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(54) DOUBLE-HEADED PISTON TYPE COMPRESSOR

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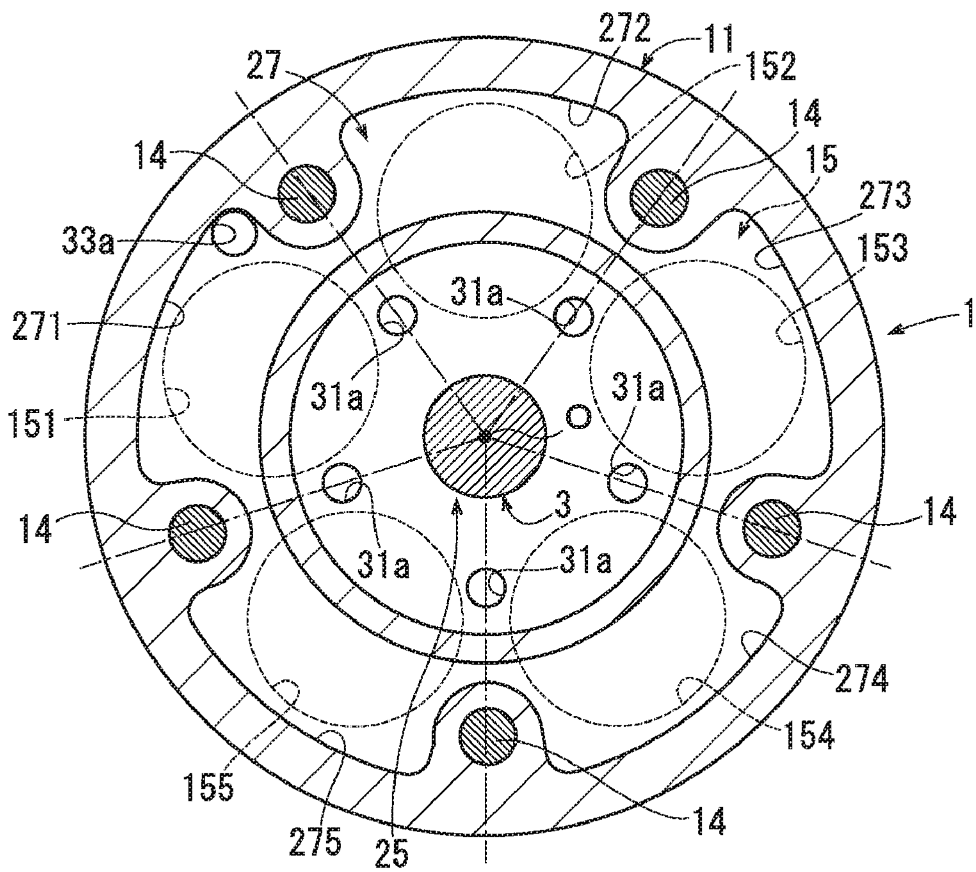
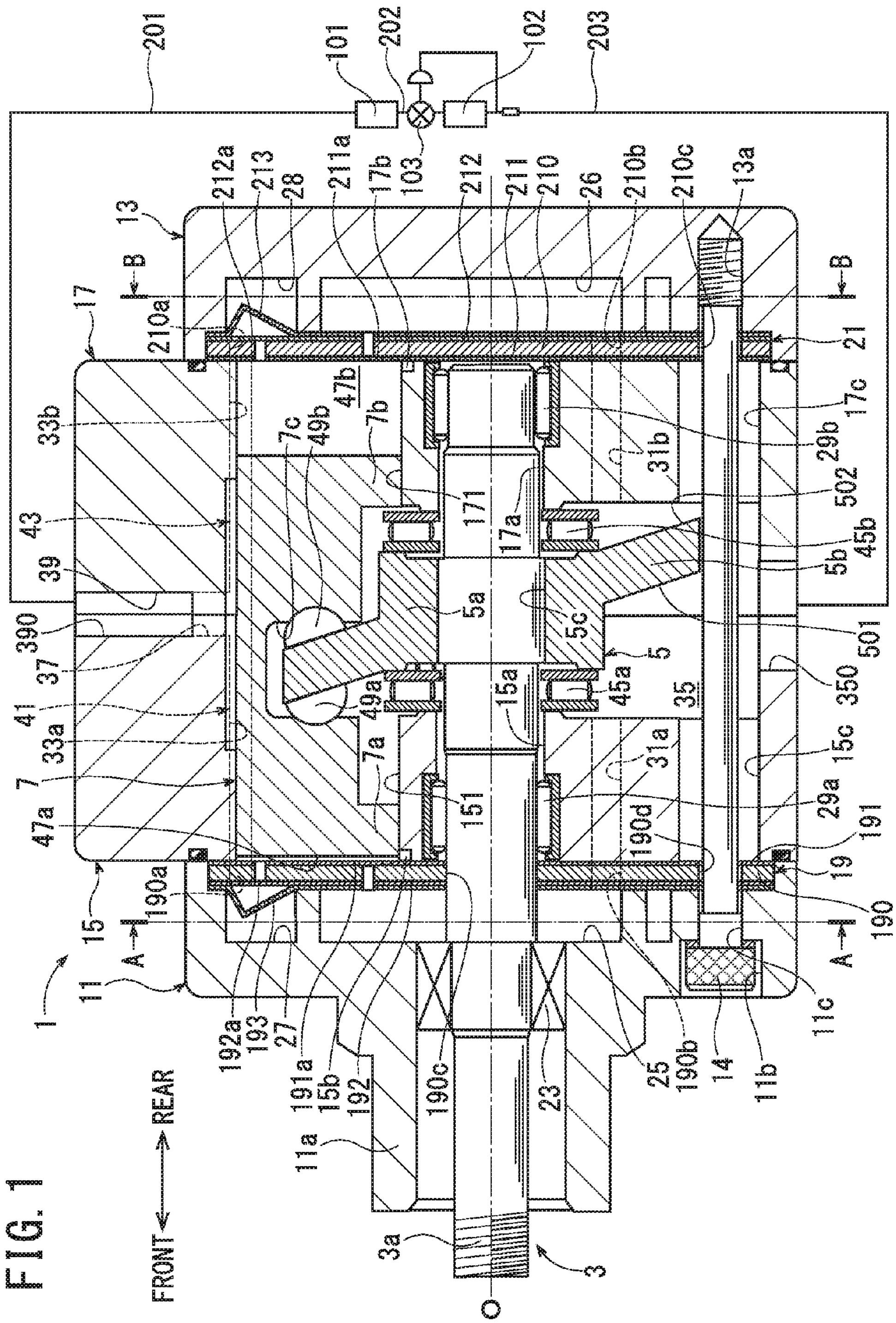
(57) ABSTRACT

In the compressor of the present invention, the first discharge chamber is divided into m first discharge sections, where m is an integer satisfying m≥2, and the second discharge chamber is divided into m second discharge sections. N out of the first discharge sections, where n is an arbitrary integer satisfying 1≤n<m, are defined as specified first discharge sections, and n out of the second discharge sections are defined as specified second discharge sections. When viewed from an axial direction of the drive shaft, at least one of the specified first discharge sections and at least one of the specified second discharge sections are disposed at positions shifted from each other. N first discharge passages each communicates with each of the specified first discharge sections and the merging portion, and n second discharge passages each communicates with each of the specified second discharge sections and the merging portion.

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203
103
212a
213
28
211a
17b
212
211
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26
210b
210c
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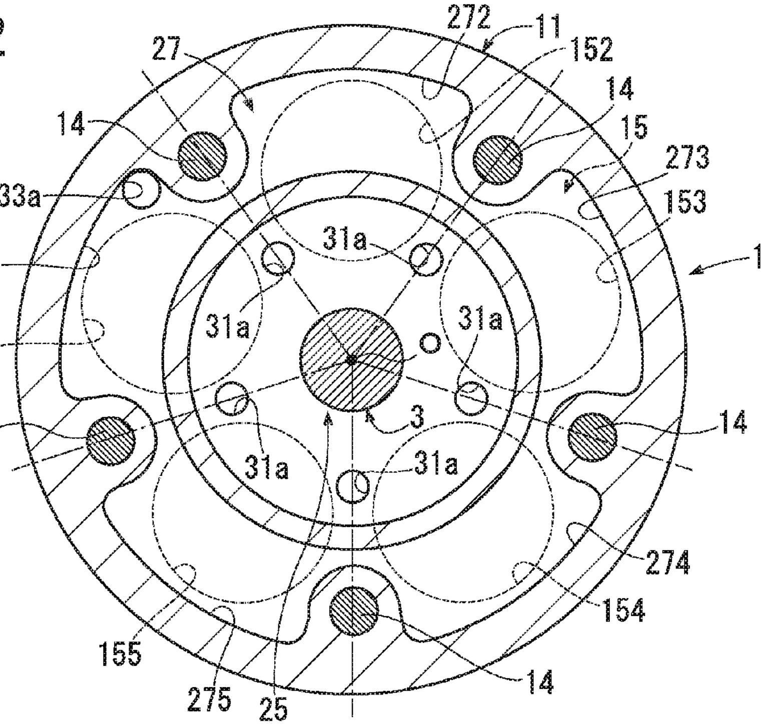
B
210a
21
33b
47b
7c
49b
7b
17c
29b
31b
502
43
171
17a
45b
5b
39
5a
5c
390
37
501
5
350
41
49a
15a
45a
35
33a
15c
7a
31a
7
151
29a
47a
190d
191
19
190a
190
15
A
11
11c
1
192a
193
27
191a
15b
192
190c
23
25
190b
14
11b
11a
FRONT
REAR
3a
3
O
FIG. 1

FIG. 2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11
27
152
14
14
15
273
33a
153
31a
271
31a
31a
1
151
14
3
14
31a
31a
274
154
155
14
275
25

FIG. 3

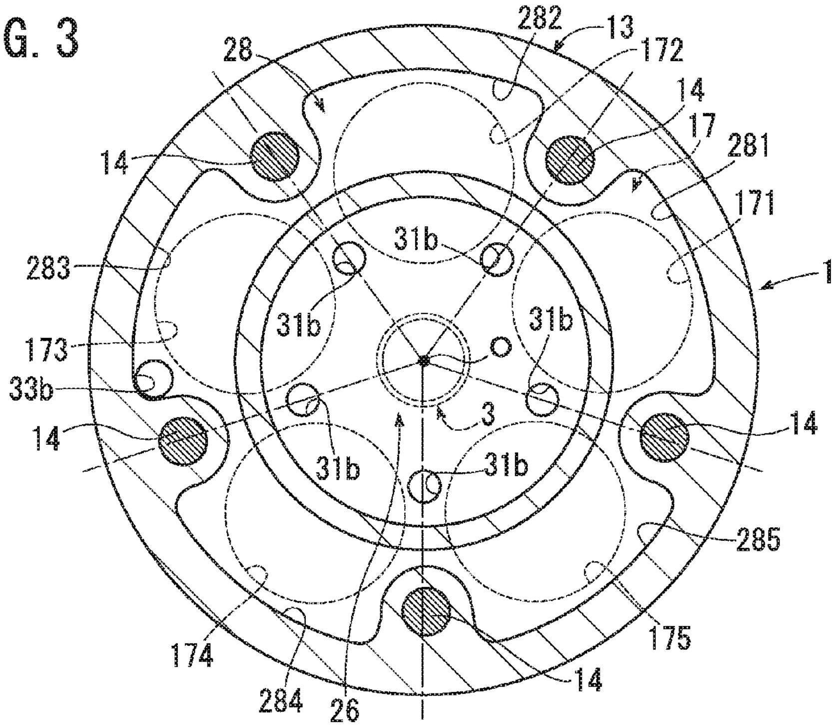

282
13
28
172
14
17
14
281
171
31b
283
31b
31b
1
173
33b
3
14
14
31b
31b
285
174
175
284
26
14

