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(54) **REFRIGERANT COMPRESSOR**

KÜHLKOMPRESSOR

COMPRESSEUR DE RÉFRIGÉRANT

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Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerant compressor. In the following text "refrigerant oil" means refrigerator oil.

BACKGROUND ART

[0002] In recent years, the efficiency of refrigerant compressors has been improved by using a low-viscosity refrigerant oil so as to reduce the input (see, for example, Patent Document 1 shown below).

[0003] The conventional refrigerant compressor disclosed in Patent Document 1 is described as follows with reference to Fig. 2 showing a longitudinal sectional view of the refrigerant compressor.

[0004] As shown in Fig. 2, the refrigerant compressor includes hermetic container 1, which is filled with refrigerant 2 and stores refrigerant oil 3 at its bottom. Hermetic container 1 accomodates electrically-driven element 6 and reciprocating compressing element 7 driven by electrically-driven element 6. Electrically-driven element 6 includes stator 4 and rotor 5. Refrigerant 2 is made of R600a, which is a hydrocarbon refrigerant.

[0005] Compressing element 7 is described in detail as follows.

[0006] Compressing element 7 includes crankshaft 8. Crankshaft 8 includes main shaft 9 to which rotor 5 is fixedly fitted, and eccentric shaft 10 is eccentric to main shaft 9. Crankshaft 8 is also provided at its bottom with lubrication pump 11 for lifting refrigerant oil 3.

[0007] Compressing element 7 further includes cylinder block 12. Cylinder block 12 includes a nearly cylindrical compression chamber 13, and bearing 14 for supporting main shaft 9.

[0008] Compressing element 7 further includes piston 15 loosely fitted into compression chamber 13. Piston 15 is connected to eccentric shaft 10 via piston pin 16 by connecting rod 17, which is a connection means. The end face of compression chamber 13 is tightly sealed by valve plate 18.

[0009] Compressing element 7 further includes head 19 forming an unillustrated high-pressure chamber. Head 19 is fixed on the other side of compression chamber 13 with respect to valve plate 18. Hermetic container 1 further includes muffler 20 sandwiched between valve plate 18 and head 19.

[0010] Hermetic container 1 further includes suction tube 21 and discharge tube 22 which are fixed thereto and connected to an unillustrated refrigeration cycle. Suction tube 21 guides refrigerant 2 into hermetic container 1, and discharge tube 22 sends refrigerant 2 to the refrigeration cycle.

[0011] The refrigerant compressor thus structured has the following operation and effects.

[0012] An unillustrated commercial power supply supplies power to electrically-driven element 6 so as to rotate rotor 5 of electrically-driven element 6, thereby rotating crankshaft 8. As a result, eccentric shaft 10 performs eccentric movement, allowing connecting rod 17 as the connection means to drive piston 15 via piston pin 16. This makes piston 15 reciprocate in compression chamber 13. Refrigerant 2 is guided into hermetic container 1 through suction tube 21 via an unillustrated suction reed from the refrigeration cycle. Refrigerant 2 is then suctioned through muffler 20 and continuously compressed in compression chamber 13. Refrigerant 2 thus compressed is discharged via an unillustrated discharge valve and sent through discharge tube 22 to the refrigeration cycle.

[0013] During these operations, refrigerant oil 3 is pumped by lubrication pump 11 of crankshaft 8 so as to lubricate sliding portions such as main shaft 9 and piston 15.

[0014] In the conventional refrigerant compressor, it has been attempted to achieve high efficiency by using refrigerant oil 3 having viscosity of less than 8 mm^2/s at 40°C so as to have a low friction loss in sliding portions of the refrigerant compressor, such as between compression chamber 13 and piston 15 and between crankshaft 8 and bearing 14.

[0015] In the conventional refrigerant compressor, however, refrigerant oil 3 has viscosity as low as less than 8 mm^2/s at 40°C and therefore a sufficient amount thereof cannot be held between compression chamber 13 and piston 15. This causes refrigerant 2 to leak from the gap between compression chamber 13 and piston 15, thereby increasing leakage loss.

[0016] The leakage of refrigerant 2 from the gap between compression chamber 13 and piston 15 can be decreased by reducing the gap. However, too small a gap causes the outer wall of piston 15 and the inner wall of compression chamber 13 to be brought into contact with each other and to be abraded when compressed refrigerant 2 has caused an increase of the ambient temperature.

Patent Document 1: Japanese Patent Unexamined Publication No. S62-059695 Further, Patent Document 2 discloses a lubricating oil composition for refrigerator, a working fluid and a refrigerator.
Patent Document 2 : European Patent Application No. 1 231 255.
Patent Document 3 discloses a reciprocating refrigerant compressor.

