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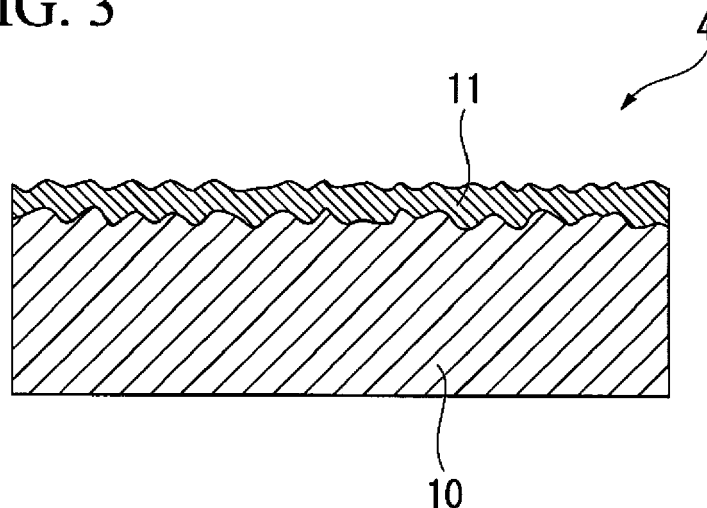
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(54) **SLIDING MEMBER OF COMPRESSOR AND COMPRESSOR HAVING THE SAME**

(57) A sliding member of a compressor is provided which reciprocates in a refrigerant atmosphere and is resistant to abrasion even in an area where a sliding speed becomes slower, thereby having excellent durability. That is, as a sliding member (4) which is incorpo-

rated in a compressor, such as a key member of an Oldham's coupling, a sliding member having a coating (11) formed on the surface of a body (10) made of light metal or an alloy thereof and having a Vickers hardness value of 500 or more is adopted.

FIG. 3



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a sliding member of a compressor which reciprocates in a refrigerant atmosphere, in the field of air conditioners.

Description of Related Art

[0002] In refrigerants which are used in air conditioners, a CFC-based or HCFC-based refrigerant is prohibited from being used due to being an ozone-depleting substance, and instead of this, an alternative refrigerant based on HFC (hydrofluorocarbon) which does not contain such an ozone-depleting substance is widely used in the present day. Since the HFC-based refrigerant is premised on use under a higher pressure than the CFC-based or HCFC-based refrigerant used previously, it is known that in a compressor of an air conditioner using this, a pressure load increases and a higher abrasion resistance than that in a previous internal compression mechanism is required for members configuring an internal compression mechanism (refer to Japanese Unexamined Patent Application, First Publication No. 2001-099066).

[0003] For example, in a scroll type compressor of an air conditioner, as a member supporting an orbiting scroll such that the orbiting scroll can orbit to revolve with respect to a fixed scroll fixed to a casing of an air conditioner with the orbiting scroll combined with the fixed scroll, there is a key member of an Oldham's coupling. The key member is supported so as to be able to reciprocate in a certain radial direction in an orbiting plane with respect to a base which holds the orbiting scroll, and supports the orbiting scroll such that the orbiting scroll can reciprocate with respect to itself in another direction orthogonal to the certain radial direction in the orbiting plane. In this way, in the orbiting scroll, only revolution is allowed with respect to the fixed scroll while rotation is prevented. That is, the key member of the Oldham's coupling is a sliding member which reciprocates in a certain radial direction in an orbiting plane with respect to a casing which is fixed to the fixed scroll and reciprocates in another direction orthogonal to the certain radial direction with respect to the orbiting scroll.

[0004] In the related art, the key member as such a sliding portion reciprocates, and therefore, vibration easily occurs compared to a member which rotates. Therefore, in order to reduce an inertial force which causes vibration, a casting having a body made of a light metal alloy such as an aluminum alloy, for example, is used, and an abrasion-resistant coating is formed on the surface thereof by alumite treatment, tin plating treatment, or the like.

SUMMARY OF THE INVENTION

[0005] In general, it is known that the slower the sliding speed of a sliding member in a compressor, the severer the lubricating condition. However, a member which reciprocates has points at which a speed becomes zero at both ends of a moving area, unlike a member which rotates, and since the speed becomes slower at the point and before and after this, the lubricating condition becomes more severe than in other members which rotate at a substantially constant speed.

[0006] The present invention has been made in view of the above circumstances and has an object to provide a sliding member of a compressor which reciprocates in a refrigerant atmosphere, which is resistant to abrasion even in an area where a sliding speed becomes slower, and has excellent durability.

[0007] A sliding member for a compressor according to the present invention includes: a body formed of light metal or an alloy thereof; and a first coating having abrasion resistance and formed on a surface of the body, in which a Vickers hardness value of the first coating is 500 or more.

[0008] In the sliding member according to the present invention, the body may be formed of an aluminum alloy and the first coating may be a ceramic coating formed on the surface of the body.

[0009] In the sliding member according to the present invention, a thickness of the first coating may be 20 μm or less.

[0010] The sliding member according to the present invention may further include: a second coating formed on the body so as to overlap the first coating and having self-lubricity.

[0011] A compressor according to the present invention has the sliding member described above, and a support member for supporting the sliding member so as to be capable of reciprocating. Specifically, the compressor according to the present invention may be a scroll type compressor including: a fixed scroll; an orbiting scroll coupled with the fixed scroll; and a key member provided between the fixed scroll and the orbiting scroll to form an Oldham's coupling along with both the scrolls, and supporting the orbiting scroll so that the orbiting scroll can orbit with respect to the fixed scroll, in which the key member is a sliding member which includes a body formed of light metal or an alloy thereof, and a first coating formed on a surface of the body and having a Vickers hardness value of 500 or more.