FIG. 4

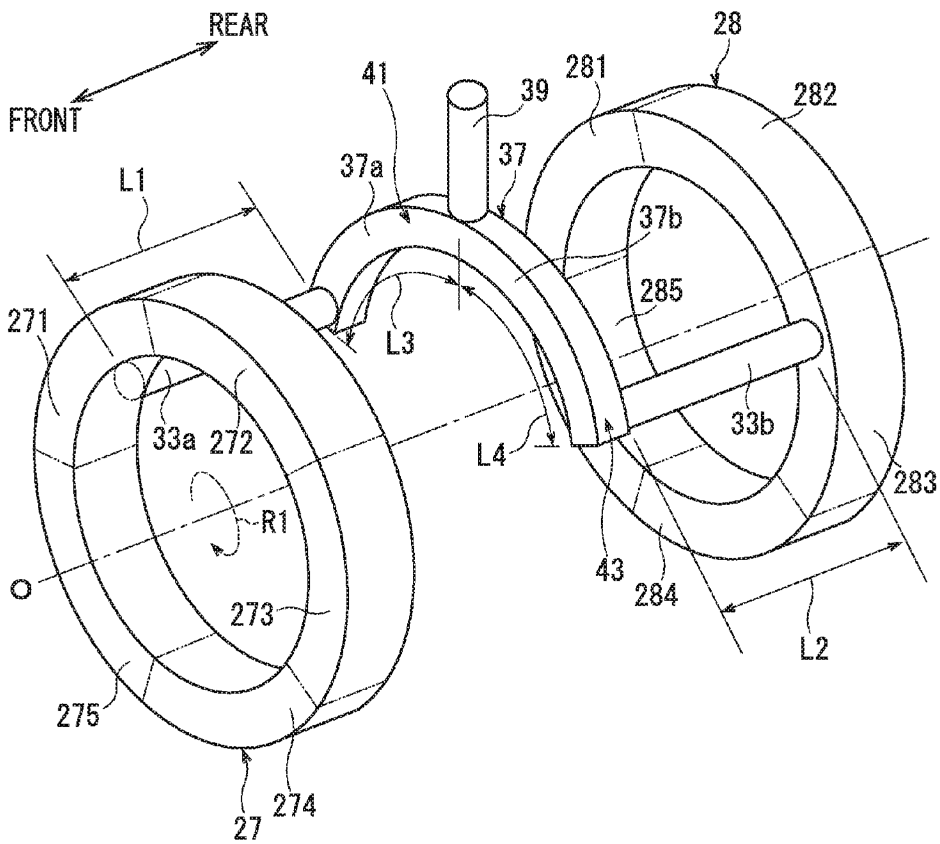

REAR
FRONT
28
281
282
41
39
37
37a
37b
L1
285
271
L3
33a
272
33b
R1
L4
283
43
284
O
273
L2
275
274
27

FIG. 5

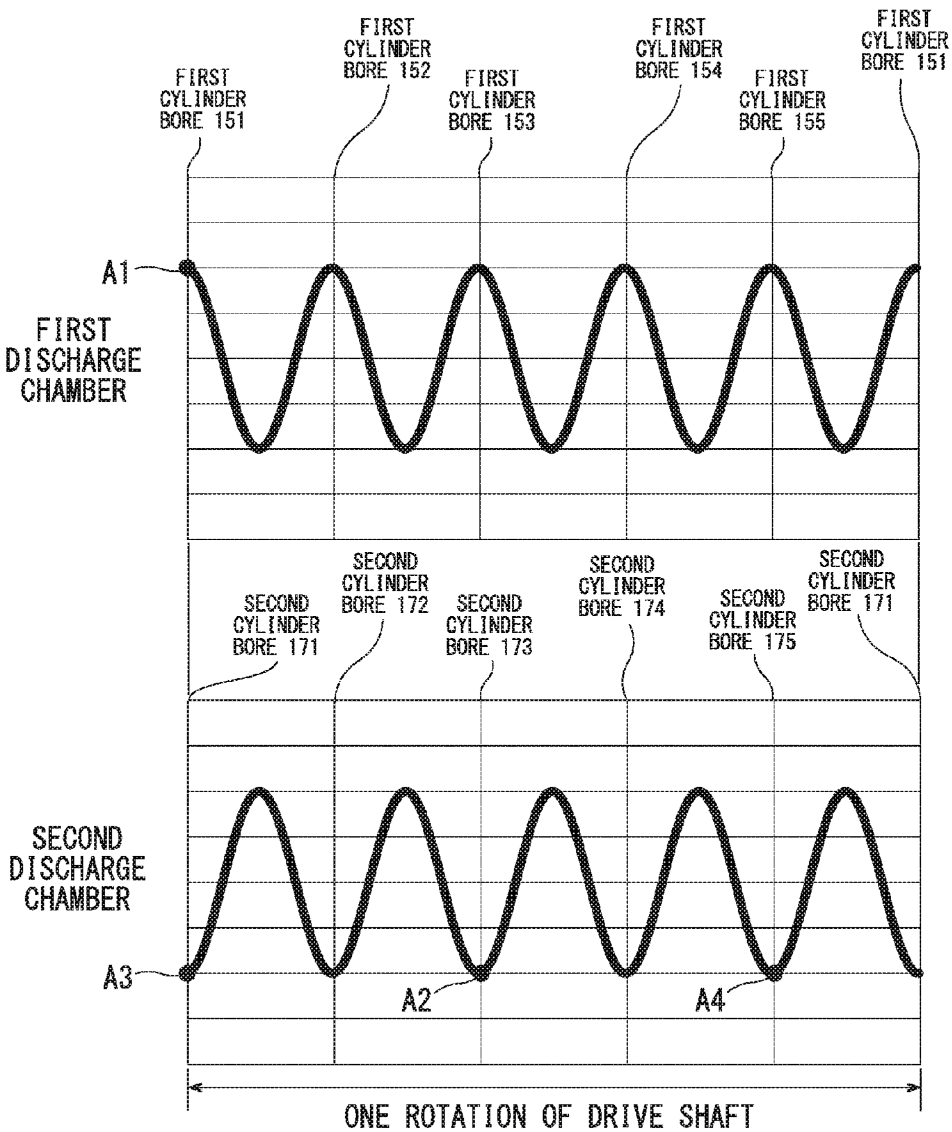
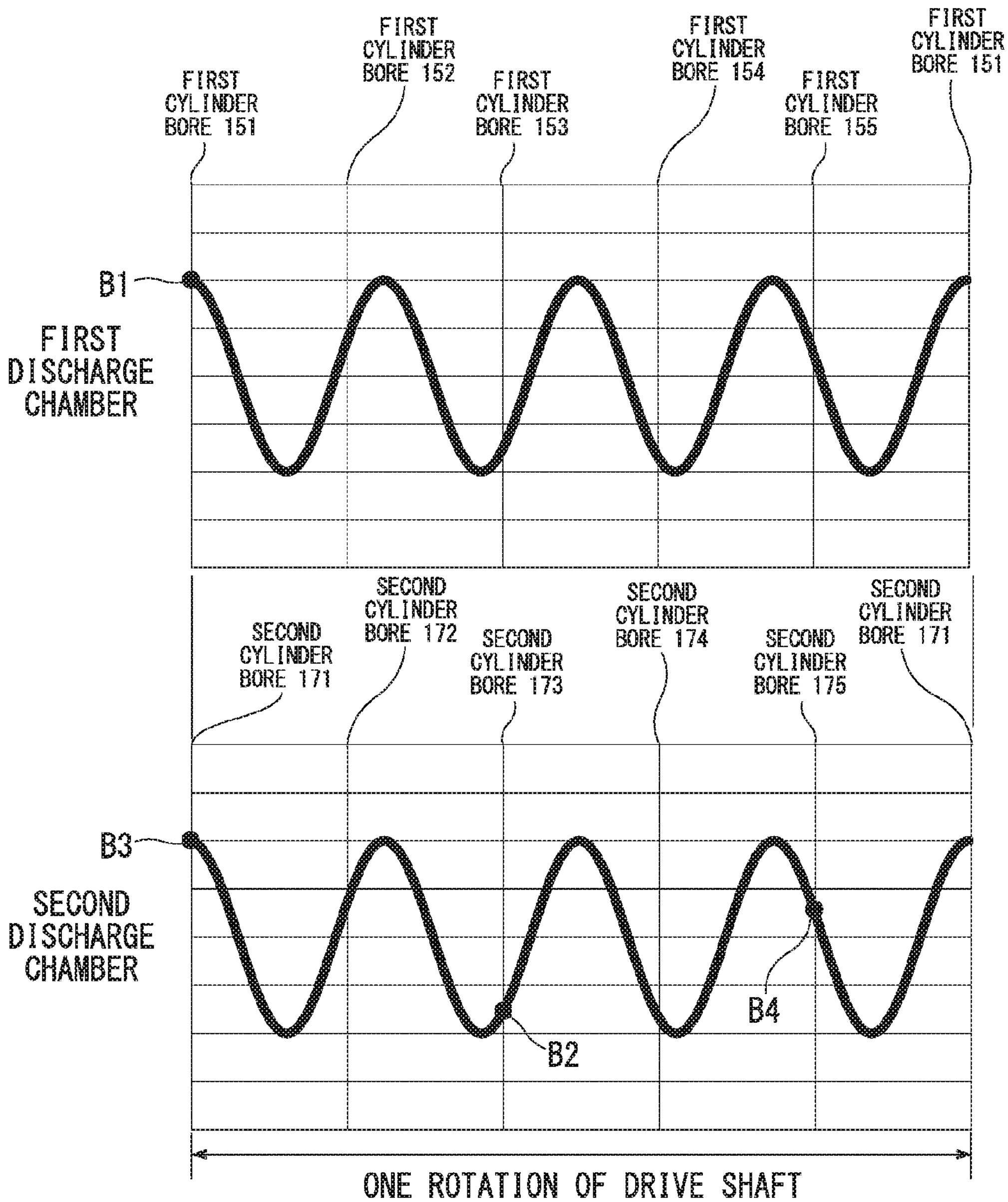

FIRST CYLINDER BORE 151
FIRST CYLINDER BORE 152
FIRST CYLINDER BORE 153
FIRST CYLINDER BORE 154
FIRST CYLINDER BORE 155
FIRST CYLINDER BORE 151
A1
FIRST DISCHARGE CHAMBER
SECOND CYLINDER BORE 171
SECOND CYLINDER BORE 172
SECOND CYLINDER BORE 173
SECOND CYLINDER BORE 174
SECOND CYLINDER BORE 175
SECOND CYLINDER BORE 171
SECOND DISCHARGE CHAMBER
A3
A2
A4
ONE ROTATION OF DRIVE SHAFT

FIG. 6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FIRST CYLINDER BORE 153
FIRST CYLINDER BORE 154
FIRST CYLINDER BORE 155
FIRST CYLINDER BORE 151
B1
FIRST DISCHARGE CHAMBER
SECOND CYLINDER BORE 171
SECOND CYLINDER BORE 172
SECOND CYLINDER BORE 173
SECOND CYLINDER BORE 174
SECOND CYLINDER BORE 175
SECOND CYLINDER BORE 171
B3
SECOND DISCHARGE CHAMBER
B2
B4
ONE ROTATION OF DRIVE SHAFT

