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(71) Applicant: **Sanden Corporation**
Isesaki-shi,
Gunma 372-8502 (JP)

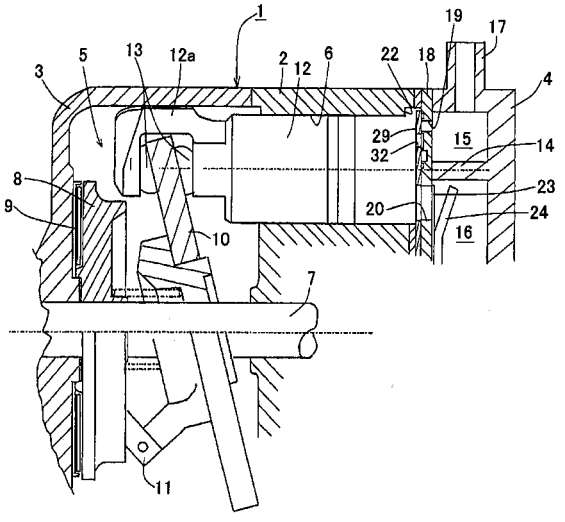
(72) Inventor: **TAKAI, Kazuhiko**
Isesaki-shi, Gunma 3728502 (JP)

(74) Representative: **Prüfer & Partner GbR**
European Patent Attorneys
Sohnckestraße 12
81479 München (DE)

(54) **COMPRESSOR**

(57) A compressor having a cylinder bore where fluid is compressed, a valve plate for partitioning the cylinder bore and a suction chamber, a suction hole provided in the valve plate and communicating the cylinder bore and the suction chamber, and a suction reed valve for opening and closing the suction hole and caused, when the valve closes the suction hole, to be in contact with a suction reed valve seal section of the valve plate. The suction reed valve seal section is located outside a suction hole-provided region. A suction reed valve support section, with which the suction reed valve can be in contact when the suction reed valve is closed, is provided also in the suction hole-provided region of the valve plate, and a valve function is provided between the outer periphery portion of the suction reed valve contact section of the suction reed valve support section and the suction reed valve. A through hole is provided in a part inside the portion where the valve function of the reed valve is provided. In the compressor, pressure loss at a suction valve portion in a suction stroke is reduced to improve suction efficiency etc. and vibration of the reed valve is suppressed by the reduction in pressure loss.

FIG. 1



EP 2 012 011 A1

Description

Technical Field of the Invention

[0001] The present invention relates to, for example, a piston-reciprocating compressor in which a piston is provided free to reciprocate in a cylinder bore, and specifically, to a compressor suitable as a compressor used in an air conditioning system for vehicles.

Background Art of the Invention

[0002] As a compressor used in an air conditioning system for vehicles, a piston-reciprocating compressor where a plurality of cylinder bores are provided in a cylinder block and a piston is provided free to reciprocate in each cylinder bore is known. In such a compressor, a suction chamber and a discharge chamber are provided in a cylinder head, and in a suction stroke, a suction hole is opened by an operation that refrigerant gas pushes to open a suction reed valve provided in a valve plate so that the refrigerant gas in the suction chamber is sucked into the cylinder bore. On the other hand, in a compression stroke, the suction reed valve is closed, and a discharge valve is opened by being pushed. Then, the compressed refrigerant gas is discharged from the cylinder bore into the discharge chamber.

[0003] In the above-described suction stroke, the pressure in the cylinder bore is reduced down to a pressure lower than the pressure in the suction chamber, the suction reed valve is pushed toward and opened into the cylinder bore when a difference between both inner pressures is caused, and at that time, there is a fear that a pressure loss at the suction valve portion becomes great and the efficiency of the compressor (e.g. adiabatic compression efficiency or volumetric efficiency) may be reduced. Although it is effective for improving the above-described pressure loss to enlarge the suction hole so as to make the opening area, when the suction hole is opened, larger, if the suction hole is formed larger, when the pressure in the cylinder bore increases momentarily, for example, ascribed to liquid compression, there may be a fear that the suction reed valve cannot endure with the increased pressure and it may be deformed or damaged. If the suction reed valve is deformed, a predetermined valve opening operation may not be carried out, and by reduction of the sealability accompanying therewith, the compression efficiency may be reduced. On the other hand, in the suction stroke, there is a case where the suction reed valve vibrates by the flow resistance at the suction valve section and the vibration causes a pressure pulsation.

