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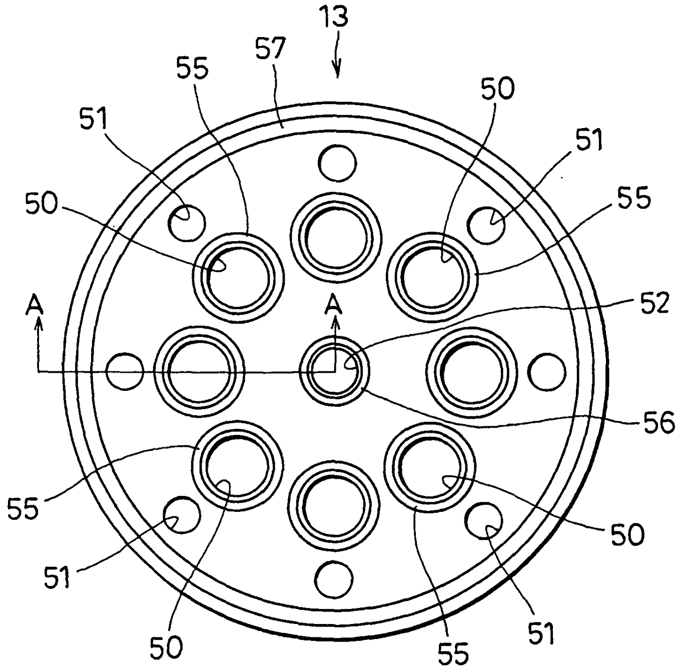
(54) Leakage prevention in a compressor utilized in a refrigeration cycle

(57) A compressor is provided as a compact unit while effectively preventing coolant leakage and assuring safety by optimizing the contact pressure at a seal member held between a plurality of housing members so as to minimize the size or the number of fasting members. In the compressor comprising at least two housing members, in which the compression mechanism is housed, a seal member (13, 14, 15) held between the housing members and fastening members used to fasten the housing members and the seal member as one. The seal member (13, 14, 15) has a bead portion (55, 56, 57) formed to assume a plateau shape.

FIG. 3



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Description

[0001] The present invention relates to a compressor for use in an automotive air-conditioning system or the like.

[0002] A vapor critical compression refrigeration cycle, in which a coolant such as CO2 circulates at a fairly high pressure, requires that special care be taken to prevent coolant leakage and assure safety. Technologies proposed in the related art to address these needs include the following. Namely, in an air-conditioning system in which a carbon dioxide gas coolant is used, the design pressure safety factors of the cabin-side devices disposed on the cabin side, among the various devices and the coolant piping constituting the refrigeration cycle, are set higher than the overall design pressure safety factors of the devices constituting the refrigeration cycle. More specifically, the wall thickness of the cabin-side piping may be set higher than that of the outside piping so as to assure a higher wall thickness for the entire flow passage through which the coolant flows at the cabin-side devices compared to the wall thickness of the flow passages at the outside devices (see Japanese Unexamined Patent Publication No. 2002-243320). It is assumed that since any damage to a component caused by an abnormal pressure increase is bound to occur at an outside device, leakage of the CO2 gas into the cabin can be prevented by adopting these measures.

[0003] While there always exists the need to achieve further miniaturization for compressors used in automotive air-conditioning systems and the like, it is particularly difficult to provide a compressor used in a vapor critical compression refrigeration cycle as a compact unit without increasing the risk of coolant leakage and sacrificing safety. In the related art, coolant leakage is prevented and better safety is assured by using many large fastening members such as bolts used to fasten the plurality of housing members constituting the outer frame of the compressor, resulting in a compressor with large exterior dimensions. Japanese Unexamined Patent Publication No. 2002-243320 cited above does not disclose an art that would allow miniaturization of the compressor while assuring safety.

[0004] Accordingly, an object of the present invention is to provide a compressor that allows the size or the number of fastening members used therein to be minimized by optimizing the contact pressures at seal members held between the plurality of housing members so as to achieve miniaturization while also preventing coolant leakage and assuring safety.

[0005] In order to achieve the object described above, the present invention provides a compressor comprising at least two housing members in which a compression mechanism is housed, a seal member held between the housing members and fastening members that fasten the housing members and the seal member as one, with the contact pressure applied to the seal member as the housing member and the seal members are fastened via the fastening members set within a range over which a critical seal pressure of the seal member is higher than the maximum operating pressure of the compressor and lower than the breaking pressure of the compressor, characterized in that the contact pressure is set within a range 2 to 5 times the contact pressure at which the critical seal pressure is equal to the maximum operating pressure and that the maximum operating pressure is within a range of 15 to 20 MPa. The term "contact pressure" in this context refers to the pressure applied to the surfaces of the seal member at which it is pressed in contact against the adjacent housing members. The contact pressure can be measured by using pressure sensitive paper or the like of the known art.

[0006] It is desirable that the contact pressure be set within a range 2 to 5 times the contact pressure at which the critical seal pressure is equal to the maximum operating pressure in the compressor. It is even more desirable to set it within a range of 3 to 4 times the contact pressure at which the critical seal pressure is equal to the maximum operating pressure.

[0007] It is also desirable that the maximum operating pressure be within a range of 15 to 20 MPa.

[0008] It is desirable that the seal member include a rubber layer formed at each of the two surfaces of a metal plate and that the thickness of the metal plate be within a range of 0.2 to 0.8 mm.

[0009] It is desirable that the seal member include a bead portion assuming a plateau shape or a mound shape and that the height of the bead portion be within a range of 0.1 to 0 .4 mm. FIG. 9 presents an example of a structure that may be adopted in a seal member 100, with reference numeral 105 indicating a bead portion (full bead) assuming the mound shape and reference numeral 106 indicating a bead portion (half bead) assuming the plateau shape in the figure.