Patent Document 3 : Japanese Patent Application No. 2002-031059.
Patent Document 4 discloses a refrigerant compressor, cooling system and refrigerator.
Patent Document 4: International Patent Application No. 2007-029884.
Patent Document 5 discloses a refrigerating machine oil.
Patent Document 5 : Japanese Patent Application No. S61-62596. Finally, Non-Patent Document 6 discloses a study regarding an optimum piston-bore fit for maximum compressor efficiency.
Non-Patent Document 6: H. Buka, International Compressor Engineering Conference (2000), Paper 1430, p. 523.

SUMMARY OF THE INVENTION

[0017] The refrigerant compressor of the present invention is defined by the independent claims and includes a hermetic container storing refrigerant oil; an electrically-driven element; and a compressing element driven by the electrically-driven element. The compressing element includes a cylinder block having a cylindrical compression chamber and a cylindrical piston reciprocating in the compression chamber. The compression chamber and the piston have a diameter difference in the range of not shorter than 4 pm to not longer than 15 pm. The refrigerant oil has viscosity of 8 mm^2/s or less at 40 °C and is prepared by mixing a first refrigerant oil having viscosity of less than 8 mm^2/s at 40 °C with a second refrigerant oil having viscosity of 20 mm^2/s or more at 40 °C and an antioxidant or an extreme-pressure additive is added to the refrigerant oil.
[0018] In the refrigerant compressor, the refrigerant oil has a low viscosity resistance to make the friction loss small. At the same time, a sufficient amount of the refrigerant oil can be held between the compression chamber and the piston so as to have a low leakage loss of the refrigerant. Furthermore, the diameter difference between the compression chamber and the piston can be optimized to prevent abrasion between them which is caused by their contact. These features result in an efficient and reliable refrigerant compressor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a longitudinal sectional view of a refrigerant compressor according to an embodiment of the present invention.
Fig. 2 is a longitudinal sectional view of a conventional refrigerant compressor.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0020] An embodiment of the present invention is described as follows with reference to drawings. Note that the present invention is not limited to this embodiment.

EMBODIMENT

[0021] Fig. 1 is a longitudinal sectional view of a refrigerant compressor according to the embodiment of the present invention.
[0022] As shown in Fig. 1, refrigerant compressor 100 includes hermetic container 101, which is filled with refrigerant 102 and stores refrigerant oil 103 at its bottom. Refrigerant compressor 100 further includes electrically-driven element 106 and reciprocating compressing element 107 driven by electrically-driven element 106. Electrically-driven element 106 includes stator 104 and rotor 105.
[0023] Compressing element 107 is described in detail as follows.
[0024] Compressing element 107 includes crankshaft 108 made of ferrous metal. Crankshaft 108 includes main shaft 109 to which rotor 105 is fixedly fitted, and eccentric shaft 110 eccentric to main shaft 109. Crankshaft 108 is also provided at its bottom with lubrication pump 111 for lifting refrigerant oil 103. Compressing element 107 further includes cylinder block 112. Cylinder block 112 includes nearly cylindrical compression chamber 113 and bearing 114 for supporting main shaft 109.
[0025] Compressing element 107 further includes piston 115 made of ferrous metal and loosely fitted into compression chamber 113. Piston 115 is connected to eccentric shaft 110 via piston pin 116 by connecting rod 117, which is a connection means.
[0026] The end face of compression chamber 113 is tightly sealed by valve plate 118. Valve plate 118 is made of laminated spring steel and forms valve member 120 composed of suction reed 119 for opening and closing an unillustrated suction port.
[0027] Compressing element 107 further includes head 121 which is fixed on the other side of compression chamber 113 with respect to valve plate 118. Hermetic container 101 further includes muffler 122 sandwiched between valve

plate 118 and head 121.

[0028] Muffler 122 is made of polybutylene terephthalate mixed with glass fiber.

[0029] Hermetic container 101 further includes suction tube 123 and discharge tube 124 which are fixed thereto and connected to an unillustrated refrigeration cycle. Suction tube 123 guides refrigerant 102 into hermetic container 101, and discharge tube 124 sends refrigerant 102 to the refrigeration cycle.

[0030] The refrigerant compressor thus structured has the following operation and effects.

[0031] An unillustrated commercial power supply supplies power to electrically-driven element 106 so as to rotate rotor 105 of electrically-driven element 106, thereby rotating crankshaft 108. As a result, eccentric shaft 110 performs eccentric movement, allowing connecting rod 117 to drive piston 115 via piston pin 116. This makes piston 115 reciprocate in compression chamber 113.

[0032] Refrigerant 102 is guided into hermetic container 101 through suction tube 123 and then suctioned into compression chamber 113 through muffler 122. Refrigerant 102 suctioned into compression chamber 113 is continuously compressed. Refrigerant 102 thus compressed is sent to the refrigeration cycle through discharge tube 124. Refrigerant 102 sent to the refrigeration cycle is guided again into hermetic container 101 through suction tube 123.

