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SPECIFICATION

TITLE OF THE INVENTION

HERMETICALLY SEALED TYPE ROTARY COMPRESSOR

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

This invention relates to a hermetically sealed type rotary compressor and, more specifically, to a hermetically sealed type rotary compressor which has an increased output and improved coefficient of performance (so-
10 called as "C.O.P." hereinafter).

2. Background Art

Fig. 7 is a sectional view of a hermetically sealed type rotary compressor (Japanese Utility Model Publication No. Hei 3-26309) of the prior art used for air conditioning
15 and refrigeration.

In Fig. 7, reference numeral 50 denotes a hermetically sealed container having an oil reservoir 51 for storing oil in a bottom portion thereof, and an electric element 52 is housed in an upper portion thereof and a rotary
20 compression element 53 is housed in a lower portion thereof. The electric element 52 comprises a rotor 55 fitted onto a rotary shaft 54 and a stator 57 having oil return holes 56 formed in the outer periphery thereof. Reference numeral 58 represents an air gap defined by the outer periphery of the
25 rotor 55 and the inner periphery of the stator 57, 59 a half-

ring balancer attached to an end ring 60 of the rotor 55, and
61 an coil end of a coil 62 incorporated in the stator 57.

The rotary compression element 53 comprises a
cylinder 63, a roller 65 which rotates in the cylinder 63 by
5 an eccentric portion 64 of the rotary shaft 54, a vane 66, in
contact with the roller, for partitioning the cylinder 63, an
upper bearing 67 and a lower bearing 68 for covering the
openings of the cylinder, an unshown discharge port 69A
having a discharge valve 69 in this lower bearing, and a cup
10 muffler 70 for covering the discharge valve. Reference
numeral 71 denotes a discharge hole formed in the upper
bearing 67 and communicating with the inside of the cup
muffler 70 through a passage 72 formed in the cylinder 63.

Reference numeral 73 designates a discharge pipe
15 extending through an upper central portion of the
hermetically sealed container 50 and an open end portion
thereof is covered by a refrigerant suction cup 74 formed
like a bottomed truncated cone and attached to the interior
wall of the hermetically sealed container 50. Reference
20 numeral 75 represents a through hole formed in the center of
the bottom portion of the refrigerant suction cup 74 in
vicinity to the rotary shaft 54 in such a manner that it
faces the rotary shaft 54.

In the hermetically sealed type compressor
25 structured above, a refrigerant compressed by the rotary

compression element 53 passes through the air gap 58 of the electric element 52 and is supplied above this electric element. Oil contained in the refrigerant supplied above the electric element 52 is separated by centrifugal force generated by the rotation of the rotor 55. This separated oil is scattered to the side of the stator 57. Therefore, only a refrigerant gas containing no oil is present above the rotor 55 and this refrigerant gas flows into the inside of the suction cup 74 from the through hole 75 formed in the bottom portion of the refrigerant suction cup 74 and is discharged to the outside of the hermetically sealed container 50 through the discharge pipe 73. The separated oil is returned to the oil reservoir 51 of the hermetically sealed container 50 from the oil return holes 56 formed in the outer periphery of the stator 57.

Fig. 4(a) is a sectional view of the rotary shaft 54 of the prior art which consists of an upper rotary shaft 54a (diameter D_1), an eccentric portion 64 and a lower rotary shaft 54b (diameter D_1) all of which are integrally formed into a single unit. The roller 65 is fitted to the eccentric portion 64. Fig. 4(b) is a sectional view of the rotary shaft 54 of Fig. 4(a) seen from below.

Fig. 5 is a diagram for explaining the relationship among the cylinder 63, roller 65, vane 66, discharge port 69A and port portion 69B where the discharge port 69A is opened

in the cylinder 63.