[0004] Where, as a proposal for smoothing the opening operation of the suction reed valve, a technology is proposed wherein a recessed portion smaller in width than an arm section of the suction reed valve is provided in a region of the valve plate with which the arm section is in contact, and by providing the recessed portion, while a sticking force due to the presence of lubricant oil, which causes a delay of valve opening operation, is reduced, the valve opening operation is smoothened by enlarging the pressure receiving area of the suction reed valve due to the pressure difference between the pressure in the cylinder bore and the pressure in the suction chamber (Patent document 1). In this proposal, however, there may be a fear that the suction reed valve is deformed by the increase of the pressure in the cylinder bore accompanied with a compression operation and whereby the sealability between the suction valve and the valve plate and it causes a reduction of the efficiency.

Patent document 1: Japanese Utility Model Laid-Open 5-89876

Disclosure of the Invention

Problems to be solved by the Invention

[0005] The object of the present invention is to provide a compressor which can prevent deformation etc. of a suction valve in a suction stroke, can improve the suction efficiency etc., and can suppress vibration of a suction reed valve by reducing pressure loss.

Means for solving the Problems

[0006] To achieve the above-described object, a compressor according to the present invention has a cylinder bore where fluid is compressed, a valve plate for partitioning the cylinder bore and a suction chamber, a suction hole provided in the valve plate and communicating the cylinder bore and the suction chamber, and a suction reed valve for opening and closing the suction hole and caused, when being closed, to be in contact with a suction reed valve seal section of the valve plate which is located outside a suction hole-provided region, and is characterized in that a suction reed valve support section, with which the suction reed valve can be in contact when the suction reed valve is closed, is provided also in the suction hole-provided region of the valve plate, a valve function is provided between an outer periphery portion of a suction reed valve contact section of the suction reed valve support section and the suction reed valve, and a through hole is provided in a part inside a portion where the valve function of the reed valve is provided. In such a structure, because the suction reed valve support section is provided in the suction hole-provided region which can be in contact with the suction reed valve when the suction reed valve is closed, when the pressure in the cylinder bore increases and the suction reed valve is closed and strongly pressed onto the valve plate side in the compression step, the suction reed valve is supported by the suction reed valve support section and the suction reed valve is prevented from being deformed. Further, because the valve function is provided between the outer periphery portion of the suction reed valve contact section of the suction reed valve support section and the

suction reed valve and the through hole is provided in the part inside the portion where the valve function of the suction reed valve is provided, refrigerant gas from the suction chamber is to be flowed into the cylinder bore passing the through hole. Further, in the embodiment provided with the through hole, substantially the same effect as that due to an enlarged suction channel can be expected, and the pressure loss at the time of suction operation can be greatly reduced. Furthermore, if a valve function is provided between the outer periphery portion of the suction reed valve contact section of the suction reed valve support section and the suction reed valve, flowing out of refrigerant gas into the suction chamber side through the through hole can be surely prevented when the suction reed valve is closed, that is, in the compression stroke. Therefore, even in a case where the suction hole is enlarged for the purpose of reducing the pressure loss, deformation of the suction valve section corresponding to the suction hole-provided region can be surely prevented.

[0007] Further, it is preferred that a groove or a recessed portion is provided on the contact surface side of the suction reed valve support section to be in contact with the suction reed valve. In such a structure, because the contact area can be reduced while keeping the supporting strength for the suction reed valve, a problem of a delay of valve opening operation ascribed to a sticking force due to lubricant oil can be surely dissolved. Further, if the above-described groove or the recessed portion is communicated with the suction chamber, because refrigerant gas in the suction chamber can be flowed into the groove or the recessed portion, a quicker and smoother valve opening operation can be ensured utilizing the pressure of the refrigerant gas flowed in.

