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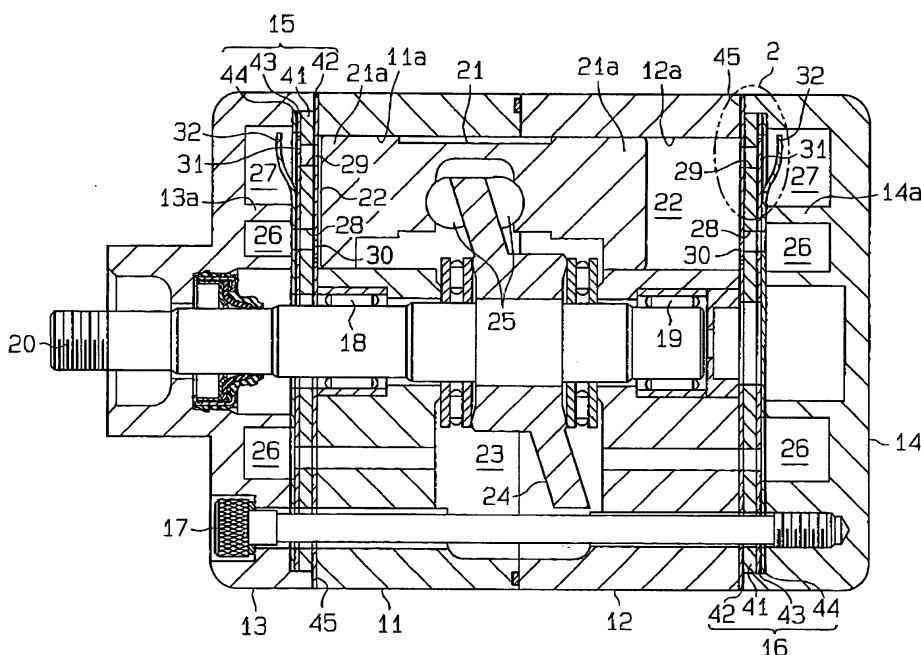
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(54) Sealing mechanism for compressor

(57) A sealing mechanism is used for a compressor. The compressor has a housing, a valve plate assembly (15, 16) located in the housing. The housing has a cylinder block (11, 12) and a cylinder head (13, 14). The cylinder block (11, 12) and the cylinder head (13, 14) are connected with each other. The valve plate assembly (15, 16) has a plurality of plates (41-44). The sealing

mechanism has a seal portion (45). The seal portion (45) is a peripheral portion of one of the plates (41-44) that extends radially outward in the compressor relative to the other plates (41-44). The seal portion (45) seals a peripheral section between the cylinder block (11, 12) and the cylinder head (13, 14). This provides an inexpensive and simple sealing mechanism of the compressor.

Fig.1



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a compressor having a valve plate assembly located in a housing, which includes a cylinder block and a cylinder head. Particularly, the present invention pertains to a sealing mechanism between adjoining sections of the cylinder block and the cylinder head.

[0002] Japanese Laid-Open Utility Model Publication No. 56-113186 (prior art (1)) discloses a sealing mechanism including a gasket. The gasket is fitted to a valve plate assembly. The diameter of the gasket is greater than the diameter of any valve plate in the valve plate assembly. The outer portion of the gasket protrudes from the valve plate assembly. The protruding portion is located between the adjoining sections of the cylinder block and the cylinder head. The protruding portion seals the adjoining sections of the cylinder block and the cylinder head.

[0003] Japanese Laid-Open Patent Publication No. 10-176669 (prior art (2)) discloses another sealing mechanism. In this structure, the outer portion of a valve plate assembly is located between a cylinder block and a cylinder head. The valve plate assembly includes a first plate and a second plate. Rubber coating is formed on both end surfaces of the first and second plates. The first plate seals the adjoining sections of the cylinder block and the valve plate assembly. The second plate seals the adjoining sections of the valve plate assembly and the cylinder head.

[0004] The sealing mechanism of prior art (1) requires a dedicated gasket (plate) for sealing the adjoining sections of the cylinder block and the cylinder head, which increases the number of parts in the compressor. The gasket also increases the thickness of the group of plates located between the cylinder block and the cylinder head, which increases the axial size of the compressor.

[0005] In the sealing mechanism of prior art (2), the rubber coating needs to be formed on both end surfaces of the first and second plates. The cost of the sealing mechanism is thus increased.