To increase the output of the hermetically sealed type rotary compressor, it is conceivable to increase the amount of eccentricity E (the amount indicating the difference between the center of the rotary shaft 54 and the center of the eccentric portion 64 shown in Fig. 4(b)). However, when the amount of eccentricity is increased, the outer diameter (R) of the roller 65 decreases and the thickness of the roller 65 reduces. The outer diameter of the eccentric portion 64 is changed to a suitably required diameter.

Since the rotary shaft 54 of the prior art consists of the upper rotary shaft 54a (diameter $D1$), the eccentric portion 64 and the lower rotary shaft 54b (diameter $D1$) which are all integrally formed into a single unit and the diameter $D1$ of the upper rotary shaft 54a and the diameter $D1$ of the lower rotary shaft 54b are the same, when the amount of eccentricity E is made too large, the roller 65 cannot be attached to the eccentric portion 64.

As shown in Fig. 5, since the port portion 69B (portion indicated by broken lines) where the discharge port 69A is opened in the cylinder 63 is sealed by the end face of the roller 65 covering the port portion 69B, if the thickness of the roller 65 is reduced, sealing will be insufficient and a gas leak from the end face of the roller 65 will increase.

Then, when this problem is to be solved by reducing the area of the port portion 69B which is opened in the cylinder 63 by changing the position of the discharge port 69A without increasing the top clearance volume of the discharge port 69A (the increase of the top clearance volume is not preferred as it increases the invalid volume), the resistance of a discharge gas passage increases and the C.O.P of the hermetically sealed type rotary compressor decreases.

10 SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a hermetically sealed type rotary compressor which has an increased output and improved C.O.P.

The inventors of the present invention have conducted intensive studies on the above problem and have found that when the diameter of the lower rotary shaft is made smaller than the diameter of the upper rotary shaft of the rotary shaft which consists of the upper rotary shaft, eccentric portion and lower rotary shaft all of which are integrally formed into a single unit, the problem that the roller cannot be attached to the eccentric portion when the amount of eccentricity is large can be solved and the problem that a gas leaks from the end face of the roller can also be solved because the thickness of the roller can be thereby increased and sealing is sufficient even when the area of the

port portion where the discharge port is opened in the cylinder is increased. Thereby, the output can be increased and the C.O.P. can be improved. The present invention is predicated upon this finding.

5 According to a first aspect of the present invention, there is provided a hermetically sealed type compressor in which an electric element having a rotary shaft is housed in an upper portion of a hermetically sealed container, a compression element driven by the rotary shaft
10 of the electric element is housed in a lower portion of the hermetically sealed container, and an absorbed refrigerant is compressed by the compression element, discharged into the hermetically sealed container and discharged to the outside of the hermetically sealed container, wherein the rotary
15 compression element comprises a cylinder having a suction port, a roller which rotates in the cylinder by the eccentric portion of the rotary shaft, a vane, in contact with the roller, for partitioning the cylinder, an upper bearing and a lower bearing for covering the openings of the cylinder, a
20 discharge port having a discharge valve provided in the upper bearing, and a cup muffler for covering this discharge valve, and the ratio ($D2/D1$) of the diameter ($D2$) of the rotary shaft from the eccentric portion to a lower end to the diameter ($D1$) of the rotary shaft from an upper end to the
25 eccentric portion is set to a value less than 1.

According to a second aspect of the present invention, there is provided a hermetically sealed type rotary compressor according to the first aspect, wherein the area of a port portion where the discharge port is opened in the cylinder is set to 50 % or more of the total sectional area of the discharge port to reduce the resistance of a discharge gas passage without increasing the top clearance volume of the discharge port.

According to a third aspect of the present invention, there is provided a hermetically sealed type rotary compressor according to the second aspect, wherein the roller is made thick enough to seal the port portion which is opened in the cylinder to prevent the refrigerant from leaking from the discharge port.

According to a fourth aspect of the present invention, there is provided a hermetically sealed type rotary compressor according to the first to third aspects, wherein the ratio ($D2/D1$) is set to 12.5/16 or more and less than 1.