[0008] Further, the contact surface at the outer periphery portion of the suction reed valve contact section of the suction reed valve support section to be in contact with the suction reed valve, which is provided with the above-described valve function, is preferably located to be flush relative to the suction reed valve seal section of the suction reed valve, which is located outside the suction reed valve support section, alternatively, closer to the cylinder bore than the suction reed valve seal section, or closer to the suction chamber than the suction reed valve seal section. In such a structure, because the seal section with a small area of the suction reed valve support section lifts the suction reed valve from the suction reed valve seal section, a delay in valve opening operation ascribed to the sticking force due to lubricant oil on the suction reed valve seal section can be reduced in the stage at which no pressure difference between the suction chamber side and the cylinder bore side has been exhibited when transferred to the suction stroke, and therefore, the valve opening operation can be more quickly and more smoothly. Where, it is also possible to set the above-described contact surface so as to be located closer to the suction chamber than the suction reed valve seal section.

[0009] The above-described suction reed valve support section either can be formed integrally with the valve plate, or can be formed the suction reed valve support section and the valve plate separately. In the structure where the suction reed valve support section and the valve plate are formed integrally with each other, the position where the suction reed valve support section contacts with the suction reed valve can be adjusted by press forming after polishing of the valve plate, for example.

Effect according to the Invention

[0010] In the compressor according to the present invention, because the suction reed valve support section, which can be in contact with the suction reed valve when the suction reed valve is closed, is provided in the suction hole-provided region, deformation of the suction reed valve can be surely prevented.

[0011] Further, in the compressor according the present invention, the valve function is provided between the outer periphery portion of the suction reed valve contact section of the suction reed valve support section and the suction reed valve, and the through hole is provided in a part inside the portion where the valve function of the suction reed valve is provided. Namely, if the through hole is provided in the suction reed valve, because refrigerant gas is flowed into the cylinder bore by passing the through hole, substantially the same effect as an enlarged suction channel is expected and the pressure loss at the time of suction operation can be greatly reduced. Further, if a valve function is provided between the outer periphery portion of the suction reed valve contact section of the suction reed valve support section and the suction reed valve, flowing out of the refrigerant gas passing the through hole when the suction valve is closed is surely prevented. Further, if the contact surface with the suction reed valve in the outer periphery portion of the suction reed valve contact section of the suction reed valve support section is located to be flush relative to the suction reed valve seal section of the suction reed valve, otherwise closer to the cylinder bore than the suction reed valve seal section, a part of the suction valve is lifted toward the cylinder bore side by the contact surface when the suction reed valve closes the suction hole. Therefore, a delay in valve opening originated from the sticking force due to lubricant oil on the suction reed valve seal section can be prevented in the stage at which the pressure difference between the suction chamber side and the cylinder bore side disappears when transferred to the suction stroke, the valve opening operation can be ensured more quickly and more smoothly.

Brief explanation of the drawings

[0012]

[Fig. 1] Fig.1 is a partial, vertical sectional view of a compressor according to an embodiment of the

present invention.

[Fig. 2] Fig.2 is an enlarged sectional view of a connecting section between a cylinder block and a cylinder head of the compressor depicted in Fig.1.

[Fig. 3] Fig.3 is a diagram for explaining the position where the suction reed valve support section is provided on the valve plate in the compressor depicted in Fig.1.

Explanation of symbols

[0013]

1: compressor
2: cylinder block
3: front housing
4: cylinder head
5: crank chamber
6: cylinder bore
7: drive shaft
8: rotor
9: thrust bearing
10: inclined plate
11: link mechanism
12: piston
12a: end portion of piston at crank chamber side
13: shoe
14: wall
15: suction chamber
16: discharge chamber
17: suction port
18: valve plate
19: suction hole
20: discharge hole
29: suction reed valve
22: stopper
23: discharge valve
24: retainer
25: suction hole-provided region
26: suction reed valve seal section
28: suction reed valve support section
28a: contact surface with suction reed valve of suction reed valve support section
28b: recessed portion
32: through hole
40, 41: valve seat groove

The Best mode for carrying out the Invention

[0014] Hereinafter, a desirable embodiment of a compressor according to the present invention will be explained referring to figures.

