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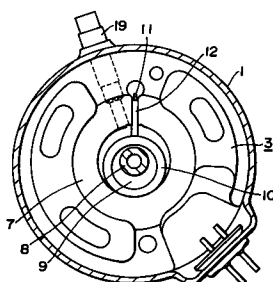
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54 **ROTARY COMPRESSOR.**

57 A rotary compressor in which 1,1,1,2-tetrafluoroethane is used as a refrigerant and polyol ester which is compatible with the above refrigerant is used as an oil, in which a roller is formed of an iron material, and a vane of a carbon-containing composite aluminium material, and in which the corrosion of the roller and/or vane due to hydrolysis of polyol ester oil is prevented by restraining the generation of sliding friction heat between the roller and vane, thereby reducing the risk of the roller and/or vane being worn.

FIG. 2



TECHNICAL FIELD

The present invention relates to a rotary compressor which uses fluorocarbon as a refrigerant and, more particularly, to a rotary compressor in which 1,1,1,2-tetrafluoroethane (hereinafter called R134a) is used as a refrigerating machine oil to restrain abrasion of sliding members of the rotary compressor due to hydrolysis of the oil as well as the occurrence of an oil sludge.

BACKGROUND OF THE INVENTION

A majority of compressors for refrigerators, vending machines and showcases have heretofore used dichlorodifluoromethane (hereinafter referred to as "R12") as a refrigerant. This R12 is subject to fluorocarbon regulation because of the environmental problem of destruction of an ozone layer, and R134a is being studied as a substituent refrigerant for R12 as disclosed in, for example, Japanese Patent Publication (unexamined) No. 1-271491/1989.

However, the refrigerant R134a does not have good compatibility with a currently used refrigerating machine oil such as a mineral oil and an alkyl benzene oil. This inferior compatibility leads to the problem that imperfect lubrication of a compressor is caused by an insufficient return of the oil to the compressor or by the suction of a refrigerant which is separated from the oil when the compressor is cold started.

For the above reasons, the present inventors investigated a polyolester oil to obtain a refrigerating machine oil compatible with the refrigerant R134a. However, it has been found that, if the polyolester oil is used with a rotary compressor, a fatty acid is generated by hydrolysis of the polyolester oil due to sliding frictional heat generated by line contact between a vane and a roller, and the fatty acid corrodes the sliding members to cause abrasion thereof. It has also been found that there are a number of problems which impair the durability of compressors. For example, dust particles resulting from the abrasion adversely affect the organic material such as a magnet wire of a power element of the compressor.

SUMMARY OF THE INVENTION

The present inventors have carried out researches so that the refrigerant R134a and a refrigerating machine oil consisting of the polyolester oil can be combined for use in a rotary compressor. From the researches, the present inventors have found that the polyolester oil for lubricating sliding members of the rotary compressor undergoes hydrolysis due to frictional heat generated at the sliding members and a fatty acid generated by the hydrolysis corrodes the sliding members, and that the hydrolysis of the polyolester oil can be restrained by reducing the frictional heat generated at the sliding members. This invention has been achieved on the basis of the above findings.

An object of the present invention is to solve the above-described problems, and is intended to reduce frictional heat generated at sliding members and restrain hydrolysis of a polyolester oil due to the frictional heat if the polyolester oil, which has compatibility with the refrigerant R134a, is used as a refrigerating machine oil.

The present invention provides a rotary compressor including a sealed container which houses a rotary compression element provided with sliding members such as a vane and a roller, in which 1,1,1,2-tetrafluoroethane is employed as a refrigerant to be compressed by the rotary compression element, and a polyolester oil composed of a polyhydric alcohol and a fatty acid is employed as an oil which has compatibility with the refrigerant and which lubricates the sliding members of the rotary compression element, and the vane which is one of the sliding members of the rotary compression element is formed of a material having a hardness higher than the roller.

In another embodiment of the present invention, the vane is formed of an aluminum composite material which contains a reinforcing material such as a carbon.

According to another embodiment of the present invention, the vane is formed of a reinforced plastics.

Since the present invention is arranged in the above-described manner, it is possible to lower the temperature of frictional heat due to sliding contact between the sliding members which are lubricated by the oil using the polyolester oil having compatibility with the refrigerant R134a, whereby it is possible to prevent the polyolester oil from easily undergoing hydrolysis.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a vertical sectional view of a rotary compressor, showing one embodiment of the present invention;

Fig. 2 is a cross sectional view of the rotary compressor according to the present invention; and
 Fig. 3 is a plan view of an Amsler testing machine.