FIG. 7

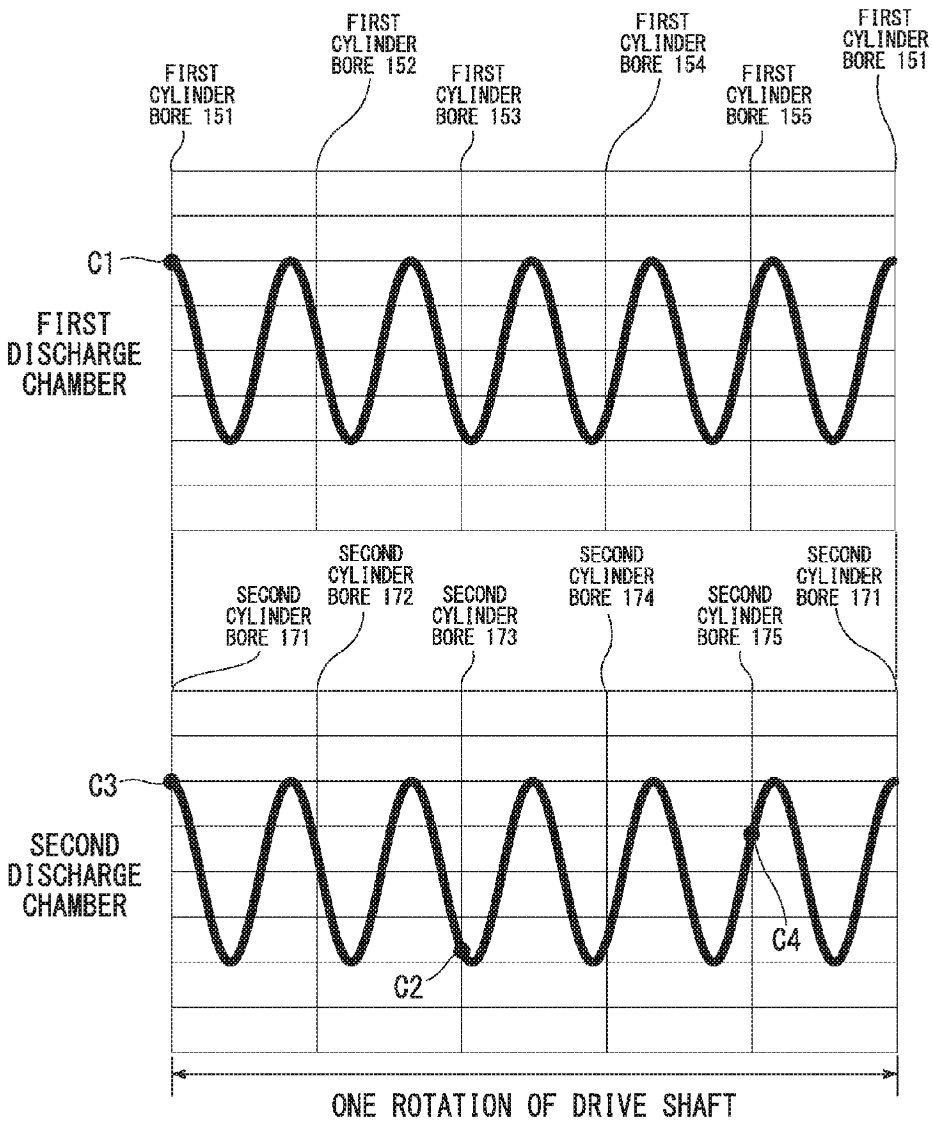

FIRST CYLINDER BORE 151
FIRST CYLINDER BORE 152
FIRST CYLINDER BORE 153
FIRST CYLINDER BORE 154
FIRST CYLINDER BORE 155
FIRST CYLINDER BORE 151
C1
FIRST DISCHARGE CHAMBER
SECOND CYLINDER BORE 171
SECOND CYLINDER BORE 172
SECOND CYLINDER BORE 173
SECOND CYLINDER BORE 174
SECOND CYLINDER BORE 175
SECOND CYLINDER BORE 171
C3
SECOND DISCHARGE CHAMBER
C2
C4
ONE ROTATION OF DRIVE SHAFT

FIG. 8

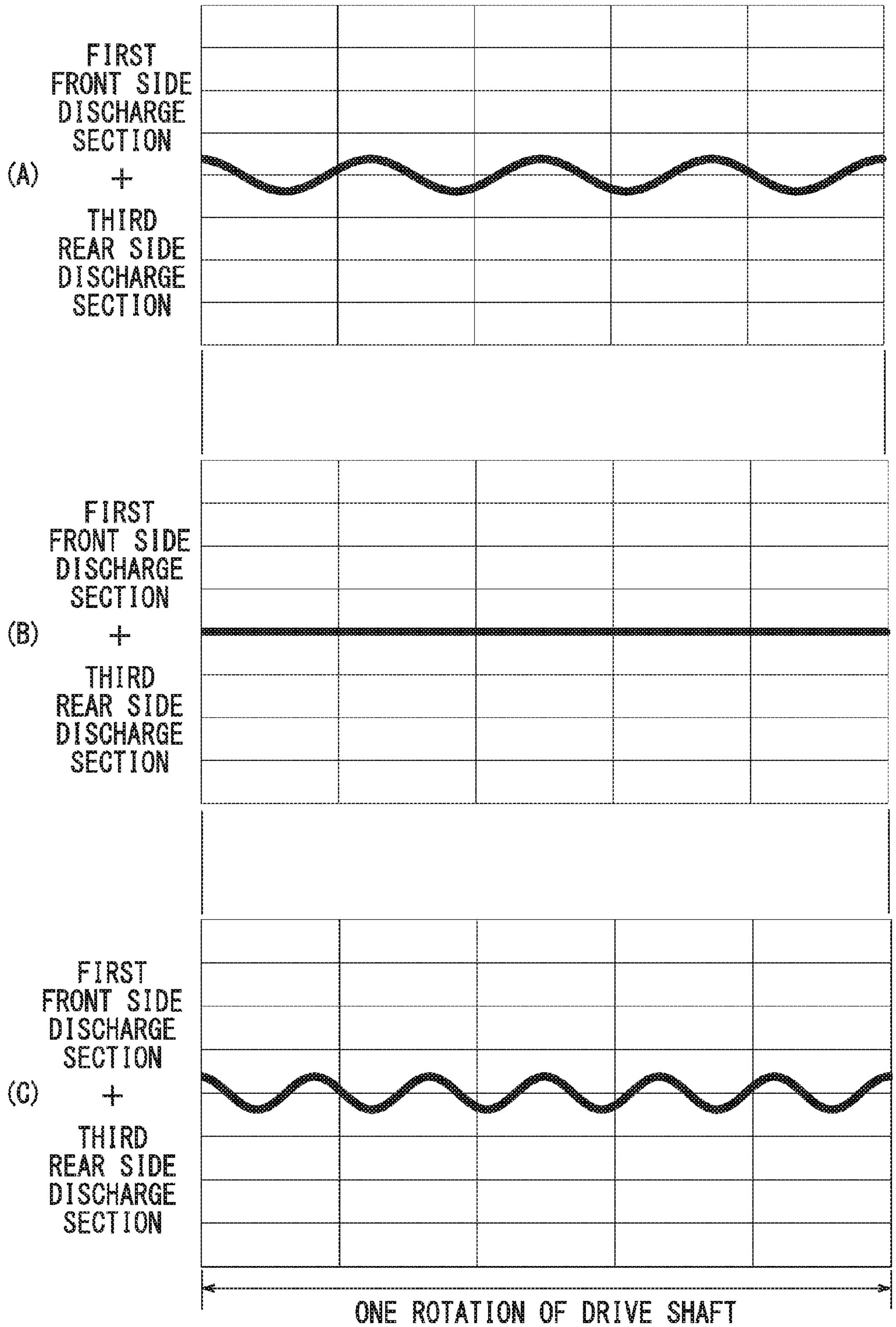

FIRST FRONT SIDE DISCHARGE SECTION
(A)
+
THIRD REAR SIDE DISCHARGE SECTION
FIRST FRONT SIDE DISCHARGE SECTION
(B)
+
THIRD REAR SIDE DISCHARGE SECTION
FIRST FRONT SIDE DISCHARGE SECTION
(C)
+
THIRD REAR SIDE DISCHARGE SECTION
ONE ROTATION OF DRIVE SHAFT

FIG. 9

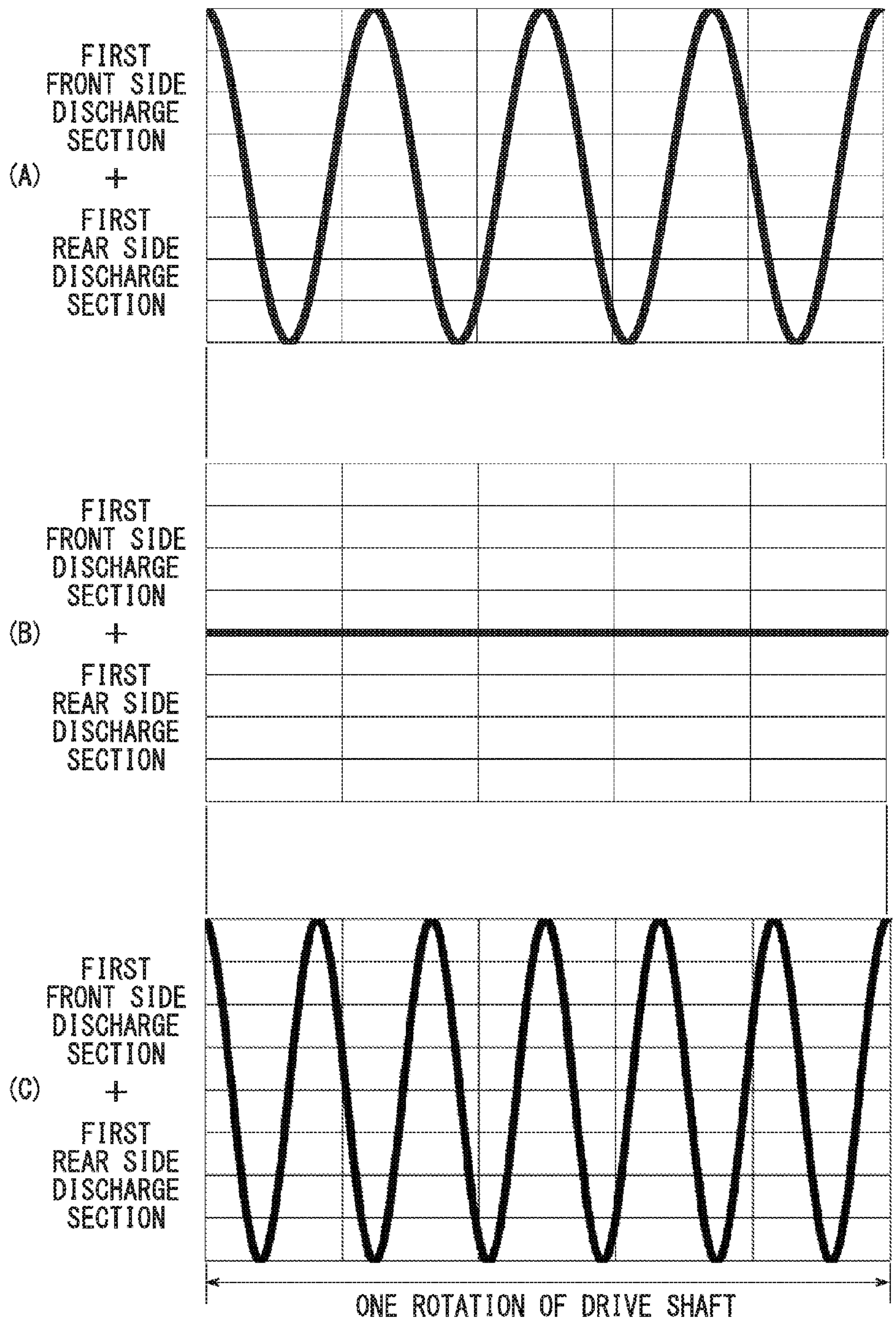

(A)
FIRST
FRONT SIDE
DISCHARGE
SECTION
+
FIRST
REAR SIDE
DISCHARGE
SECTION
(B)
FIRST
FRONT SIDE
DISCHARGE
SECTION
+
FIRST
REAR SIDE
DISCHARGE
SECTION
(C)
FIRST
FRONT SIDE
DISCHARGE
SECTION
+
FIRST
REAR SIDE
DISCHARGE
SECTION
ONE ROTATION OF DRIVE SHAFT