[0012] A compressor according to the present invention may be a rotary type compressor including: a cylindrical housing; a rotor being rotatable inside the housing; and a pair of vanes supported by the rotor so as to be capable of reciprocating in a radial direction of the rotor, and being pressed onto an inner surface of the housing by a spring disposed in the rotor, in which each of the vanes is a sliding member which includes a body formed of light metal or an alloy thereof, and a first coating formed

on a surface of the body and having a Vickers hardness value of 500 or more.

[0013] A compressor according to the present invention may be a reciprocal type compressor including: a cylinder; a piston disposed in the cylinder so as to be in contact with an inner surface of the cylinder; and a piston rod connected with the piston and supporting the piston such that the piston can reciprocate in a longitudinal direction of the cylinder, in which the piston is a sliding member which includes a body formed of light metal or an alloy thereof, and a first coating formed on a surface of the body and having a Vickers hardness value of 500 or more.

[0014] An air-conditioning system according to the present invention includes: a compressor for compressing a gaseous refrigerant; a condenser for condensing the gaseous refrigerant compressed by the compressor to release heat from the gaseous refrigerant; an expansion valve for expanding a liquid refrigerant liquefied by the condenser to reduce the pressure of the liquid refrigerant; and an evaporator for evaporating the liquid refrigerant expanded by the expansion valve to absorb heat of the liquid refrigerant, in which the compressor, the condenser, the expansion valve, and the evaporator are installed on a refrigerant tubing so as to be connected in sequence, the refrigerant as a heat-transfer medium is circularly transferred between the condenser and the evaporator through the refrigerant tubing to perform air-conditioning, and a sliding member in the compressor includes a body formed of light metal or an alloy thereof, and a first coating having abrasion resistance and formed on a surface of the body, in which a Vickers hardness value of the first coating is 500 or more.

[0015] According to the present invention, the above-described member is adopted as a sliding member in a compressor, whereby the member is not easily worn even in an area where a sliding speed specific to a reciprocating member becomes slower, and thus the durability is improved. Such improvement in abrasion resistance makes it possible to maintain the soundness of the compressor for a long period of time even in a case where a compressor is operated in a very severe lubricating state or refrigerating machine oil having low viscosity has to be adopted due to design restrictions, and accordingly, it is possible to realize a longer life of an air-conditioning system which includes the compressor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG 1 is an exploded perspective view showing a fixed scroll, an orbiting scroll, and a key member configuring an Oldham's coupling along with both the scrolls, which are main components of a scroll type compressor according to the present invention.

FIG 2 is a block diagram showing an air-conditioning system which includes the scroll type compressor

according to the present invention.

FIG 3 is a partial sectional view showing an example of a surface structure of the key member of the Oldham's coupling as a sliding member according to the present invention.

FIG 4 is a schematic sectional view showing a main structure of a rotary type compressor according to the present invention.

FIG 5 is a schematic sectional view showing a main structure of a reciprocal type compressor according to the present invention.

FIG 6 is a partial sectional view showing another example of the surface structure of the key member of the Oldham's coupling as the sliding member according to the present invention and shows the shape of a surface in an unused state at the time of manufacturing of the key member.

FIG 7 is a partial sectional view showing another example of the surface structure of the key member of the Oldham's coupling as in FIG 6 and shows a state in which the shape of the surface of the key member has changed through an operation of a compressor.

DETAILED DESCRIPTION OF THE INVENTION

(First Embodiment)

[0017] A scroll type compressor as a first embodiment of a compressor which includes a sliding member according to the present invention will be described hereinafter.

[0018] As shown in FIG 1, a scroll type compressor 1 is provided with a fixed scroll 2, an orbiting scroll 3, a key member (a sliding member) 4 configuring an Oldham's coupling along with both the scrolls, and a base 5. The fixed scroll 2 has an end plate 2a and a spiral protrusion 2b formed on the surface on one side of the end plate 2a. The orbiting scroll 3 has an end plate 3a and a spiral protrusion 3b formed on the surface on one side of the end plate 3a. The spiral protrusion 3b of the orbiting scroll 3 has substantially the same shape as the spiral protrusion 2b of the fixed scroll 2.

[0019] The key member 4 has an annular portion 4a which is disposed so as to be able to orbit around the spiral protrusions 2b and 3b, a pair of engaging protrusions 4b and 4b formed on the surface on one side of the annular portion 4a, and a pair of engaging protrusions 4c and 4c formed on the surface on the other side of the annular portion 4a. The engaging protrusions 4b and 4b are formed at positions spaced apart from each other in a diameter direction of the annular portion 4a on the surface on one side of the annular portion 4a. On the other hand, the engaging protrusions 4c and 4c are formed at positions spaced apart from each other in the diametrical direction and shifted from the engaging protrusions 4b and 4b by 90° on the surface on the other side of the annular portion 4a.