BEST MODE FOR CARRYING OUT THE INVENTION

A preferred embodiment of the present invention will be described with reference to the accompanying drawings.

Fig. 1 is a vertical sectional view of a rotary compressor. Fig. 2 is a sectional view of the rotary compressor, taken along line A-A of Fig. 1. In Figs. 1 and 2, a power element 2 is housed in an upper side of the sealed container 1, while a rotary compression element 3 which is driven by the power element 2 is housed in a lower side of the sealed container 1. The power element 2 is made up of a stator 5 having a coil winding 4 electrically insulated by an organic material and a rotor 6 provided inside of the stator 5.

The rotary compression element 3 is made up of a cylinder 7, a roller 10 which is rotated along the inner wall of the cylinder 7 by an eccentric portion 9 of a rotary shaft 8, a vane 12 which is pressed by a spring 11 and a high-pressure refrigerant discharged into the sealed container 1 in such a manner as to be pressed against the peripheral face of the roller 10 to partition the interior of the cylinder 7 into an intake side and a discharge side, and upper and lower bearings 13 and 14 for sealing the corresponding apertures of the cylinder 7 and for rotatably supporting the rotary shaft 8.

The upper bearing 13 has a discharge hole 15 which communicates with the discharge side of the cylinder 7. The upper bearing 13 also has a discharge valve 16 for opening/closing the discharge hole 15 and a discharge muffler 17 which is mounted to cover the discharge valve 16.

The vane 12 is formed of a composite aluminum material prepared by impregnating a carbon powder with a molten aluminum alloy material. The roller 10 is formed of an iron alloy or an aluminum material having a surface subjected to anodizing. The vane 12 has, because of its carbon material content, higher melting point and hardness than the roller 10, thereby raising a temperature at which adhesive wear develops between the vane 12 and the roller 10. More specifically, the vane 12 formed of the composite aluminum material can resist abrasion even if it is in line contact with the roller 10. Accordingly, it is possible to restrain acceleration of abrasion due to dust particles resulting from the abrasion and it is also possible to reduce frictional heat due to the sliding contact between the vane 12 and the roller 10.

The vane 12 may be formed of a plastics material having a refrigerant resistance. The plastics material may be formed of, for example, engineering plastics such as polyester ether ketones, polyimides, polyamide imides, polyphenylene sulfides, aromatic polyesters, polyether sulfones and polyether imides. The roller 10 is formed of an iron material such as a carbon having a melting point and a hardness higher than the roller 10 formed of the iron material can have its abrasion resistance improved.

An oil 18, which is a polyolester oil, is stored on a bottom portion of the sealed container 1. The oil 18 lubricates the respective sliding-contact surfaces of the roller 10 and the vane 12 both of which constitute sliding members of the rotary compression element 3.

A refrigerant flowing into the cylinder 7 of the rotary compression element 3 and compressed by a cooperative work of the roller 10 and the vane 12 is R134a having compatibility with the oil 18 which is a polyolester oil.

An intake pipe 19, which is secured to the sealed container 1, introduces the refrigerant into the intake side of the cylinder 7. A discharge pipe 20 is secured to an upper wall of the sealed container 1 and discharges the refrigerant compressed by the rotary compression element 3 to the outside of the sealed container 1.

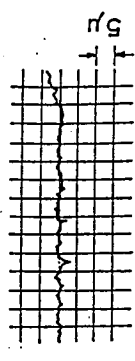
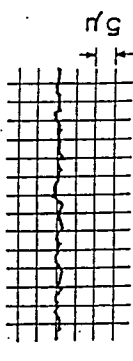
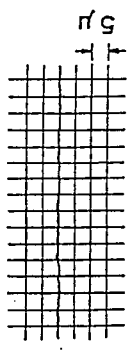
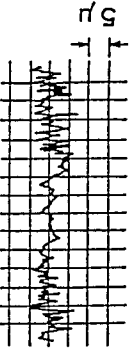
In the rotary compressor arranged in the above-described manner, the refrigerant R134a which has flown into the intake side of the cylinder 7 through the intake pipe 19 is compressed by a cooperative work of the roller 10 and the vane 12, and opens the discharge valve 16 and is discharged into the discharge muffler 17 through the discharge hole 15. The refrigerant in the discharge muffler 17 passes through the power element 2 and is discharged outward from the sealed container 1 through the discharge pipe 20. The oil 18 is supplied to and lubricates the respective sliding-contact surfaces of the sliding members, such as the roller 10 and the vane 12, of the rotary compression element 3. The oil 18 also serves to prevent the refrigerant compressed in the cylinder 7 from leaking into a low-pressure side along the sliding-contact surfaces.