[0033] During these operations, refrigerant oil 103 is pumped by lubrication pump 111 of crankshaft 108 so as to lubricate sliding portions such as main shaft 109 and piston 115.

[0034] The following is a description, with reference to Table 1, of the relation between the diameter difference between compression chamber 113 and piston 115, the type of refrigerant oil, and the efficiency of the compressor.

[0035] Table 1 shows the results of the efficiency analysis of refrigerant compressors having the same specification with piston 115 of a 30 mm outer diameter. The analysis is performed by changing the diameter differences between compression chamber 113 and piston 115 and using three types of refrigerant oils.

[0036] Refrigerant oil "A" is refrigerant oil 103 used in the refrigerant compressor according to the embodiment of the present invention. Refrigerant oil "A" has viscosity of 8 mm^2/s at 40°C and is prepared by mixing mineral oil having viscosity of 7.5 mm^2/s at 40°C as a first refrigerant oil with 3 wt% of mineral oil having viscosity of 20 mm^2/s at 40°C as a second refrigerant oil.

[0037] Refrigerant oil "B", which is used to be compared with refrigerant oil "A", is mineral oil having viscosity of 8 mm^2/s at 40°C.

[0038] Refrigerant oil "C", which is also used to be compared with refrigerant oil "A", is mineral oil having viscosity of 10 mm^2/s at 40°C.

[0039] The analysis is performed at a condensation temperature of 54.4°C and an evaporation temperature of -23.3°C. The efficiencies of three refrigerant compressors are compared by using R600a as a refrigerant and by changing the diameter difference between compression chamber 113 and piston 115 in the range of not shorter than 4 μm to not longer than 18 μm.

Table 1

diameter difference between compression chamber and piston (μm) / refrigerant oil	4	8	10	12	15	18
refrigerant oil "A" (the present invention)	○	○	○	○	○	△
refrigerant oil "B"	△	△	△	△	△	△
refrigerant oil "C"	standard					

Note: ○ indicates the compressor efficiency is higher than in the case of refrigerant oil "C", and △ indicates the compressor efficiency is equal to or less than in the case of refrigerant oil "C".

[0040] Table 1 indicates that when the diameter difference between compression chamber 113 and piston 115 is in the range of not shorter than 4 μm to not longer than 18 μm, the efficiency of the compressor using refrigerant oil "B" made of only the mineral oil having viscosity of 8 mm^2/s at 40°C is equal to or less than that of the compressor using refrigerant oil "C" made of only the mineral oil having viscosity of 10 mm^2/s at 40°C.

[0041] The reason for the low efficiency of the compressor using refrigerant oil "B" is considered as follows. Refrigerant oil "B" has a low viscosity resistance to make the friction loss low. However, the low viscosity of refrigerant oil "B" causes refrigerant oil "B" to flow out from the gap between compression chamber 113 and piston 115. This reduces the sealing effect for the gap between compression chamber 113 and piston 115, thereby causing a leakage of refrigerant 102.

[0042] On the other hand, the compressor using refrigerant oil "A", which is refrigerant oil 103 used in the refrigerant compressor according to the embodiment of the present invention, has a higher efficiency than the compressor using refrigerant oil "C" when the diameter difference between compression chamber 113 and piston 115 is in the range of not shorter than 4 μm to not longer than 15 μm.

[0043] The reason for the high efficiency of the compressor using refrigerant oil "A" is considered as follows. The mineral oil having viscosity as high as 20 mm^2/s at 40°C reduces the amount of refrigerant oil "A" flowing out from the gap between compression chamber 113 and piston 115. On the other hand, the low-viscosity oil reduces friction loss. In addition, refrigerant oil 103 prevents a reduction in the sealing effect between compression chamber 113 and piston 115.

[0044] Although detailed results are not available, the following has been performed. Different refrigerant oils having viscosity of 8 mm^2/s or less at 40°C are prepared by mixing an oil having viscosity lower than 7.5 mm^2/s at 40°C as the first refrigerant oil with an oil having viscosity higher than 20 mm^2/s at 40°C as the second refrigerant oil. Then, these different refrigerant oils having viscosity of 8 mm^2/s or less at 40°C are used to analyze the efficiencies of compressors. As a result, these refrigerant oils having viscosity of 8 mm^2/s or less at 40°C have similar effects to refrigerant oil "A" which is superior to refrigerant oils "B" and "C".