FIG. 10

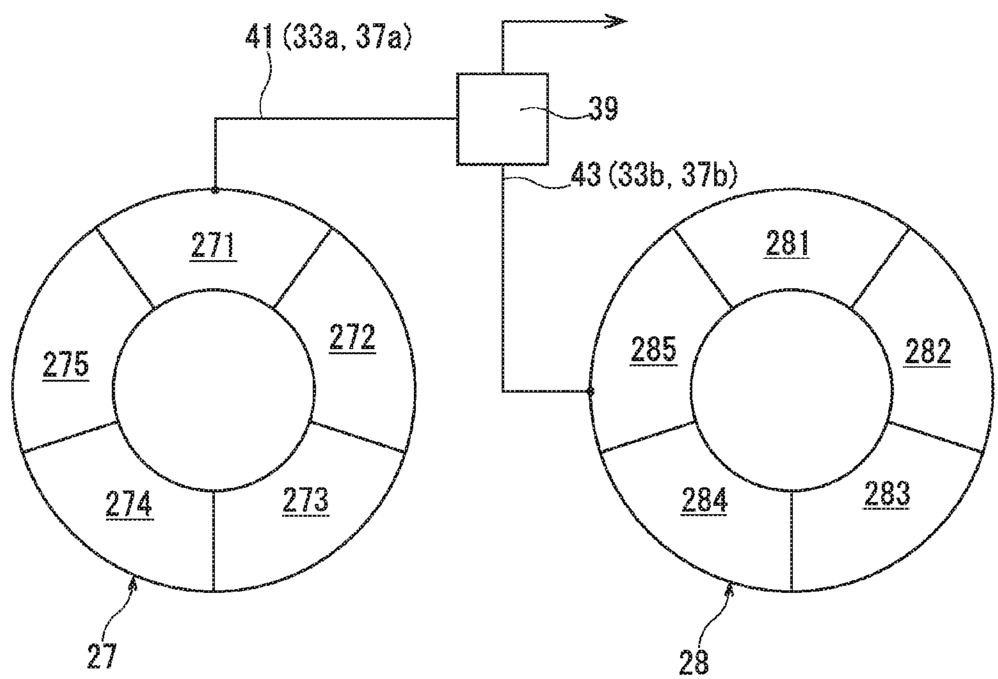

41 (33a, 37a)
39
43 (33b, 37b)
271
272
273
274
275
281
282
283
284
285
27
28

FIG. 11

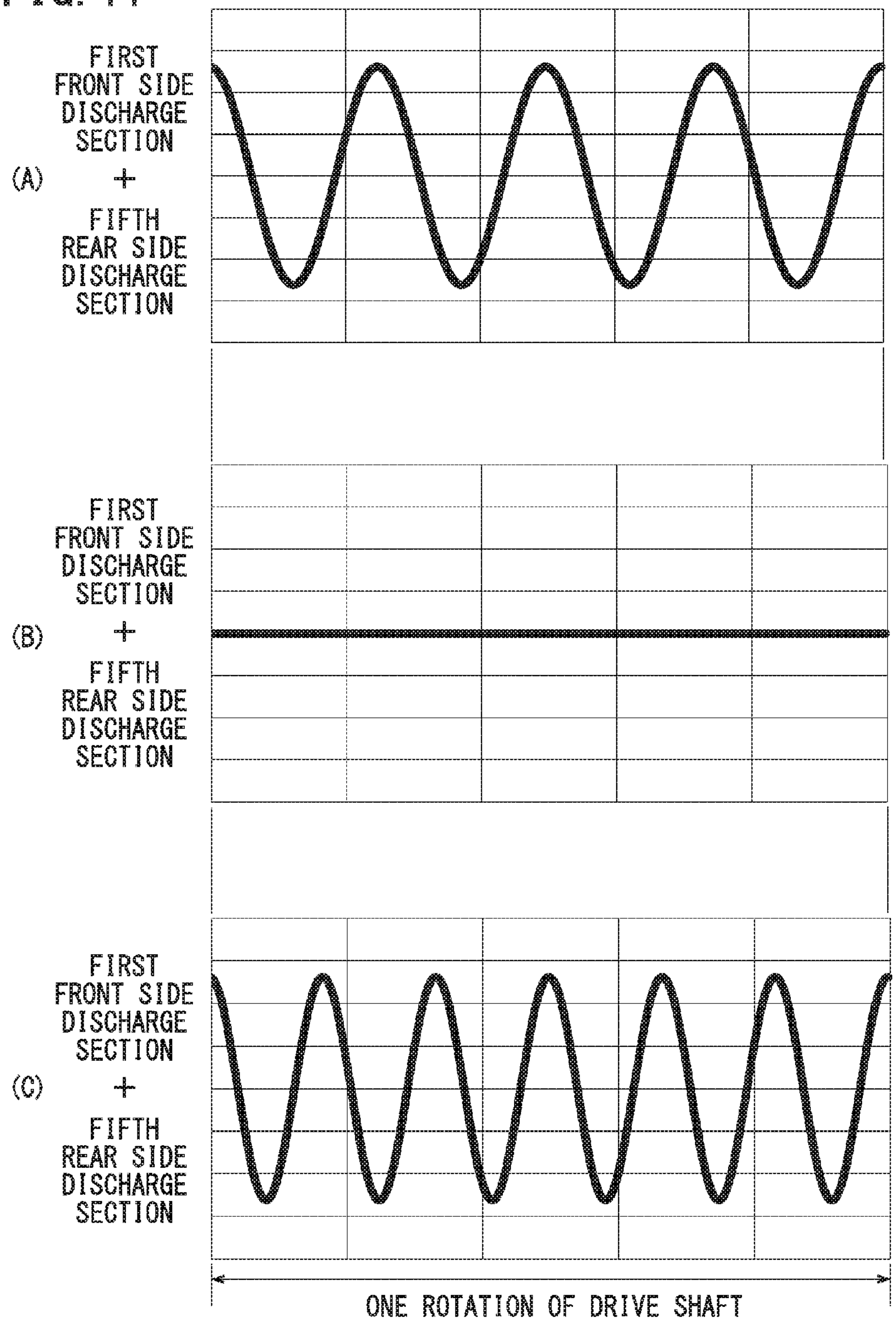

FIRST
FRONT SIDE
DISCHARGE
SECTION
(A) +
FIFTH
REAR SIDE
DISCHARGE
SECTION
FIRST
FRONT SIDE
DISCHARGE
SECTION
(B) +
FIFTH
REAR SIDE
DISCHARGE
SECTION
FIRST
FRONT SIDE
DISCHARGE
SECTION
(C) +
FIFTH
REAR SIDE
DISCHARGE
SECTION
ONE ROTATION OF DRIVE SHAFT

FIG. 12

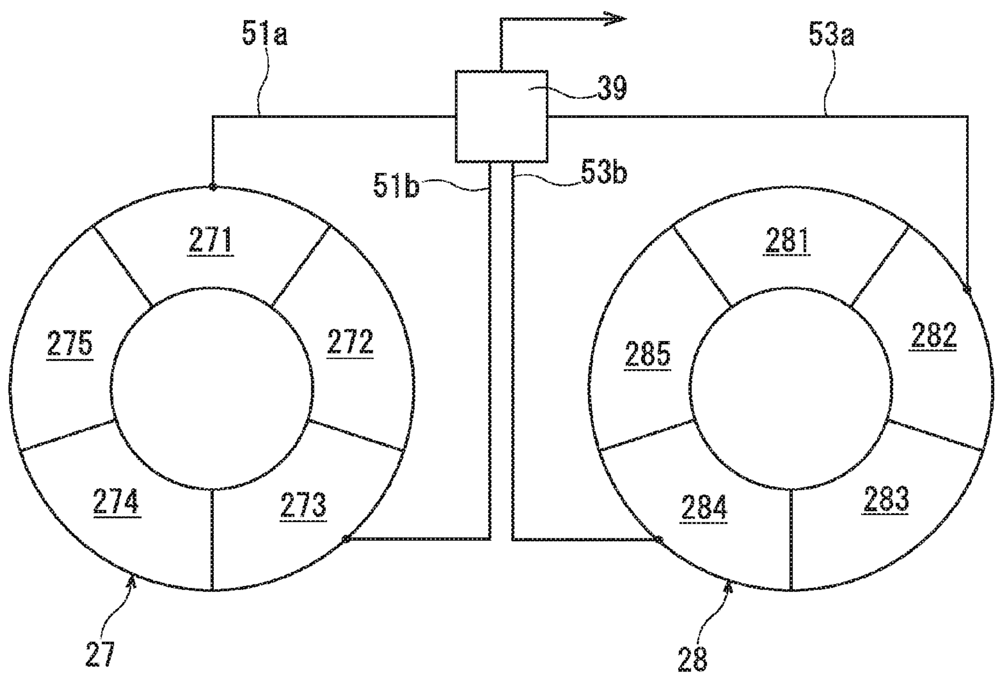
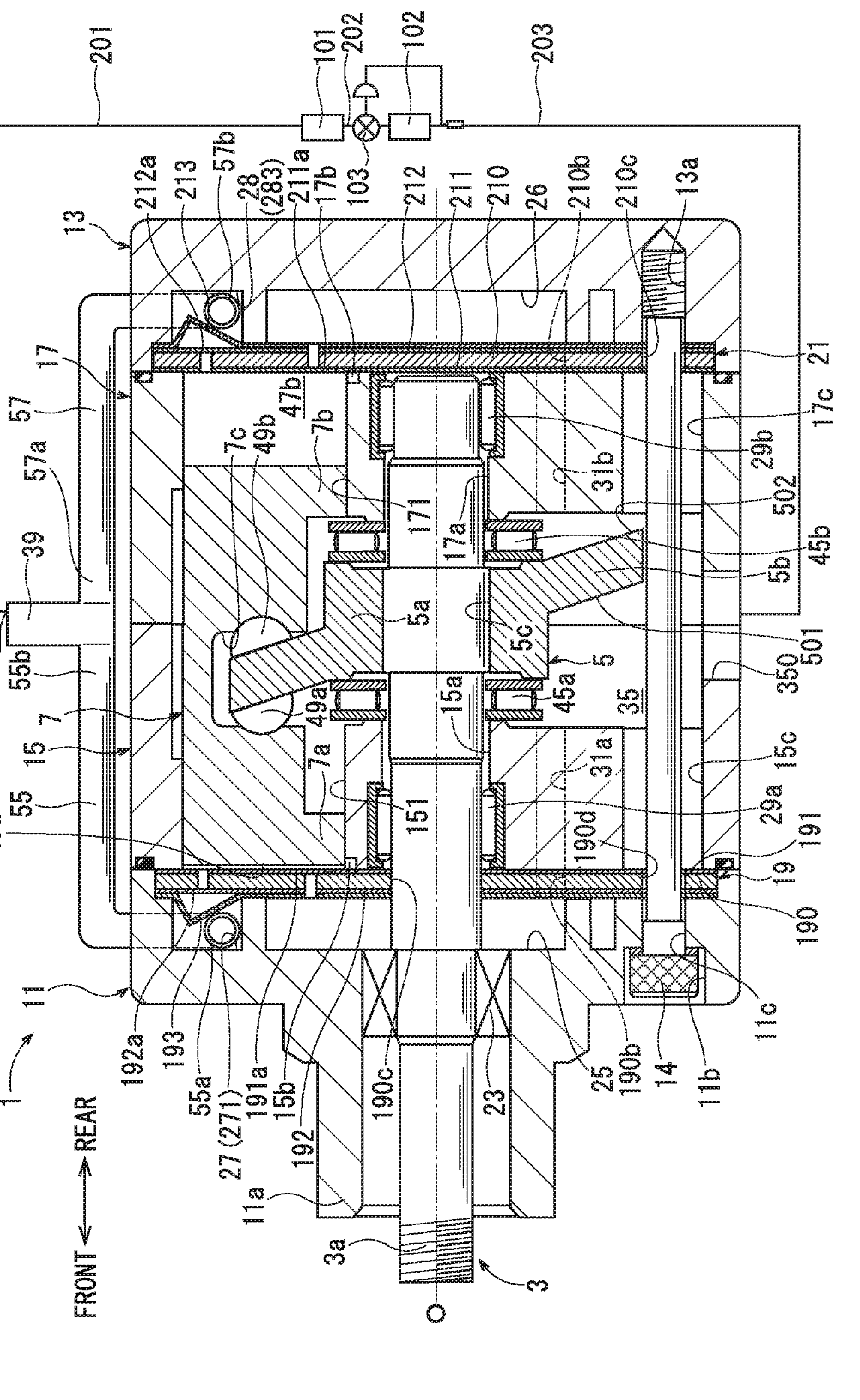


FIG. 13


FRONT
REAR
1
3
3a
O
5
5a
5b
5c
7
7a
7b
7c
11
11a
11b
11c
13
13a
14
15
15a
15b
15c
17
17a
17b
17c
19
21
23
25
26
27 (271)
28 (283)
29a
29b
31a
31b
35
39
45a
45b
47a
47b
49a
49b
55
55a
55b
57
57a
57b
101
102
103
151
171
190
190b
190c
190d
191
191a
192
192a
193
201
202
203
210
210b
210c
211
211a
212
212a
213
350
390
501
502

DOUBLE-HEADED PISTON TYPE COMPRESSOR

TECHNICAL FIELD

[0001] The present invention relates to a double-headed piston type compressor.

BACKGROUND ART

[0002] Japanese Patent Laid-Open No. 10-103228 discloses a conventional double-headed piston type compressor (hereinafter, simply referred to as a compressor). The compressor comprises a drive shaft, a housing that rotatably supports the drive shaft, and five double-headed pistons.