SUMMARY OF THE INVENTION

[0006] Accordingly, it is an objective of the present invention to provide an inexpensive and simple sealing mechanism of a compressor.

[0007] To achieve the above objective, the present invention provides a sealing mechanism for a compressor. The compressor has a housing and a valve plate assembly. The valve plate assembly is located in the housing. The housing has a cylinder block and a cylinder head. The cylinder block and the cylinder head are connected with each other. The valve plate assembly has a plurality of plates. The sealing mechanism has a seal

portion. The seal portion is a peripheral portion of one of the plates that extends radially outward in the compressor relative to the other plates. The seal portion seals a peripheral section between the cylinder block and the cylinder head.

[0008] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a cross-sectional view illustrating a double-headed piston type variable displacement compressor according to a preferred embodiment of the present invention;

Fig. 2 is an enlarged cross-sectional view showing a part surrounded by a circle of a broken line in Fig. 1;

Fig. 3 is an enlarged cross-sectional view illustrating a compressor according to another embodiment;

Fig. 4 is an enlarged cross-sectional view illustrating a compressor according to another embodiment; and

Fig. 5 is an enlarged cross-sectional view illustrating a compressor according to another embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] A double-headed piston swash plate type compressor according to a preferred embodiment of the present invention will be described with reference to Figs. 1 and 2. The compressor forms part of a refrigeration cycle of a vehicular air conditioning system.

[0011] As shown in Fig. 1, the swash plate type compressor includes a front cylinder block 11, a rear cylinder block 12, a front cylinder head 13, and a rear cylinder head 14. The front cylinder block 11 and the rear cylinder block 12 are adjacent to each other. The left end of the compressor in Fig. 1 is defined as the front of the compressor, and the right end is defined as the rear of the compressor.

[0012] The front cylinder head 13 is secured to the front end face of the front cylinder block 11 with a front valve plate assembly 15 in between. The rear cylinder head 14 is secured to the rear end face of the rear cylinder block 12 with a rear valve plate assembly 16 in between. The front cylinder block 11, the rear cylinder

block 12, the front cylinder head 13, the rear cylinder head 14 are fastened together with bolts 17 (only one is shown) and form the housing of the compressor.

[0013] A bearing 18 is located in the front cylinder block 11. A bearing 19 is located in the rear cylinder block 12. The bearings 18, 19 rotatably support a drive shaft 20, which extends through the cylinder blocks 11, 12. The drive shaft 20 is coupled to an external drive source, which is a vehicle engine (not shown) in this embodiment. The drive shaft 20 is rotated by power supplied by the engine.

[0014] First cylinder bores 11a (only one is shown in Fig. 1) are formed in the front cylinder block 11. The first cylinder bores 11a surround the drive shaft 20. Second cylinder bores 12a (only one is shown in Fig. 1) are formed in the rear cylinder block 12. The second cylinder bores 12a surround the drive shaft 20. Each first cylinder bore 11a and one of the second cylinder bores 12a are aligned along an axis parallel to the drive shaft 20 and forms a pair. The compressor has several pairs of the cylinder bores 11a, 12a (only one is shown in Fig. 1).

[0015] Each pair of the cylinder bores 11a, 12a accommodates a double-headed piston 21. Each piston 21 has two cylindrical heads 21a. The end face of each head 21a of each piston 21 and the corresponding one of the valve plate assemblies 15, 16 define a compression chamber 22.

[0016] The front cylinder block 11 and the rear cylinder block 12 define a crank chamber 23 in between. A drive plate, which is a swash plate 24 in this embodiment, is coupled to the drive shaft 20 and is located in the crank chamber 23. The swash plate 24 rotates integrally with the drive shaft 20. Each piston 21 has a pair of shoes 25 at an axial center, and is coupled to the peripheral portion of the swash plate 24 with the shoes 25. Rotation of the drive shaft 20 is converted into reciprocation of the pistons 21 by the swash plate 24 and the shoes 25.

[0017] A dividing wall 13a projects from the inner surface of the front cylinder head 13 toward the front valve plate assembly 15. A dividing wall 14a projects from the inner surface of the rear cylinder head 14 toward the rear valve plate assembly 16. The distal end of the dividing wall 13a contacts the front valve plate assembly 15, which defines a suction chamber 26 and a discharge chamber 27 in the front cylinder head 13. The discharge chamber 27 is located about the suction chamber 26. The distal end of the dividing wall 14a contacts the rear valve plate assembly 16, which defines a suction chamber 26 and a discharge chamber 27 in the rear cylinder head 14. The discharge chamber 27 is located about the suction chamber 26.