Figs. 1 to 3 show a compressor according to an embodiment of the present invention. In Fig. 1, symbol 1 indicates a compressor. Compressor 1 has cylinder block 2, front housing 3 and cylinder head 4. Crank chamber 5 is formed between cylinder block 2 and front housing 3. A plurality of cylinder bores 6 are provided in the circumferential direction of cylinder block 2.

[0015] Drive shaft 7 is provided in crank chamber 5 so as to extend through crank chamber 5. Rotor 8 is fixed to drive shaft 7. Rotor 8 is supported by front housing 3 via thrust bearing 9. Further, drive shaft 7 is inserted through inclined plate 10. Inclined plate 10 is connected to rotor 8 via link mechanism 11 so that the inclination angle of inclined plate 10 can be changed by link mechanism 11. The amount in movement of piston 12 connected to inclined plate 10 in cylinder bore 6 is regulated by changing the inclination angle of inclined plate 10, thereby changing the displacement of compressor 1.

[0016] Piston 12 is provided free to be reciprocated in cylinder bore 6. Shoes 13 are held in the end portion 12a of piston 12 located at crank chamber 5 side. Shoes 13 are in sliding contact with the surfaces of the outer periphery portion of inclined plate 10 so that rotating movement of inclined plate 10 is transformed into reciprocating movement of piston 12 by the sliding contact.

[0017] The inside of cylinder head 4 is partitioned to suction chamber 15 and discharge chamber 16 by wall 14. Suction port 17 for sucking refrigerant gas into suction chamber 15 is provided in suction chamber 15.

[0018] Valve plate 18 is interposed between cylinder block 2 and cylinder head 4. Suction hole 19 which communicates cylinder bore 6 with suction chamber 15 and discharge hole 20 which communicates cylinder bore 6 with discharge chamber 16 are provided in valve plate 18. Suction hole 19 is opened and closed by suction reed valve 29. The opening degree of suction reed valve 29 is restricted by a condition where the tip of suction reed valve 29 is brought into contact with stopper 22 which is formed integrally with cylinder block 2. On the other hand, discharge hole 20 is opened and closed by discharge valve 23 which is formed as a reed valve. The opening degree of discharge valve 23 is restricted by retainer 24.

[0019] When suction hole 19 is closed, suction reed valve 29 is in contact with suction reed valve seal section 26 located outside of suction hole-provided region 25 of valve plate 18 so that suction hole 19 is closed. In this embodiment, suction reed valve support section 28, which can be in contact with suction reed valve 29 when the suction reed valve is closed, is provided in suction hole-provided region 25.

[0020] Contact surface 28a to be in contact with the suction reed valve of suction reed valve support section 28 is located to be flush relative to suction reed valve seal section 26 of valve plate 18 which is located outside suction reed valve support section 28. Where, it is also possible to dispose contact surface 28a so as to be located closer to the suction chamber than suction reed valve seal section 26. Further, because suction reed valve support section 28 is formed integrally with valve plate 28 in this embodiment, contact surface 28a can be located to be flush relative to suction reed valve seal section 26 or closer to the suction chamber than suction reed valve seal section 26, for example, by performing press forming on suction reed valve support section 28 after

polishing and manufacturing valve plate 18.

[0021] Recessed portion 28b is provided between contact surface 28a of suction reed valve support section 28 and suction reed valve seal section 26 of valve plate 18 located outside of suction reed valve support section 28, and recessed portion 28b is communicated with suction chamber 15 as depicted in Fig. 3. Where, Fig.3(A) is a sectional view of valve plate 18 along A_1-O_1-B_1 line of Fig.3(B) and Fig.3(C) is an elevational view showing a state in which reed valve 29 is stacked on the state shown in Fig.3(B).

[0022] In this embodiment, because suction reed valve support section 28 which can be in contact with suction reed valve 29 when the suction reed valve 29 is closed is provided in suction hole-provided region 25, suction reed valve 29 is supported by contact surface 28a of suction reed valve support section 28 when the pressure in cylinder bore 6 is increased and suction reed valve 29 is closed and pressed strongly onto the valve plate side at the stage of compression operation, thereby preventing deformation of suction reed valve 29 etc. Further, even in a case where suction hole 19 is enlarged for the purpose of reduction of the pressure loss, deformation of the part of suction reed valve 29 corresponding to suction hole-provided region 25 can be surely prevented.