[0003] The housing has five first cylinder bores and five second cylinder bores. The first cylinder bores are disposed at one side of the drive shaft. The second cylinder bores are disposed at the other side of the drive shaft and face the respective first cylinder bores. The double-headed pistons reciprocate in the first cylinder bores and the second cylinder bores respectively.

[0004] The housing has also an annular first discharge chamber, an annular second discharge chamber, a merging portion, a first discharge passage and a second discharge passage. Refrigerant that has been compressed in the respective first cylinder bores is discharged into the first discharge chamber. Refrigerant that has been compressed in the respective second cylinder bores is discharged into the second discharge chamber. The refrigerant discharged into the first discharge chamber and the refrigerant discharged into the second discharge chamber flow into and merge together in the merging portion. The merging portion is capable of discharging the merged refrigerant to the outside. The first discharge passage provides communication between the first discharge chamber and the merging portion. The second discharge passage provides communication between the second discharge chamber and the merging portion.

[0005] In this compressor, when the respective double-headed pistons reciprocate by rotation of the drive shaft, the refrigerant that has been compressed in the respective first cylinder bores is successively discharged into the first discharge chamber and reaches the merging portion through the first discharge passage, and the refrigerant that has been compressed in the respective second cylinder bores is successively discharged into the second discharge chamber and reaches the merging portion through the second discharge passage. Then, the refrigerant from the first discharge chamber merges with the refrigerant from the second discharge chamber in the merging portion, and the merged refrigerant is discharged outside. At this time, pressures in the first and second discharge chambers momentarily increase at every discharge, and this causes discharge pulsation. When the discharge pulsation is analyzed using a fast Fourier transform (FFT), it is found that the pulsation includes various frequency components from a first-order to quite a high-order of rotation components. If the refrigerant is discharged outside from the merging portion without reducing the discharge pulsation, components in a refrigeration circuit such as a condenser vibrate and noise is generated.

[0006] In this regard, in this compressor, among the frequency components of the discharge pulsation, the fifth-order rotation component corresponding to the number (five) of the double-headed pistons (where, the fifth-order rotation component is a five-cycle fluctuation component during one rotation of the drive shaft) in the first discharge chamber differ in phase by 180° from the fifth-order rotation component in the second discharge chamber. Therefore, in the merging portion, the refrigerant which has passed through the first discharge passage merges with the refrigerant which has passed through the second discharge passage in a state where the phases of their fifth-order rotation components are shifted from each other, and this reduces the amplitude of fifth-order rotation component in the merging portion.

[0007] Furthermore, in this compressor, countermeasures are taken against other factors that may increase the fifth-order rotation component. That is, the timing of discharging the refrigerant from any one of the first cylinder bores is made different from any of the timing of discharging the refrigerant from the respective second cylinder bores. In addition, in this compressor, a pair of pulsation reducing means are provided; one consisting of the first discharge chamber and the first discharge passage, and the other consisting of the second discharge chamber and the second discharge passage. The pulsation reducing means are configured such that the reduction rate of the discharge pulsation at one side of the drive shaft is made equal to the reduction rate of the discharge pulsation at the other side of the drive shaft in the housing. By employing such a configuration, this compressor attempts to reliably reduce the fifth-order rotation component of the discharge pulsation.

[0008] The inventors of the present application intensively analyzed various frequency components of discharge pulsations and reached the findings that, in the case of employing the configuration in which refrigerant compressed in the first and second cylinder bores are respectively discharged into the annular first and second discharge chambers, not only a m^{th}-order rotation component corresponding to the number m of double-headed pistons, but also $(m\pm1)^{th}$-order rotation components reach a high level depending on the conditions at the time of operation and become the factor of generating vibration and noise of the refrigeration circuit unit. Furthermore, the inventors confirmed that, with the conventional compressor described above, the $(m\pm1)^{th}$-order rotation components of the discharge pulsation are difficult to reduce. That is, in the conventional compressor, it is difficult to reliably reduce the vibration and noise at the time of operation.

[0009] The present invention has been made in view of the conventional situation described above, and an object of the invention is to provide a double-headed piston type compressor capable of reliably reducing vibration and noise at the time of operation.

SUMMARY OF THE INVENTION

[0010] A double-headed piston type compressor of the present invention comprises: a drive shaft; a housing that rotatably supports the drive shaft and has m first cylinder bores, where m is an integer satisfying $m\geq2$, at one side of the drive shaft and m second cylinder bores facing the respective first cylinder bores at the other side of the drive shaft; m double-headed pistons that reciprocate in the respective first and second cylinder bores by rotation of the drive shaft; a first discharge chamber that is formed into an annular shape in the housing and into which refrigerant compressed in the first cylinder bores is discharged; a second discharge chamber that is formed into an annular shape in the housing and into which refrigerant compressed in the second cylinder bores is discharged; a merging portion in which the refrigerant discharged into the first discharge chamber and the refrigerant discharged into the second discharge chamber merge together, the merging portion being capable of discharging the merged refrigerant to the outside; at least one first discharge passage that provides communication between the first discharge chamber and the merging portion; and at least one second discharge passage that provides communication between the second discharge chamber and the merging portion. The first discharge chamber is divided into m first discharge sections that correspond to the respective first cylinder bores. The second discharge chamber is divided into m second discharge sections that correspond to the respective second cylinder bores. N out of the first discharge sections, where n is an arbitrary integer satisfying $1 \le n < m$, are defined as specified first discharge sections, and n out of the second discharge sections are defined as specified second discharge sections. When viewed from an axial direction of the drive shaft, at least one of the specified first discharge sections and at least one of the specified second discharge sections are disposed at positions shifted from each other. The at least one first discharge passage is n in number and each communicates with each of the specified first discharge sections and the merging portion. The at least one second discharge passage is n in number and each communicates with each of the specified second discharge sections and the merging portion.

[0011] Other aspects and advantages of the present invention will be apparent from the embodiments disclosed in the following description and the attached drawings, the illustrations exemplified in the drawings, and the concept of the invention disclosed in the entire description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** shows a sectional view of a compressor according to Embodiment 1.

[0013] FIG. **2** relates to the compressor according to Embodiment 1, showing a sectional view taken along line A-A of FIG. **1**.

[0014] FIG. **3** relates to the compressor according to Embodiment 1, showing a sectional view taken along line B-B of FIG. **1**.

[0015] FIG. **4** relates to the compressor according to Embodiment 1, showing a schematic perspective view of a first discharge chamber, a second discharge chamber, a merging portion, a first discharge passage, and a second discharge passage.

[0016] FIG. **5** relates to the compressor according to Embodiment 1 and is a series of graphs showing fifth-order rotation components of discharge pulsations in the first and second discharge chamber.

[0017] FIG. **6** relates to the compressor according to Embodiment 1 and is a series of graphs showing fourth-order rotation components of the discharge pulsations in the first and second discharge chambers.

[0018] FIG. **7** relates to the compressor according to Embodiment 1 and is a series of graphs showing sixth-order rotation components of the discharge pulsations in the first and second discharge chambers.

[0019] FIG. **8** relates to the compressor according to Embodiment 1; (A) is a graph showing a fourth-order rotation component of a discharge pulsation in the merging portion; (B) is a graph showing a fifth-order rotation component of the discharge pulsation in the merging portion; and (C) is a graph showing a sixth-order rotation component of the discharge pulsation in the merging portion.

[0020] FIG. **9** relates to a compressor of a comparative example; (A) is a graph showing a fourth-order rotation component of a discharge pulsation in a merging portion; (B) is a graph showing a fifth-order rotation component of the discharge pulsation in the merging portion; and (C) is a graph showing a sixth-order rotation component of the discharge pulsation in the merging portion.

[0021] FIG. **10** relates to a compressor according to Embodiment 2, showing a schematic view of a first discharge chamber, a second discharge chamber, a merging portion, a first discharge passage, and a second discharge passage.

[0022] FIG. **11** relates to the compressor according to Embodiment 2; (A) is a graph showing a fourth-order rotation component of a discharge pulsation in the merging portion; (B) is a graph showing a fifth-order rotation component of the discharge pulsation in the merging portion; and (C) is a graph showing a sixth-order rotation component of the discharge pulsation in the merging portion.

[0023] FIG. **12** relates to a compressor according to Embodiment 3, showing a schematic view of a first discharge chamber, a second discharge chamber, a merging portion, a first discharge passage, and a second discharge passage.

[0024] FIG. **13** is shows a sectional view of a compressor according to Embodiment 4.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0025] Hereinafter, Embodiments 1 to 4 of the present invention will be described with reference to the drawings. The compressors of Embodiments 1 to 4 are all mounted on vehicles and constitute refrigeration circuits of air-conditioning apparatus for the vehicles.

Embodiment 1

[0026] As shown in FIG. **1**, the compressor in Embodiment 1 comprises a housing **1**, a drive shaft **3**, a swash plate **5**, and five double-headed pistons **7**.

[0027] The housing **1** has a first housing **11**, a second housing **13**, a first cylinder block **15**, a second cylinder block **17**, a first valve formation plate **19**, and a second valve formation plate **21**. In the present embodiment, the front-rear direction of the compressor is defined on the assumption that the side on which the first housing **11** is disposed is the front side of the compressor, and the side on which the second housing **13** is disposed is the rear side of the compressor. The front side of the compressor corresponds to "one side of the drive shaft" in the present invention, and the rear side of the compressor corresponds to "the other side of the drive shaft" in the present invention.

[0028] The housing **1** is formed by aligning the first housing **11**, the first valve formation plate **19**, the first cylinder block **15**, the second cylinder block **17**, the second valve formation plate **21**, and the second housing **13** in this order from the front side to the rear side of the compressor and joining them all together using five through-bolts **14** shown in FIGS. **1** to **3**.

[0029] As shown in FIG. **1**, the first housing **11** has a boss **11*a*** that protrudes frontward. A shaft seal device **23** is provided in the boss **11*a***. As shown in FIGS. **1** and **2**, a first suction chamber **25** and a first discharge chamber **27** are formed in the first housing **11**. The first suction chamber **25** is disposed in a center portion of the first housing **11**. The first discharge chamber **27** is disposed at an outer circumferential side of the first suction chamber **25**, and is formed into a substantially annular shape to surround the first suction chamber **25**. Furthermore, as shown in FIG. **1**, the first housing **11** has recesses **11***b*, in which front end portions of the respective through-bolts **14** can be accommodated, and bolt holes **11***c* that communicate with the recesses **11***b*.

[0030] As shown in FIGS. **1** and **3**, a second suction chamber **26** and a second discharge chamber **28** are formed in the second housing **13**. The second suction chamber **26** is disposed in a center portion of the second housing **13**. The second discharge chamber **28** is disposed at an outer circumferential side of the second suction chamber **26**, and is formed into a substantially annular shape to surround the second suction chamber **26**. Furthermore, as shown in FIG. **1**, the second housing **13** has bolt holes **13***a*. The bolt holes **13***a* are formed with threads (not illustrated) to be screwed with the through-bolts **14**.

[0031] The first cylinder block **15** is disposed at the front side of the second cylinder block **17** in the compressor. As shown in FIGS. **1** and **2**, the first cylinder block **15** has five first cylinder bores **151** to **155** that extend in an axial direction, i.e., in the direction of an axis O of the drive shaft **3**. The first cylinder bores **151** to **155** are arranged at equiangular intervals around the axis O of the drive shaft **3**.

[0032] As shown in FIG. **1**, the first cylinder block **15** has a first shaft hole **15***a* through which the drive shaft **3** is inserted. A first radial bearing **29***a* is provided in the first shaft hole **15***a*. Furthermore, the first cylinder block **15** has a first retainer groove **15***b* that restricts the maximum opening degree of first suction reed valves **191***a*, which will be described later, and also has bolt holes **15***c* through which the through-bolts **14** are inserted.

[0033] As shown in FIGS. **1** and **2**, the first cylinder block **15** has five first communication paths **31***a*. The first communication paths **31***a* are arranged at equiangular intervals around the axis O of the drive shaft **3**. Furthermore, the first cylinder block **15** has a first connecting passage **33***a*. The first communication paths **31***a* and the first connecting passage **33***a* all extend in the axial direction, and front ends thereof are opened to a front end surface of the first cylinder block **15**. In FIG. **2**, illustration of the first valve formation plate **19** is omitted for ease of explanation.