[0018] Each valve plate assembly 15, 16 includes suction ports 28 and suction valve flaps 30 for closing the suction ports 28. Each valve plate assembly 15, 16 also includes discharge ports 29 and discharge valve flaps 31 for closing the discharge ports 29. Further, each valve plate assembly 15, 16 includes a retainer 32.

When opened, the discharge valve flaps 31 contact the retainer 32, which defines the maximum opening degree of the discharge valve flaps 31.

[0019] Refrigerant gas is drawn into each suction chamber 26 from an external refrigerant circuit (not shown). As each piston 21 moves from the top dead center position to the bottom dead center position in relation to one of the suction chambers 26, the refrigerant is drawn into the corresponding compression chamber 22 through the corresponding suction port 28 while flexing the suction valve flap 30. When each piston 21 moves from the bottom dead center position to the top dead center position in relation to one of the discharge chambers 27, refrigerant in the corresponding compression chamber 22 is compressed to a certain pressure. The compressed gas is then discharged to the discharge chamber 27 through the corresponding discharge port 29 while flexing the discharge valve flap 31. The discharged gas is supplied to the external refrigerant circuit from the discharge chamber 27.

[0020] The structure of the valve plate assemblies 15, 16 and the sealing mechanism of the compressor using the valve plate assemblies 15, 16 will now be described. Since the front valve plate assembly 15 has the same structure as that of the rear valve plate assembly 16, only the explanation of the rear valve plate assembly 16 will be given, and the explanation of the front valve plate assembly 15 will be omitted.

[0021] Fig. 2 is an enlarged image of a portion enclosed by broken line in Fig. 1. As shown in Fig. 2, the valve plate assembly 16 includes a main plate 41, a first plate 42 located between the main plate 41 and the rear cylinder block 12, a second plate 43 located between the main plate 41 and the rear cylinder head 14, and a retainer plate 44 located between the second plate 43 and the rear cylinder head 14.

[0022] The main plate 41 is made of, for example, a metal such as SPCC. The suction ports 28 and the discharge ports 29 are formed in the main plate 41. The first plate 42 is made of, for example, a metal such as hardened carbon steel. The suction valve flaps 30, which are reed valves, are integrally formed with the first plate 42. The second plate 43 is made of, for example, a metal such as stainless steel. The discharge valve flaps 31, which are reed valves, are integrally formed with the second plate 43. The retainer plate 44 is made of, for example, a metal such as SPCC. The retainers 32 are integrally formed with the retainer plate 44. The retainers 32 bulge into the discharge chamber 27.

[0023] A rubber layer 46 is formed between the retainer plate 44 and the rear cylinder head 14. The distal end of the dividing wall 14a contacts the retainer plate 44. Accordingly, the rubber layer 46 seals the suction chamber 26 and the discharge chamber 27 from each other.

[0024] A rubber layer 47 is formed on each of the front end face and the rear end face of the first plate 42. That is, the first plate 42 has sealing function with rubber coatings and thus functions as a gasket. The peripheral por-

tion of the first plate 42 is extended outward compared to the plates 41, 43, 44 in the radial direction of the compressor. The projecting peripheral portion forms an annular rim. The rim and the corresponding portions of the rubber layers 47 form a seal portion 45. The seal portion 45 is located between the adjoining peripheral sections of the rear cylinder block 12 and the rear cylinder head 14 and seals the adjoining peripheral sections.

[0025] Like the rear valve plate assembly 16, the front valve plate assembly 15 has a first plate 42 with a seal portion 45. The seal portion 45 seals the adjoining peripheral sections of the front cylinder block 11 and the front cylinder head 13.

[0026] The embodiment of Figs. 1 and 2 provides the following advantages.

(1) The adjoining peripheral sections of the peripheral portions of each cylinder block 11, 12 and the corresponding cylinder head 13, 14 is sealed by the rubber coated first plate 42. Therefore, no dedicated sealing plate is required, and the number of parts in the compressor is reduced. Also, the embodiment of the Figs. 1 and 2 reduces the thickness of the group of plates between each cylinder block 11, 12 and the corresponding cylinder head 13, 14. This reduces the size of the compressor along the axis of the drive shaft 20.