[0020] The engaging protrusions 4b and 4b of the key member 4 are fitted into guide grooves 2c and 2c formed on the surface on one side of the fixed scroll 2. The guide grooves 2c and 2c are formed at positions spaced apart from each other in the diametrical direction of the end plate 2a with the spiral protrusion 2b interposed therebetween, and the key member 4 is supported so as to be able to reciprocate in the diameter direction of the fixed scroll 2 along the guide grooves 2c and 2c with respect to the fixed scroll 2. Further, the engaging protrusions 4c and 4c of the key member 4 are fitted into guide grooves 5a and 5a formed on the surface on one side of the base 5 on the orbiting scroll 3 side. The guide grooves 5a and 5a are formed at positions spaced apart from each other in the diametrical direction of the base 5 with the spiral protrusion 3b interposed therebetween, and the key member 4 is supported so as to be able to reciprocate in the diameter direction of the orbiting scroll 3 along the guide grooves 5a and 5a with respect to the base 5 on the orbiting scroll 3 side. However, the reciprocating direction of the key member 4 with respect to the orbiting scroll 3 is different by 90° from the reciprocating direction of the key member 4 with respect to the fixed scroll 2. In this way, in the orbiting scroll 3, only revolution is allowed with respect to the fixed scroll 2 while rotation is prevented.

[0021] If the orbiting scroll 9 orbits to revolve while being prevented from rotating, the spiral protrusions 2b and 3b of both the scrolls mesh with each other, so that a plurality of arcuate compression cells are defined between the wall faces of the spiral protrusions 2b and 3b. The compression cells move while decreasing the volume toward the center of the spiral due to the orbiting motion of the orbiting scroll 3. The scroll type compressor 1 adiabatically compresses a refrigerant introduced into the compression cells by utilizing a decrease in volume associated with the orbiting motion of the orbiting scroll 3.

[0022] An air-conditioning system which includes the scroll type compressor 1 is provided with a condenser 12, an expansion valve 13, and an evaporator 14, as shown in FIG 2, for example, and the respective elements are connected in sequence through a refrigerant tubing 15 through which a refrigerant flows. In the system, the condenser 12 condenses and liquefies a high-temperature and high-pressure gaseous refrigerant to release heat from the gaseous refrigerant, the expansion valve 13 adiabatically expands a high-temperature and high-pressure liquid refrigerant obtained by being liquefied by the condenser 12, to reduce the pressure of the liquid refrigerant, the evaporator 14 evaporates and vaporizes a low-temperature and low-pressure liquid refrigerant expanded by the expansion valve 13, to absorb heat of the liquid refrigerant, and the compressor 1 adiabatically compresses a low-temperature and low-pressure gaseous refrigerant which has passed through the evaporator 14. The high-temperature and high-pressure gaseous refrigerant compressed by the compressor 1 is supplied to the condenser 12. The refrigerant as a heat-transfer me-

dium is circulated in the closed system in this manner, whereby movement of heat from the evaporator 14 to the condenser 12 is realized to enable air conditioning (heating and cooling) in a room.

[0023] Lubricating oil of the scroll type compressor circulates in the air-conditioning system which includes the evaporator, the expansion valve, and the condenser in a state of being mixed with the refrigerant, and returns to the compressor. Lubricating oil of the air-conditioning system is first used without being replaced for a period in which the air-conditioning system is used, in a state of being sealed in the system together with the refrigerant

[0024] As shown in FIG 3, the key member 4 of this embodiment has a body 10 made of light metal such as aluminum, magnesium, or titanium, or an alloy thereof, and a ceramic coating (a first coating) 11 having abrasion resistance and formed on the surface of the body 10. The body 10 is a casted body made of, for example, an aluminum alloy, and has relatively rough irregularities formed on the surface thereof. However, the ceramic coating 11 is formed on the surface, whereby the irregularities on the surface of the body 10 are suppressed.

[0025] Here, the Vickers hardness value of the ceramic coating 11 is preferably 500 or more and more preferably 700 or more. If the Vickers hardness value of the ceramic coating 11 is smaller than 500, the difference in hardness between the ceramic coating 11 and a member that is a rubbing partner is small, and therefore, under a condition where a lubrication state is severe, there is a possibility that the abrasion of the ceramic coating 11 may progress. However, if the Vickers hardness value of the ceramic coating 11 is 500 or more, the difference in hardness between the ceramic coating 11 and the mating member is sufficient, and therefore, even under a condition where a lubrication state is severe, it becomes possible to suppress abrasion of the ceramic coating 11.

[0026] Further, it is preferable that the ceramic coating 11 be formed to a thickness of 20 μm or less. If the thickness of the ceramic coating 11 is larger than 20 μm, the surface roughness after film formation treatment increases (the surface becomes rough), and therefore, if the compressor is operated with the parts assembled directly, abrasion of the mating member progresses because a sliding surface becomes rough. In order to prevent the progress of such abrasion, it is necessary to additionally polish the surface to reduce the surface roughness to a specified value or less. Further, in order to increase the film thickness, it is necessary to lengthen a time required for the film formation treatment, and thus the cost of the film formation treatment increases. Further, there is also a problem in that the coating easily peels off

[0027] For the formation of the ceramic coating 11, it is preferable to adopt the electrolytic ceramic coating method disclosed in, for example, Japanese Patent No. 5345115. In this method, in an electrolytic solution, light metal such as aluminum, magnesium, or titanium or an alloy thereof is used as an anode and anodic oxidation treatment is performed on the surface thereof. However,

at that time, due to applying a high voltage exceeding several hundred volts, a hard ceramic coating is formed on the surface of the light metal or the alloy thereof as an object to be treated, while accompanying plasma emission.

[0028] In general, it is known that the slower the sliding speed of a sliding member in a compressor, the severer the lubricating condition. This is no exception in a scroll type compressor as well. The key member 4 is supported so as to be able to reciprocate in a certain radial direction (that is, a direction connecting the two protrusions 4b and 4b) in an orbiting plane of the orbiting scroll 3 with respect to the fixed scroll 2, and supports the orbiting scroll 3 such that the orbiting scroll 3 can reciprocate with respect to itself in a direction (that is, a direction connecting the two protrusions 4c and 4c) orthogonal to the certain radial direction in the orbiting plane. In this way, in the orbiting scroll 3, only revolution is allowed with respect to the fixed scroll 2 while rotation is prevented.

