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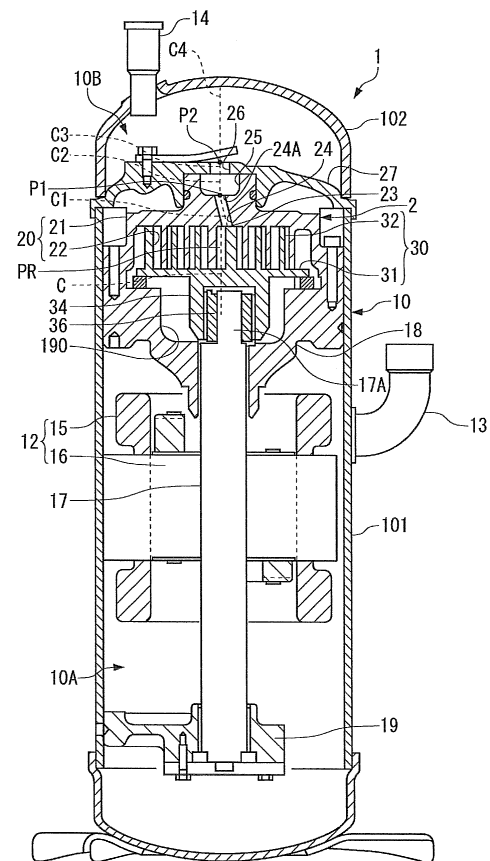
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(54) **COMPRESSOR**

(57) Provided is a compressor with reduced noise. This compressor is provided with an orbiting scroll (30) which is rotatably linked to an eccentric shaft portion of a main shaft (17), a fixed scroll (20) which forms a compression chamber (PR) which compresses the refrigerant by opposing the orbiting scroll and which, in the end plate (21), has an upstream discharge port (24) through which the compressed refrigerant passes and which communicates with the compression chamber (PR), and a discharge cavity (25) which communicates with the downstream side of the upstream discharge port (24) and has a larger volume than the upstream discharge port (24). The upstream discharge port (24) is provided with an open end (24B) on the upstream side and an open end (24A) on the downstream side. The upstream open end (24B) is eccentric relative to the central axis (C) of the fixed scroll (20) and the central axis (C2) of the discharge cavity (25) is in the area occupied by the downstream open end (24A).



Description

TECHNICAL FIELD

[0001] The present invention relates to a compressor, and in particular, to a scroll compressor.

BACKGROUND ART

[0002] A scroll compressor, which is used in a refrigeration cycle such as in an air conditioning device, a refrigerator, or the like, includes a fixed scroll and an orbiting scroll. The fixed scroll and the orbiting scroll each have a spiral wrap formed integrally therewith on one surface side of a disk-shaped end plate. The fixed scroll and the orbiting scroll are arranged so as to oppose each other with the respective wraps engaging each other, and the orbiting scroll is caused to revolve in relation to the fixed scroll by an electric motor or the like. By moving a compression chamber formed between the wraps from the outer periphery to the inner periphery and reducing the inner volume thereof, the refrigerant gas within the compression chamber is compressed.

[0003] The refrigerant gas compressed in the compression chamber flows through a discharge port formed in the end plate of the fixed scroll and flows into a high pressure chamber between a discharge cover and a housing, and is discharged towards a refrigerant circuit from a discharge pipe provided in the housing. The discharge port is often provided in an eccentric fashion in relation to a central axis of the fixed scroll in consideration of performance or the compression ratio of the refrigerant.

[0004] The discharge port formed in the fixed scroll has an effect on the performance of the scroll compressor or noise, and various configurations have been proposed.

[0005] For example, Patent Document 1 proposes a configuration in which a cylindrical collar with a hollow center is fitted onto the discharge port in order to mitigate vibration/noise resulting from the discharge of fluid compressed by the revolution of the scroll. By providing a collar, it is possible to reduce excitation force from pressure pulsation within the cylinder and to mitigate noise.

CITATION LIST

Patent Literature

[0006] Patent Document 1: Japanese Unexamined Utility Model Application Publication No. H4-82391U

SUMMARY OF INVENTION

Technical Problem

[0007] Vibrations/noise generated by the scroll compressor have a wide frequency range, and noise occurs due to resonance in a plurality of different frequency

bands. Thus, it is difficult to reduce noise in all frequency bands by using one noise reduction means as in Patent Document 1.

[0008] The present invention is made in view of such technical problems, and an object thereof is to provide a scroll compressor by which it is possible to reduce noise in a plurality of frequency bands occurring in a scroll compressor.

10 Solution to Problem

[0009] In accordance with this object, a compressor of the present invention is provided with an orbiting scroll that is rotatably linked to an eccentric shaft portion of a main shaft, a fixed scroll that forms a compression chamber that compresses the refrigerant by opposing the orbiting scroll and that, in the end plate, has a first refrigerant path through which the compressed refrigerant passes and that communicates with the compression chamber, and a second refrigerant path that communicates with the downstream side of the first refrigerant path and has a larger interior volume than that of the first refrigerant path. The first refrigerant path is provided with an open end on the upstream side and an open end on the downstream side. The upstream open end is eccentric relative to the central axis of the fixed scroll and the central axis of the second refrigerant path is in the area occupied by the downstream open end.

[0010] By the configuration above, the refrigerant is discharged from the downstream side open end of the first refrigerant path towards nodes of a plurality of resonance modes formed in the central axis of the second refrigerant path. Thus, it is possible to reduce the number of resonance modes generated and to reduce noise in the second refrigerant path.