(2) The peripheral portion of each first plate 42 radially protrudes outward in relation to the other plates 41, 43, 44 in the associated valve plate assembly 15, 16. That is, only the first plate 42 is located between the peripheral portions of each pair of the cylinder block 11, 12 and the cylinder head 13, 14. Therefore, to seal the adjoining peripheral sections of each cylinder block 11, 12 and the corresponding cylinder head 13, 14, only the first plate 42 needs to be coated with rubber, which reduces the cost of the sealing mechanism.

(3) Since reed valves (the suction valves 30) are integrally formed with each first plate 42, the first plates 42 are more likely to elastically deform compared to the main plates 41. That is, the first plates 42 are made of thinner or more flexible material. Therefore, the seal portion 45 of each first plate 42 is elastically deformed to compensate for machining errors in the peripheral portions of the corresponding cylinder block 11, 12 and the corresponding cylinder head 13, 14. Accordingly, the sealing property between the peripherally portions is improved.

(4) The sealing mechanism of the embodiment shown in Figs. 1 and 2 is used in the double-head piston type compressor. The double-headed piston type compressor has two sets of adjoining peripheral sections of the cylinder blocks 11, 12 and the

cylinder heads 13, 14. The compressor also has the two valve plate assemblies 15, 16. Therefore, the advantages (1) and (2) are obtained at the front and rear sections of the compressor. In other words, double-headed piston type compressors are particularly favorable for applying the sealing mechanism of the present invention.

[0027] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the invention may be embodied in the following forms.

[0028] As shown in modified embodiments of Figs. 3 to 5, the rubber layers 47 may be formed on both sides of any one of the plates 41, 43, 44 other than the first plate 42. The peripheral portion of the one of the plates 41, 43, 44 on which the rubber layers 47 are formed is radially extended outward than the other plates 41 to 44. The projected portion functions as the seal portion 45. The seal portion 45 in each of the embodiments of Figs. 3 to 5 is located between each cylinder block 11, 12 and the corresponding cylinder head 13, 14.

[0029] In Fig. 3, the main plate 41 seals the adjoining peripheral sections of each cylinder block 11, 12 and the corresponding cylinder head 13, 14. In Fig. 4, the second plate 43 seals the adjoining peripheral sections of each cylinder block 11, 12 and the corresponding cylinder head 13, 14. In Fig. 5, the retainer plate 44 seals the adjoining peripheral sections of each cylinder block 11, 12 and the corresponding cylinder head 13, 14. Particularly, in the embodiment of Fig. 4, the adjoining peripheral sections of each cylinder block 11, 12 and the cylinder head 13, 14 are effectively sealed for the reason mentioned in the advantage (3) of the embodiment shown in Fig. 2. In the embodiment of Fig. 5, the rubber layers 47 are formed only on both sides of the retainer plate 44. The rubber layers 47 seal the adjoining peripheral sections of each cylinder block 11, 12 and the corresponding cylinder head 13, 14. The rubber layers 47 also seal the suction chamber 26 and the discharge chamber 27 from each other. Therefore, the embodiment of Fig. 5 further reduces the cost of the sealing mechanism.

[0030] In the embodiments of Figs. 1 to 5, the rubber layers 47 may be formed only on the seal portion 45. This reduces the amount of rubber used in the compressor. However, forming rubber layers on the entire end faces of the plates 41 to 44 as illustrated in Figs. 1 to 5 is easier than forming rubber layers on part (peripheral portion) of the plates 41 to 44. Forming rubber layers on the entire end faces of the plates 41 to 44 eliminates spaces between each adjacent pair of the plates 41 to 44 and stabilizes the plates 41 to 44.

[0031] The sealing material is not limited to rubber. However, resin or soft metal may be used.

[0032] Each retainer 32 need not be located in the cor-

responding valve plate assembly 15, 16. For example, the maximum opening degree of each discharge valve flap 31 may be defined by contact between the discharge valve flaps 31 and the inner wall of the corresponding cylinder head 13, 14. In this case, the retainer plates 44 may be omitted and the structure of the valve plate assemblies 15, 16 is simplified. In this modification, the dividing wall 13a, 14a of each cylinder head 13, 14 contacts the corresponding second plate 43. If the retainer plates 44 are omitted from the embodiments of Figs. 2 and 3, a rubber coating is formed on the end face of each second plate 43 that faces the corresponding cylinder head 13, 14 to seal the suction chamber 26 and the discharge chamber 27 from each other.