[0010] Alternatively, the compressor according to the present invention, comprising at least two housing members in which a compression mechanism is housed, a seal member held between the housing members and fastening members that fasten the housing members and the seal member as one, with the contact pressure applied to the seal member as the housing members and the seal member are fastened via the fastening members set within a range over which a critical seal pressure of the seal member is higher than the maximum operating pressure of the compressor and lower than the breaking pressure of the compressor, may be characterized in that the seal member includes a bead portion formed to assume a plateau shape or a mound shape and that the bead portion located closer to any of the fastening members is formed so as to have a lower height.

[0011] It is desirable that a bead line pressure representing a force applied to the bead portion per unit distance during the fastening process be within a range 10 to 25 times the maximum operating pressure.

[0012] The housing members in the compressor may include a substantially cylindrical cylinder block with a plurality of bores formed therein to define compression spaces, a front head with a crankcase formed therein, which seals off one end surface of the cylinder block and a rear head with an intake chamber and an outlet chamber formed therein, which seals off another end surface of the cylinder block. The fastening members in this compressor may include a plurality of bolts passing through areas of the front head, the cylinder block and the rear head near the outer edges thereof.

[0013] In addition, it is desirable that the diameter of a pitch circle formed by connecting the individual bolts be equal to or less than 110 mm.

[0014] The housing members in the compressor may include a cylinder block having a plurality of bores formed therein to define compression spaces, a front head with a crankcase formed therein, which seals off one end surface of the cylinder block and assumes a size and a shape that allow the front head to enclose the cylinder block, and a rear head with an intake chamber and an outlet chamber formed therein, which seals off another end surface of the cylinder block. The fastening members in this compressor may include a threaded portion formed at an outer wall of the front head near its end toward the rear head and a ring nut constituted with a threaded portion to interlock with the threaded portion and a holding portion that holds the rear head. This provides the advantage that a compact structure can be achieved and, as a result, further miniaturization of the compressor can be achieved.

[0015] The housing members in the compressor may include a cylinder block having a plurality of bores formed therein to define compression spaces, a front head with a crankcase formed therein, which seals off one end surface of the cylinder block and assumes a size and a shape that allow the front head to enclose the cylinder block, and a rear head with an intake chamber and an outlet chamber formed therein, which seals off another end surface of the cylinder block. The fastening members in this compressor may include a threaded portion formed at an outer wall of the front head near its end toward the rear head and a threaded portion formed at an inner wall of the rear head near its end toward the front head to interlock with the threaded portion. This provides the advantage that a compact structure can be achieved and, as a result, further miniaturization of the compressor can be achieved.

[0016] In addition, it is desirable that the compressor be utilized in a refrigeration cycle in which CO2 is used as a coolant.

[0017] In the compressor according to the present invention, the contact pressure at the seal members held between the plurality of housing members is optimized, which allows the size or number of the fastening members to be minimized. As a result, the compressor can be provided as a compact unit while effectively preventing coolant leakage and assuring safety.

[0018] The results of research conducted by the inventor of the present invention et al. indicate that the object of the present invention can be achieved with an even higher degree of effectiveness by setting the maximum operating pressure of the compressor and adopting a specific structure in the seal member or by setting the bead line pressure (see the embodiment described below).

[0019] Furthermore, while there is a concern that if the diameter of the bolt pitch circle is too large in the compressor adopting the structure in which the bolts are disposed near the outer edge of the compressor, the fastening force imparted via the bolts can be lower over the central area of the circle, a sufficient level of fastening force is assured over the entire surface by adopting the structure disclosed in which the diameter of the pitch circuit formed by connecting the bolts is equal to or less than 110 mm.

[0020] Further advantages and characteristics of the invention ensue from the description below of the preferred embodiments, with reference to the accompanying drawings, in which:

FIG. 1 is a sectional view of a structural example that may be adopted in the compressor according to the present invention;

FIG. 2 is a graph indicating the relationship between the contact pressure at a seal member and the critical seal pressure of the seal member;

FIG. 3 is a top view of a structural example that may be adopted in the gasket held between the cylinder block and the intake valve;

FIG. 4 is a sectional view of the gasket shown in FIG. 3 taken along A-A;

FIG. 5 is a partial enlargement of the gasket in FIG. 3 showing the central lines of the bead portions;

FIG. 6 shows the positions at which the bolts are disposed, viewed from the rear head side;

FIG. 7 shows the second housing structure;

FIG. 8 shows the third housing structure; and

FIG. 9 presents a structural example that may be adopted in the seal member, which includes a mound bead portion (a full bead) and a plateau bead portion (a half bead).

[0021] Embodiments of the present invention are now explained in reference to the attached drawings. A compressor 1 in FIG. 1, constituting part of a refrigeration cycle in an automotive air-conditioning system, in which CO2 is used as a coolant, comprises a cylinder block 2, a front head 3, a rear head 4, a drive shaft 5, a swashplate mechanism 6, pistons 7, a valve plate 10, intake valves 11, outlet valves 12, gaskets 13, 14 and 15 and the like.

[0022] The cylinder block 2 is a substantially cylindrical member with a plurality of bores 20 arrayed circumferentially.

Inside each bore 20, a compression space 21 where the coolant is compressed is formed. The front head 3 is a member that seals off one end surface of the cylinder block 2, with a crankcase 22 formed inside. The rear head 4 with an intake chamber 25 and an outlet chamber 26 formed therein seals off another end surface of the cylinder block 2. The drive shaft 5 is a member assuming a substantially rod-like shape. It is rotatably held at bearings and seal members disposed at the cylinder block 2 and the front head 3, and its portion 5a projecting beyond the front head 3 is connected to a pulley (not shown) which is caused to rotate by a drive source such as an engine or a motor. The swashplate mechanism 6, which is disposed inside the crankcase 22, includes a swashplate 30, shoes 31, an angle adjustment mechanism 32, a thrust flange 33 and the like. It converts the rotational force of the drive shaft 5 to a reciprocal motion of the pistons 7 and the angle of the swashplate 30 is adjusted in conformance to predetermined conditions. The pistons 7 are each linked to the shoes 31 so as to be allowed to move reciprocally and are also each slidably fitted inside one of the bores 20.