[0011] In the compressor of the present invention, it is preferable that a center of a downstream side open end of the first refrigerant path coincide with a central axis of the second refrigerant path.

[0012] By having the center of the downstream side open end of the first refrigerant path coincide with the central axis of the second refrigerant path, it is possible to discharge the refrigerant from the first refrigerant path towards the central axis of the second refrigerant path, and thus, it is possible to reduce noise in the second refrigerant path.

[0013] Furthermore, in the compressor of the present invention, it is preferable that the first refrigerant path be formed at an incline with respect to the central axis of the second refrigerant path.

[0014] By forming the first refrigerant path at an incline with respect to the central axis of the second refrigerant path, it is possible to discharge the refrigerant from the first refrigerant path towards the central axis of the second refrigerant path.

[0015] Additionally, in the present invention, instead of forming the first refrigerant path at an incline with respect to the central axis of the second refrigerant path, it is

possible to form the first refrigerant path such that the central axis thereof coincides with the central axis of the fixed scroll extending in the vertical direction.

[0016] By having the central axis of the first refrigerant path coincide with the central axis of the fixed scroll, there is no need to form the first refrigerant path at an incline, thereby improving ease of processing.

[0017] The present invention can also provide a compressor in which the first refrigerant path and the second refrigerant path are formed in an end plate of the fixed scroll.

Advantageous Effects of Invention

[0018] According to the present invention, by forming the upstream discharge port portion in the discharge port of the compressor such that refrigerant is discharged from the upstream discharge port portion towards the central axis of the discharge cavity, it is possible to reduce noise occurring in the discharge cavity.

Brief Description of Drawings

[0019]

FIG. 1 is a vertical cross-sectional view depicting a scroll compressor pertaining to an embodiment of the present invention.

FIG. 2 is a partial enlarged view of FIG. 1 in the vicinity of a discharge port of a fixed scroll.

FIGS. 3A and 3B are illustrations for describing the effect of noise reduction in an embodiment of the present invention.

FIG. 4 is an illustration for describing a second embodiment of the present invention.

FIG. 5 is an illustration for describing another example of the second embodiment of the present invention.

Description of Embodiments

[First Embodiment]

[0020] Below, embodiments of the present invention will be described with reference to the attached drawings.

[0021] As illustrated in FIG. 1, a scroll compressor 1 of the present embodiment includes an electric motor 12, and a scroll compression mechanism 2 driven by the electric motor 12 within a housing 10. The scroll compressor 1 compresses a refrigerant and supplies it to a refrigerant circuit in an air conditioner, a refrigerator, or the like, for example. A configuration of the scroll compressor 1 will be described below.

[0022] The housing 10 includes a main housing body 101 that is a bottomed cylinder with an open top, and a housing top 102 that covers the open top of the main housing body 101.

[0023] The side surface of the main housing body 101

is provided with an intake pipe 13 through which refrigerant is introduced from an accumulator (not illustrated) into the main housing body 101.

[0024] The housing top 102 is provided with a discharge pipe 14 that discharges refrigerant that has been compressed by the scroll compression mechanism 2. The interior of the housing 10 is partitioned by a discharge cover 27 into a low pressure chamber 10A and a high pressure chamber 10B.

[0025] The electric motor 12 includes a stator 15 and a rotor 16.

[0026] The stator 15 is provided with a coil that generates a magnetic field as a result of power being supplied thereto through a power supply unit (not illustrated) attached to the side surface of the main housing body 101. The rotor 16 includes as primary components a permanent magnet and a yoke, and furthermore, a main shaft 17 is joined integrally therewith in the center of the rotor 16.

[0027] An upper bearing 18 and a lower bearing 19, which rotatably support the main shaft 17, are provided on either end of the main shaft 17 across the electric motor 12.

[0028] An eccentric pin 17A provided on the upper end of the main shaft 17 protrudes into and is accommodated in an accommodation space 190 formed in the upper bearing 18.

[0029] The scroll compression mechanism 2 includes a fixed scroll 20 and an orbiting scroll 30 that revolves in relation to the fixed scroll 20.

[0030] The fixed scroll 20 includes a fixed end plate 21 and a spiral wrap 22 that is stood upright from one surface of the fixed end plate 21. In the fixed scroll 20, the fixed end plate 21 includes a discharge port 23. The fixed scroll 20 is provided such that the central axis C thereof coincides with the central axis of the main shaft 17.

[0031] As illustrated in FIG. 2, the discharge port 23 includes an upstream discharge port portion 24 and a discharge cavity 25 that communicates with the upstream discharge port portion 24 and has a larger interior volume than that of the upstream discharge port portion 24, both the upstream discharge port portion 24 and the discharge cavity 25 having a circular opening shape. In the present embodiment, the upstream discharge port portion 24 corresponds to the first refrigerant path of the present invention, and the discharge cavity 25 corresponds to the second refrigerant path of the present invention.

[0032] The upstream discharge port portion 24 is disposed to the upstream side according to a flow direction A of the refrigerant, and the discharge cavity 25 is disposed to the downstream side. The center of the open end 24B on the upstream side of the upstream discharge port portion 24 is formed so as to be eccentric in relation to the central axis C of the fixed scroll 20. In the upstream discharge port portion 24, the center P1 of the open end 24A on the downstream side coincides with the central axis C2, which coincides with the central axis C, of the discharge cavity 25. Thus, the upstream discharge port

portion 24 is formed so as to be inclined in relation to the central axis C2 (flow direction A of refrigerant). The fact that the upstream discharge port portion 24 is formed in an inclined fashion in this manner is a characteristic of the present embodiment, and the refrigerant passing through the upstream discharge port portion 24 is discharged towards the central axis C2 of the discharge cavity 25. Details will be described later, but as a result of the flow of refrigerant, the scroll compressor 1 can prevent the generation of a number of resonance modes.