[0033] The adjoining peripheral sections of the front cylinder block 11 and the front cylinder head 13 may be sealed by a different one of the plates 41 to 44 from the plate that seals the adjoining peripheral sections of the rear cylinder block 12 and the rear cylinder head 14. For example, the peripheral adjoining sections of the front cylinder block 11 and the front cylinder head 13 may be sealed by the first plate 42 of the front valve plate assembly 15, and the peripheral adjoining sections of the rear cylinder block 12 and the rear cylinder head 14 may be sealed by the second plate 43 of the rear valve plate assembly 16.

[0034] The present invention may be embodied in the sealing mechanism of a single-headed piston type compressor.

[0035] The present invention may be embodied in the sealing mechanism of a wobble plate type compressor.

[0036] The present invention may be embodied in the sealing mechanism of a wave cam type compressor having a wave cam instead of a swash plate. The wave cam functions as a drive plate.

[0037] Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

Claims

1. A sealing mechanism for a compressor, wherein the compressor has a housing, a valve plate assembly (15, 16) located in the housing, wherein the housing has a cylinder block (11, 12) and a cylinder head (13, 14), wherein the cylinder block (11, 12) and the cylinder head (13, 14) are connected with each other, wherein the valve plate assembly (15, 16) has a plurality of plates (41-44), the sealing mechanism being characterized by:

a seal portion (45), wherein the seal portion (45) is a peripheral portion of one of the plates (41-44) that extends radially outward in the compressor relative to the other plates (41-44),

and wherein the seal portion (45) seals a peripheral section between the cylinder block (11, 12) and the cylinder head (13, 14).

2. The sealing mechanism according to claim 1, **characterized in that** the cylinder block (11, 12) has a cylinder bore (11a, 12a), wherein the valve plate assembly (15, 16) has a first plate (42), a main plate (41), and a second plate (43), wherein the first plate (42) has a suction valve flap (30), which is opened when gas is drawn in the cylinder bore (11a, 12a), wherein the main plate (41) has a suction port (28) and a discharge port (29) to permit the gas to pass there through, and wherein the second plate (43) has a discharge valve flap (31), which is opened when the gas is discharged from the cylinder bore (11a, 12a).
3. The sealing mechanism according to claim 2, **characterized in that** the valve plate assembly (15, 16) has a retainer plate (44), which restricts the opening of the discharge valve flap (31).
4. The sealing mechanism according to claim 2, **characterized in that** the seal portion (45) is located in one of the first plate (42) and the second plate (43).
5. The sealing mechanism according to claim 3, **characterized in that** the seal portion (45) is located in the retainer plate (44).
6. The sealing mechanism according to any one of claims 1 to 5, **characterized in that** the seal portion (45) is formed by coating at least part of the peripheral surface of one of the plates (41-44) with seal material.
7. The sealing mechanism according to claim 6, **characterized in that** the seal material is coated substantially on the entire surface of the one of the plates (41-44).
8. The sealing mechanism according to any one of claims 1 to 7, **characterized in that** the compressor is double-headed piston type compressor.
9. A compressor having the sealing mechanism according to any one of claims 1 to 8.