[0029] The key member 4 reciprocates in each of two directions orthogonal to each other in the orbiting plane, unlike a member which rotates, such as a shaft which drives the orbiting scroll 3, and there are points (so-called "dead points") at which a speed becomes zero at both ends of a reciprocating area thereof. At the point and before and after this point, the speed of the key member 4 when the key member 4 slides with respect to the base 5 becomes extremely slow and the speed when the key member 4 slides with respect to the orbiting scroll 3 also becomes extremely slow. In such a low-speed area, the lubricating condition of a sliding portion becomes severe compared to a member which rotates at a substantially constant speed.

[0030] In the air-conditioning system described above, the refrigerant used as a heat-transfer medium is an HFC-based refrigerant such as R410A, R134A, R407C, or R32 (in the future, use of a CO₂ refrigerant, a HFO refrigerant, or the like is also studied). Further, lubricating oil used in accordance with these refrigerants is refrigerating machine oil which is compatible with the refrigerant, such as POE, PVE, or PAG for example.

[0031] The lubricating of the key member 4 is generally considered to depend on a change in an operating state of a scroll type compressor. For example, in the scroll type compressor, usually, there is a possibility of falling into the following states during an operation.

- (1) Rotational speed of the orbiting scroll: 20 rev/sec or less
- (2) Temperature of a refrigerant in the vicinity of a sliding portion: 50°C or more

[0032] First, if the rotational speed of the orbiting scroll decreases and approaches the state of the above (1), the speed of the reciprocating motion of the key member 4 in two directions also decreases. Further, if the temperature of the refrigerant flowing in a sliding portion of the key member 4 between the key member 4 and the

base 5 and the surroundings thereof, and a sliding portion of the key member 4 between the key member 4 and the orbiting scroll 3 and the surroundings thereof rises and approaches the state of the above (2), the viscosity of the refrigerating machine oil existing together with the refrigerant decreases. Even if the lubricating state in the sliding portion including the key member 4 becomes severe due to such a decrease in the sliding speed of the key member 4 and a decrease in the viscosity of the refrigerating machine oil, in the above-described scroll type compressor in which the ceramic coating 11 is formed on the surface of the key member 4 and the coefficient of friction is kept low, the surface of the key member 4 is hardly worn, and thus the durability of the key member 4 is improved. In this way, it is possible to maintain the soundness of the compressor for a long period of time and extend the life of the air-conditioning system which includes the compressor.

[0033] The lubricating of the key member 4 is also considered to depend on a change in the properties of the refrigerant and the refrigerating machine oil. For example, as a refrigerant as a heat-transfer medium circulating in the system of the air-conditioning system and refrigerating machine oil as lubricating oil of the compressor, a refrigerant and refrigerating machine oil which exhibit the following properties are generally used.

- (a) Solubility of the refrigerant in the refrigerating machine oil: 40% or more
- (b) Viscosity grade of the refrigerating machine oil: VG 100 or less, preferably VG 68 or less. Here, the viscosity grade is an index indicating the degree of viscosity when the temperature of the refrigerating machine oil is 40°C.

[0034] First, if the refrigerant is dissolved in the refrigerating machine oil, the viscosity of the refrigerating machine oil existing together with the refrigerant decreases.

[0035] Further, in order to smooth the conveyance of the refrigerant by the compressor and save energy in the air-conditioning system by reducing energy which is consumed in the compressor, there is a strong tendency that refrigerating machine oil having a low viscosity grade is used for the refrigerating machine oil. In particular, the R32 refrigerant not only has a lower viscosity grade but also becomes higher in temperature than other refrigerants under the use condition in the air-conditioning system, and therefore, a decrease in viscosity is more remarkable than others. Even if the lubricating state of the sliding portion including the key member 4 becomes severe due to such a decrease in the viscosity of the refrigerating machine oil due to the dissolution of the refrigerant into the refrigerating machine oil, and the use of the low viscosity refrigerating machine oil, in the above-described scroll type compressor in which the ceramic coating 11 is formed on the surface of the key member 4 and the coefficient of friction is kept low, the surface of the key member 4 is hardly worn, and thus the durability of

the key member 4 is improved. In this way, it is possible to maintain the soundness of the compressor for a long period of time and extend the life of the air-conditioning system which includes the compressor.

[0036] Further, the HFC-based refrigerant which is widely used at present is premised on use under a higher pressure than the CFC-based or HCFC-based refrigerant used previously, and therefore, in order to secure the liquid tightness of the compression cell in the machine, the surface pressure between both the scrolls is set to be higher than that in the compressor of the related art, which uses the CFC-based or HCFC-based refrigerant. In this manner, even in a case where the surface pressure between both the scrolls is set to be high, in the above-described scroll type compressor in which the ceramic coating 11 is formed on the surface of the key member 4 and the coefficient of friction is kept low, the surface of the key member 4 is hardly worn, and thus the durability of the key member 4 is improved. In this way, it is possible to maintain the soundness of the compressor for a long period of time and extend the life of the air-conditioning system which includes the compressor.

[0037] Incidentally, in this embodiment, the ceramic coating is adopted as a first coating having abrasion resistance. However, in addition to this, DLC (diamond-like carbon) can be mentioned as a material expected to be used as the first coating. Even if, instead of the ceramic coating, a DLC coating is formed on the surface of the key member, the same effects as those described above are obtained.