[0034] As shown in FIG. **1**, the second cylinder block **17** is disposed at the rear side of first cylinder block **15** in the compressor. As shown in FIGS. **1** and **3**, the second cylinder block **17** has five second cylinder bores **171** to **175** that extend in the axial direction. The first cylinder bores **171** to **175** are arranged at equiangular intervals around the axis O of the drive shaft **3**, and are respectively paired with the above described first cylinder bores **151** to **155**. Thereby, the first cylinder bore **151** faces the second cylinder bore **171** in the direction of the axis O of the drive shaft **3**. Similarly, the first cylinder bores **152** to **155** face the corresponding second cylinder bores **172** to **175** in the direction of the axis O of the drive shaft **3**.

[0035] As shown in FIG. **1**, the second cylinder block **17** has a second shaft hole **17***a* through which the drive shaft **3** is inserted. A second radial bearing **29***b* is provided in the second shaft hole **17***a*. Furthermore, the second cylinder block **17** has a second retainer groove **17***b* that restricts the maximum opening degree of second suction reed valves **211***a*, which will be described later, and also has bolt holes **17***c* through which the through-bolts **14** are inserted.

[0036] As shown in FIGS. **1** and **3**, the second cylinder block **17** has five second communication paths **31***b*. The second communication paths **31***b* are arranged at equiangular intervals around the axis O of the drive shaft **3**. Furthermore, the second cylinder block **17** has a second connecting passage **33***b*. The second communication paths **31***b* and the second connecting passage **33***b* all extend in the axial direction, and rear ends thereof are opened to a rear end surface of the second cylinder block **17**. In FIG. **3**, illustration of the second valve formation plate **21** is omitted for ease of explanation.

[0037] As shown in FIG. **1**, by joining the first cylinder block **15** and the second cylinder block **17** with each other, a swash plate chamber **35**, an inlet port **350**, a connection passage **37**, a merging portion **39** and an outlet port **390** are formed therebetween.

[0038] The swash plate chamber **35** is disposed substantially at a center of the housing **1** in the front-rear direction of the compressor. Rear ends of the first communication paths **31***a* and front ends of the second communication paths **31***b* respectively communicate with the swash plate chamber **35**. The inlet port **350** also communicates with the swash plate chamber **35**.

[0039] In FIG. **1**, the first connecting passage **33***a*, the second connecting passage **33***b*, the connection passage **37** and the merging portion **39** are schematically illustrated, and the actual shapes thereof are as shown in FIG. **4**. That is, the connection passage is formed into a circular arc shape and extends in a circumferential direction of the housing **1**. One end of the connection passage **37** is connected to a rear end of the first connecting passage **33***a*, and the other end of the connection passage **37** is connected to a front end of the second connecting passage **33***b*. Furthermore, the merging portion **39** is connected to a center of the connection passage **37** in the circumferential direction.

[0040] In this configuration, the connection passage **37** is divided into the following two portions: a first portion **37***a*, which is the portion extending from the position where the first connecting passage **33***a* is connected to the position where the merging portion **39** is connected; and a second portion **37***b*, which is the portion extending from the position where the second connecting passage **33***b* is connected to the position where the merging portion **39** is connected. In this compressor, the first connecting passage **33***a* and the first portion **37***a* of the connection passage **37** form a first discharge passage **41**. Similarly, the second connecting passage **33***b* and the second portion **37***b* of the connection passage **37** forma second discharge passage **43**.

[0041] In the present embodiment, a length L**1**, which is the length of the first connecting passage **33***a*, and a length L**2**, which is the length of the second connecting passage **33***b*, are made equal. Furthermore, a length L**3**, which is the length of the first portion **37***a* of the connection passage **37**, and a length L**4**, which is the length of the second portion **37***b* of the connection passage **37**, are also made equal. Accordingly, the length of the first discharge passage **41** (L**1**+L**3**) and the length of the second discharge passage **43** (L**2**+L**4**) are equal.

[0042] As shown in FIG. **1**, the first valve formation plate **19** is disposed between the first housing **11** and the first cylinder block **15**. The first valve formation plate **19** has a first valve plate **190**, a first suction valve plate **191**, a first discharge valve plate **192** and a first retainer plate **193**. The first valve formation plate **19** is provided with a first discharge communication hole **190***a* and five first suction communication holes **190***b*. Furthermore, the first valve formation plate **19** is also provided with a communication hole **190**c and bolt holes **190**d. Additionally, although not illustrated, the first valve formation plate **19** is also provided with five first suction ports and five first discharge ports that respectively correspond to the first cylinder bores **151** to **155**.

[0043] The first suction valve plate **191** is provided on the rear surface of the first valve plate **190**. The five first suction reed valves **191**a, which can open and close the respective first suction ports by elastic deformation, are formed on the first suction valve plate **191**. The first discharge valve plate **192** is provided on the front surface of the first valve plate **190**. Five first discharge reed valves **192**a, which can open and close the respective first discharge ports by elastic deformation, are formed on the first discharge valve plate **192**. The first retainer plate **193** is provided on the front surface of the first discharge valve plate **192**. The first retainer plate **193** restricts the maximum opening degree of the first discharge reed valves **192**a.

[0044] The first cylinder bores **151** to **155** shown in FIG. **2** communicate with the first suction chamber **25** through the respective first suction ports (not illustrated) and communicate also with the first discharge chamber **27** through the respective first discharge ports (not illustrated). As shown in FIG. **2**, the first discharge chamber **27** of the present embodiment is divided into first to fifth front side discharge sections **271** to **275** equiangularly around the axis O of the drive shaft **3** so as to correspond to the respective first cylinder bores **151** to **155**. The first to fifth front side discharge sections **271** to **275** correspond to first discharge sections in the present invention.

[0045] Specifically, the first front side discharge section **271** corresponds to the first cylinder bore **151**; the second front side discharge section **272** corresponds to the first cylinder bore **152**; the third front side discharge section **273** corresponds to the first cylinder bore **153**; the fourth front side discharge section **274** corresponds to the first cylinder bore **154**; and the fifth front side discharge section **275** corresponds to the first cylinder bore **155**.

[0046] As shown in FIG. **2**, when viewed from the direction of the axis O of the drive shaft **3**, the first connecting passage **33**a is provided at a position overlapping with the first front side discharge section **271** of the first discharge chamber **27**. The first connecting passage **33**a communicates with the first front side discharge section **271** through the first discharge communication hole **190**a shown in FIG. **1**. Thereby, as shown in FIG. **4**, the first discharge chamber **27** communicates with the first discharge passage **41** at the first front side discharge section **271**. Among the first to fifth front side discharge sections **271** to **275**, the first front side discharge section **271** corresponds to a specified first discharge section in the present invention.

[0047] As shown in FIG. **1**, the first suction chamber **25** communicates with the respective first communication paths **31**a through the first suction communication holes **190**b and thus communicates with the swash plate chamber **35**. Therefore, the pressure in the swash plate chamber **35** is substantially equal to the pressure in the first suction chamber **25**. The drive shaft **3** is inserted through the insertion hole **190**c, and the bolts **14** are inserted through the bolt holes **190**d.

[0048] The second valve formation plate **21** is disposed between the second housing **13** and the second cylinder block **17**. The second valve formation plate **21** has a second valve plate **210**, a second suction valve plate **211**, a second discharge valve plate **212** and a second retainer plate **213**. The second valve formation plate **21** is provided with a second discharge communication hole **210**a and five second suction communication holes **210**b. Furthermore, the second valve formation plate **21** is also provided with bolt holes **210**c. Additionally, although not illustrated, the second valve formation plate **21** is also provided with five second suction ports and five second discharge ports that respectively correspond to the second cylinder bores **171** to **175**.

[0049] The second suction valve plate **211** is provided on the front surface of the second valve plate **210**. The five second suction reed valves **211**a, which can open and close the respective second suction ports by elastic deformation, are formed on the second suction valve plate **211**. The second discharge valve plate **212** is provided on the rear surface of the second valve plate **210**. Five second discharge reed valves **212**a, which can open and close the respective second discharge ports by elastic deformation, are formed on the second discharge valve plate **212**. The second retainer plate **213** is provided on the rear surface of the second discharge valve plate **212**. The second retainer plate **213** restricts the maximum opening degree of the second discharge reed valves **212**a.

[0050] The respective second cylinder bores **171** to **175** shown in FIG. **3** communicate with the second suction chamber **26** through the respective second suction ports (not illustrated) and communicate with the second discharge chamber **28** through the respective second discharge ports (not illustrated). As shown in FIG. **3**, the second discharge chamber **28** of the present embodiment is divided into a first to fifth rear side discharge sections **281** to **185** equiangularly around the axis O of the drive shaft **3** so as to correspond to the respective second cylinder bores **171** to **175**. The first to fifth rear side discharge sections **281** to **285** correspond to second discharge sections in the present invention.

[0051] Specifically, the second rear side discharge section **281** corresponds to the second cylinder bore **171**; the second rear side discharge section **282** corresponds to the second cylinder bore **172**; the third rear side discharge section **283** corresponds to the second cylinder bore **173**; the fourth rear side discharge section **284** corresponds to the second cylinder bore **174**; and the fifth rear side discharge section **285** corresponds to the second cylinder bore **175**.

[0052] As shown in FIG. **3**, when viewed from the direction of the axis O of the drive shaft **3**, the second connecting passage **33**b is provided at a position overlapping with the third rear side discharge section **283** of the second discharge chamber **28**. The second connecting passage **33**b communicates with the third rear side discharge section **283** through the second discharge communication hole **210**a shown in FIG. **1**. Thereby, as shown in FIG. **4**, the second discharge chamber **28** communicates with the second discharge passage **43** at the third rear side discharge section **283**. Among the first to fifth rear side discharge sections **281** to **285**, the third rear side discharge section **283** corresponds to a specified second discharge section in the present invention.

[0053] As shown in FIG. **4**, when the first discharge chamber **27** and the second discharge chamber **28** are viewed from the direction of the axis O of the drive shaft **3**, the first front side discharge section **271** is located at a position facing the first rear side discharge section **281**. Similarly, the second front side discharge section **272**, the third front side discharge section **273**, the fourth front side discharge section **274**, and the fifth front side discharge section **275** are located at positions facing the second rear side discharge section **282**, the third rear side discharge section **283**, the fourth rear side discharge section **284**, and the fifth rear side discharge section **285**, respectively.

[0054] The first front side discharge section **271** is located apart from the third rear side discharge section **283** by 144°, which is twice as large as 360°/5, in the direction of the dashed arrow R**1** in FIG. **4** around the axis O of the drive shaft **3**. That is, the first front side discharge section **271** is most apart from the third rear side discharge section **283** across the axis O of the drive shaft **3** in the direction of the dashed arrow R**1**. In other words, when the first discharge chamber **27** and the second discharge chamber **28** are viewed from the direction of the axis O of the drive shaft **3**, the first front side discharge section **271** and the third rear side discharge section **283** are disposed at positions shifted from each other. Consequently, in this compressor, when viewed from the direction of the axis O, the position where the first connecting passage **33***a* of the first discharge passage **41** communicates with the first front side discharge section **271** of the first discharge chamber **27** is shifted from the position where the second connecting passage **33***b* of the second discharge passage **43** communicates with the third rear side discharge section **283** of the second discharge chamber **28**.

[0055] As shown in FIG. **1**, the second suction chamber **26** communicates with the respective second communication paths **31***b* through the second suction communication holes **210***b* and thus communicates with the swash plate chamber **35**. Therefore, the pressure in the swash plate chamber **35** is also substantially equal to the pressure in the second suction chamber **26**. The bolts **14** are inserted through the bolt holes **210***c*.

[0056] The drive shaft **3** is inserted into the housing **1** so as to extend in the direction of the axis O. A front side of the drive shaft **3** is inserted through the shaft seal device **23** in the boss **11***a* and supported by the first radial bearing **29***a* in the first shaft hole **15***a* of the first cylinder block **15**. A rear side of the drive shaft **3** is supported by the second radial bearing **29***b* in the second shaft hole **17***a* of the second cylinder block **17**. The housing **1** supports the drive shaft **3** so as to be rotatable around the axis O of the drive shaft **3**.

[0057] A threaded portion **3***a* is formed at a front end of the drive shaft **3**. The drive shaft **3** is connected to a pulley or an electromagnetic clutch (not illustrated) via the threaded portion **3***a*.