Fig.1

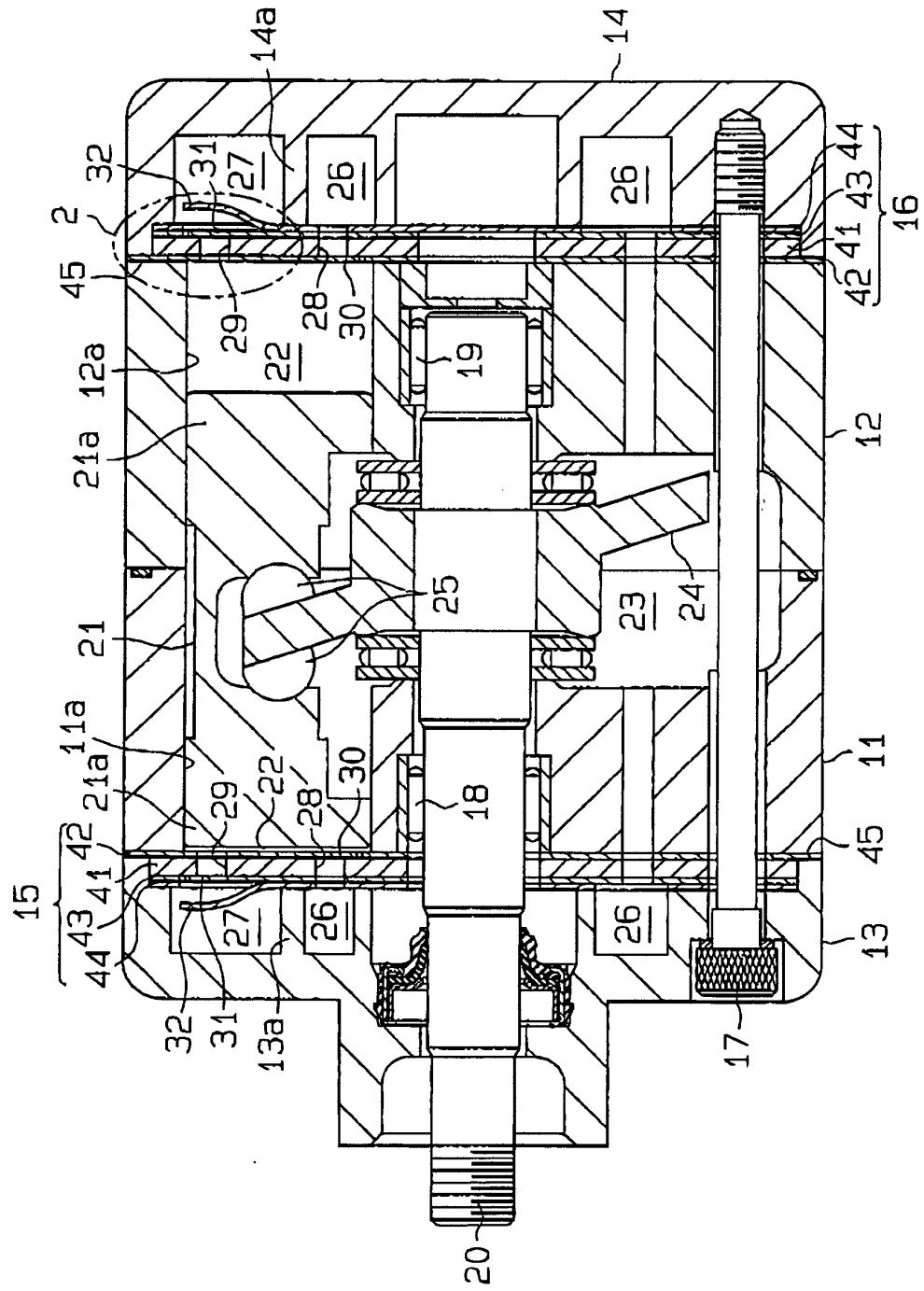


Fig. 2

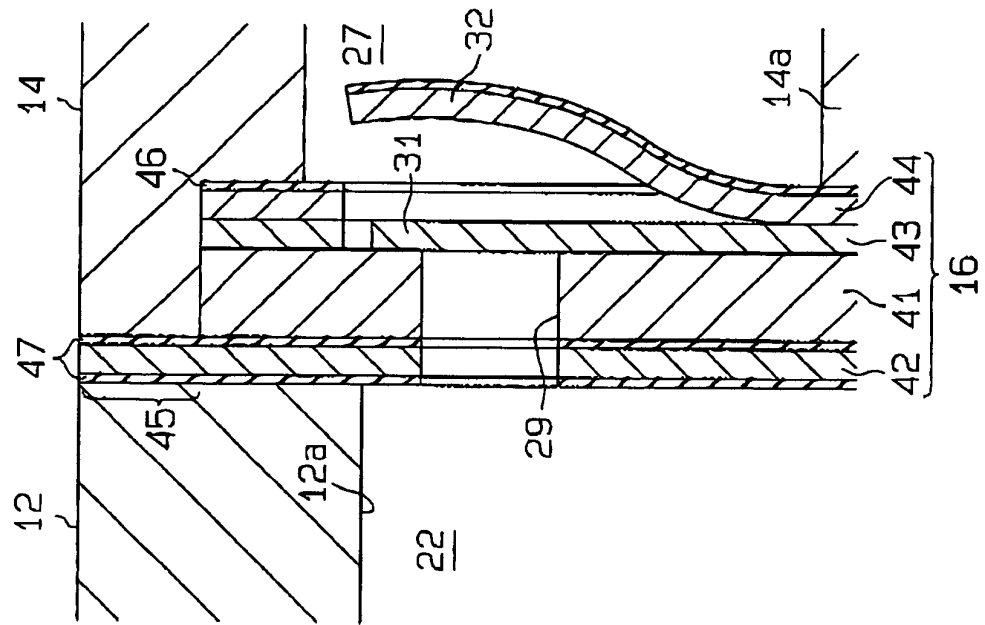


Fig. 3