[0045] Thus, setting the diameter difference between compression chamber 113 and piston 115 to the range of not shorter than 4 μm to not longer than 15 μm prevents abrasion between compression chamber 113 and piston 115 which is caused when the gap between them is too small. Furthermore, the refrigerant oil having a low viscosity prevents friction loss, and the second refrigerant oil prevents a decrease in the sealing effect between compression chamber 113 and piston 115. These features result in an efficient refrigerant compressor.

[0046] Particularly when a refrigerant compressor has been operated for a long time, compression chamber 113 and piston 115 sliding along each other can be abraded, causing an increase in the gap between them. Even so, the oil-sealing effect for the sliding portion between compression chamber 113 and piston 115 can be secured to maintain high efficiency.

[0047] When a low-viscosity oil having viscosity of less than 8 mm^2/s at 40°C is used as the first refrigerant oil in order to reduce the friction loss in sliding portions or other portions, it is possible to use a high-viscosity oil having viscosity of 20 mm^2/s or more at 40°C as the second refrigerant oil to obtain the same effect as refrigerant oil "A". It goes without saying that there are numerous viscosity combinations and numerous mixing ratios between the first and second refrigerant oils.

[0048] In the refrigerant compressor according to the embodiment of the present invention, the first refrigerant oil having viscosity of less than 8 mm^2/s at 40°C is mineral oil. Alternatively, the first refrigerant oil may be ester oil or hard alkyl benzene oil.

[0049] In the refrigerant compressor according to the embodiment of the present invention, the second refrigerant oil having viscosity of 20 mm^2/s or more at 40°C is mineral oil. Alternatively, the second refrigerant oil may be ester oil, hard alkyl benzene oil, a poly-α-olefin oil, or a polyalkylene glycol oil.

[0050] Refrigerant compressors in which the diameter difference between compression chamber 113 and piston 115 is set to 15 μm are operated for 500 hours at a condensation temperature of 54.4°C and an evaporation temperature of -23.3°C. As a result, in the refrigerant compressor using refrigerant oil "B" having viscosity of 8 mm^2/s at 40°C, oligomer that seems to have been extracted from muffler 122 has been observed on valve member 120. On the other hand, no deposits such as oligomer or oil sludge have been observed in the refrigerant compressor using refrigerant oil "A" which is a mixture of mineral oil having viscosity of 7.5 mm^2/s at 40°C as the first refrigerant oil, and 3 wt% or more of mineral oil having viscosity of 20 mm^2/s at 40°C as the second refrigerant oil.

[0051] The reason for this is considered as follows. The mineral oil having viscosity of 20 mm^2/s at 40°C reduces the evaporation of refrigerant oil 103, thereby preventing oligomer or oil sludge from remaining on valve member 120, which is raised to high temperature.

[0052] In addition, the weight percentage of the second refrigerant oil is made greater than 3 wt% so as to further reduce the evaporation, thereby increasing the effect of preventing the deposition of oligomer on valve member 120.

[0053] Although detailed results are not available, the following has been performed. Different refrigerant oils having viscosity of 8 mm^2/s or less at 40°C are prepared by mixing an oil having viscosity lower than 7.5 mm^2/s at 40°C as the first refrigerant oil and an oil having viscosity higher than 20 mm^2/s at 40°C as the second refrigerant oil. Then, these different refrigerant oils having viscosity of 8 mm^2/s or less at 40°C have been tested and found that no deposits such as oligomer or oil sludge are observed when the content of the second refrigerant oil is 3 wt% or more.

[0054] Thus, a reliable compressor causing no deposition of oligomer onto the valve member and other portions can be provided by using refrigerant oil "A" which is a mixture of mineral oil having viscosity of less than 8 mm^2/s at 40°C and 3 wt% or more of an oil having viscosity of 20 mm^2/s or more at 40°C.

[0055] Next, the compatibility between refrigerants and refrigerant oils of the present invention are described as follows with reference to Table 2. R134a which is an HFC refrigerant and R600a which is an HC refrigerant are aged in hermetic container 101 for 14 days at 140°C with refrigerant oil of the present invention having ester oil, mineral oil, or hard alkyl benzene oil as base oil so as to test their compatibility.

Table 2

refrigerant	R134a			R600a		
refrigerant oil	ester oil	mineral oil	hard alkyl benzene oil	ester oil	mineral oil	hard alkyl benzene oil
degradation of refrigerant oil	no degradation					

[0056] Table 2 indicates that all the combinations between the refrigerants and the refrigerant oils show good results, causing no oil sludge or other deposits.

[0057] In other words, a reliable refrigerant compressor can be achieved by combining either an HFC refrigerant or an HC refrigerant with refrigerant oil having ester oil, mineral oil, or hard alkyl benzene oil as base oil without degradation of the refrigerant oil.

[0058] Alternatively, it is possible to mix ester oil, mineral oil, and hard alkyl benzene oil to obtain the same effect.