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BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects as well as advantages of the present invention will become clear by the following description of a preferred embodiment of the present invention with reference to the accompanying drawings,

wherein:

Fig. 1 is a sectional view of a hermetically sealed type rotary compressor according to an embodiment of the present invention;

5 Fig. 2(a) is a sectional view of a rotary shaft used in the present invention and Fig. 2(b) is a sectional view of the rotary shaft of Fig. 2(a) seen from below;

Fig. 3 is a diagram for explaining the relationship among a cylinder, roller, vane, discharge port and port
10 portion where the discharge port is opened in the cylinder as used in the present invention;

Fig. 4(a) is a sectional view of a rotary shaft of the prior art and Fig. 4(b) is a sectional view of the rotary shaft of Fig. 4(a) seen from below;

15 Fig. 5 is a diagram for explaining the relationship among a cylinder, roller, vane, discharge port and port portion where the discharge port is opened in the cylinder of the prior art;

Fig. 6 is a graph showing the ratio of the area of
20 the port portion opened in the cylinder to the total sectional area of the discharge port and the C.O.P. of the hermetically sealed type rotary compressor; and

Fig. 7 is a sectional view of a hermetically sealed type rotary compressor of the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a sectional view of a hermetically sealed type rotary compressor according to an embodiment of the present invention.

5 In Fig. 1, reference numeral 1 denotes a hermetically sealed container having an oil reservoir 2 for storing oil in a bottom portion thereof, and an electric element 3 is housed in an upper portion of the container and a rotary compression element 5 driven by the rotary shaft 4
10 of the electric element is housed in a lower portion of the container. The electric element 3 comprises a stator 6 fixed to the interior wall of the hermetically sealed container 1 and a rotor 8 fitted onto the rotary shaft 4 through an air gap 7 within the stator. The stator 6 comprises an iron core
15 10 having oil return holes 9 formed by cutting away the outer periphery thereof and a coil 12 having coil ends 11 arranged at upper and lower ends thereof. The rotor 8 comprises an iron core 13 and end rings 14 provided at upper and lower ends of the iron core.

20 A half-ring upper balancer 15 and lower balancer 16 are attached to the respective end rings. The rotary compression element 5 comprises a cylinder 17, a roller 19 which rotates in the cylinder 17 by the eccentric portion 18 of the rotary shaft 4, a vane 20, in contact with the roller,
25 for partitioning the cylinder 17, an upper bearing 21 and a

lower bearing 22 for covering the openings of the cylinder 17, a discharge port 23A having a discharge valve 23 provided in the upper bearing, and a cup muffler 24 for covering the discharge valve. A discharge port 25 is formed in the top surface of the cup muffler in such a manner that it faces the rotary orbit of the lower balancer 16.

Reference numeral 26 denotes a refrigerant discharge pipe extending through the end cap 27 for covering a top portion of the hermetically sealed container 1.

10 Reference numeral 28 represents an accumulator and 29 a separation plate. Arrows show the flow directions of a refrigerant.

In the hermetically sealed type rotary compressor structured above, the refrigerant flowing into the cylinder 17 from the suction port 30 through the accumulator 28 is compressed by the roller 19 and the vane 20 which work together and discharged from the discharge port 23A into the cup muffler 24 by opening the discharge valve 23. The refrigerant in the cup muffler passes through the air gap 7 of the electric element 3 from the discharge port 25 and is discharged above the electric element. The refrigerant discharged above the electric element 3 is turned by the rotation of the rotor 8 and oil having a heavy mass contained in the refrigerant is scattered to the side of the interior wall of the hermetically sealed container 1 and separated by

centrifugal force generated by turning. The refrigerant from which the oil has been separated is discharged to the outside of the hermetically sealed container 1 from the discharge pipe 26. The separated oil is returned to the oil reservoir 2 from the oil return holes 9 of the stator 6.