The roller 10 and the vane 12, which partition the interior of the cylinder 7 into the intake side and the discharge side, are formed of the iron material and the carbon-containing composite aluminium material, respectively. Accordingly, a temperature at which adhesive wear develops between the vane 12 and the roller 10 is made higher so that it is possible to reduce sliding frictional heat generated by pressing one end of the vane 12 against the peripheral face of the roller 10 by means of the spring 11 and the internal high

pressure of the sealed container 1. For this reason, if the polyolester oil is used as the oil 18 which is supplied to the respective sliding-contact surfaces of the roller 10 and the vane 12, hydrolysis of such an ester oil is restrained so that corrosion of the sliding members can be prevented.

Performance evaluation was conducted with an Amsler abrasion testing machine by the method shown in Fig. 3. The result is shown in Table 1.

Table 1

	Stationary piece (vane member)	Rotary piece (Roller member)	Characteristics of Polyolester oil after test		Abrasion situation of testpiece		
			Total acid number (mgKOH/g)	Amount of generated sludge (mg)	Maximum abrasion width of stationary piece (mm)	Size variation of rotary piece (External size, μm)	Surface roughness of rotary piece
Embodiment 1	Composite aluminum alloy	Iron material	0.01	6.3	0.71	-3	
ditto 2	Carbon material	ditto	0.02	6.2	0.66	-2	
ditto 3	Plastics material	ditto	0.01	4.2	0.10	± 0	
Comparison 1	Iron material	ditto	0.09	45.3	1.08	-11	

A stationary piece 21 corresponding to a vane had at one end thereof a curved face and was subjected to load L. A rotary piece 22 corresponding to a roller was rotated for 20 hours while an oil 23 made from a polyolester oil was being supplied to the portion of the rotary piece 22 which was in pressure contact with the stationary piece 21.

It can be seen from Table 1 that the combination of the stationary piece 21 made of a carbon-containing aluminum alloy with the rotary piece 22 made of an iron material has an excellent abrasion resistance; the reason is that generation of sliding frictional heat is restrained at the respective sliding-contact surfaces of the rotary piece 22 and the stationary piece 21 and hydrolysis by heat of the polyolester oil is restrained, thereby preventing corrosion due to a fatty acid generated by the hydrolysis. In the case of plastics as well, abrasion is restrained for a similar reason.

As described above, according to the present invention, 1,1,1,2-tetrafluoroethane is employed as a refrigerant to be compressed by the rotary compression element, and a polyolester oil composed of a polyhydric alcohol and a fatty acid is employed as an oil which has compatibility with the refrigerant and which lubricates the sliding members of the rotary compression element, as well as the vane which is one of the sliding members of the rotary compression element is formed of a material having a hardness higher than the roller. Accordingly, a temperature at which adhesive wear develops is made higher at the respective sliding-contact surfaces of the vane and the roller to restrain generation of frictional heat. It is, therefore, possible to prevent the polyolester oil having compatibility with the refrigerant made of 1,1,1,2-tetrafluoroethane from undergoing hydrolysis due to the frictional heat. Thus, it is possible to prevent a fatty acid resulting from the hydrolysis from corroding the sliding members to cause abrasion thereof.

Claims

1. A rotary compressor comprising a sealed container and a rotary compression element in said sealed container, said rotary compression element having sliding members including a vane and a roller, wherein 1,1,1,2-tetrafluoroethane is employed as a refrigerant to be compressed by said rotary compression element, and a polyolester oil composed of a polyhydric alcohol and a fatty acid is employed as an oil, said oil having compatibility with the refrigerant and lubricating the sliding members, and said vane is formed of a material having a hardness higher than said roller.
2. A rotary compressor according to claim 1, wherein said vane is formed of an aluminum composite material containing a carbon as a reinforcing material.
3. A rotary compressor according to claim 1, wherein said vane is formed of a reinforced plastics.

