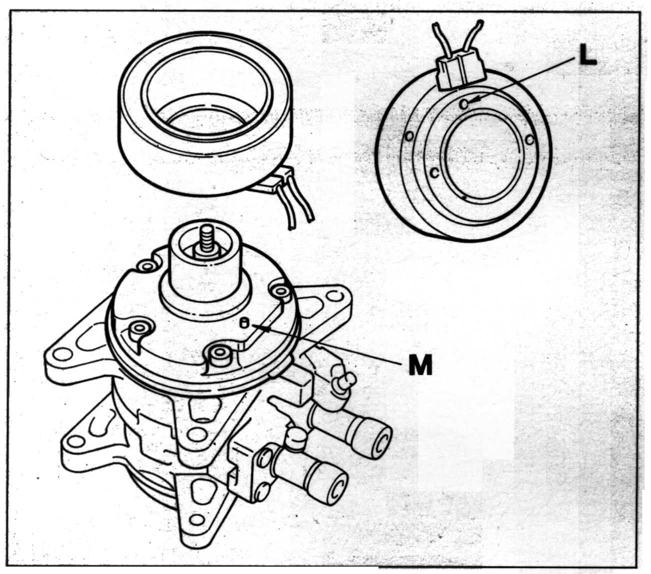
Remove solenoid lead retaining screw (G).



P3W012H02

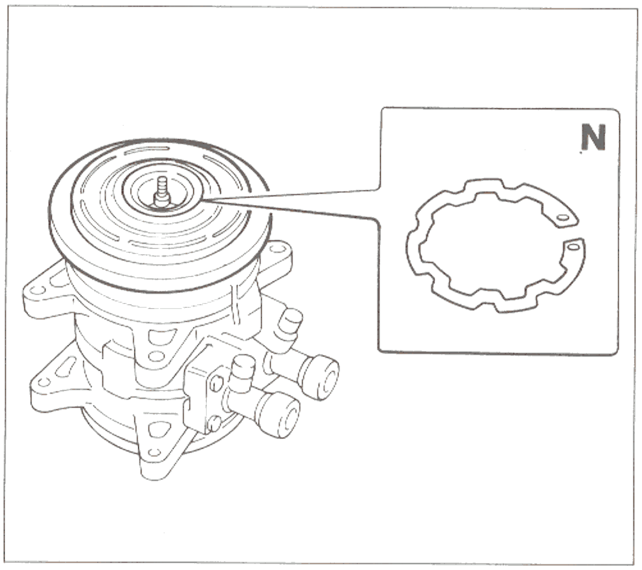
Remove ring (H) retaining solenoid and solenoid (I)

Refitting



P3W012H03

Reassemble the components by reversing order of operations described for disassembly with particular attention to the following details:
Refit solenoid taking care to insert pin (M) properly in seat (L)



