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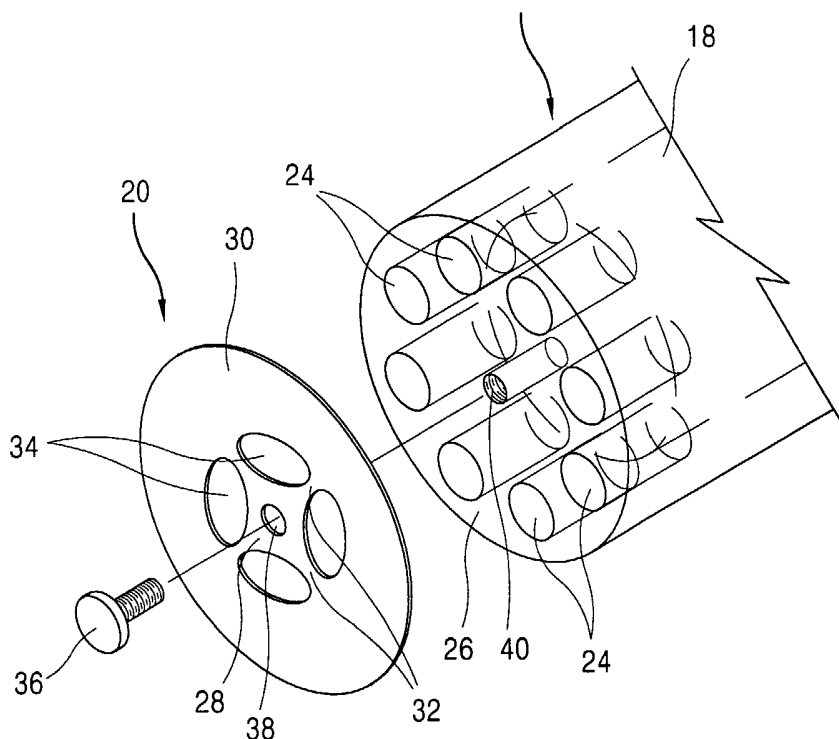
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(54) Title: VALVE ASSEMBLY OF RECIPROCATING COMPRESSOR



(57) Abstract: In a valve assembly of a reciprocating compressor including a piston having a valve seat portion (26) at the front and plural suction (24) holes for sucking a fluid at regular intervals in the circumferential direction; and a suction valve (20) arranged on the valve seat portion (26) to perform opening/closing operation of the suction holes (24), wherein the suction valve (20) includes a fixed portion fixed to the valve seat portion (26) of the piston; an open/close portion formed at the outside of the fixed portion to perform opening/closing operation of the suction holes (24); and plural neck (32) portions formed between the fixed portion (28) and the open/close portion (30) at regular intervals. Accordingly, by minimizing fatigue occurrence according to continued opening/closing operation by reducing an opening

angle of the valve, damage or breakage of the valve can be minimized.

## **VALVE ASSEMBLY OF RECIPROCATING COMPRESSOR**

### **TECHNICAL FIELD**

The present invention relates to a valve assembly, and in particular  
5 to a valve assembly of a reciprocating compressor capable of preventing  
damage of a valve due to compressive pressure and improving productivity.

### **BACKGROUND ART**

Generally, various types of compressors can be applied according  
10 to compression methods, and a hermetic compressor is mainly used for an  
air conditioner required to be small-sized and light-weighted. The hermetic  
compressor can be divided into a rotary compressor, a reciprocating  
compressor and a scroll compressor, etc. according to fluid compressing  
methods.

15 In the reciprocating compressor, a fluid is compressed while a  
piston of a compressing unit performs a linear reciprocating motion inside a  
cylinder by a driving force generated in a driving unit.

a valve assembly of the reciprocating compressor is installed  
between a compression chamber in which a fluid is compressed and a  
20 suction passage in which the fluid is sucked. When the fluid is sucked, the  
valve assembly is open by pressure of the fluid and supplies the fluid  
through the suction passage into the compression chamber. And, when the  
fluid is compressed, the valve assembly prevents the fluid compressed in  
the compression chamber from flowing backward.

Figure 1 is a partial-sectional view illustrating a valve assembly of a reciprocating compressor in accordance with the conventional art, and Figure 2 is an exploded-perspective view illustrating the conventional valve assembly.

5           A compressing unit of a reciprocating compressor in accordance with the conventional art includes a cylinder 104 is fixed to a casing (not shown) and having a compression chamber 102; a piston 106 inserted in the cylinder 104 so as to perform a linear reciprocating motion and compress a fluid; a suction valve 108 installed to the front of the piston 106  
10   to perform opening/closing operation so as to control the fluid flowing into the compression chamber 102; and a discharge valve assembly 110 for discharging the fluid from the compression chamber 102 to the outside when the fluid is compressed by higher than a certain level in the compression chamber 102.

15           In the piston 106 having a suction passage 112 for sucking a fluid is formed at the center thereof, and a suction hole 114 for supplying the fluid sucked into the suction passage 112 to a compressing chamber 102 is formed at the front thereof. And, a valve seat portion 116 on which the suction valve 108 is contacted is formed at the front of the piston 106.