[0033] The upstream side of the upstream discharge port portion 24 communicates with a compression chamber PR formed between the fixed scroll 20 and the orbiting scroll 30. The downstream side of the discharge cavity 25 communicates with a downstream discharge port portion 26 of the discharge cover 27 covering the top of the fixed scroll 20.

[0034] The discharge cavity 25, the downstream discharge port portion 26, and the high pressure chamber 10B are provided such that the respective central axes C2, C3, and C4 thereof coincide with the central axis C of the fixed scroll 20 along the vertical direction. Thus, the center P2 of the downstream side open end 26A of the downstream discharge port portion 26 coincides with the central axis C4 of the high pressure chamber 10B, and the center of the upstream side open end 26B coincides with the central axis C2.

[0035] The orbiting scroll 30 also includes an orbiting end plate 31 having a disk shape and a spiral wrap 32 that is stood upright from one surface of the orbiting end plate 31.

[0036] The rear surface of the orbiting end plate 31 of the orbiting scroll 30 is provided with a boss 34, and a drive bush 36 is attached to the boss 34 through a bearing. The eccentric pin 17A is fitted into the inside of the drive bush 36. In this manner, the orbiting scroll 30 is joined in an eccentric manner to the center of main shaft 17, and thus, when the main shaft 17 rotates, the orbiting scroll 30 rotates (revolves) with the eccentric distance from the center of the main shaft 17 being the turning radius.

[0037] The orbiting scroll 30 is provided with an Oldham ring (not illustrated) that restricts rotation between the orbiting scroll 30 and the main shaft 17 such that the orbiting scroll 30 revolves but does not rotate.

[0038] Wraps 22 and 32, which are eccentric with respect to each other by a prescribed amount and are engaged with each other while being shifted by a 180° phase, are in contact with each other in a plurality of positions according to the rotational angle of the orbiting scroll 30. In this manner, the compression chamber PR is formed so as to have point symmetry about the center (innermost periphery) of the spirals of the wraps 22 and 32, and as a result of the revolution of the orbiting scroll 30, the compression chamber is moved gradually inward while the inner volume thereof decreases. The refrigerant is compressed to the maximum in the center of the spirals. The compression chamber PR of FIG. 1 illustrates

this portion.

[0039] Next, the operation of the scroll compressor 1 having the above configuration will be described.

[0040] In order to start up the scroll compressor 1, the electric motor 12 is excited and refrigerant is introduced into the housing 10 through the intake pipe 13.

[0041] When the electric motor 12 is excited, the main shaft 17 rotates, and as a result, the orbiting scroll 30 revolves in relation to the fixed scroll 20. This results in the refrigerant being compressed in the compression chamber PR between the orbiting scroll 30 and the fixed scroll 20, and the refrigerant introduced from the intake pipe 13 into the low pressure chamber 10A in the housing 10 is drawn into the area between the orbiting scroll 30 and the fixed scroll 20. Then, the refrigerant compressed in the compression chamber PR passes through the discharge port 23 of the fixed end plate 21 and the downstream discharge port portion 26 of the discharge cover 27 in that order, is discharged into the high pressure chamber 10B, and is then discharged outside through the discharge pipe 14. In this manner, the refrigerant is drawn in, compressed, and discharged in succession.

[0042] Next, the avoidance of generation of resonance modes, which is a characteristic of the scroll compressor 1, will be described with reference to FIGS. 3A and 3B.

[0043] When the scroll compressor 1 is in operation and the refrigerant passes through the discharge cavity 25, resonance modes, which are a cause for noise, can be generated. An object of the present embodiment is to reduce noise by reducing the number of resonance modes generated.

[0044] In the discharge cavity 25, a plurality of resonance modes from a primary mode to a high-order mode are generated (six resonance modes (i) to (vi) are illustrated in FIG. 3A). When these resonance modes are generated by the inflow of refrigerant from the upstream discharge port portion 24, noise is generated in the discharge cavity 25. However, when the refrigerant passes the node of the resonance mode, the resonance mode is not generated.

[0045] In FIG. 3A, the positions of the nodes of the plurality of resonance modes generated in the discharge cavity 25 are depicted with the broken lines DL. The upper portion of FIG. 3A illustrates plan views of the discharge cavity 25 whereas the lower portion illustrates a vertical edge face. The two circles 28 and 29 in each discharge cavity 25 each illustrate positions where the refrigerant is discharged (hereinafter referred to as a vibration input position). The solid line circle 28 illustrates a case in which the vibration input position coincides with the central axis C2 of the discharge cavity 25, and the broken line circle 29 illustrates a case in which the vibration input position is shifted from the central axis C2 and the node.

[0046] In the case of the primary mode illustrated in (i) of FIG. 3A, a node is formed on the inner wall of the discharge cavity 25. Meanwhile, in the case of the secondary mode illustrated in (ii) of FIG. 3A, the node is formed directly on a diametrical line passing through the

central axis C2 of the discharge cavity 25.