[0023] Because contact surface 28a with the suction reed valve of the above-described suction reed valve support section 28 is located to be flush relative to suction reed valve seal section 26 of the valve plate which is located outside of suction reed valve support section 28, suction reed valve 29 is brought into contact with contact surface 28a of suction reed valve support section 28 in the compression stroke. However, because in a case where the stroke shifts to the suction stroke and the inner pressure of cylinder bore 6 has decreased, suction reed valve 29 receives the pressure difference between cylinder bore 6 and suction chamber 15 so as to be quickly got away from contact surface 28a, a quick and smooth valve opening operation can be ensured.

[0024] Further, because recessed portion 28b is communicated with suction chamber 25, refrigerant gas in suction chamber 15 is flowed into recessed portion 28b so that the valve opening operation can be ensured more quickly and more smoothly.

[0025] Further, suction reed valve support section 28 is formed integrally with valve plate 18. By forming suction reed valve support section 28 integrally with valve plate 18, cost up accompanied with increase of number of parts can be prevented. Further, suction reed valve support section 28 has contact surface 28a with suction reed valve 29 and recessed portion 28b which is formed outside of it and is communicated with suction chamber 15. A valve function is provided between the outer periphery portion of contact surface 28a with suction reed valve 29 of valve plate support section 28 and suction reed valve 29. The valve function is exhibited by the contact of suction reed valve 29 with contact surface 28a of suction reed valve support section 28 when suction reed valve 29 is closed. Further, through hole 32 is provided in a part inside the portion of suction reed valve 29 to be in contact with contact surface 28a, in other words, inside the portion where the valve function is provided. Where, symbols 40, 41 indicate valve seats.

[0026] By providing through hole 32 in suction reed valve 29, because refrigerant gas can easily move toward the back of suction reed valve 29 (piston side) passing through the through hole 32, a pressure difference between before and after suction reed valve 29 disappears and therefore, valve vibration can be suppressed. Further, in this embodiment, because through hole 32 is provided in suction reed valve 29, refrigerant gas from suction chamber 15 flows into cylinder bore 6 passing through the through hole 32, as a result, substantially the same effect as that enlargement of the suction channel can be expected, thereby reducing the pressure loss at the suction operation greatly. Further, because a valve function is provided between the outer periphery portion of contact surface 28a of suction reed valve support section 28 and suction reed valve 29, flowing out of refrigerant gas from through hole 32 can be surely prevented when suction reed valve 29 is closed.

[0027] Furthermore, because contact surface 28a is located to be flush relative to suction reed valve seal section 26 located outside suction reed valve supported section 28 as depicted in Fig.3, the sealing state with contact surface 28a is canceled almost simultaneously with the cancelling of sealing state of suction reed valve seal section 26. Therefore, a quick and smooth opening operation of suction reed valve 29 can be ensured. Further, contact surface 28a with suction reed valve 29 can also be located closer to the cylinder bore than suction reed valve seal section 26 located outside suction reed valve support section 28. In this case, because a part of suction reed valve 29 is lifted toward the cylinder bore side when suction reed valve 29 closes suction hole 19, a problem such that suction valve 29 sticks onto contact surface 28a by lubricant oil and it causes a delay of valve opening operation can be dissolved, and a quick and smooth opening operation of suction reed valve 29 can be ensured. However, it is also possible to dispose contact surface 28a with suction reed valve 29 so as to be located closer to the suction chamber side than suction reed valve seal section 26 located outside suction reed valve support section 28. Where, although valve seats 40, 41 are provided in this embodiment, the same operation and advantage can be obtained even in an embodiment without valve seats 40, 41.

[0028] Where, though there is a possibility that providing suction reed valve support section 28 as in the above-described embodiment may decrease the opening area of suction hole 19 and cause an increase of the pressure loss of flow path, for such a case, the pressure loss at an entrance portion of suction hole 19 can be reduced by performing R chamfering or C chamfering at the edge around the opening portion of suction hole 19 at the side of suction chamber 15.