[0023] The gasket 13, the intake valve 11, the valve plate 10, the outlet valve 12 and the gasket 14 disposed in this order starting from the cylinder block side are held between the cylinder block 2 and the rear head 4, whereas the gasket 15 is held between the cylinder block 2 and the front head 3. The front head 3, the gasket 15, the cylinder block 2, the gasket 13, the intake valve 11, the valve plate 10, the outlet valve 12, the gasket 14 and the rear head 4 are held together with a predetermined level of fastening force via a plurality (8) of bolts 40 passing through the areas near their outer edges and nuts 41. The gasket 13, the intake valve 11, the valve plate 10, the outlet valve 12, the gasket 14 and a retainer 42 are held at the central area of the cylinder block 2 via a bolt 43.

[0024] At the valve plate 10, which is a disk-shaped member constituted of metal, an intake port constituting part of intake passages 45 communicating between the intake chamber 25 and the compression spaces 21, an outlet port constituting part of outlet passages 46 communicating between the compression spaces 21 and the outlet chamber 26, through holes at the outer edge thereof through which the bolts 40 pass and a through hole through which the central bolt 43 passes, are formed.

[0025] At the intake valve 11, which is constituted with a metal plate and includes a lead portion for opening/closing the outlet passages 46, an outlet port constituting part of the outlet passages 46, through holes at the outer edge thereof through which the bolts 40 pass and a through hole through which the central bolt 43 passes, are formed. At the outlet valve 12, which is constituted with a metal plate and includes a lead portion for opening/closing the intake passages 45, an intake port constituting part of the intake passages 45, through holes at the outer edge thereof through which the bolts 40 pass and a through hole through which the central bolt 43 passes, are formed.

[0026] The gaskets 13, 14 and 15 are members formed by covering both surfaces of a metal plate with a rubber layer. The gaskets 13 and 14 disposed between the cylinder block 2 and the rear head each have communicating holes formed therein communicating between the intake passages 45 and the outlet passages 46, through holes at the outer edge thereof through which the bolts 40 pass and an opening through which the central bolt 43 passes. At the central opening of the gasket 14, the retainer 42, which restricts the movement of the lead portion of the outlet valve 12 along the opening direction, is disposed. At the gasket 15 disposed between the cylinder block 2 and the front head 3, a hole with a diameter equal to that of the crankcase 27 and through holes through which the bolts 40 pass at the outer edge thereof are formed.

[0027] In the compressor 1 adopting the structure described above, the front head 3, the cylinder block 2, the valve plate 10 in the rear head 4 constitute housing members that are sealed by the gaskets 13, 14 and 15 used as seal members. In addition, specific types of seal members may be disposed between the valve plate 10 and the intake valve 11 and between the valve plate 10 and the outlet valve 12, as necessary.

[0028] The contact pressure at the seal members (gaskets 13, 14 and 15) generated as the bolts 40 used as fastening members are tightened in the structure described above is set as shown in FIG. 2. The term "contact pressure" in this context refers to the pressure applied at a surface of each seal member (gasket 13, 14 or 15) at which the seal member is pressed in contact against an adjacent housing member (the front head 3, the cylinder block 2 or the rear block 4). This pressure can be measured by using pressure sensitive paper or the like of the known art. The relationship between the pressure measured by using the pressure sensitive paper and the corresponding fastening force imparted via the fastening members (bolts 40) must be ascertained in advance through testing or the like. It is also necessary to ascertain in advance through testing or the like the relationship (the curve X in FIG. 2) between the contact pressure at the seal member and the critical seal pressure (the critical pressure at which coolant leakage can be prevented) of the seal member. In FIG. 2, Pa indicates the maximum operating pressure of the compressor 1,Pb indicates the breaking pressure of the compressor 1 and P1 indicates the contact pressure at which the critical seal pressure is equal to the maximum operating pressure Pa. It is desirable that the maximum operating pressure Pa be within a range of 15 to 20 MPa and if the compressor includes an abnormally high pressure preventing means such as a relief valve, the maximum operating pressure is represented by the operating pressure of the abnormally high pressure preventing means. The contact pressure at the seal members is set within a range R1, which is 2 to 5 times the contact pressure P1 in the compressor 1 adopting the structure described above. It is even more desirable to set the seal member contact pressure within a range R2, which is 3 to 4 times the contact pressure P1. With the seal member contact pressure set within these ranges, the coolant is made to leak through the seal member before the pressure inside the compressor 1 having exceeded the maximum operating pressure Pa under abnormal conditions reaches the breaking pressure Pb, thereby improving safety.

At the same time, since the size or quantity of fastening members (bolts) 40 can be reduced over that in the related art, the compressor 1 can be provided as a more compact, lighter weight unit. The research conducted by the inventor of the present invention et al. indicates that by adopting the structure described above, the outer diameter of the compressor 1 can be reduced by approximately 10 mm and the weight of the compressor 1 can be reduced by 15 to 20%.

[0029] FIG. 3 shows a structure that may be adopted in the gasket 13 disposed between the cylinder block 2 and the intake valve 11. At the gasket 13, communicating holes 50, each formed at a position facing opposite one of the bores 20 to communicate between the compressor 21 and the corresponding intake passages 45 and between the compressor 21 and the corresponding outlet passages 46, bead portions 55, each formed so as to range around one of the communicating holes 50, through holes 51 through which the bolts 40 pass at the outer edge thereof, a through hole 52 through which the central bolt 43 passes, a bead portion 56 formed so as to range around the through hole 52 and a bead portion 57 formed so as to range along an area near the outer edge of the gasket 13 are formed. It is to be noted that the structure described above simply represents an example of a structure that may be adopted in the gasket 13, and the present invention is in no way limited by the example. In other words, the shapes and quantities of the communicating holes 50, the through holes 51 and 52 and the bead portions 55, 56 and 57 should be adjusted as necessary and the present invention may be achieved without including all of them. For instance, while the bead portions 55, 56 and 57 are all formed as full beads, some of them may instead be half beads (see FIG. 9).