[0047] Nodes formed in other resonance modes are illustrated in (iii) to (vi) of FIG. 3A, and are formed in various positions on the discharge cavity 25, but with the exception of (i), which depicts the primary mode, and (iv), which depicts a high-order mode, the node of each of the resonance modes passes through the central axis C2 of the discharge cavity 25. As a result, nodes of a plurality of different resonance modes include the central axis C2 of the discharge cavity 25 as a common point.

[0048] The refrigerant discharged from the upstream discharge port portion 24 passes through the discharge cavity 25 as a spherical wave. Consequently, by having the center P1 of the downstream side open end 24A coincide with the central axis C2, the refrigerant passes through the central axis C2 and is discharged to the downstream discharge port portion 26.

[0049] Thus, in the example of FIG. 3A, when the refrigerant is discharged to the discharge cavity 25 from the position indicated with the solid line circle 28, the resonance modes (ii), (iii), (v), and (vi) in FIG. 3A are not generated, and only the resonance modes (i) and (iv) are generated. On the other hand, if the refrigerant is discharged to the discharge cavity 25 from the position indicated with the broken line circle 29, then all resonance modes from (i) to (vi) in FIG. 3A are generated. The generation of resonance modes is depicted with solid lines and broken lines in FIG. 3B, and by having the vibration input position coincide with the central axis C2 of the discharge cavity 25, the number of resonance modes generated is reduced, which allows for a reduction in noise.

[0050] The scroll compressor 1 has realized this effect of reducing noise.

[0051] In other words, in the present embodiment, by having the center P1 of the downstream side open end 24A of the upstream discharge port portion 24 coincide with the central axis C2 of the discharge cavity 25, the number of resonance modes generated is reduced.

[0052] However, as a result of the upstream side open end 24B of the upstream discharge port portion 24 being eccentric with respect to the central axis C2, the upstream discharge port portion 24 is formed at an incline, and the center P1 coincides with the central axis C2.

[0053] According to the present embodiment, by having the center P1 of the upstream discharge port portion 24 coincide with the central axis C2, the refrigerant discharged from the upstream discharge port portion 24 passes through nodes of a plurality of resonance modes formed on the central axis C2. These plurality of resonance modes are not generated, and thus, noise within the discharge cavity 25 is reduced.

[0054] The most preferable example of the center P1 of the upstream discharge port portion 24 coinciding with the central axis C2 is applied to the scroll compressor 1 above, but the only requirement is that the refrigerant passes through nodes of resonance modes. Thus, even if the center P1 is shifted from the central axis C2, as

long as the central axis C2 is present in the area occupied by the open end 24B, the effects of the present invention can still be attained.

5 [Second Embodiment]

[0055] As illustrated in FIG. 4, in the present embodiment, instead of forming the upstream discharge port portion 24 at an incline, the position of the discharge cavity 25 is shifted, thereby causing the central axis C2 of the discharge cavity 25 to coincide with the central axis C1 (center P1) of the upstream discharge port portion 24. In this manner, noise occurring in the discharge cavity 25 is reduced. The upstream discharge port portion 24 is formed such that the central axis C thereof traces the vertical direction. The shift in position here refers to the shifting of the discharge cavity 25 of the present embodiment in relation to the discharge cavity 25 of the first embodiment.

[0056] The discharge cavity 25 is eccentric in relation to the central axis C of the fixed scroll 20, and by combining this eccentricity with the position shift of the discharge cover 27 and the housing top 102, the central axes C3 and C4 coincide with the central axis C1.

[0057] According to the present embodiment, similar to the first embodiment, it is possible to reduce the number of resonance modes generated in the discharge cavity 25. Consequently, noise is reduced in the discharge cavity 25.

[0058] Also, there is no need to form the upstream discharge port portion 24 at an incline as in the first embodiment, and thus, the second embodiment exhibits an improvement in terms of ease of processing.

[0059] Furthermore, the positions of the discharge cover 27 and the housing top 102 are shifted in conjunction with the shift in position of the discharge cavity 25, and thus, the central axis C3 of the downstream discharge port portion 26 continues to coincide with the central axis C4 of the high pressure chamber 10B. Consequently, by mitigating an increase in the number of resonance modes generated in the high pressure chamber 10B, it is possible to prevent an increase in noise in the high pressure chamber 10B.

[0060] In the present invention, as illustrated in FIG. 5, by inclining the downstream discharge port portion 26 instead of shifting the positions of the discharge cover 27 and the housing top 102, it is possible to have the center P2 of the downstream side open end 26A of the downstream discharge port portion 26 coincide with the central axis C4 of the high pressure chamber 10B. In such a case, it would be necessary to form the downstream discharge port portion 26 at an incline, but the discharge cover 27 is thin compared to the fixed end plate 21, and processing thereof is easier compared to forming the upstream discharge port portion 24 at an incline.

[0061] Also, even if the center P2 is shifted from the central axis C4, as long as the central axis C4 is present in the area occupied by the open end 26A, the effects of

the present invention can still be attained, as described above.

[0062] The embodiments have been described above. However, in addition to the configurations above, as long as there is no departure from the spirit and scope of the present invention, configurations described in the modes of the above embodiments can be selected as desired, or can be changed to other configurations as necessary.

[0063] For example, the present invention can also be applied to a scroll compressor that is not provided with the discharge cover 27. In such a case, the fixed end plate would only include a discharge port of the same diameter (because no portions corresponding to the discharge cavity 25 would be present), and the discharge port would be directly connected to the high pressure chamber 10B. The discharge port corresponds to the first refrigerant path of the present invention, and the high pressure chamber corresponds to the second refrigerant path of the present invention.