[0038] Further, in this embodiment, the invention has been described with the key member 4 as the sliding member. However, a configuration may be adopted in which a member on the side supporting the key member 4, that is, the fixed scroll 2 of the orbiting scroll 3, is set as the sliding member according to the present invention and a hard film such as a ceramic coating is formed as a first coating on at least a portion which is in contact with the key member 4.

[0039] In this embodiment, description has been made taking the scroll type compressor as an example of the compressor which includes the sliding member. However, the sliding member according to the present invention can also be adopted for rotary type and reciprocal type compressors other than the scroll type compressor.

[0040] A rotary type compressor 30 shown in FIG 4 is provided with a cylindrical housing 31, a rotor 32 which rotates in the housing 31, and a pair of vanes 34 and 34 supported by the rotor 32 so as to be able to reciprocate in a radial direction of the rotor and pressed onto the inner surface of the housing 31 by a spring 33 disposed in the rotor 32. In the rotary type compressor 30, the rotor 32 is rotated with respect to the housing 31, a compression cell C is defined between the inner surface of the housing 31, the outer surface of the rotor 32, and the vanes 34 and 34 which slide along a groove of the rotor 32 and are pressed onto the inner surface of the housing 31, a refrigerant in the cell is compressed in a process in which

the volume of the cell increases, and the compressed refrigerant in the cell is discharged in a process in which the volume of the compression cell C decreases. The sliding member according to the present invention is adopted for each of the pair of vanes 34 and 34 (or the inner surface of the groove on the rotor side, which accommodates the vanes), whereby the sliding between the rotor 32 and the vane 34 is smoothed, and thus it is possible to maintain the soundness of the compressor for a long period of time.

[0041] A reciprocal type compressor 40 shown in FIG 5 is provided with a cylinder 41, a piston 42 disposed so as to be in contact with the inner surface of the cylinder 41, and a piston rod 43 which is connected to the piston 42 and makes the piston reciprocate inside the cylinder 41 in a longitudinal direction of the cylinder. In the reciprocal type compressor 40, the piston 42 reciprocates inside the cylinder 41, a refrigerant is sucked into the cylinder 41 in a process in which the piston 42 is drawn out from the cylinder 41, and in a process in which the piston 42 is pushed into the cylinder 41, the refrigerant is compressed and the compressed refrigerant is discharged from the cylinder 41. The sliding member according to the present invention is adopted for the piston 42 (or the inner surface of the cylinder 41), whereby the sliding between the inner surface of the cylinder and the piston is smoothed, and thus it is possible to maintain the soundness of the compressor for a long period of time.

(Second Embodiment)

[0042] Next, a second embodiment of the sliding member according to the present invention will be described below.

[0043] As shown in FIG 6, a key member 20 of an Oldham's coupling according to this embodiment has the body 10 made of a light alloy of aluminum, titanium, magnesium, or the like, the ceramic coating 11 formed on the surface of the body 10, and a fluorine resin coating (a second coating) 21 formed on the surface of the ceramic coating 11 so as to overlap the ceramic coating 11 and having self-lubricity. Here, Teflon (registered trademark) is used as a fluorine resin configuring the coating 21.

[0044] In the surface of the key member 20 having the fluorine resin coating 21 formed on the surface of the ceramic coating 11 so as to overlap the ceramic coating 11, before the scroll type compressor is assembled, the surface shape of the ceramic coating 11 is reflected in the surface of the key member 20 almost as is, and thus some irregularities remain on the surface of the key member 20. However, the fluorine resin coating 21 is superior in self-lubricity and is softer than the ceramic coating 11, and therefore, while the scroll type compressor is operated, as shown in FIG 7, the fluorine resin coating 21 placed on the convex portion of the ceramic coating 11 is gradually scraped off, and finally, a state where the fluorine resin coating 21 remains in only the concave portion of the ceramic coating 11 is created, so that the sur-

face of the key member 20 becomes smooth without irregularities.

[0045] In a case where the key member 4 having only the ceramic coating 11 formed on the surface of the body 10 is used, if the compressor is operated for a long time under an extremely severe lubricating condition, the convex portions of the ceramic coating are rubbed against the mating member to be chipped off, and thus there is a possibility that a state where fragments are contained in the refrigerant may be created. If such fragments circulate in the air-conditioning system together with the refrigerant and are introduced into the compressor again, the fragments can be caught between the sliding members to cause scratches or impair oil lubricity.

[0046] In this embodiment, as shown in FIG 7, a state where the fluorine resin coating 21 remains in only the concave portion of the ceramic coating 11 is created, so that the surface of the key member 20 becomes smooth without irregularities, and therefore, even if the compressor is operated for a long time under an extremely severe lubricating condition, fragments of the ceramic coating do not easily occur. Therefore, oil lubricity is not impaired by fragments of the ceramic coating.

[0047] Incidentally, in this embodiment, the fluorine resin coating is adopted as the second coating having self-lubricity. However, in addition to this, a molybdenum disulfide coating can be mentioned as a material which is expected to be used as the second coating. Even if, instead of the fluorine resin coating, the molybdenum disulfide coating is formed on the ceramic coating 11 so as to overlap the ceramic coating 11, the same effects as those described above are obtained. Further, in addition to this, a graphite-based material (a carbon-based composite material), boron nitride, or a tungsten disulfide-based material can be used as the second coating.

[0048] The preferred embodiments of the present invention have been described above. However, the present invention is not limited to the embodiments described above. Additions, omissions, substitutions, and other changes in the configuration can be made within a scope which does not depart from the scope of the present invention, which is defined by the claims. The present invention is not limited by the description above and is limited only by the matters stated in the claims.