[0059] Refrigerant oil 103 may be added with an antioxidant to prevent degradation of refrigerant oil 103 when exposed to a high-temperature high-humidity environment during storage, thereby achieving a reliable refrigerant compressor.

[0060] Refrigerant oil 103 may be added with an extreme-pressure additive such as tricresyl phosphate that undergoes a chemical reaction to form a film on a metal surface. This reduces the abrasion of the sliding portions, thereby achieving a reliable refrigerant compressor.

[0061] Refrigerant oil 103 may be added with an oil agent that can absorb a metal physically or chemically, such as higher fatty acid, higher alcohol, or a compound having an ester group. The addition of such an oil agent can reduce the deposition of oligomer onto the metal surface if the oligomer is extracted from muffler 122, thereby reducing the blockage of the passage of refrigerant 102 in the refrigeration cycle. This results in a reliable refrigerant compressor.

[0062] As described hereinbefore, the efficient and reliable refrigerant compressor according to the embodiment of the present invention is achieved by setting the diameter difference between compression chamber 113 and piston 115 to the range of not shorter than 4 μm to not longer than 15 μm, and by using refrigerant oil 103 having viscosity of 8 mm^2/s or less at 40°C. Refrigerant oil 103 is a mixture of the first refrigerant oil having viscosity of less than 8 mm^2/s at 40°C and the second refrigerant oil having viscosity of 20 mm^2/s or more at 40°C.

INDUSTRIAL APPLICABILITY

[0063] As described above, the refrigerant compressor of the present invention has high efficiency and therefore is applicable to a device having a refrigeration cycle.

Claims

1. A refrigerant compressor (100) comprising:

a hermetic container (101) storing refrigerator oil (103);
an electrically-driven element (106); and
a compressing element (107) driven by the electrically-driven element (106), the compressing element (107) including a cylinder block (112) having a cylindrical compression chamber (113) and a cylindrical piston (115) reciprocating in the compression chamber (113), wherein
the compression chamber (113) and the piston (115) have a diameter difference in a range of not shorter than 4 μm to not longer than 15 μm,
characterized in that
the refrigerator oil (103) has viscosity of not more than 8 mm^2/s at 40°C and consists of a first refrigerator oil and a second refrigerator oil, the refrigerator oil is prepared by mixing the first refrigerator oil having viscosity of less than 8 mm^2/s at 40°C with the second refrigerator oil having viscosity of not less than 20 mm^2/s at 40°C, and an antioxidant is added to the refrigerator oil (103).

2. The refrigerant compressor of claim 1, wherein
the refrigerator oil contains the second refrigerant oil of not less than 3 wt%.

3. The refrigerant compressor of one of claims 1 and 2, wherein

a refrigerant (102) to be compressed in the compression chamber is one of an HFC refrigerant and an HC refrigerant, and
the refrigerator oil (103) contains one of ester oil, mineral oil, and hard alkyl benzene oil as base oil.

4. A refrigerant compressor (100) comprising:

a hermetic container (101) storing refrigerator oil (103);
an electrically-driven element (106); and
a compressing element (107) driven by the electrically-driven element (106), the compressing element (107) including a cylinder block (112) having a cylindrical compression chamber (113) and a cylindrical piston (115) reciprocating in the compression chamber (113), wherein
the compression chamber (113) and the piston (115) have a diameter difference in a range of not shorter than 4 μm to not longer than 15 μm,
characterized in that
the refrigerator oil (103) has viscosity of not more than 8 mm^2/s at 40°C and consists of a first refrigerator oil and a second refrigerator oil, the refrigerator oil is prepared by mixing the first refrigerator oil having viscosity of less than 8 mm^2/s at 40°C with the second refrigerator oil having viscosity of not less than 20 mm^2/s at 40°C,

wherein an extreme-pressure additive is added to the refrigerator oil (103).

5. The refrigerant compressor of claim 4, wherein the refrigerator oil (103) contains the second refrigerator oil of not less than 3 wt%.

6. The refrigerant compressor of one of claims 4 and 5, wherein

a refrigerant (102) to be compressed in the compression chamber is one of an HFC refrigerant and an HC refrigerant, and
the refrigerator oil (103) contains one of ester oil, mineral oil, and hard alkyl benzene oil as base oil.