[0030] FIG. 4 shows a sectional view of the gasket 13 adopting the structure described above taken along A-A. The gasket 13 is formed by covering the two surfaces of a metal plate 58 respectively with rubber layers 59a and 59b, with the bead portions 55, 56 and 57 formed as projections cresting toward the cylinder block 2. The thickness t of the metal plate 58 is within a range of 0.2 to 0.8 mm, with the heights of the bead portions 55, 56 and 57 all set within a range of 0.1 to 0.4 mm and the bead portions formed so as to have higher height further away from the through holes 51 through which the bolts 40 pass. Namely, with h1 indicating the height of the bead portion 56 formed around the through hole 52, h2 indicating the height of the bead portions 55 formed around the communicating holes 50 and h3 indicating the height of the bead portion 57 formed near the outer edge of the gasket 13, a relationship expressed as $0.4 \geq h1 > h2 > h3 \geq 0.1$ is achieved. Thus, a reliable seal is assured even over areas far away from the bolts 40, i.e., the fastening members.

[0031] It is also desirable that the force applied to the bead portions 55, 56 and 57 per unit distance during the fastening process be within a range 10 to 25 times the maximum operating pressure Pa. The bead line pressure is a value calculated as; (total fastening force achieved via the bolts 40)/(total distance over which the central lines of bead portions 55, 56 and 57 extend). The central lines of the bead portions 55, 56 and 57 are indicated as L1 to L 10 in FIG. 5, and the total distance is represented by the grand total (L1 + L2 + L3... L10) of the sum of the distances over which the central lines L1 to L8 (only L1 to L3 are shown in FIG. 5) of the eight bead portions 55, the distance over which the central line L9 of the bead portion 56 extends and the distance over which the central line L10 of the bead portion 57 extends.

[0032] In addition, it is also desirable that the diameter Dc of a pitch circle C formed by connecting the eight bolts 40 in the compressor 1 adopting the structure described above be equal to or less than 110 mm, as shown in FIG. 6, so as to prevent the central portion of the valve plate 10 or the like from becoming lifted off by the internal pressure, which tends to occur readily when the diameter Dc is very large.

[0033] Alternatively, the present invention may be adopted in a compressor 60 shown in FIG. 7. The housing members of the compressor 60 include a cylinder block 61, a front head 62 that seals off one end surface of the cylinder block 61 and assumes a size and shape that allow the front head 62 to enclose the cylinder block 61 and a rear head 63 that seals off another end surface of the cylinder block 61. The fastening members (or means) include a threaded portion 65 formed at the outer wall of the front head 62 near its end toward the rear head 63, a ring nut 70 constituted with a threaded portion 66 to interlock with the threaded portion 65 and a flange 67 that holds the end of the rear head 63 at the circumferential edge thereof, and a bolt (not shown) that firmly holds the cylinder block 61 to the rear head 63. A gasket 71 is held between the front head 62 and the rear head 63, and a gasket 72, an intake valve 73, a valve plate 74 and an outlet valve 75 disposed in this order from the cylinder block side, are held between the gasket 71 and the cylinder block 61. The contact pressure at the gasket 71 can be adjusted through adjustment of the fastening force imparted via the ring nut 70, whereas the contact pressure at the gasket 72 can be adjusted through adjustment of the fastening force imparted via the bolts. This structure allows the housing to be provided as a compact unit, which, in turn, contributes to miniaturization of the compressor.

[0034] As a further alternative, the present invention may be adopted in a compressor 80 shown in FIG. 8. The housing members of the compressor 80 include a cylinder block 81, a front head 82 that seals off one end surface of the cylinder block 81 and assumes a size and shape that allow the front head 82 to enclose the cylinder block 81 and a rear head 83 that seals off another end surface of the cylinder block 81. The fastening members (or means) include a threaded portion 85 formed at the outer wall of the front head 82 near its end toward the rear head 83, a threaded portion 86 formed at the inner wall of the rear head 83 near its end toward the front head 82 to interlock with the threaded portion 85 and a bolt (not shown) that firmly holds the cylinder block 81 to the rear head 83. A gasket 91 is held between the front head 82 and the rear head 83, and a gasket 92, an intake valve 93, a valve plate 94 and an outlet valve 95 disposed in this order from the cylinder block side, are held between the gasket 91 and the cylinder block 81. The contact pressure at the gasket 91 can be adjusted through adjustment of the fastening force imparted via the threaded portions 85 and 86, whereas the contact pressure at the gasket 92 can be adjusted through adjustment of the fastening force imparted via the bolts. This structure also allows the housing to be provided as a compact unit, which, in turn, contributes to miniaturization of the compressor.

[0035] As described above, the contact pressure at the seal members held between the plurality of housing members is optimized and thus the size or the number of fastening members can be minimized according to the present invention. As a result, the compressor can be provided as a compact unit while effectively preventing coolant leakage and assuring a high level of safety.

Explanation of Reference Numerals

[0036]

1. 60, 80	compressor
2, 61, 81	cylinder block (housing member)
3, 62, 82	front head (housing member)
4, 63, 83	rear head (housing member)
10	valve plate (housing member)
11	intake valve
12	outlet valve
13, 14, 15, 71, 72, 91, 92	gasket (seal member)
40	bolt (fastening member)
55, 56, 57	bead portion
65, 66, 85, 86	threaded portion (fastening member)
67	flange (holding portion)
70	ring nut (fastening member)
C	pitch circle
Dc	pitch circle diameter
h1 to 3	bead portion height
t1	thickness of metal plate at gasket (seal member)
t2	thickness of rubber layer at the gasket (seal member)

Claims

1. A compressor, comprising:

at least two housing members (2,3,4,10) in which a compression mechanism is housed;
a seal member (13,14,15) held between said housing members (2,3,4,10); and
fastening members (40) that fasten said housing members (2,3,4,10) and said seal member (13,14,15) as one, with a contact pressure applied to said seal member (13,14,15) as said housing members (2,3,4,10) and said seal member (13,14,15) are fastened via said fastening members (40) set within a range over which a critical seal pressure of said seal member (13,14,15) is higher than a maximum operating pressure of said compressor and lower than a breaking pressure of said compressor, **characterized in:**

that said seal member (13,14,15) includes a bead portion (55,56,57) formed to assume a plateau shape or a mound shape and that the bead portion (55,56,57) located closer to any of the fastening members (40) is formed so as to have a lower height.