FIG. 1

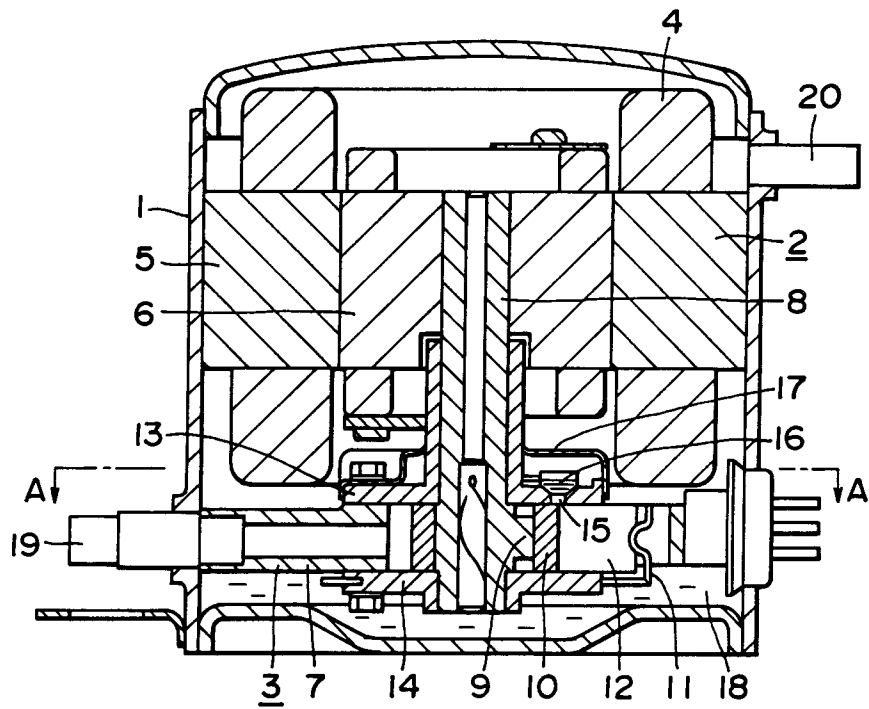


FIG. 2

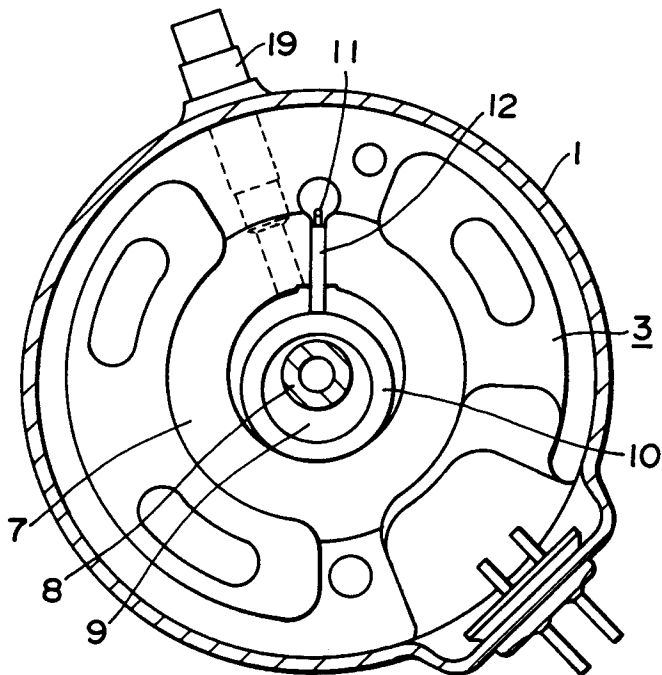
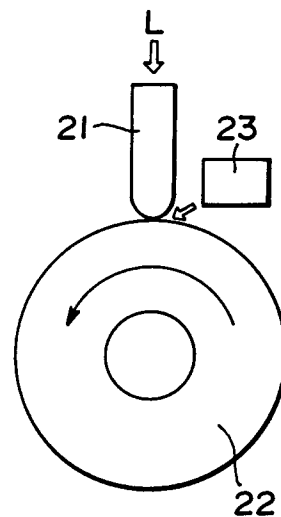


FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP92/00461

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl ⁵ F04C18/356, 29/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC	F04C18/356, 29/00	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
Jitsuyo Shinan Koho 1926 - 1992 Kokai Jitsuyo Shinan Koho 1971 - 1992		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	JP, A, 2-276894 (The Dow Chemical Co.), November 13, 1990 (13. 11. 90), (Family: none)	1-3
Y	JP, A, 63-154883 (Matsushita Refrigeration Co.), June 28, 1988 (28. 06. 88), Lines 2 to 11, lower left column, page 2 (Family: none)	1
Y	JP, A, 62-55490 (Matsushita Electric Ind. Co., Ltd.), March 11, 1987 (11. 03. 87), Lines 12 to 18, lower right column, page 2 (Family: none)	1-2
Y	JP, A, 63-85269 (Toshiba Corp.), April 15, 1988 (15. 04. 88), Lines 3 to 18, upper right column, page 2 (Family: none)	3
[*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
May 29, 1992 (29. 05. 92)	June 16, 1992 (16. 06. 92)	
International Searching Authority	Signature of Authorized Officer	
Japanese Patent Office		