Patentansprüche

1. Kältemittelverdichter (100), umfassend:

einen hermetischen Behälter (101) zur Lagerung von Kältemaschinenöl (103);
ein elektrisch betriebenes Element (106); und
ein Verdichtungselement (107), das durch das elektrisch betriebene Element (106) angetrieben wird, wobei das Verdichtungselement (107) einen Zylinderblock (112) mit einem zylindrischen Verdichtungsraum (113) und einen zylindrischen Kolben (115) umfasst, der sich im Verdichtungsraum (113) hin- und herbewegt, wobei der Verdichtungsraum (113) und der Kolben (115) eine Durchmesserdifferenz in einem Bereich von nicht kürzer als 4 μm bis nicht länger als 15 μm aufweisen,
dadurch gekennzeichnet, dass
das Kältemaschinenöl (103) eine Viskosität von nicht mehr als 8 mm^2/s bei 40°C hat und aus einem ersten Kältemaschinenöl und einem zweiten Kältemaschinenöl besteht, wobei das Kältemaschinenöl durch Mischen des ersten Kältemaschinenöls mit einer Viskosität von weniger als 8 mm^2/s bei 40°C mit dem zweiten Kältemaschinenöl mit einer Viskosität von nicht weniger als 20 mm^2/s bei 40°C hergestellt wird und wobei dem Kältemaschinenöl (103) ein Antioxidationsmittel zugesetzt wird.

2. Kältemittelverdichter nach Anspruch 1, wobei das Kältemaschinenöl das zweite Kältemaschinenöl von nicht weniger als 3 Gew.-% enthält.

3. Kältemittelverdichter nach einem der Ansprüche 1 und 2, wobei ein Kältemittel (102), das im Verdichtungsraum verdichtet werden soll, eines von HFC-Kühlmittel und HC-Kühlmittel ist, und
das Kältemaschinenöl (103) eines von Esteröl, Mineralöl und Hartalkyl Benzolöl als Basisöl enthält.

4. Kältemittelverdichter (100), umfassend:

einen hermetischen Behälter (101) zur Lagerung von Kältemaschinenöl (103);
ein elektrisch betriebenes Element (106); und
ein Verdichtungselement (107), das vom elektrisch betriebenen Element (106) angetrieben wird,
wobei das Verdichtungselement (107), einen Zylinderblock (112) mit einem zylindrischen Verdichtungsraum (113) und einem zylindrischen Kolben (115) umfasst, der sich im Verdichtungsraum (113) hin- und herbewegt, wobei
der Verdichtungsraum (113) und der Kolben (115) eine Durchmesserdifferenz in einem Bereich von nicht kürzer als 4 μm bis nicht länger als 15 μm aufweisen,
dadurch gekennzeichnet, dass
das Kältemaschinenöl (103) eine Viskosität von nicht mehr als 8 mm^2/s bei 40°C hat und aus einem ersten Kältemaschinenöl und einem zweiten Kältemaschinenöl besteht, wobei das Kältemaschinenöl durch Mischen des ersten Kältemaschinenöls mit einer Viskosität von weniger als 8 mm^2/s bei 40°C mit dem zweiten Kältemaschinenöl mit einer Viskosität von nicht weniger als 20 mm^2/s bei 40°C hergestellt wird, wobei dem Kältemaschinenöl (103) ein Hochdruckzusatz zugesetzt wird.

5. Kältemittelverdichter nach Anspruch 4, wobei das Kältemaschinenöl (103) das zweite Kältemaschinenöl von nicht weniger als 3 Gew.-% enthält.

6. Kältemittelverdichter nach einem der Ansprüche 4 und 5, wobei
ein Kältemittel (102), das im Verdichtungsraum verdichtet werden soll, eines von HFC-Kühlmittel und HC-Kühlmittel ist, und
das Kältemaschinenöl (103) eines von Esteröl, Mineralöl und Hartalkyl Benzolöl als Basisöl enthält.

Revendications

1. Compresseur de réfrigérant (100) comprenant :

   un récipient hermétique (101) stockant de l'huile de réfrigérateur (103) ;
   un élément entraîné électriquement (106) ; et
   un élément de compression (107) entraîné par l'élément entraîné électriquement (106), l'élément de compression (107) comprenant un bloc cylindres (112) ayant une chambre de compression cylindrique (113) et un piston cylindrique (115) effectuant un mouvement de va-et-vient dans la chambre de compression (113),
   dans lequel la chambre de compression (113) et le piston (115) ont une différence de diamètre située dans la plage allant d'au moins 4 μm à au plus 15 μm,
   caractérisé en ce que l'huile de réfrigérateur (103) a une viscosité non supérieure à 8 mm^2/s à 40°C et consiste en une première huile de réfrigérateur et d'une deuxième huile de réfrigérateur, l'huile de réfrigérateur est préparée par mélange de la première huile de réfrigérateur ayant une viscosité inférieure à 8 mm^2/s à 40°C avec la deuxième huile de réfrigérateur ayant une viscosité non inférieure à 20 mm^2/s à 40°C, et un antioxydant est ajouté à l'huile de réfrigérateur (103).