[0064] Also, if the upstream discharge port portion 24 or the downstream discharge port portion 26 is formed at an incline, it may be formed in a curve or inclined in a stepwise fashion such as in a crank shape or a step shape, instead of forming in a straight line.

[0065] The horizontal cross-sectional shape of the discharge cavity 25 is not limited to being a circle, and another cross-sectional shape may be adopted.

Reference Signs List

[0066]

- 1 Scroll compressor
- 2 Scroll compression mechanism
- 10 Housing
- 10A Low pressure chamber
- 10B High pressure chamber
- 12 Electric motor
- 13 Intake pipe
- 14 Discharge pipe
- 15 Stator
- 16 Rotor
- 17 Main shaft
- 17A Eccentric pin
- 18 Upper bearing
- 19 Lower bearing
- 20 Fixed scroll
- 21 Fixed end plate
- 22, 32 Wrap
- 23 Discharge port
- 24 Upstream discharge port portion (first refrigerant path) 12A, 12B Open end
- 25 Discharge cavity (second refrigerant path)
- 26 Downstream discharge port portion
- 26A, 26B Open end
- 27 Discharge cover
- 30 Orbiting scroll
- 31 Orbiting end plate

- 34 Boss
- 36 Drive bush
- 101 Main housing body
- 102 Housing top
- 190 Accommodation space
- A Direction
- C, C1, C2, C3, C4 Central axis
- P1, P2 Center
- PR Compression chamber

Claims

1. A compressor comprising:

an orbiting scroll that is rotatably linked to an eccentric shaft portion of a main shaft;
a fixed scroll that opposes the orbiting scroll to form a compression chamber for compressing refrigerant, the fixed scroll having in an end plate a first refrigerant path connected to the compression chamber through which the compressed refrigerant passes; and
a second refrigerant path connected to a downstream side of the first refrigerant path and having a larger interior volume than that of the first refrigerant path,
the first refrigerant path including an upstream side open end and a downstream side open end; the upstream side open end being eccentric in relation to a central axis of the fixed scroll; and
a central axis of the second refrigerant path being present in an area corresponding to where the downstream side open end occupies.

2. The compressor according to claim 1, wherein a center of the downstream side open end of the first refrigerant path coincides with the central axis of the second refrigerant path.

3. The compressor according to claim 1 or 2, wherein the first refrigerant path is formed at an incline with respect to the central axis of the second refrigerant path.

4. The compressor according to claim 1 or 2, wherein the first refrigerant path is formed such that a central axis thereof coincides with the central axis of the fixed scroll extending in a vertical direction.

5. The compressor according to any one of claims 1 to 4, wherein the first refrigerant path and the second refrigerant path are formed in the end plate of the fixed scroll.