[0049] The present invention relates to a sliding member of a compressor which is provided with a body made of light metal or an alloy thereof, and a first coating having abrasion resistance and formed on a surface of the body, in which the Vickers hardness value of the first coating is 500 or more, and a compressor having the sliding member.

[0050] If the sliding member is adopted for a compressor, even in a case where the compressor is operated in a very severe lubricating state or low viscosity refrigerating machine oil has to be adopted due to design restrictions, the surface of the sliding member is hardly worn, and thus it is possible to improve the durability of

the sliding member.

[0051] While preferred embodiments of the invention have been described and illustrated above, it should be understood that these are exemplary of the invention and are not to be considered as limiting. Additions, omissions, substitutions, and other modifications can be made without departing from the scope of the present invention as defined by the claims. Accordingly, the invention is not to be considered as being limited by the foregoing description, and is only limited by the scope of the appended claims.

EXPLANATION OF REFERENCES

[0052]

- 1: scroll type compressor
- 2: fixed scroll
- 3: orbiting scroll
- 4, 20: key member (sliding member)
- 10: body
- 11: ceramic coating (first coating)
- 21: fluorine resin coating (second coating)
- 30: rotary type compressor
- 40: reciprocal type compressor

Claims

1. A sliding member (4, 20) for a compressor (1, 30, 40), comprising:
 - a body (10) formed of light metal or an alloy thereof; and
 - a first coating (11) having abrasion resistance and formed on a surface of the body (10), wherein a Vickers hardness value of the first coating (11) is 500 or more.
2. The sliding member (4, 20) according to Claim 1, wherein
 - the body (10) is formed of an aluminum alloy, and
 - the first coating (11) is a ceramic coating formed on the surface of the body (10).
3. The sliding member (4, 20) according to Claim 1 or 2, wherein
 - a thickness of the first coating (11) is 20 μm or less.
4. The sliding member (20) according to any one of Claims 1 to 3, further comprising:
 - a second coating (21) formed on the body (10)

so as to overlap the first coating (11) and having self-lubricity.

5. A compressor (1, 30, 40), comprising:

the sliding member (4, 20) according to any one of Claims 1 to 4; and
a support member for supporting the sliding member (4, 20) so as to be capable of reciprocating.

6. A scroll type compressor (1), comprising:

a fixed scroll (2);
an orbiting scroll (3) coupled with the fixed scroll (2); and
a key member (4) provided between the fixed scroll (2) and the orbiting scroll (3) to form an Oldham's coupling along with both the scrolls (2, 3), and supporting the orbiting scroll (3) so that the orbiting scroll can orbit with respect to the fixed scroll (2), wherein
the key member (4) is a sliding member which includes a body formed of light metal or an alloy thereof, and a first coating formed on a surface of the body and having a Vickers hardness value of 500 or more.

7. A rotary type compressor (30), comprising:

a cylindrical housing (31);
a rotor (32) being rotatable inside the housing (31); and
a pair of vanes (34) supported by the rotor so as to be capable of reciprocating in a radial direction of the rotor (32), and being pressed onto an inner surface of the housing (31) by a spring (33) disposed in the rotor (32), wherein
each of the vanes (34) is a sliding member which includes a body formed of light metal or an alloy thereof, and a first coating formed on a surface of the body and having a Vickers hardness value of 500 or more.

8. A reciprocal type compressor (40), comprising:

a cylinder (41);
a piston (42) disposed in the cylinder (41) so as to be in contact with an inner surface of the cylinder (41); and
a piston rod (43) connected with the piston (42) and supporting the piston such that the piston (42) can reciprocate in a longitudinal direction of the cylinder (41), wherein
the piston (42) is a sliding member which includes a body formed of light metal or an alloy thereof, and a first coating formed on a surface of the body and having a Vickers hardness value

of 500 or more.

9. An air-conditioning system, comprising:

a compressor (1) for compressing a gaseous refrigerant;
a condenser (12) for condensing the gaseous refrigerant compressed by the compressor (1) to release heat from the gaseous refrigerant;
an expansion valve (13) for adiabatically expanding a liquid refrigerant liquefied by the condenser (12) to reduce the pressure of the liquid refrigerant; and
an evaporator (14) for evaporating the liquid refrigerant expanded by the expansion valve (13) to absorb heat of the liquid refrigerant, wherein the compressor (1), the condenser (12), the expansion valve (13), and the evaporator (14) are installed on a refrigerant tubing (15) so as to be connected in sequence,
the refrigerant as a heat-transfer medium is circularly transferred between the condenser (12) and the evaporator (14) through the refrigerant tubing (15) to perform air-conditioning,
a sliding member in the compressor (1) includes a body formed of light metal or an alloy thereof, and a first coating having abrasion resistance and formed on a surface of the body, and
a Vickers hardness value of the first coating is 500 or more.