[0058] The swash plate **5** includes a cylindrical portion **5***a* and a swash plate main body **5***b*. An insertion hole **5***c* is formed through the cylindrical portion **5***a*. The swash plate main body **5***b* is formed into a plate shape and has a front surface **501** and a rear surface **502**. The swash plate main body **5***b* is inclined at a predetermined angle with respect to the axis O of the drive shaft **3** and formed integrally with the cylindrical portion **5***a*. By press-fitting the drive shaft **3** to the insertion hole **5***c*, the swash plate **5** is integrated with the drive shaft **3** and rotatable in the swash plate chamber **35** along with the rotation of the drive shaft **3**.

[0059] In the swash plate chamber **35**, a first thrust bearing **45***a* is provided between the swash plate **5** and the first cylinder block **15**. Furthermore, in the swash plate chamber **35**, a second thrust bearing **45***b* is provided between the swash plate **5** and the second cylinder block **17**. The first thrust bearing **45***a* receives a frontward thrust force acting on the drive shaft **3** at the time of operation of the compressor, and the second thrust bearing **45***b* receives a rearward thrust force acting on the drive shaft **3** at the time of operation of the compressor.

[0060] The double-headed pistons **7** each has a first head portion **7***a* at a front end thereof a second head portion **7***b* at a rear end thereof. The first head portions **7***a* are reciprocally accommodated in the respective first cylinder bores **151** to **155**. First compression chambers **47***a* are defined by the respective first head portions **7***a* and the first valve formation plate **19** within the first cylinder bores **151** to **155**. The second head portions **7***b* are reciprocally accommodated in the respective second cylinder bores **171** to **175**. Second compression chambers **47***b* are defined by the respective second head portions **7***b* and the second valve formation plate **21** within the second cylinder bores **171** to **175**.

[0061] The double-headed pistons **7** each has an engaging portion **7***c* at a center thereof. Semispherical shoes **49***a* and **49***b* are provided in the respective engaging portions **7***c*. The shoes **49***a* slide on the front surface **501** of the swash plate main body **5***b*. The shoes **49***b* slide on the rear surface **502** of the swash plate main body **5***b*. In this way, the shoes **49***a* and **49***b* convert rotation of the swash plate **5** into reciprocation of the double-headed pistons **7**. Therefore, when the drive shaft **3** rotates, the first head portions **7***a* of the respective double-headed pistons **7** reciprocate in the respective first cylinder bores **151** to **155**, and the second head portions **7***b* reciprocate in the respective second cylinder bores **171** to **175**.

[0062] In this compressor, a pipe **201**, which is connected to a condenser **101**, is connected to the outlet port **390**. The condenser **101** is connected to an evaporator **102** via a pipe **202**. Furthermore, an expansion valve **103** is provided on the pipe **202**. The evaporator **102** and the inlet port **350** are connected via a pipe **203**. In this manner, the refrigeration circuit of vehicle air-conditioning apparatus is configured. Detailed explanation on configurations of the condenser **101**, the evaporator **102**, the expansion valve **103**, and the pipes **201** to **203** are omitted.

[0063] In the compressor configured as above, by rotation of the drive shaft **3**, the swash plate **5** rotates and the double-headed pistons **7** reciprocate in the first cylinder bores **151** to **155** and the second cylinder bores **171** to **175**. At this time, a suction phase for sucking refrigerant gas that has passed through the evaporator **102** into the compression chambers **47***a* and **47***b* of the first cylinder bores **151** to **155** and the second cylinder bores **171** to **175** respectively, a compression phase for compressing the refrigerant gas in the first and second compression chambers **47***a* and **47***b*, and a discharge phase for discharging the compressed high-pressure refrigerant gas into the first and second discharge chambers **27** and **28** take place repeatedly. The high-pressure refrigerant gas discharged into the first and second discharge chambers **27** and **28** reaches the merging portion **39** through the first and second discharge passages **41** and **43** and is then discharged to the condenser **101** through the outlet port **390**.

[0064] More specifically, in this compressor, by rotation of the drive shaft **3**, the high-pressure refrigerant gas compressed in the compression chamber **47***a* of the first cylinder bore **151** is discharged into the first front side discharge section **271** of the first discharge chamber **27**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***a* of the first cylinder bore **152** is discharged into the second front side discharge section **272**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***a* of the first cylinder bore **153** is discharged into the third front side discharge section **273**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***a* of the first cylinder bore **154** is discharged into the fourth front side discharge section **274**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***a* of the first cylinder bore **155** is discharged to the fifth front side discharge section **275**. Discharging operation is repeated in this order.

[0065] Similarly, by rotation of the drive shaft **3**, the high-pressure refrigerant gas compressed in the compression chamber **47***b* of the second cylinder bore **171** is discharged into the first rear side discharge section **281**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***b* of the second cylinder bore **172** is discharged into the second rear side discharge section **282**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***b* of the second cylinder bore **173** is discharged into the third rear side discharge section **283**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***b* of the second cylinder bore **174** is discharged into the fourth rear side discharge section **284**. Subsequently, the high-pressure refrigerant gas compressed in the compression chamber **47***b* of the second cylinder bore **175** is discharged to the fifth rear side discharge section **285**. Discharging operation is repeated in this sequence.

[0066] During the discharging operation, the pressures in the first and second discharge chambers **27** and **28** momentarily increase every time the high-pressure refrigerant gas is discharged, and this causes discharge pulsation. In this compressor, since the number of the double-headed pistons **7** is five, a fifth-order rotation component is the main component among various frequency components of the discharge pulsation. As shown in FIG. **5**, the fifth-order rotation component on the side of the first discharge chamber **27** differs in phase by 180° from the fifth-order rotation component on the side of the second discharge chamber **28**. Accordingly, when, for example, the phase of the fifth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point A**1** in FIG. **5** at a certain point in time, the phase of the fifth-order rotation component of the high-pressure refrigerant gas discharged from the third rear side discharge section **283** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point A**2** in FIG. **5**. Therefore, in this compressor, the high-pressure refrigerant gas from the first discharge passage **41** merges with the high-pressure refrigerant gas from the second discharge passage **43** in the merging portion **39** in a state where the phases of their fifth-order rotation components differ from each other by 180°, and this reduces the amplitude of the fifth-order rotation component of the discharge pulsation in the merging portion **39** as shown in FIG. **8**(B). As compared with the fifth-order rotation components in the first and second discharge chambers **27** and **28** shown in FIG. **5**, the amplitude of the fifth-order rotation component in the merging portion **39** is surely reduced to almost zero.

[0067] In this compressor, since the number of the double-headed pistons **7** is an odd number, the timing of discharging the high-pressure refrigerant gas from any one of the compression chambers **47***a* of the first cylinder bores **151** to **155** differs from any of the timing of discharging the high-pressure refrigerant gas from the respective discharge chambers **47***b* of the second cylinder bores **171** to **175**. Furthermore, in this compressor, as shown in FIG. **4**, the length of the first discharge passage **41** (L**1**+L**3**) is equal to the length of the second discharge passage **43** (L**2**+L**4**). Accordingly, the reduction rate of the discharge pulsations of the high-pressure refrigerant gas is substantially equal between the first discharge passage **41** and the second discharge passage **43**. Therefore, even if there are other factors which may increase the fifth-order rotation component as described in Japanese Patent Laid-Open No. 10-103228, the compressor of the present embodiment is capable of reliably reduce the fifth-order rotation component of the discharge pulsation.

[0068] Furthermore, in this compressor, the first and second discharge chambers **27** and **28** are formed into the substantially annular shapes. The high-pressure refrigerant gas compressed in the compression chambers **47***a* of the first cylinder bores **151** to **155** is discharged into the first discharge chamber **27**. The high-pressure refrigerant gas compressed in the compression chambers **47***b* of the second cylinder bores **171** to **175** is discharged into the second discharge chamber **28**. In such a compressor, depending on the conditions of operation, fourth-order rotation components of the discharge pulsations in the first and second discharge chambers **27** and **28** also increases to a high level as shown in FIG. **6**. Similarly, depending on the conditions of operation, sixth-order rotation components of the discharge pulsations in the first and second discharge chambers **27** and **28** also increases to a high level as shown in FIG. **7**.

[0069] In this regard, as shown in FIG. **4**, when the compressor is viewed from the direction of the axis O of the drive shaft **3**, the position of the first front side discharge section **271** where the first discharge passage **41** communicates with the first discharge chamber **27** is shifted from the position of the third rear side discharge section **283** where the second discharge passage **43** communicates with the second discharge chamber **28**.

[0070] Accordingly, when, for example, the phase of the fourth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point B**1** in FIG. **6** at a certain point in time, the phase of the fourth-order rotation component of the high-pressure refrigerant gas discharged from the third rear side discharge section **283** of the second discharge chamber **28** and flowing into the merging point **39** through the second discharge passage **43** corresponds to the point B**2** in FIG. **6**. Therefore, in the merging portion **39**, the high-pressure refrigerant gas which has flowed through the first discharge passage **41** from the first front side discharge section **271** merges with the high-pressure refrigerant gas which has flowed through the second discharge passage **43***d* from the third rear side discharge section **283** in a state where the phases of their fourth-order rotation components are shifted from each other, and this reduces the amplitude of the fourth-order rotation component of the discharge pulsation in the merging portion **39** as shown in FIG. **8**(A). As compared with the fourth-order rotation components in the first and second discharge chambers **27** and **28** shown in FIG. **6**, the amplitude of the fourth-order rotation component in the merging portion **39** is surely reduced.

[0071] Furthermore, when, for example, the phase of the sixth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point C**1** in FIG. **7** at a certain point in time, the phase of the sixth-order rotation component of the high-pressure refrigerant gas discharged from the third rear side discharge section **283** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point C**2** in FIG. **7**. Therefore, in the merging portion **39**, the high-pressure refrigerant gas which has flowed through the first discharge passage **41** from the first front side discharge section **271** merges with the high-pressure refrigerant gas which has flowed through the second discharge passage **43** from the third rear side discharge section **283** in a state where the phases of their sixth-order rotation components are shifted from each other, and this reduces the amplitude of the sixth-order rotation component of the discharge pulsation in the merging portion **39** as shown in FIG. **8**(C). As compared with the sixth-order rotation components in the first and second discharge chambers **27** and **28** shown in FIG. **7**, the amplitude of the sixth-order rotation component in the merging portion **39** is surely reduced.

[0072] A comparative example is shown in FIG. **9**. In a compressor of the comparative example, although not illustrated, the first connecting passage **33***a* is connected to the first discharge chamber **27** at the first front side discharge section **271**, and the second connecting passage **33***b* is connected to the second discharge chamber **28** at the first rear side discharge section **281**. That is, in the compressor of the comparative example, the first front side discharge section **271** is the first specified discharge section, and the first rear side discharge section **281** is the second specified discharge section. Therefore, when the compressor of the comparative example is viewed from the direction of the axis O of the drive shaft **3**, the first front side discharge section **271** where the first discharge passage **41** communicates with the first discharge chamber **27** faces the first rear side discharge section **281** where the second discharge passage **43** communicates with the second discharge chamber **28**. The other configurations in the compressor of the comparative example are the same as those of the compressor in Embodiment 1.

[0073] Also In the compressor of the comparative example, the fifth-order rotation component on the side of the first discharge chamber **27** differs in phase by 180° from the fifth-order rotation component on the side of the second discharge chamber **28**. Accordingly, when, for example, the phase of the fifth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point A**1** in FIG. **5** at a certain point in time, the phase of the fifth-order rotation component of the high-pressure refrigerant gas discharged from the first rear side discharge section **281** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point A**3** in FIG. **5**. Therefore, the amplitude of the fifth-order rotation component in the compressor of the comparative example is also surely reduced to almost zero as shown in FIG. **9**(B).

[0074] However, in the compressor of the comparative example, when, for example, the phase of the fourth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point B**1** in FIG. **6** at a certain point in time, the phase of the fourth-order rotation component of the high-pressure refrigerant gas discharged from the first rear side discharge section **281** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point B**3** in FIG. **6**. Therefore, in the merging portion **39**, the refrigerant gas which has flowed through the first discharge passage **41** from the first front side discharge section **271** merges with the high-pressure refrigerant gas which has flowed through the second discharge passage **43** from the first rear side discharge section **281** in a state where the phases of their fourth-order rotation components overlap each other, and this increases the amplitude of the fourth-order rotation component of the discharge pulsation in the merging portion **39** as shown in FIG. **9**(A). As compared with the fourth-order rotation components in the first and second discharge chambers **27** and **28** shown in FIG. **6**, the amplitude of the fourth-order rotation component in the merging portion **39** is significantly increased.