2. Compresseur de réfrigérant selon la revendication 1, dans laquelle l'huile de réfrigérateur contient la deuxième huile de réfrigérant à raison d'au moins 3 % en poids.

3. Compresseur de réfrigérant selon l'une des revendications 1 et 2, dans lequel
un réfrigérant (102) devant être comprimé dans la chambre de compression est l'un parmi un réfrigérant HFC et un réfrigérant HC, et
l'huile de réfrigérateur (103) contient, en tant qu'huile de base, l'une parmi une huile de type ester, une huile minérale, et une huile d'alkylbenzène dure.

4. Compresseur de réfrigérant (100) comprenant :

   un récipient hermétique (101) stockant de l'huile de réfrigérateur (103) ;
   un élément entraîné électriquement (106) ; et
   un élément de compression (107) entraîné par l'élément entraîné électriquement (106), l'élément de compression (107) comprenant un bloc cylindres (112) ayant une chambre de compression cylindrique (113) et un piston cylindrique (115) effectuant un mouvement de va-et-vient dans la chambre de compression (113),
   dans lequel la chambre de compression (113) et le piston (115) ont une différence de diamètre située dans la plage allant d'au moins 4 μm à au plus 15 μm,
   caractérisé en ce que l'huile de réfrigérateur (103) a une viscosité non supérieure à 8 mm^2/s à 40°C et consiste en une première huile de réfrigérateur et d'une deuxième huile de réfrigérateur, l'huile de réfrigérateur est préparée par mélange de la première huile de réfrigérateur ayant une viscosité inférieure à 8 mm^2/s à 40°C avec la deuxième huile de réfrigérateur ayant une viscosité non inférieure à 20 mm^2/s à 40°C, dans lequel un additif extrême pression est ajouté à l'huile de réfrigérateur (103).

5. Compresseur de réfrigérant selon la revendication 4, dans laquelle l'huile de réfrigérateur (103) contient la deuxième huile de réfrigérateur à raison d'au moins 3 % en poids.

6. Compresseur de réfrigérant selon l'une des revendications 4 et 5, dans lequel
un réfrigérant (102) devant être comprimé dans la chambre de compression est l'un parmi un réfrigérant HFC et un réfrigérant HC, et
l'huile de réfrigérateur (103) contient, en tant qu'huile de base, l'une parmi une huile de type ester, une huile minérale, et une huile d'alkylbenzène dure.