2. A compressor according to claim 1, **characterized in:**

that a bead line pressure representing a force applied to said bead portion (55,56,57) per unit distance during a fastening process is within a range 10 to 25 times said maximum operating pressure.

3. A compressor according to claim 1 or 2, **characterized in:**

that said housing members include a substantially cylindrical cylinder block (2) with a plurality of bores (20)

formed therein to define compression spaces (21), a front head (3) with a crankcase (22) formed therein, which seals off one end surface of said cylinder block (2) and a rear head (4) with an intake chamber (25) and an outlet chamber (26) formed therein, which seals off another end surface of said cylinder block (2); and
that said fastening members include a plurality of bolts (40) passing through areas of said front head (3), said cylinder block (2) and said rear head (4) near the outer edges thereof.

4. A compressor according to claim 3, **characterized in:**

that the diameter of a pitch circle formed by connecting said bolts (40) is equal to or less than 110 mm.

5. A compressor according to claim 1 or 2, **characterized in:**

that said housing members include a cylinder block (61) having a plurality of bores formed therein to define compression spaces, a front head (62) with a crankcase formed therein, which seals off one end surface of the cylinder block (61) and assumes a size and a shape that allow said front head (62) to enclose said cylinder block (61) and a rear head (63) with an intake chamber (25) and an outlet chamber (26) formed therein, which seals off another end surface of said cylinder block (61); and
that said fastening members include a threaded portion (65) formed at an outer wall of said front head (62) near an end thereof toward said rear head (63) and a ring nut (70) constituted with a threaded portion (66) to interlock with said threaded portion (65) and a holding portion (67) that holds said rear head (63).

6. A compressor according to claim 1 or 2, **characterized in:**

that said housing members include a cylinder block (81) having a plurality of bores formed therein to define compression spaces, a front head (82) with a crankcase formed therein, which seals off one end surface of said cylinder block (81) and assumes a size and shape that allows said front head (82) to enclose said cylinder block (81) and a rear head (83) with an intake chamber and an outlet chamber formed therein, which seals off another end surface of said cylinder block (81); and
that said fastening members include a threaded portion (85) formed at an outer wall of said front head (82) near an end thereof toward said rear head (83) and a threaded portion (86) formed at an inner wall of said rear head (83) near its end toward said front head (82) to interlock with said threaded portion (85).

7. A compressor according to claim 1 through 6, **characterized in**, utilized in a refrigeration cycle in which CO2 is used as a coolant.

FIG. 1

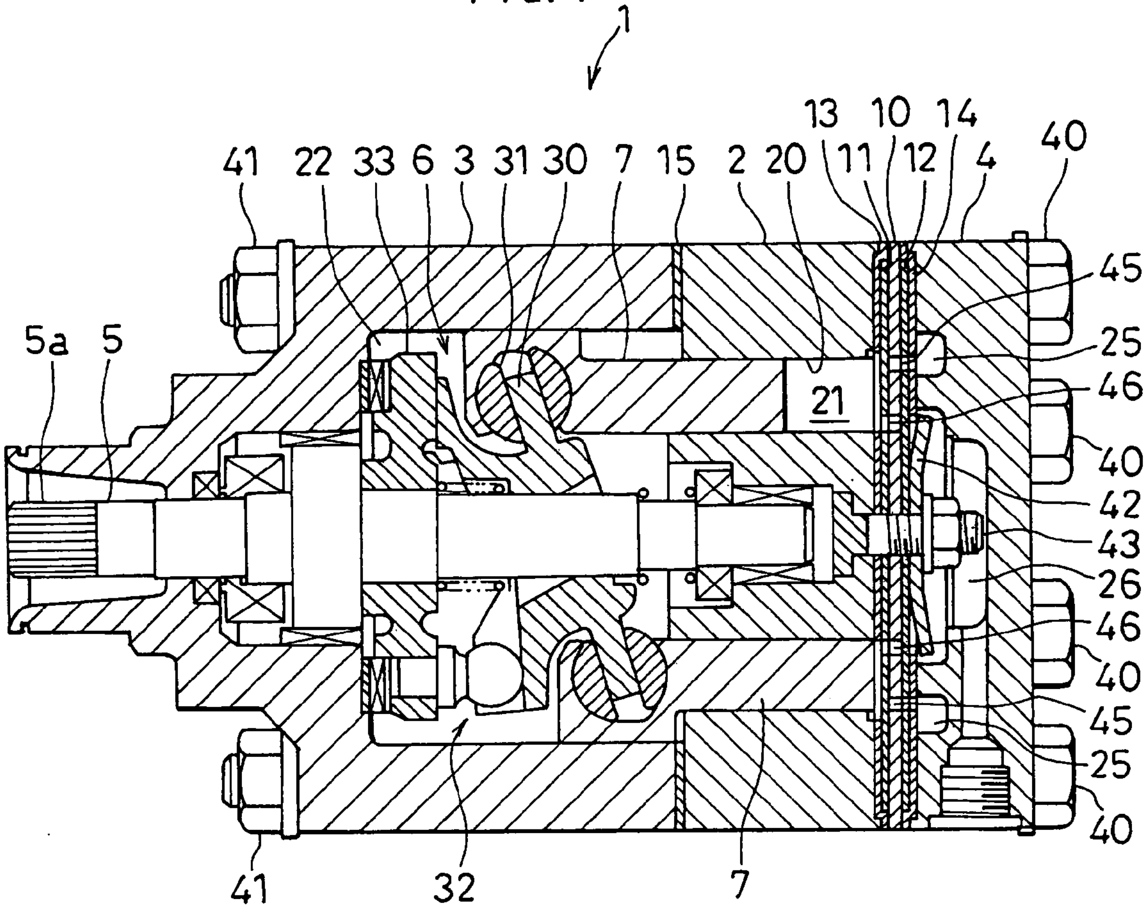
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FIG. 2