Industrial Applications of the Invention

[0029] The present invention can be broadly applied to piston-reciprocating compressors provided with pistons freely reciprocating in cylinder bores, and these compressors are suitable as compressors used in air conditioning systems for vehicles.

Claims

1. A compressor having a cylinder bore where fluid is compressed, a valve plate for partitioning said cylinder bore and a suction chamber, a suction hole provided in said valve plate and communicating said cylinder bore and said suction chamber, and a suction reed valve for opening and closing said suction hole and caused, when being closed, to be in contact with a suction reed valve seal section of said valve plate which is located outside a suction hole-provided region, **characterized in that** a suction reed valve support section, with which said suction reed valve can be in contact when said suction reed valve is closed, is provided also in said suction hole-provided region of said valve plate, a valve function is provided between an outer periphery portion of a suction reed valve contact section of said suction reed valve support section and said suction reed valve, and a through hole is provided in a part inside a portion where said valve function of said reed valve is provided.

2. The compressor according to claim 1, wherein a contact surface with said reed valve in said outer periphery portion of said suction reed valve contact section of said suction reed valve support section where said valve function is provided is located to be flush relative to said suction reed valve seal section of said suction reed valve, which is located outside said suction reed valve support section, or closer to said cylinder bore than said suction reed valve seal section, or closer to said suction chamber than said suction reed valve seal section.

3. The compressor according to claim 1, wherein said suction reed valve support section is formed integrally with said valve plate.

4. The compressor according to claim 3, wherein a position where said suction reed valve support section is in contact with said suction reed valve is adjusted by press forming after polishing of said valve plate.