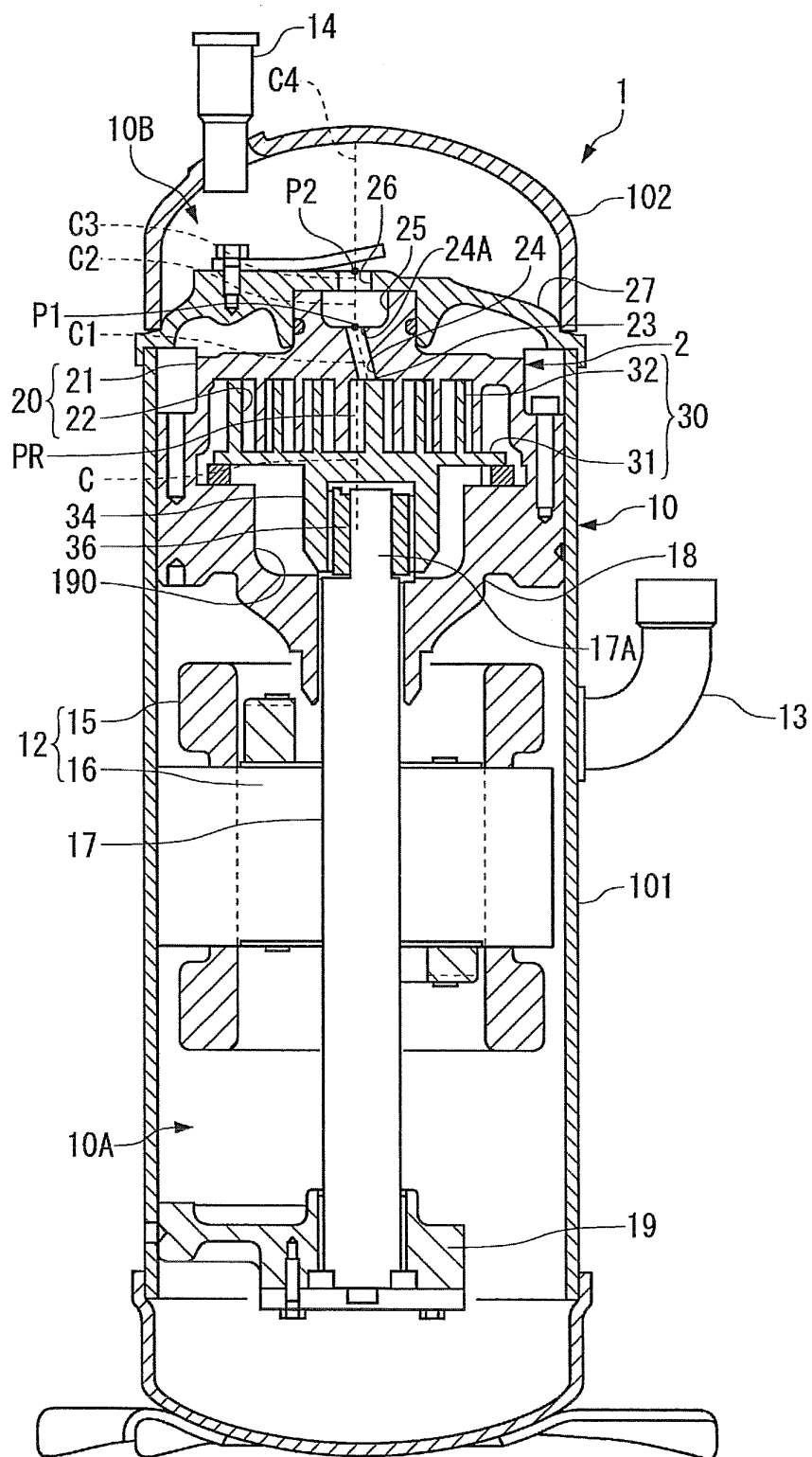


FIG. 1

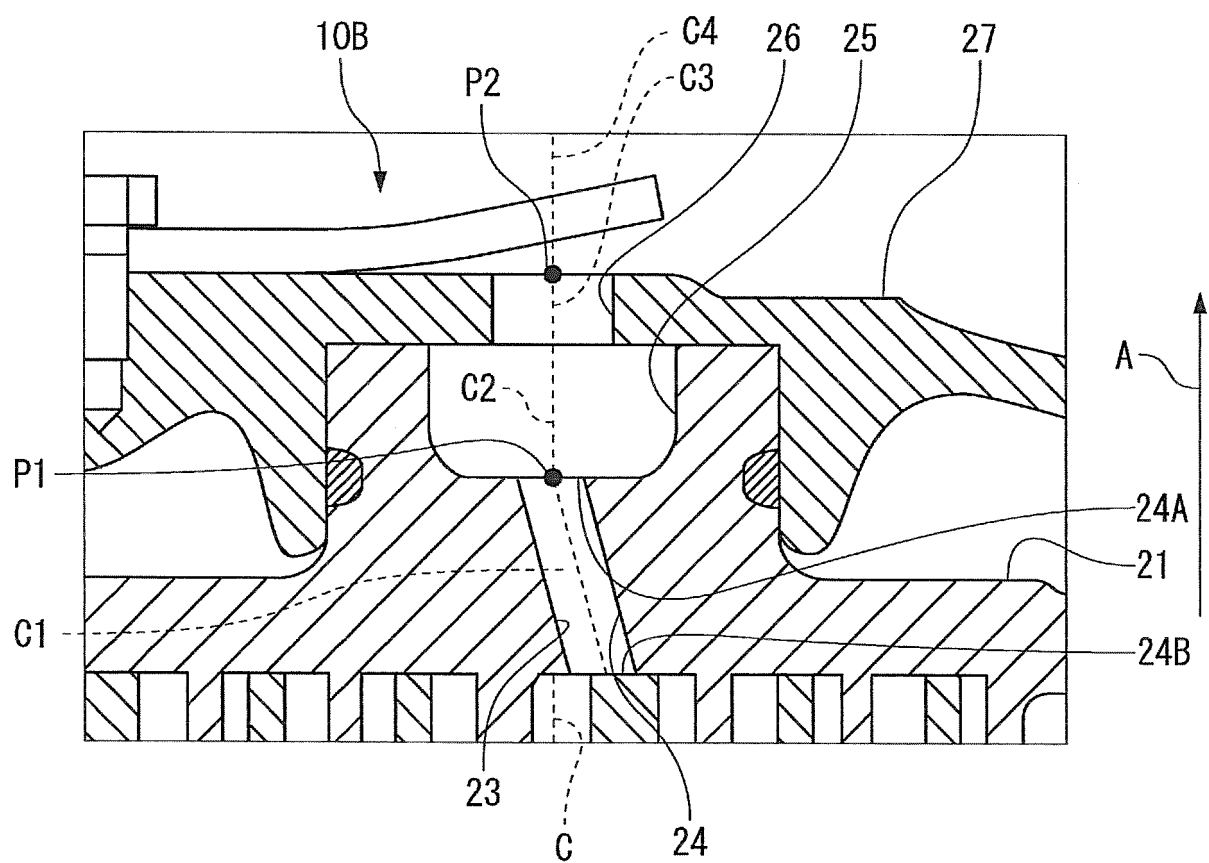


FIG. 2

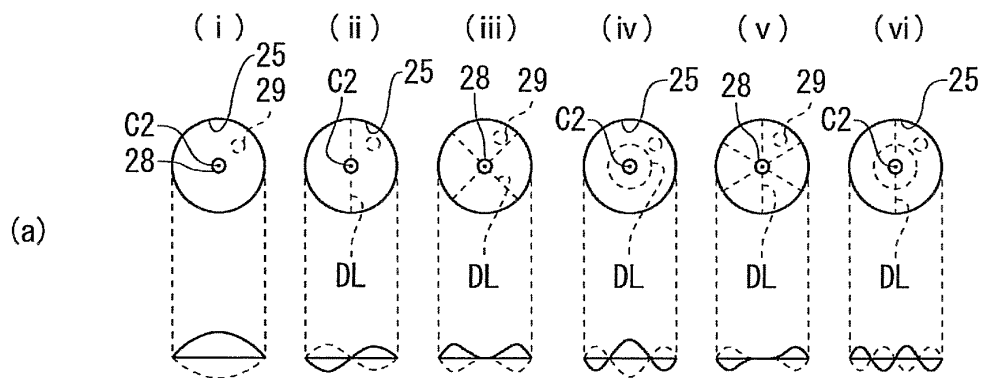


FIG. 3A

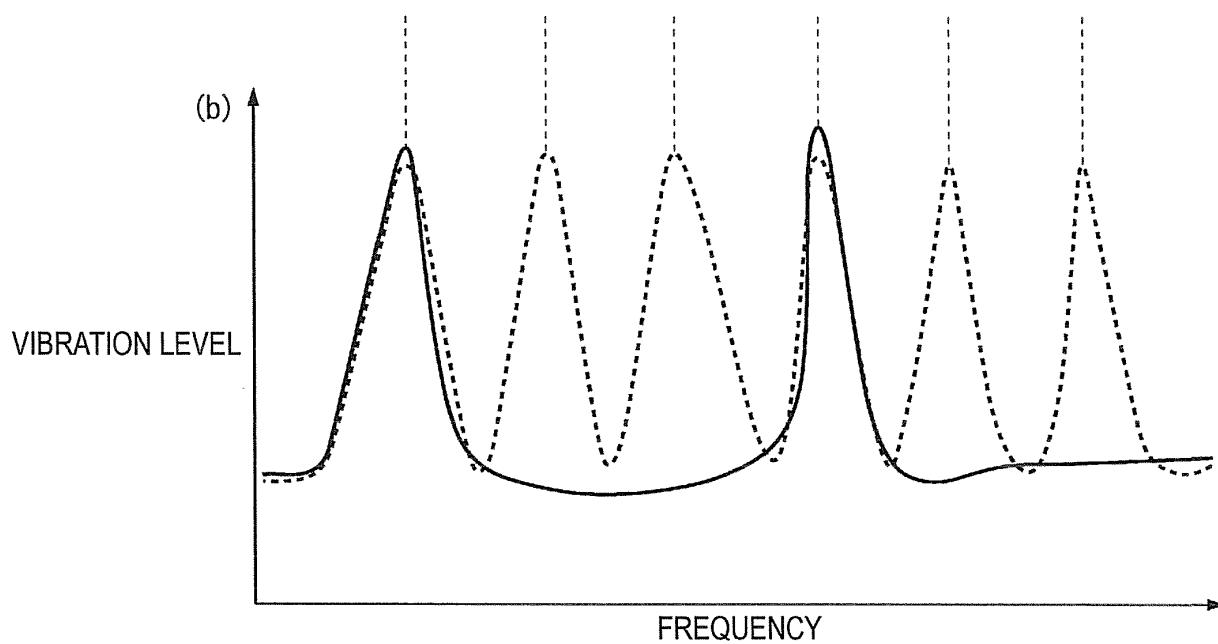


FIG. 3B

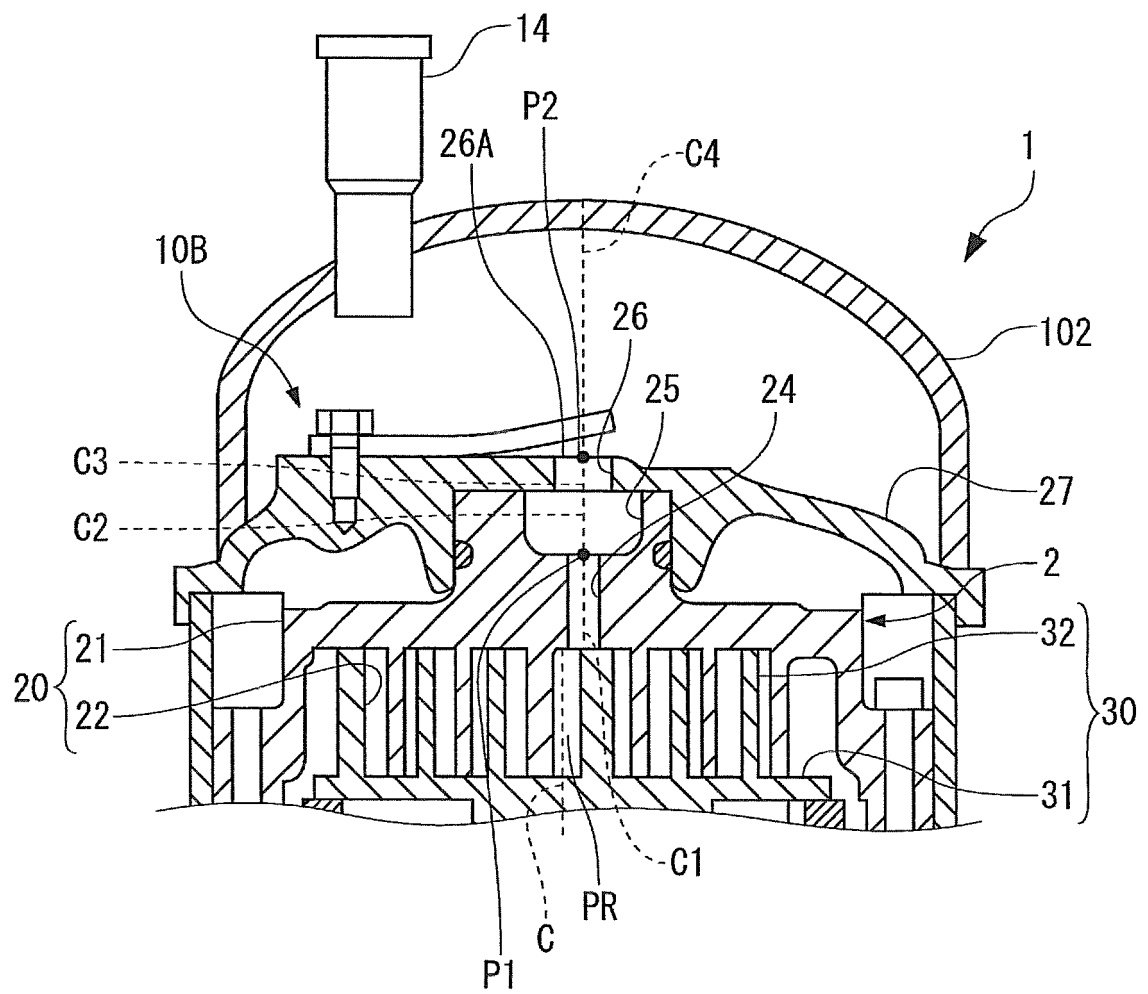


FIG. 4

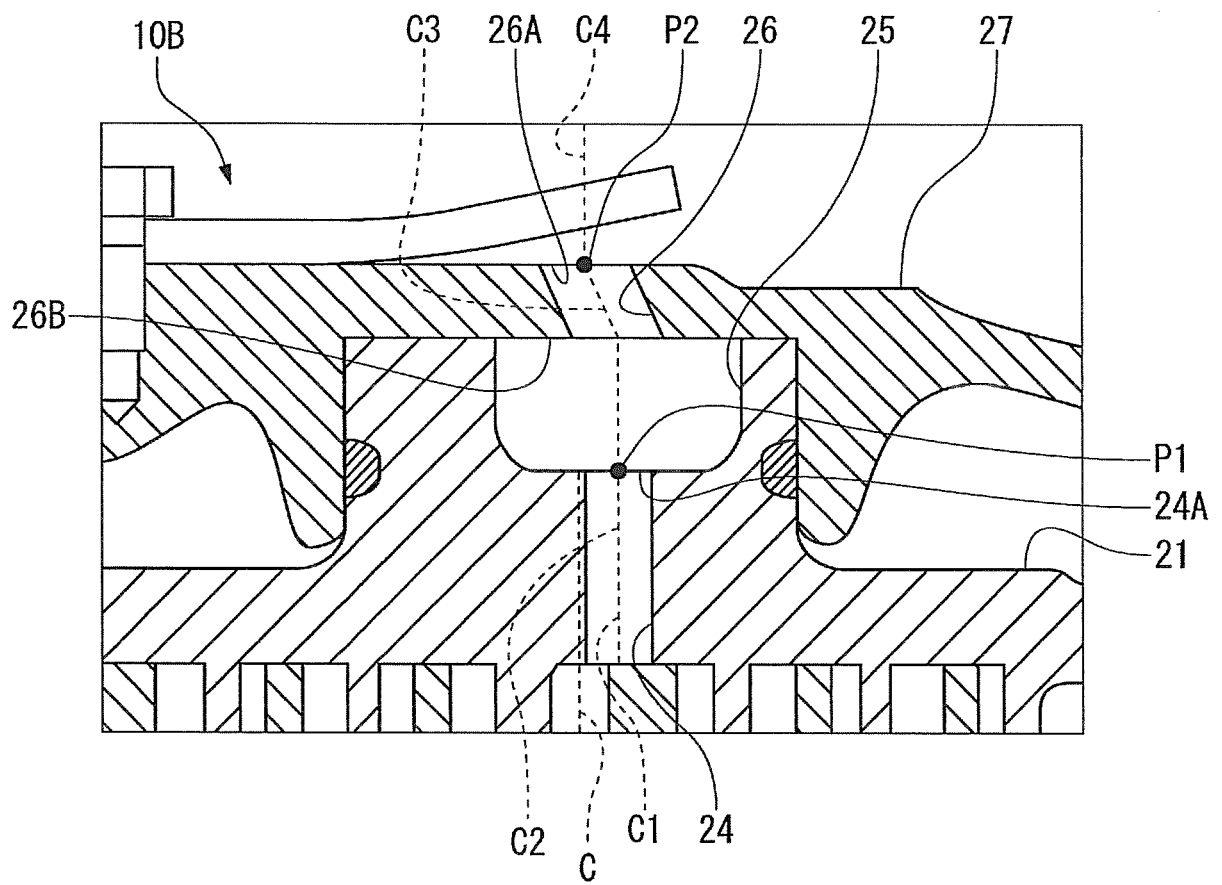


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/003201

A. CLASSIFICATION OF SUBJECT MATTER

F04C18/02(2006.01)i, F04C29/06(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04C18/02, F04C29/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
 Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3-121286 A (Sanyo Electric Co., Ltd.), 23 May 1991 (23.05.1991), entire text; all drawings (Family: none)	1-5
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 38884/1992 (Laid-open No. 92487/1993) (Mitsubishi Electric Corp.), 17 December 1993 (17.12.1993), entire text; all drawings (Family: none)	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

22 August, 2014 (22.08.14)

Date of mailing of the international search report

02 September, 2014 (02.09.14)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/003201

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 6-341387 A (Coopland Corp.), 13 December 1994 (13.12.1994), entire text; all drawings & US 35216 E & EP 479421 A1 & KR 10-0188324 B & CN 1060699 A	1-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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