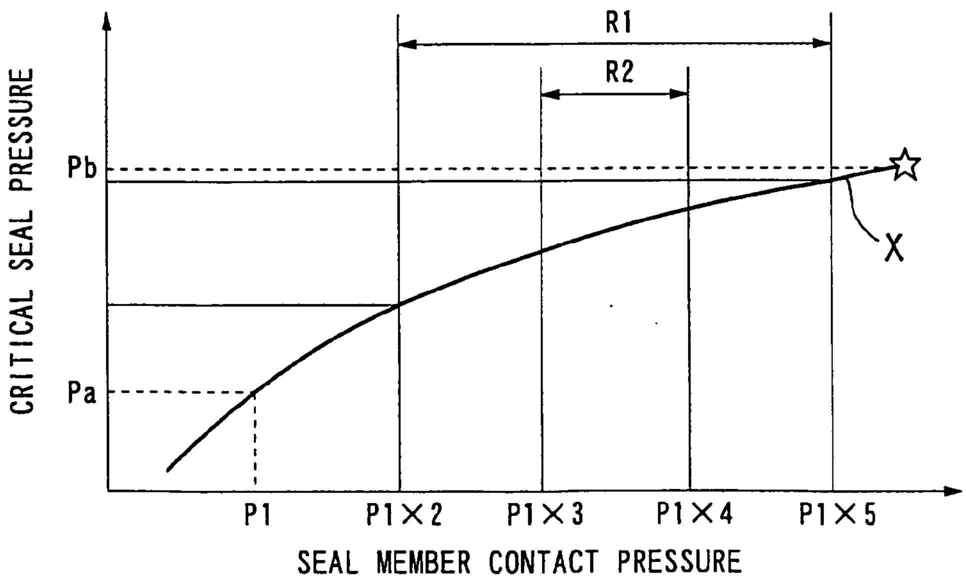
R1
R2
Pb
Pa
X
CRITICAL SEAL PRESSURE
P1
P1×2
P1×3
P1×4
P1×5
SEAL MEMBER CONTACT PRESSURE

FIG. 3

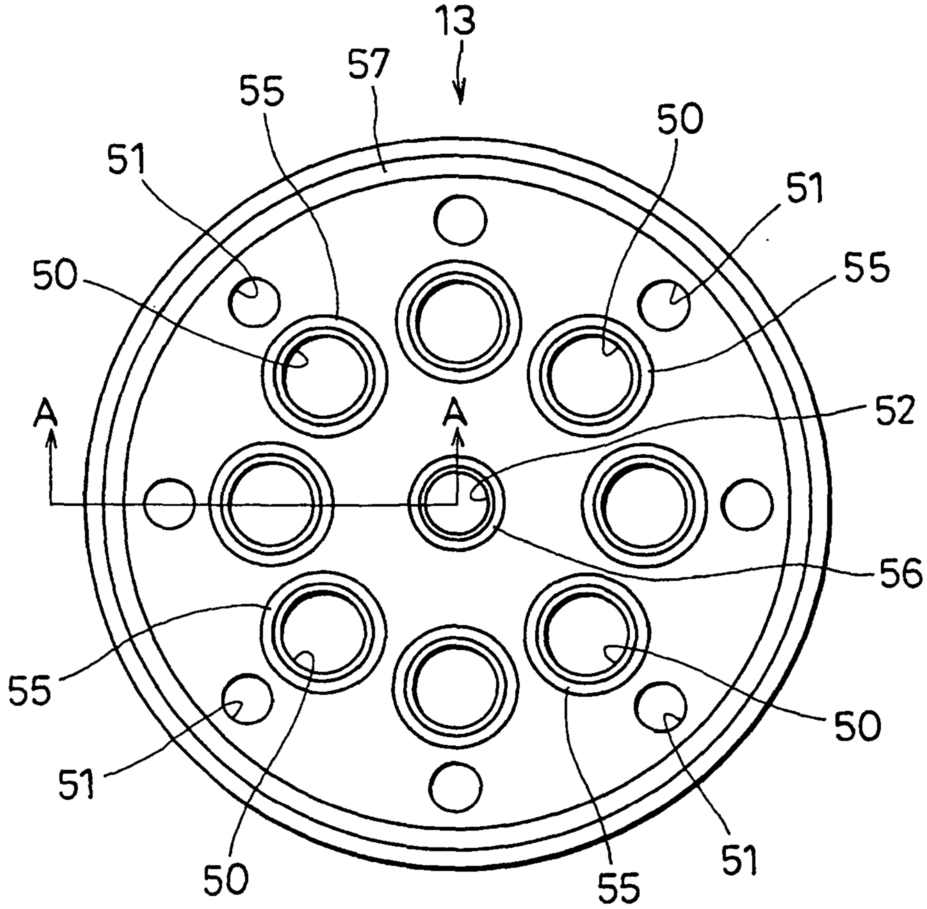
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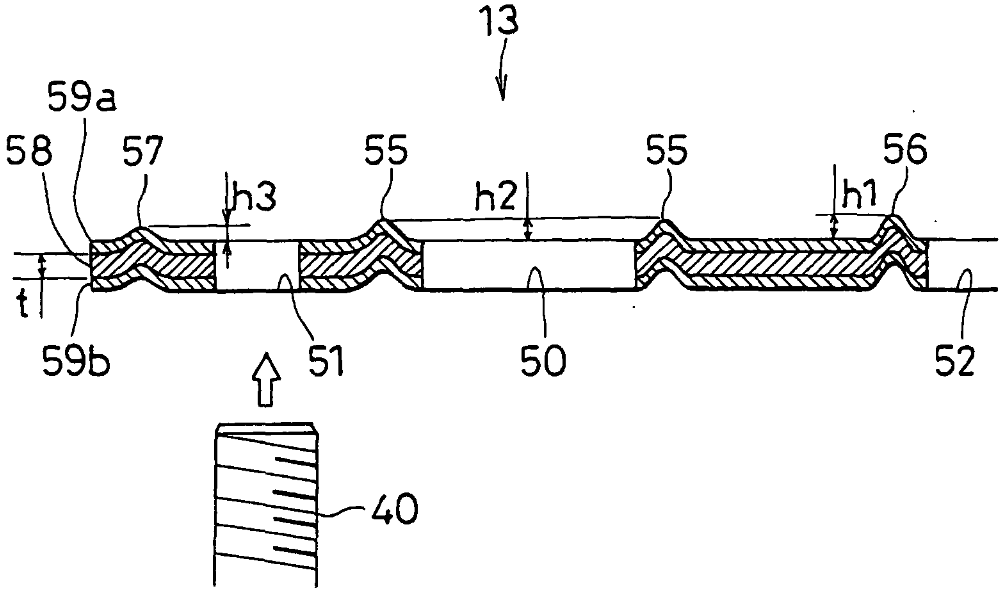
FIG. 4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59a
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57
55
h3
h2
55
h1
56
t
59b
51
50
52
40