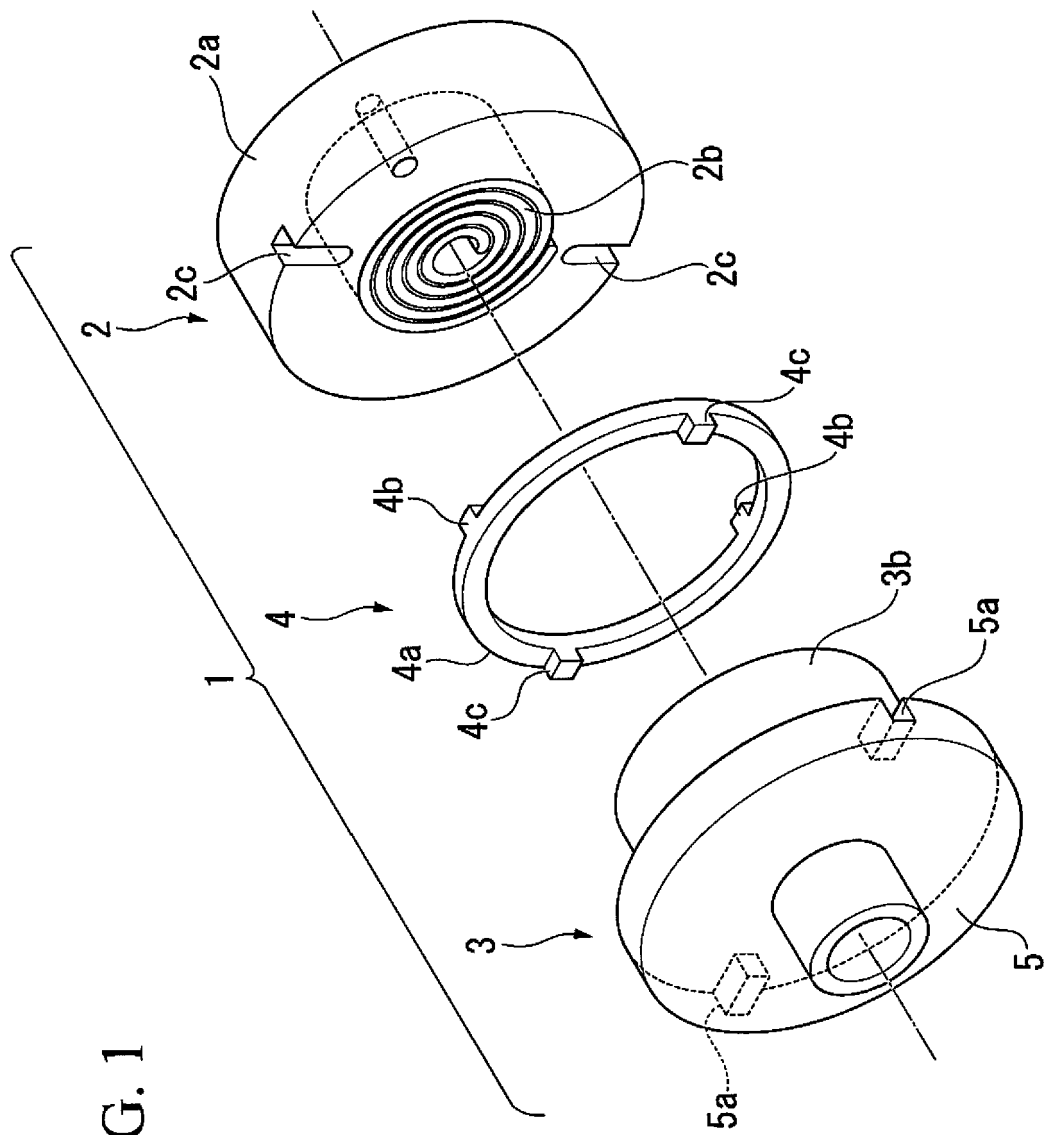


FIG. 1

FIG. 2

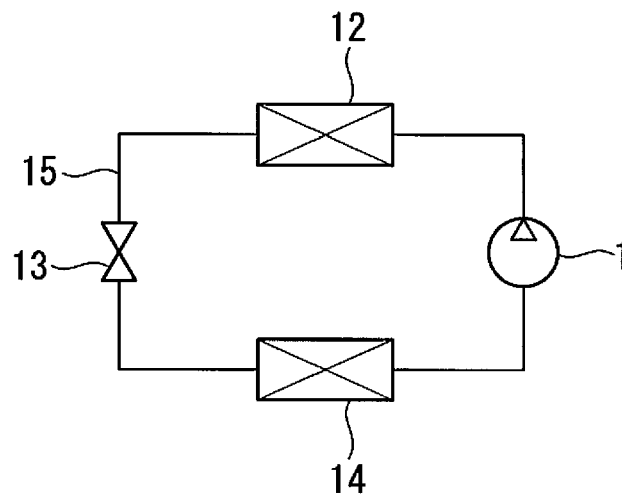


FIG. 3

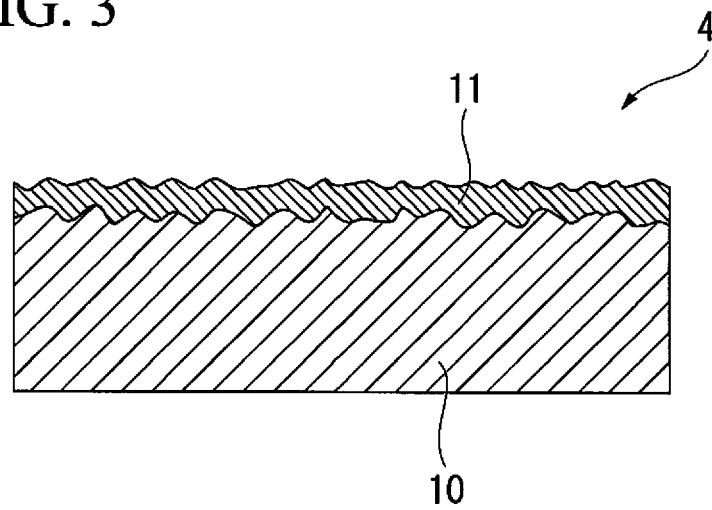


FIG. 4

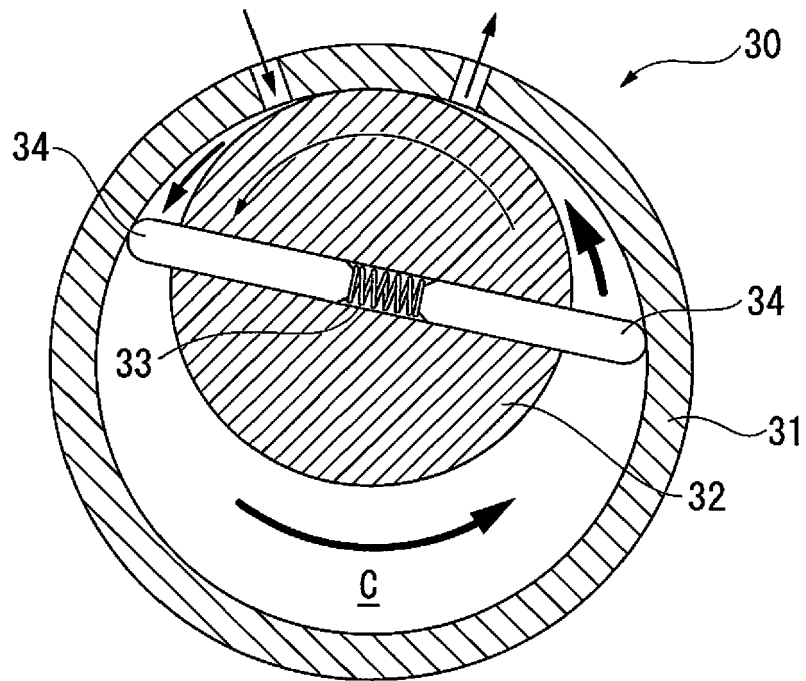


FIG. 5

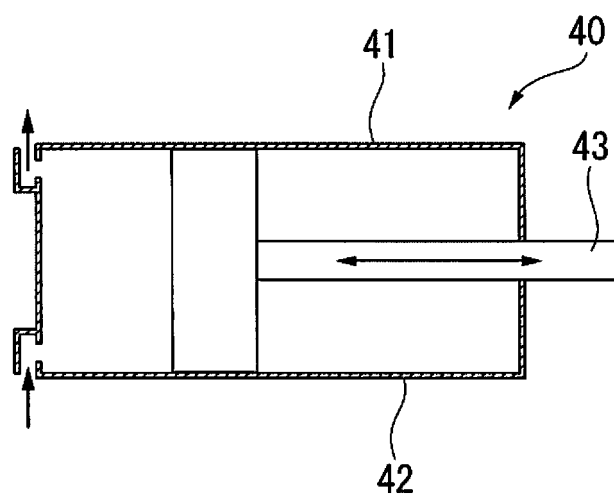


FIG. 6