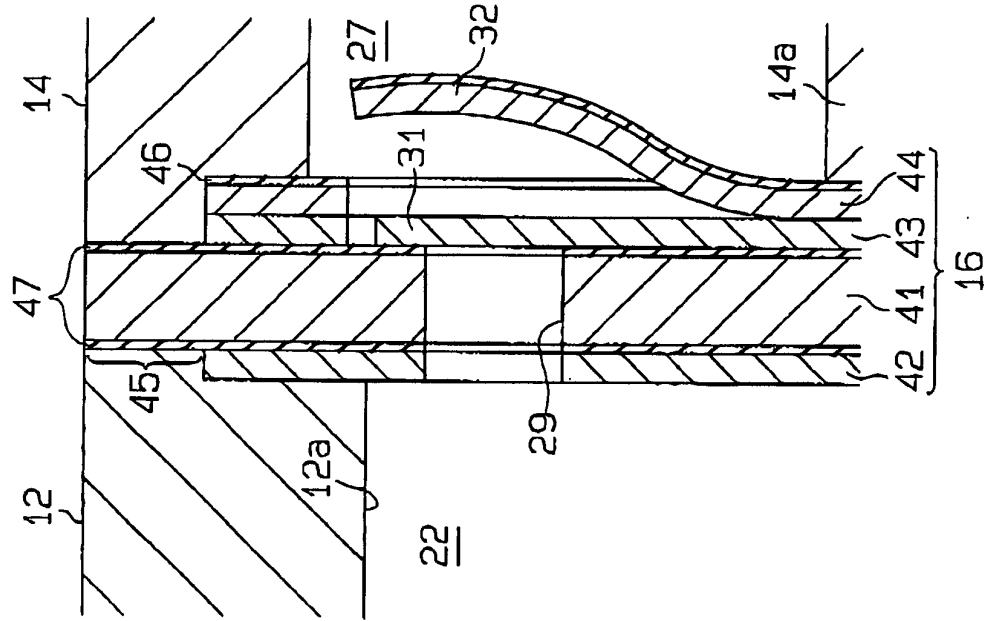


Fig. 4

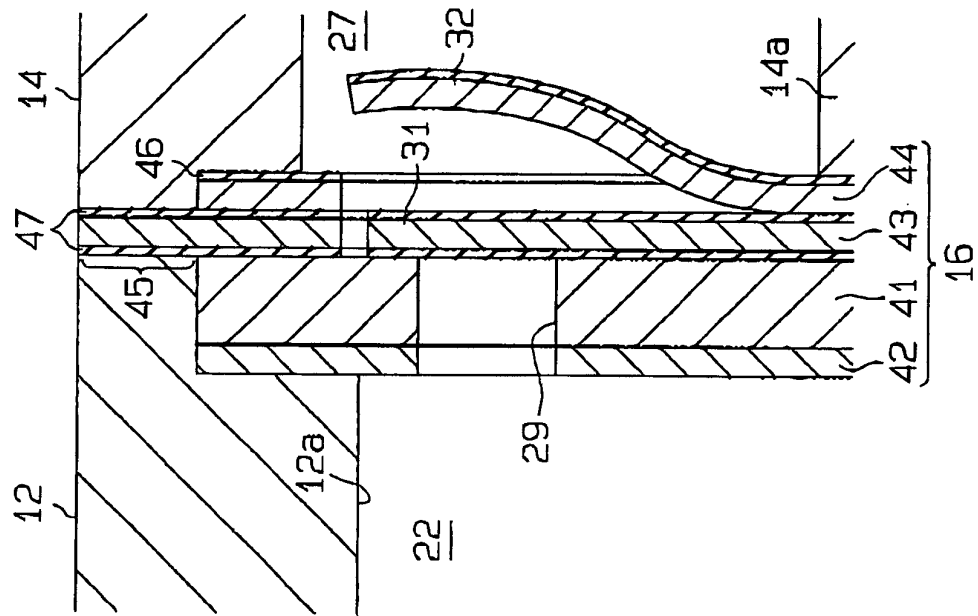


Fig. 5