FIG. 5

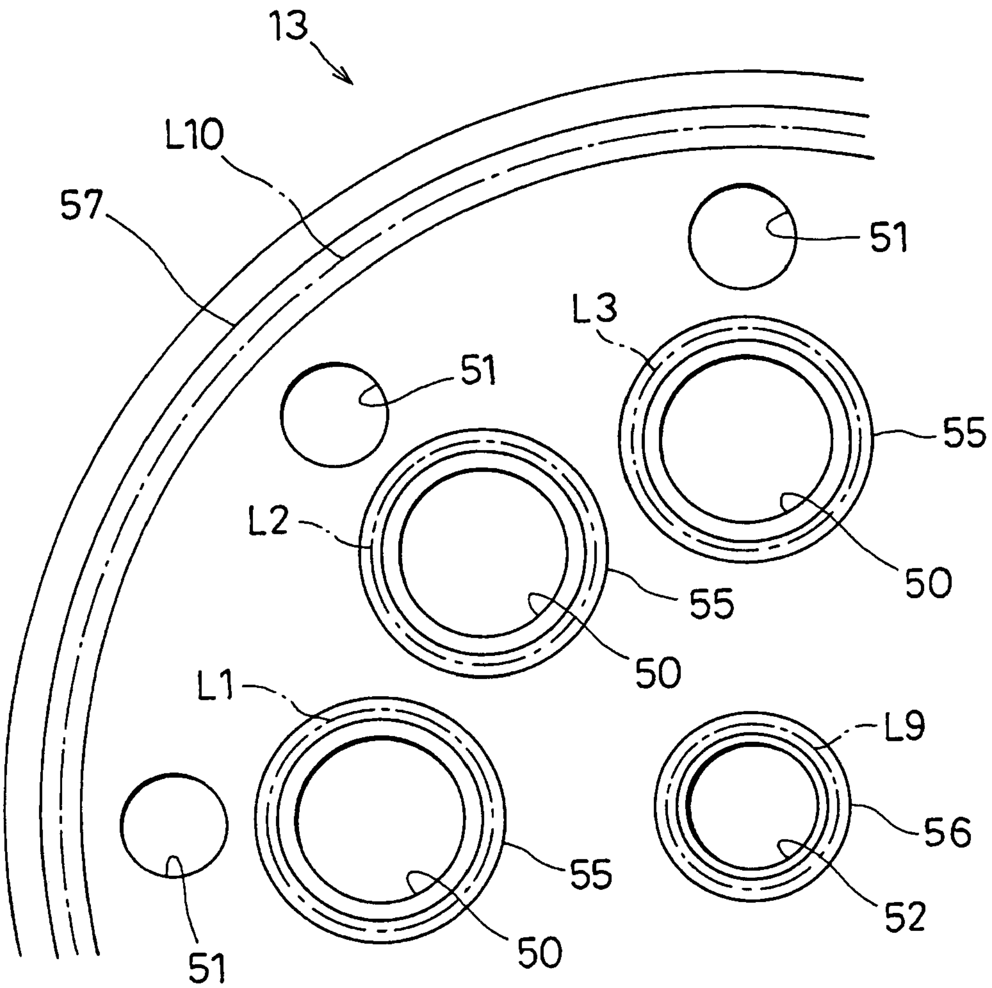
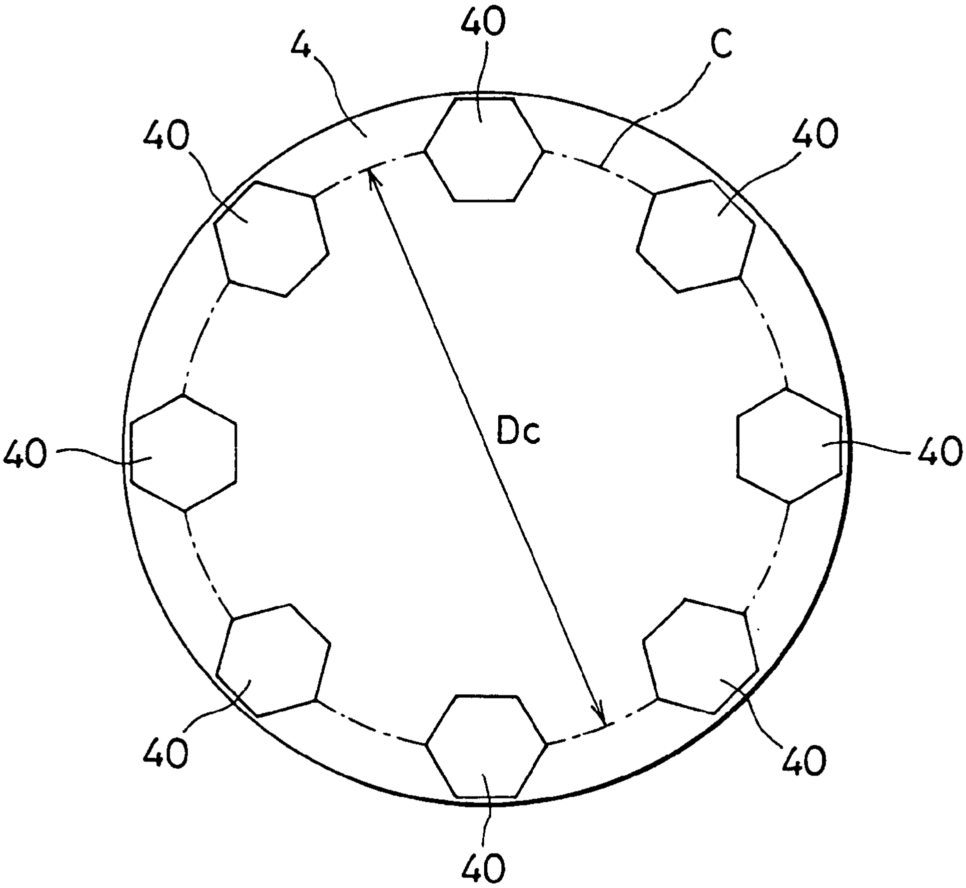