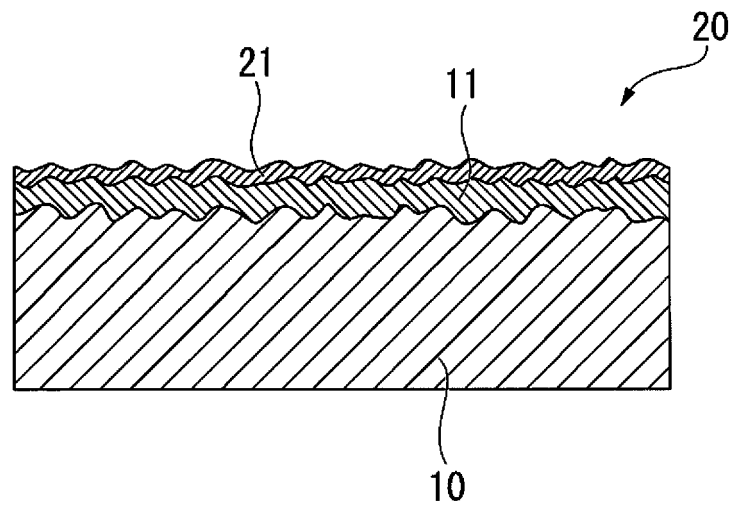
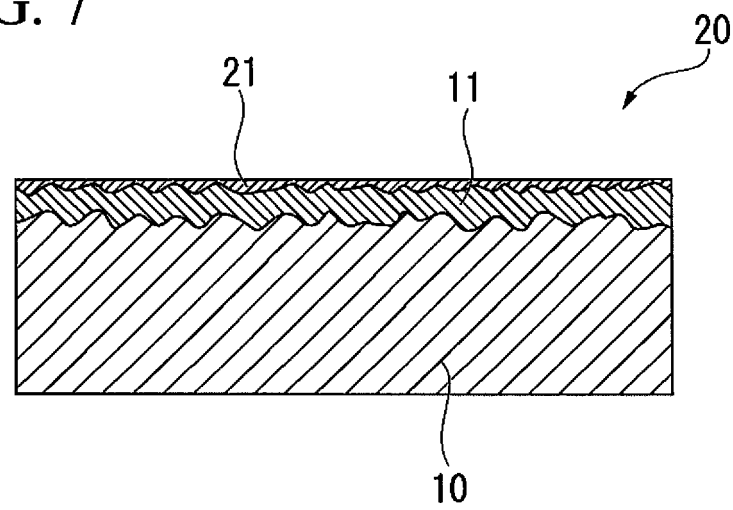


FIG. 7





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Place of search Munich		Date of completion of the search 6 June 2018	Examiner Grilli, Muzio
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