FIG. 1

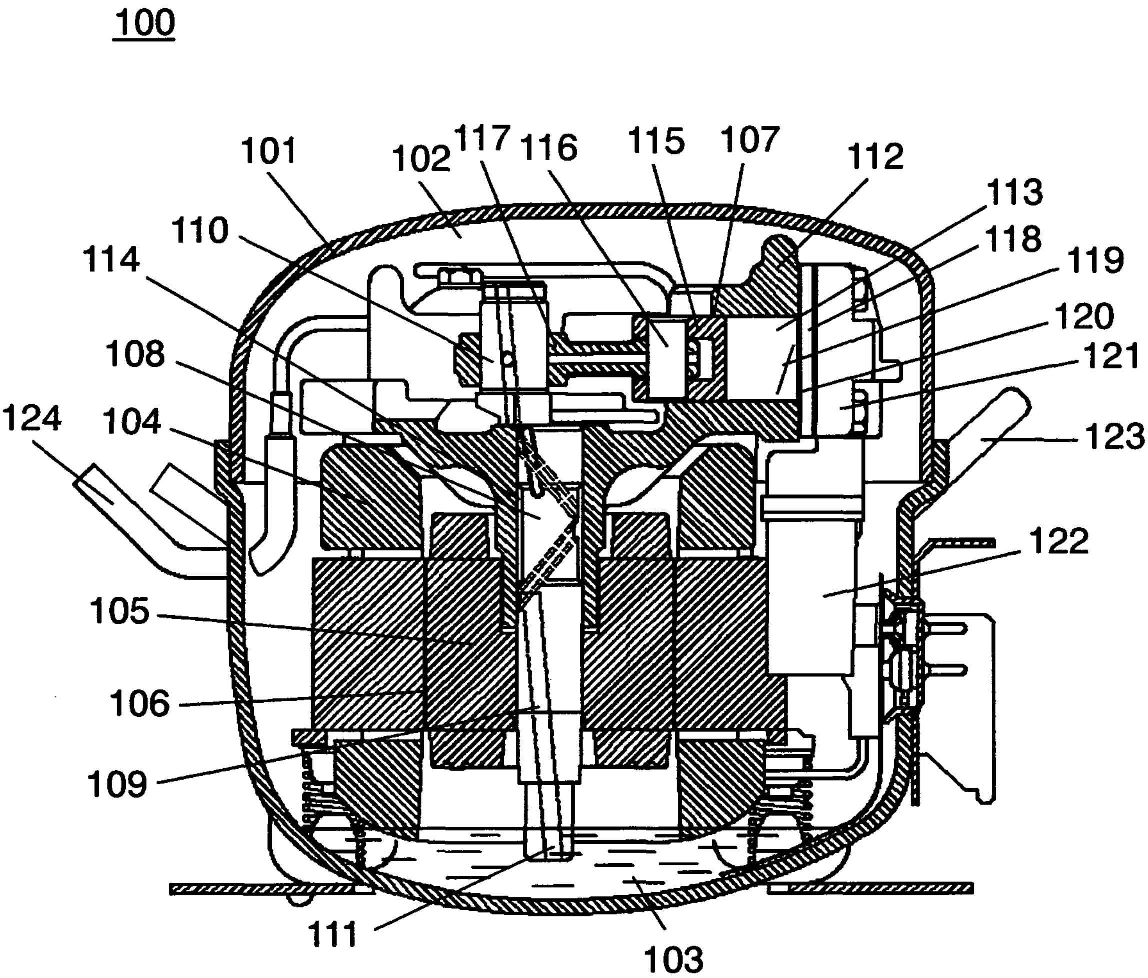
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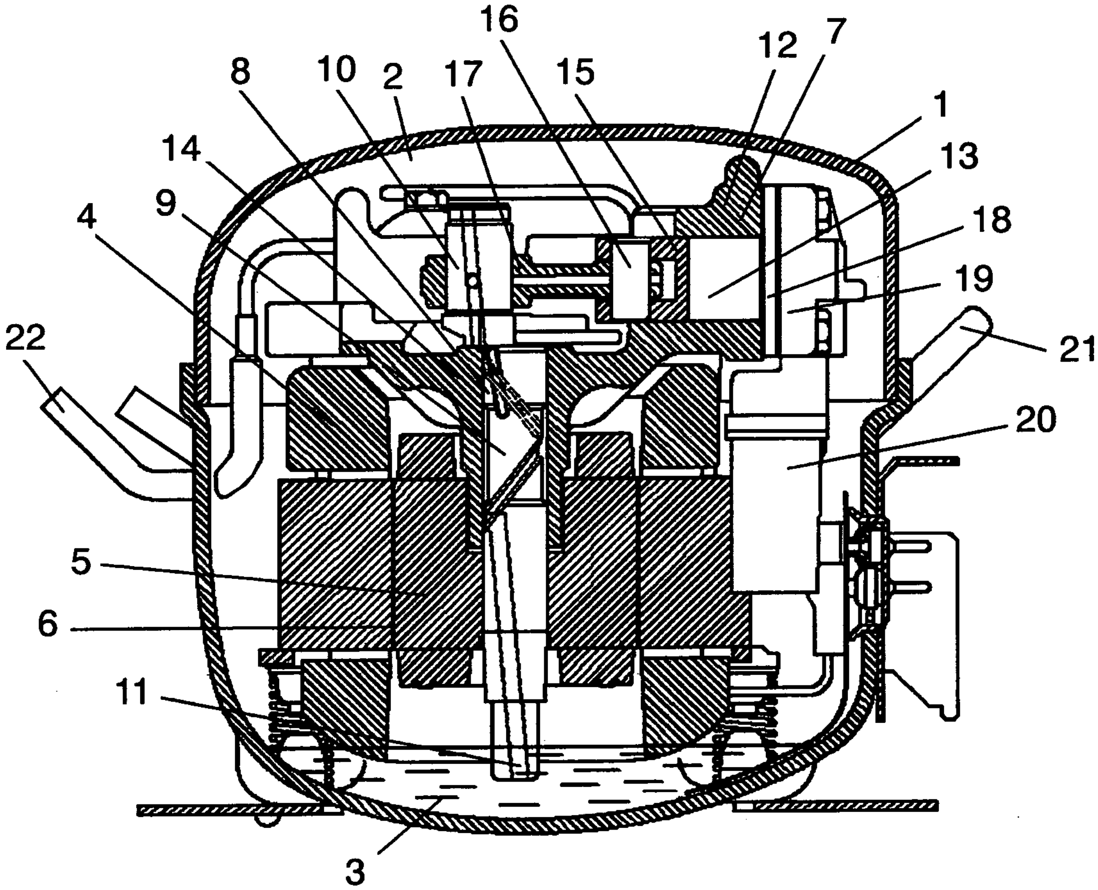
FIG. 2



REFERENCE MARKS IN THE DRAWINGS

100 refrigerant compressor
101 hermetic container
102 refrigerant
103 refrigerant oil
106 electrically-driven element
107 compressing element
112 cylinder block
113 compression chamber
115 piston

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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