FIG. 6


4
40
C
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Dc
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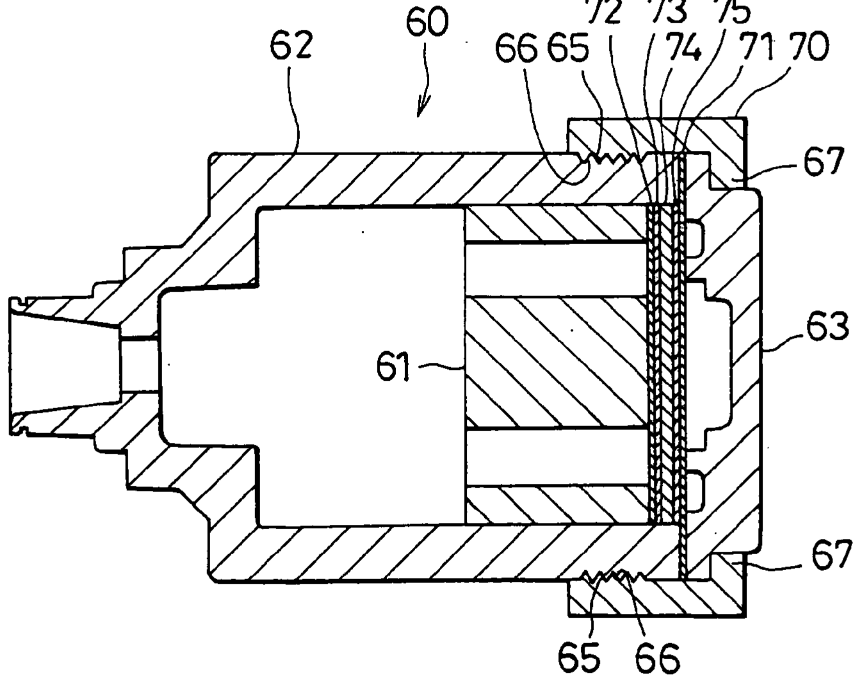
FIG. 7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66 65
72 73 75
74 71 70
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65 66

FIG. 8

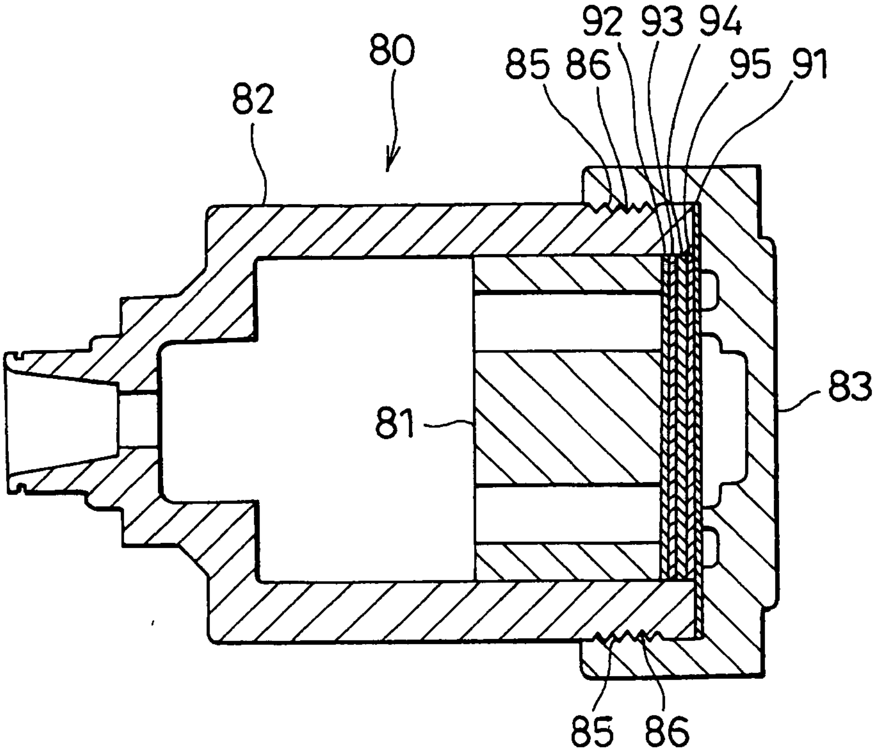
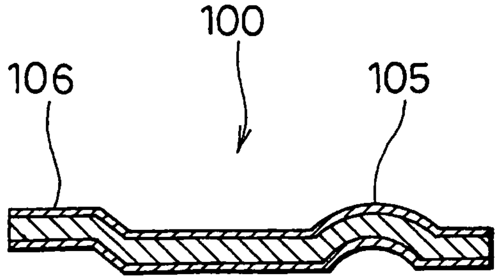


FIG. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 6146

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 October 2008	Gnüchtel, Frank

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