Fig. 2(a) is a sectional view of the rotary shaft 4 used in the present invention which consists of the upper rotary shaft 4a (diameter D1), the eccentric portion 18 and the lower rotary shaft 4b (diameter D2) all of which are integrally formed into a single unit. The roller 19 is fitted onto the eccentric portion 18. Fig. 2(b) is a sectional view of the rotary shaft 4 shown in Fig. 2(a) seen from below.

Fig. 3 is a diagram for explaining the relationship among the cylinder 17, roller 19, vane 20, discharge port 23A and port portion 23B where the discharge port 23A is opened in the cylinder 17 as used in the present invention.

The rotary shaft 4 used in the present invention consists of the upper rotary shaft 4a (diameter D1), the eccentric portion 18 and the lower rotary shaft 4b (diameter D2) all of which are integrally formed into a single unit. Since the diameter D1 of the upper rotary shaft 4a is made larger than the diameter D2 of the lower rotary shaft 4b, if the amount of eccentricity E is increased, such a problem that the roller 19 cannot be attached to the eccentric

portion 18 is eliminated. The ratio ($D2/D1$) is less than 1, preferably 12.5/16 or more and less than 1. If the ratio is less than 12.5/16, the strength of the rotary shaft 4 will be insufficient.

5 As shown in Fig. 3, the port portion 23B (indicated by broken lines) where the discharge port 23A is opened in the cylinder 17 is sealed by the end face of the roller 19 covering the port portion 23B. Since the roller 19 used in the present invention is thick enough for sealing, a gas leak
10 from the end face of the roller is prevented.

Fig. 6 shows the measurement result of the C.O.P. of the hermetically sealed type rotary compressor (having an excluded volume of 13.3 cc and a nominal output of 700 W) which increases the proportion of the area of the port
15 portion 23B which is opened in the cylinder by changing the position of the discharge port 23A without increasing the top clearance volume of the discharge port 23A as shown in Fig.
3.

The ratio of the area of the port portion 23B where
20 the discharge port 23A is opened in the cylinder 17 to the total sectional area of the discharge port 23A is plotted for the axis of abscissas of Fig. 6 and C.O.P based on the condition that C.O.P. is 1 when the above ratio is 30 % of a conventional ratio is plotted for the axis of ordinate.

25 It is understood from Fig. 6 that C.O.P. increases

as the above ratio grows and the ratio is preferably 50 %.

Since the present invention is constituted above, it is possible to increase the output and improve the C.O.P. of the hermetically sealed type rotary compressor.

WHAT IS CLAIMED IS:

1. A hermetically sealed type rotary compressor in which an electric element having a rotary shaft is housed in an upper portion of a hermetically sealed container, a compression
5 element driven by the rotary shaft of the electric element is housed in a lower portion of the hermetically sealed container, and an absorbed refrigerant is compressed by the compression element, discharged into the hermetically sealed container and then discharged to the outside of the
10 hermetically sealed container, wherein

the rotary compression element comprises a cylinder having a suction port, a roller which rotates in the cylinder by an eccentric portion of the rotary shaft, a vane, in contact with the roller, for partitioning the cylinder, an
15 upper bearing and a lower bearing for covering the openings of the cylinder, a discharge port having a discharge valve provided in the upper bearing, and a cup muffler for covering the discharge valve; and the ratio $(D2/D1)$ of the diameter $(D2)$ of the rotary shaft from the eccentric portion to a
20 lower end to the diameter $(D1)$ of the rotary shaft from an upper end to the eccentric portion is set to a value less than 1.

2. The hermetically sealed type rotary compressor according
25 to claim 1, wherein the area of a port portion where the

discharge port is opened in the cylinder is set to 50 % or more of the total sectional area of the discharge port to reduce the resistance of a discharge gas passage without increasing the top clearance volume of the discharge port.

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3. The hermetically sealed type rotary compressor according to claim 2, wherein the roller is made thick enough to seal the port portion which is opened in the cylinder to prevent the refrigerant from leaking from the discharge port.

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4. The hermetically sealed type rotary compressor of claims 1 to 3, wherein the ratio ($D2/D1$) is set to 12.5/16 or more and less than 1.