[0075] Furthermore, when, for example, the phase of the sixth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point C**1** in FIG. **7** at a certain point in time, the phase of the sixth-order rotation component of the high-pressure refrigerant gas discharged from the first rear side discharge section **281** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point C**3** in FIG. **7**. Therefore, in the merging portion **39**, the high-pressure refrigerant gas which has flowed through the first discharge passage **41** from the first front side discharge section **271** merges with the high-pressure refrigerant gas which has flowed through the second discharge passage **43** from the first rear side discharge section **281** in a state where the phases of their sixth-order rotation components overlap each other, and this increases the amplitude of the sixth-order rotation component of the discharge pulsation in the merging portion **39** as shown in FIG. **9**(C). As compared with the sixth-order rotation components in the first and second discharge chambers **27** and **28** shown in FIG. **7**, the amplitude of the sixth-order rotation component in the merging portion **39** is significantly increased.

[0076] Since the compressor of Embodiment 1 is capable of reducing the amplitudes of the fourth, fifth and sixth-order rotation components in this way, it is possible to reduce the discharge pulsation of the high-pressure refrigerant gas flowing into the pipe **201** through the merging portion **39** and the outlet port **390**.

[0077] Therefore, the compressor of Embodiment 1 is capable of reliably reducing vibration and noise at the time of operation.

[0078] Furthermore, in this compressor, since the first discharge passage **41**, the second discharge passage **43**, and the merging portion **39** are formed in the housing **1**, it is possible to simplify the outer shape of the compressor as well as the assembly process thereof.

Embodiment 2

[0079] In the compressor of Embodiment 2, as shown in FIG. **10**, the second discharge chamber **28** communicates with the second connecting passage **33***b* and thus the second discharge passage **43** at the fifth rear side discharge section **285**. That is, in this compressor, the fifth rear side discharge section **285** corresponds to the specified second discharge section of the present invention.

[0080] In this compressor, the first front side discharge section **271** is located apart from the fifth rear side discharge section **285** by 72°, which is 360°/5, in the opposite direction of the dashed arrow R**1** in FIG. **4** around the axis O of the drive shaft **3**. The other configurations in this compressor are the same as those of the compressor of Embodiment 1. Where the components are the same as Embodiment 1, same reference numerals are used and detailed explanation thereof is omitted.

[0081] Also in this compressor, the fifth-order rotation component of the discharge pulsation on the side of the first discharge chamber **27** differs in phase by 180° from the fifth-order rotation component on the side of the second discharge chamber **28**. Accordingly, when, for example, the phase of the fifth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point A**1** in FIG. **5** at a certain point in time, the phase of the fifth-order rotation component of the high-pressure refrigerant gas discharged from the fifth rear side discharge section **285** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point A**4** in FIG. **5**. Therefore, the amplitude of the fifth-order rotation component in this compressor is surely reduced to almost zero as shown in FIG. **11**(B).

[0082] Furthermore, in this compressor, when, for example, the phase of the fourth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point B**1** in FIG. **6** at a certain point in time, the phase of the fourth-order rotation component of the high-pressure refrigerant gas discharged from the fifth rear side discharge section **285** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point B**4** in FIG. **6**. Therefore, in the merging portion **39**, the high-pressure refrigerant gas which has flowed through the first discharge passage **41** from the first front side discharge section **271** merges with the high-pressure refrigerant gas which has flowed through the second discharge passage **43** from the fifth rear side discharge section **285** in a state where the phases of their fourth-order rotation components are shifted from each other, and thereby, as shown in FIG. **11**(A), the degree of increase of the amplitude of the fourth-order rotation component in the merging portion **39** can be made smaller than that of the comparative example shown in FIG. **9**(A).

[0083] Furthermore, when, for example, the phase of the sixth-order rotation component of the high-pressure refrigerant gas discharged from the first front side discharge section **271** of the first discharge chamber **27** and flowing into the merging portion **39** through the first discharge passage **41** corresponds to the point C**1** in FIG. **7** at a certain point in time, the phase of the sixth-order rotation component of the high-pressure refrigerant gas discharged from the fifth rear side discharge section **285** of the second discharge chamber **28** and flowing into the merging portion **39** through the second discharge passage **43** corresponds to the point C**4** in FIG. **7**. Therefore, in the merging portion **39**, the high-pressure refrigerant gas which has flowed through the first discharge passage **41** from the first front side discharge section **271** merges with the high-pressure refrigerant gas which has flowed through the second discharge passage **43** from the fifth rear side discharge section **285** in a state where the phases of their sixth-order rotation components are shifted from each other, and thereby, as shown in FIG. **11**(C), the degree of increase of the amplitude of the sixth-order rotation component in the merging portion **39** can be made smaller than that of the comparative example shown in FIG. **9**(C).

[0084] Therefore, the compressor of Embodiment 2 is also capable of reliably reducing vibration and noise at the time of operation.

Embodiment 3

[0085] Unlike the compressor of Embodiment 1, the compressor of Embodiment 3 is provided with two first discharge passages **51***a* and **51***b* and two second discharge passages **53***a* and **53***b* as shown in FIG. **12**.

[0086] The first discharge passage **51***a* communicates with the first front side discharge section **271** in the first discharge chamber **27** and the merging portion **39**. The first discharge passage **51***b* communicates with the third front side discharge section **273** in the first discharge chamber **27** and the merging portion **39**.

[0087] The second discharge passage **53***a* communicates with the second rear side discharge section **282** in the second discharge chamber **28** and the merging portion **39**. The second discharge passage **53***b* communicates with the fourth rear side discharge section **284** in the second discharge chamber **28** and the merging portion **39**.

[0088] The first front side discharge section **271** and the third front side discharge section **273** correspond to the first specified discharge section in the present invention. The second rear side discharge section **282** and the fourth rear side discharge section **284** correspond to the second specified discharge section in the present invention.

[0089] When viewed from the direction of the axis O of the drive shaft **3**, the first front side discharge section **271** and the third front side discharge section **273**, i.e., the first specified discharge section, and the second rear side discharge section **282** and the fourth rear side discharge section **284**, i.e., the second specified discharge section, are disposed at positions shifted from each other. The other configurations of this compressor are the same as those of the compressor in Embodiment 1.

[0090] With the compressor of Embodiment 3 configured as above, similarly to the compressors of Embodiments 1 and 2, it is possible to reliably reduce vibration and noise at the time of operation.

Embodiment 4

[0091] As shown in FIG. **13**, the compressor of Embodiment 4 employs a first discharge passage **55** and a second discharge passage **57** instead of the first discharge passage **41** and the second discharge passage **43** in the compressor of Embodiment 1. In the present embodiment, the first discharge passage **55**, the second discharge passage **57**, and the merging portion **39** are disposed outside of the housing **1**. Furthermore, the first and second valve formation plates **19** and **21** in this embodiment do not have the first and second discharge communication paths **190***a* and **210***a* provided in Embodiment 1.

[0092] The first discharge passage **55** communicates with the first discharge chamber **27** at a front end **55***a* thereof and communicates with the merging portion **39** at a rear end **55***b* thereof. Furthermore, the second discharge passage **57** communicates with the merging portion **39** a front end **57***a* thereof and communicates with the second discharge chamber **28** a rear end **57***b* thereof. The front end **55***a* of the first discharge passage **55** is connected to the first discharge chamber **27** from outside of the first housing **11** at a position where the first front side discharge section **271** is located. Similarly, the rear end **57***b* of the second discharge passage **57** is connected to the second discharge chamber **28** from outside of the second housing **13** at a position where the third rear side discharge section **283** is located. The other configurations of this compressor are the same as those of the compressor in Embodiment 1.

[0093] Similarly to the compressors of Embodiments 1 and 2, the compressor of Embodiment 4 is also capable of reliably reducing vibration and noise at the time of operation. Furthermore, in this compressor, since the first discharge passage **55**, the second discharge passage **57**, and the merging portion **39** do not need to be formed in the first and second cylinder blocks **15** and **17**, configurations of the first and second cylinder blocks **15** and **17** can be simplified.

[0094] Although the present invention has been described in line with the embodiments above, it is needless to say that the invention is not limited to the above-described embodiments, but may be appropriately modified in application without departing from the gist of the invention.

[0095] For example, selection of the specified first discharge section and the specified second discharge section is not limited to those in Embodiments 1 to 4. The compressor of Embodiment 1 may be configured such that the second discharge chamber **28** communicates with the second discharge passage **43** at the fourth rear side discharge section **284**. In this case, the first front side discharge section **271** is located apart from the fourth rear side discharge section **284** by 144° in the opposite direction of the dashed arrow R**1** in FIG. **4** around the axis O of the drive shaft **3**. Therefore, it is possible to exhibit the same effect as the compressor of Embodiment 1.

[0096] Furthermore, although m=5 and n=1 in Embodiments 1, 2 and 4 and m=5 and n=2 in Embodiment 3, the present invention is not limited to these configurations. In the present invention, the numbers m and n may be freely selected as long as the compressor is operable. For example, when m=5 and n=4, the compressor may be configured such that, when viewed from the axial direction of the drive shaft, one of the four specified first discharge sections and one of the four specified second discharge sections are disposed at positions shifted from each other, and the other three of the four specified first discharge sections and the other three of the four specified second discharge sections are disposed at positions facing each other.

[0097] Furthermore, although the discharge capacity of the compressors in Embodiments 1 to 4 is fixed at a constant value by fixing the inclination angle of the swash plate main body **5***b* at a predetermined value with respect to the axis O of the drive shaft **3**, the swash plate **5** may be configured such that its inclination angle with respect to the axis O of the drive shaft **3** is changeable by pressure in the swash plate chamber **35** and an exclusive actuator.

1. A double-headed piston type compressor comprising:

a drive shaft;

a housing that rotatably supports the drive shaft and has m first cylinder bores, where m is an integer satisfying m≥2, at one side of the drive shaft and m second cylinder bores facing the respective first cylinder bores at the other side of the drive shaft;

m double-headed pistons that reciprocate in the respective first and second cylinder bores by rotation of the drive shaft;

a first discharge chamber that is formed into an annular shape in the housing and into which refrigerant compressed in the first cylinder bores is discharged;

a second discharge chamber that is formed into an annular shape in the housing and into which refrigerant compressed in the second cylinder bores is discharged;

a merging portion in which the refrigerant discharged into the first discharge chamber and the refrigerant discharged into the second discharge chamber merge together, the merging portion being capable of discharging the merged refrigerant to the outside;

at least one first discharge passage that provides communication between the first discharge chamber and the merging portion; and

at least one second discharge passage that provides communication between the second discharge chamber and the merging portion,

wherein the first discharge chamber is divided into m first discharge sections that correspond to the respective first cylinder bores,

the second discharge chamber is divided into m second discharge sections that correspond to the respective second cylinder bores,

n out of the first discharge sections, where n is an arbitrary integer satisfying 1≤n<m, are defined as specified first discharge sections,

n out of the second discharge sections are defined as specified second discharge sections,

when viewed from an axial direction of the drive shaft, at least one of the specified first discharge sections and at least one of the specified second discharge sections are disposed at positions shifted from each other,

the at least one first discharge passage is n in number and each communicates with each of the specified first discharge sections and the merging portion, and

the at least one second discharge passage is n in number and each communicates with each of the specified second discharge sections and the merging portion.

2. The double-headed piston compressor according to claim **1**,

Wherein, when viewed from the axial direction of the drive shaft, all of the specified first discharge sections and all of the specified second discharge sections are disposed at positions shifted from one another.

3. The double-headed piston type compressor according to claim **2**,

wherein m is an odd number satisfying m≥3, and n=1.

4. The double-headed piston type compressor according to claim **3**, wherein the specified first discharge section is located apart from the specified second discharge section by at least an integer multiple of 360°/m around an axis of the drive shaft.

5. The double-headed piston type compressor according to claim **4**,

wherein the specified first discharge section is located most apart from the specified second discharge section across the axis of the drive shaft.

6. The double-headed piston type compressor according to claim **3**,

wherein the first discharge passage and the second discharge passage are substantially equal in length.

7. The double-headed piston type compressor according to claim **1**,

wherein the first discharge passage, the second discharge passage and the merging portion are formed in the housing.

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