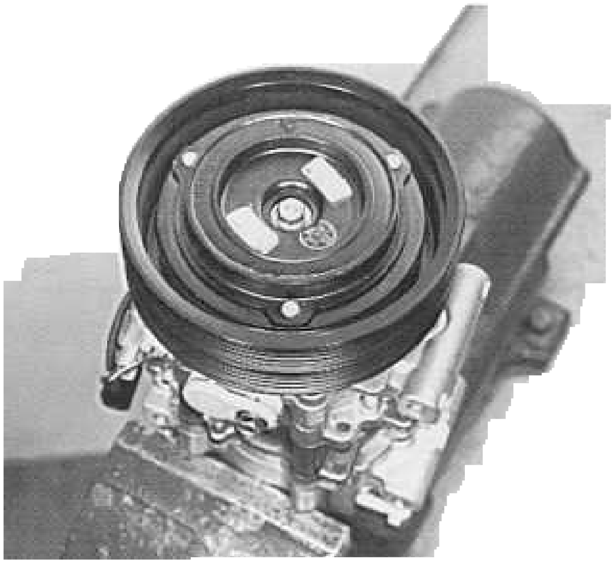
P3W012H04

Refit ring (N) retaining pulley with convex part facing upward

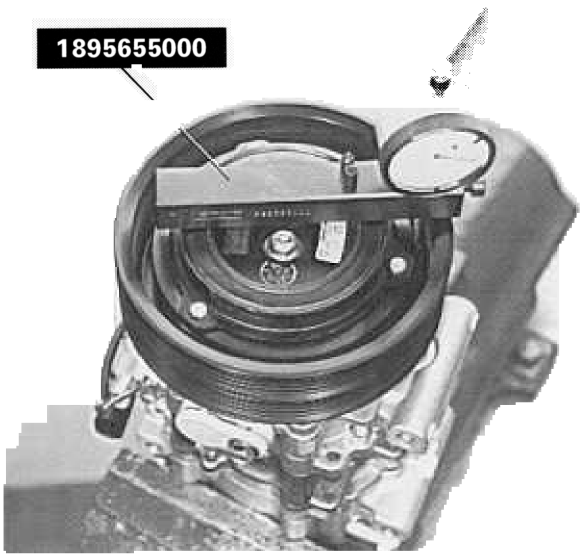
When fitting, replace all retaining rings removed previously

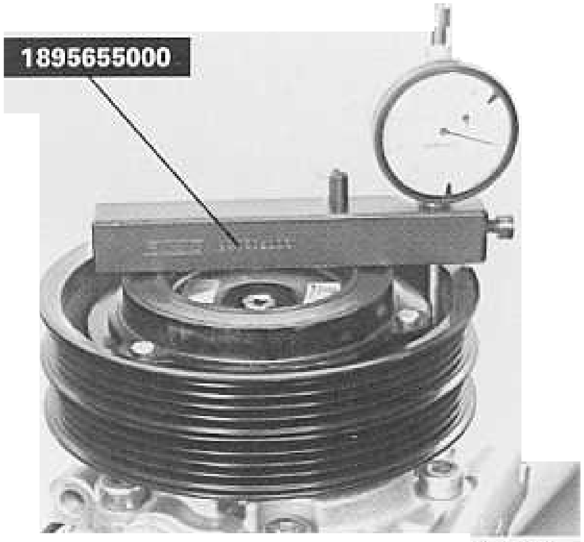
Adjusting clutch clearance

Clearance between hub and pulley must be 0.5 ± 0.15 mm.
Proceed as follows to check clutch clearance.



Rest plate 1895655000 on hub surface.
Use a gauge to measure the gap between the plate and the lower part of the clutch (gap X).
Excite solenoid with a voltage of 12V and use gauge to measure the gap between the plate and the bottom part of the clutch (gap Y).
Clutch clearance is equal to: X - Y.





If the measurement obtained is not as specified, add or remove shims between hub and compressor shaft.
For this purpose, shims are available in the following thicknesses: 0.10 - 0.30 - 0.50 mm.

After adjusting the clutch clearance, tighten the bolt retaining the assembly to the compressor shaft to a torque of: 10.8 - 16.2 Nm

OPERATION OF COMPRESSOR ECU.

When button (157a) is pressed to activate the air conditioner, ECU (99) is supplied with a positive voltage of 12 V at terminal (1) (with contacts 1 and 3 of the three stage pressure switch closed).
Under these conditions, the ECU sends a positive signal to terminal (15) of the fuel injection control unit (1), which activates (negative signal) relay (96C) in order to engage electromagnetic coupling of compressor (95) after a delay of a some microseconds used to compensate for engine idle speed.
If evaporator temperature reaches levels of less than 3 °C, the ECU eliminates the positive signal to injection control unit (1) and consequently de-activates the compressor pulley electromagnetic coupling (anti-frost function).
The electromagnetic coupling is also de-activated by the injection ECU (1) in the case of full acceleration and when engine temperature reaches a pre-established threshold, to prevent overheating.

Evaporator temperature sensor

Temperature sensor (96) is an NTC resistor and positioned close to the evaporator outlet pipe. It is not accessible from the outside.

⚠ *In the case of Service operations that involve evaporator removal/refitting, it is important NOT TO MOVE THE SENSOR FROM ITS ORIGINAL POSITION, because the different temperature levels read by a differently positioned sensor could lead to incorrect compressor output control.*

Sensor reference values are.

at 0 °C = 4852 Ω ± 243 Ω
at 15 °C = 2341 Ω ± 234 Ω
at 25 °C = 1500 Ω