FIG. 1

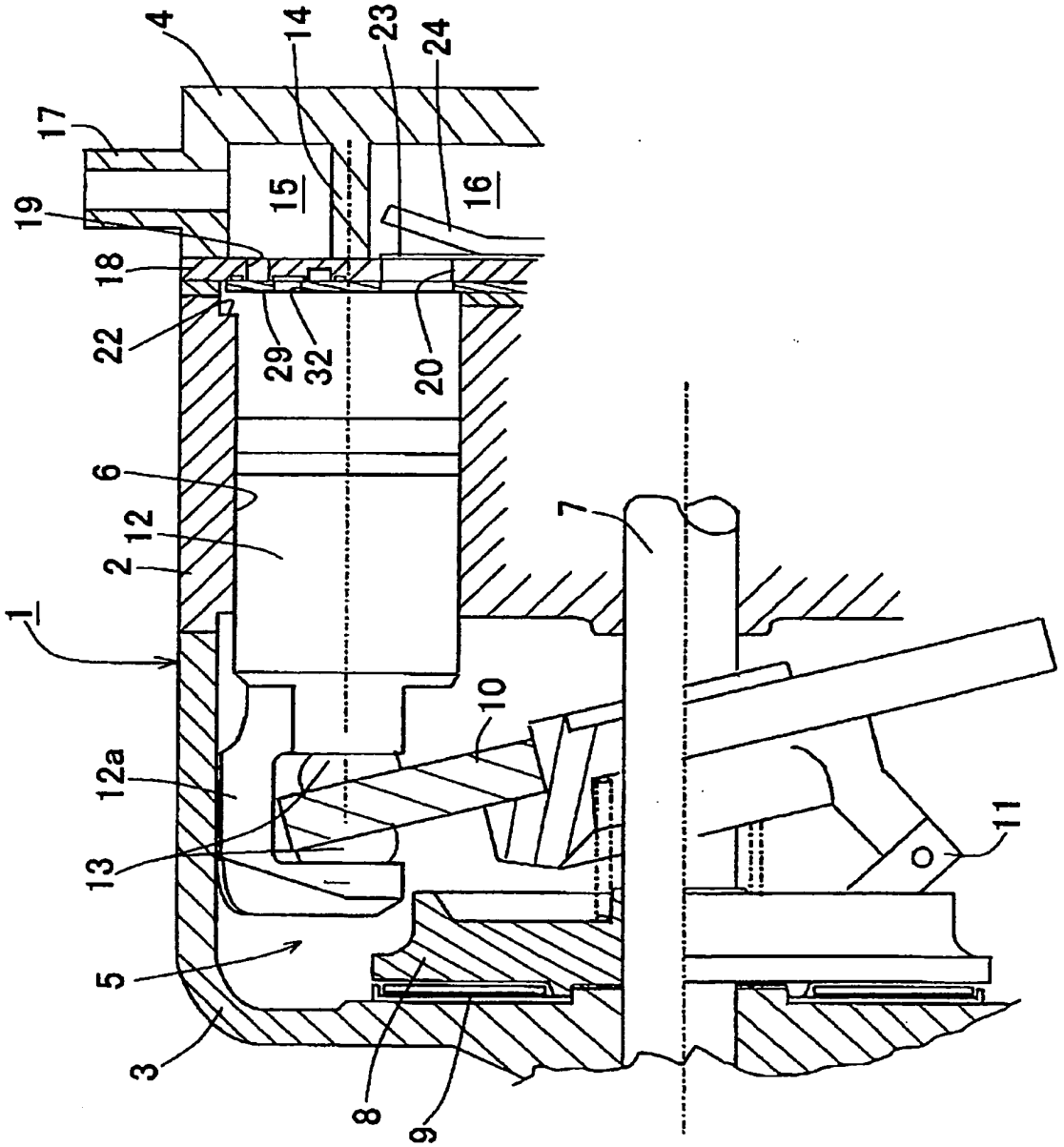


FIG. 2

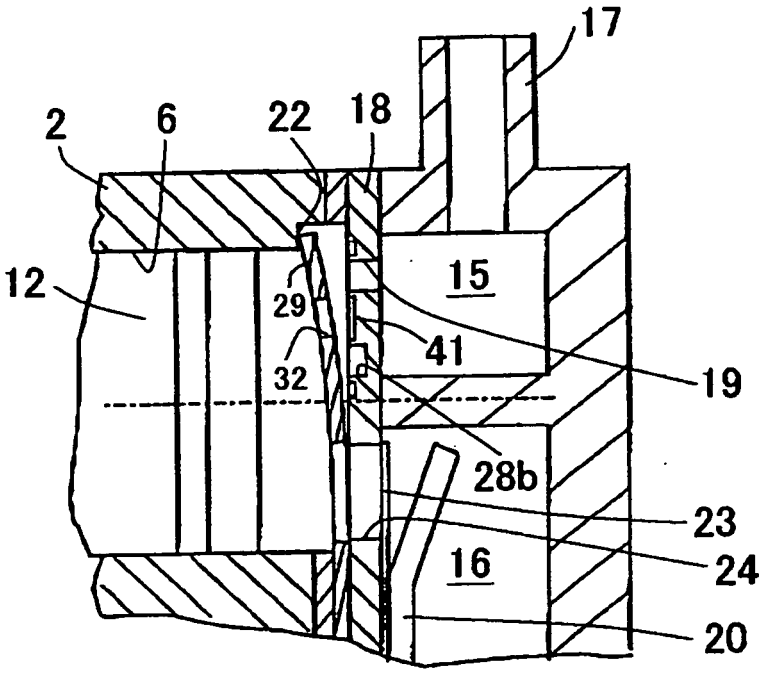
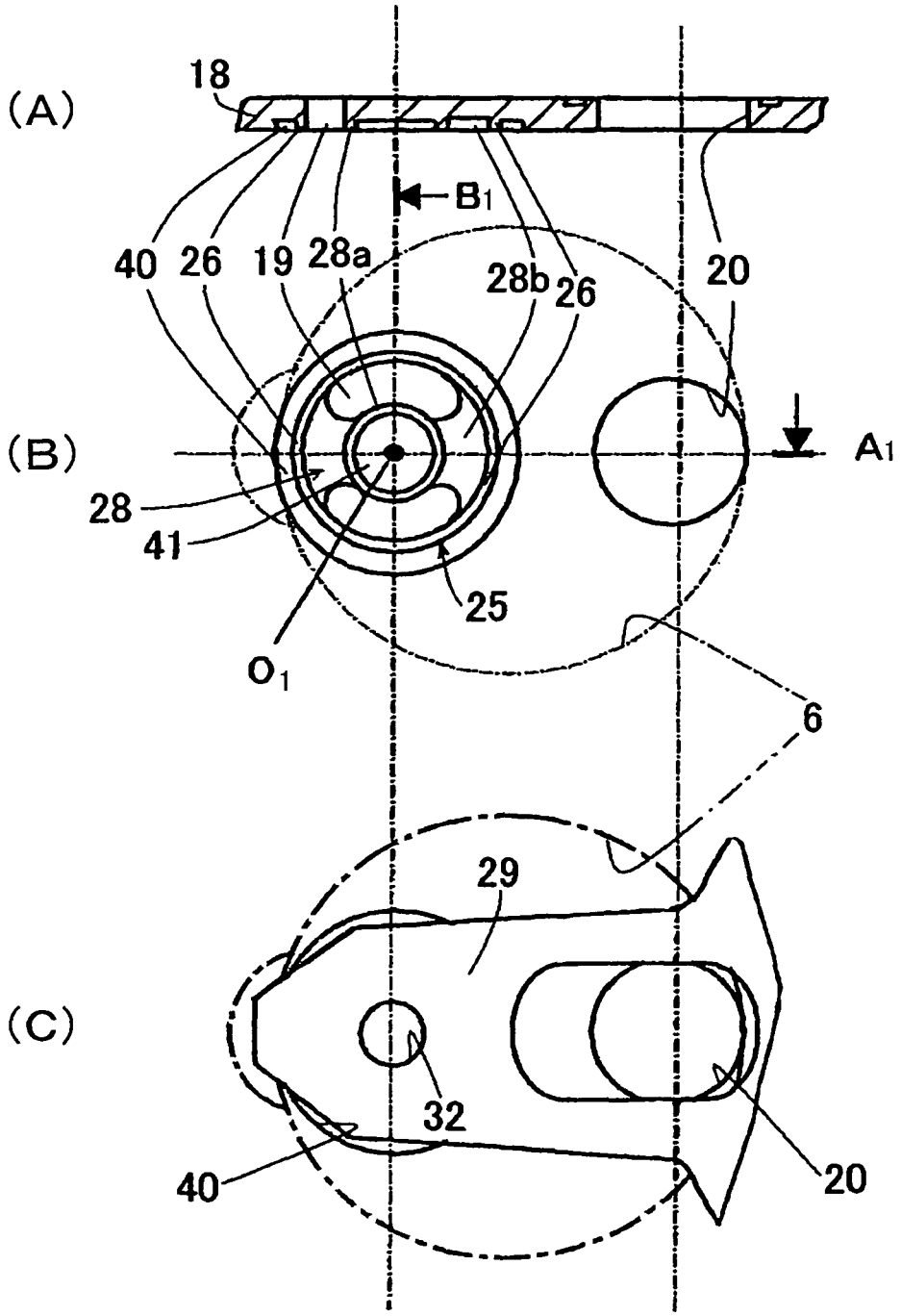


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057660

A. CLASSIFICATION OF SUBJECT MATTER
F04B39/10(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04B39/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 31-4281 B1 (Robert Bosch GmbH), 06 June, 1956 (06.06.56), Page 2, left column, lines 11 to 39; page 2, right column, lines 22 to 36; Figs. 3, 5 (Family: none)	1,3 4
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 63691/1973(Laid-open No. 13222/1975) (Tokyo Shibaura Electric Co., Ltd.), 12 February, 1975 (12.02.75), Page 3, line 4 to page 4, line 7; Figs. 1 to 4 (Family: none)	1-2

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
19 June, 2007 (19.06.07)	03 July, 2007 (03.07.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057660

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-176783 A (Toyota Industries Corp.), 27 June, 2003 (27.06.03), Par. Nos. [0025] to [0028]; Fig. 3 (Family: none)	4
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 40185/1990(Laid-open No. 1682/1992) (Toyoda Automatic Loom Works, Ltd.), 08 January, 1992 (08.01.92), Full text; Figs. 1 to 3 (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5089876 A **[0004]**