20           The suction valve 108 is formed as a thin disc shape having a certain elastic force and is fixed to the valve seat portion 116 of the piston 106 by a bolt 118.

In more detail, as depicted in Figure 2, the suction valve 108 includes a fixed portion 120 formed at the center thereof so as to fixed the

valve seat portion 116 of the piston 106 by a bolt 118, and an open/close portion 124 formed at one surface of the fixed portion 120 and opening/closing operation of the suction holes 114. Herein, the fixed portion 120 and the open/close portion 124 are formed by cutting part of  
5 the suction valve 108 and are connected with each other by a neck portion 122 having a certain elastic force.

And, the discharge valve assembly 110 includes a valve cover 132 installed at the front of the cylinder 104 and having a discharge hole 130 for discharging a fluid; a discharge valve 134 tightly contacted to the front  
10 of the cylinder 104 to perform opening/closing operation; and a spring 136 interposed between the discharge valve 134 and an internal wall of the valve cover 132 to provide a certain elastic force to the discharge valve 134.

The operation of the reciprocating compressor in accordance with  
15 the conventional art will be described. When the piston 106 is retreated in order to supply the fluid to the compression chamber 102, because the open/close portion 124 of the suction valve 108 is separated from the valve seat portion 116 of the piston 106 by the suction pressure, the suction hole 114 is open, the fluid sucked into the suction passage 112 is supplied to  
20 the compression chamber 102 through the suction hole 114.

In that state, when the piston 106 is proceeded to compress the fluid, the suction valve 108 closes the suction hole 114 by being tightly contacted to the valve seat portion 116 of the piston 106 due to its own elastic force. When the piston 106 is proceeded more, the discharge valve

134 is separated from the cylinder 104 by the pressure inside the compression chamber 102, and the fluid compressed in the compression chamber 102 is discharged to the outside through the discharge hole 130.

However, in the suction valve of the reciprocating compressor in accordance with the conventional art, when the fluid is supplied to the compression chamber 102, by the suction pressure, the open/close portion 124 of the suction valve 108 is separated from the valve seat portion 116 of the piston 106. Herein, because the open/close portion 124 performs the opening/closing operation of the suction hole 114 by bending the neck portion 122, concentrated stress is acted on the neck portion 122, and accordingly the neck portion 122 may be damaged by fatigue due to continuous opening/closing operation or excessive opening operation.

In addition, because the open/close portion 124 has to be placed so as to face the suction holes 114 of the piston 106, a position of the open/close portion 124 has to be adjusted accurately in an assembly process of the suction valve 108. In addition, the fixed portion 120 has to be fixed firmly to the piston 106 in order to prevent a position of the open/close portion 124 from being changed in opening/closing of the suction valve 108, and accordingly the assembly operation is intricate.

20

#### **TECHNICAL GIST OF THE PESENT INVENTION**

In order to solve the above-described problems, it is an object of the present invention to provide a valve assembly of a reciprocating compressor capable of preventing damage or breakage of a valve by

minimizing fatigue occurrence due to continuous opening/closing operation by reducing an opening angle of the valve.

It is another object of the present invention to provide a valve assembly of a reciprocating compressor capable of improving productivity  
5 by assembling a valve regardless of a position thereof.

In order to achieve the above-mentioned objects, a valve assembly of a reciprocating compressor in accordance with the present invention includes a piston having a valve seat portion at the front and plural suction holes for sucking a fluid at regular intervals in the circumferential direction;  
10 and a suction valve arranged at the valve seat portion to perform opening/closing operation of the suction holes, wherein the suction valve includes a fixed portion fixed to the valve seat portion of the piston; an open/close portion formed at the outside of the fixed portion to perform opening/closing operation of the suction holes; and plural neck portions  
15 formed between the fixed portion and the open/close portion at regular intervals.

The fixed portion as the central portion of the suction valve is fixed to the center of the valve seat portion of the piston.

The neck portion is formed between space portions formed by  
20 cutting portions between the fixed portion and the open/close portion at regular intervals.

The neck portion is radially formed between space portions formed by cutting partial portions between the fixed portion and the open/close portion.

A guide groove on which a fluid passing the suction hole is discharged is formed at the circumference of the open/close portion at regular intervals.

5

### **BRIEF DESCRIPTION OF DRAWINGS**

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles  
10 of the invention.

In the drawings:

Figure 1 is a partial sectional view illustrating a suction valve of a compressor in accordance with the conventional art;

Figure 2 is an exploded perspective view illustrating the suction  
15 valve in accordance with the conventional art;

Figure 3 is a sectional view illustrating a compressor using a suction valve assembly in accordance with the present invention;

Figure 4 is an exploded perspective view illustrating the suction valve assembly in accordance with the present invention;

20 Figure 5 is a front view illustrating the suction valve assembly in accordance with the present invention;

Figure 6 is a sectional view illustrating an operational state of a suction valve in accordance with the present invention;

Figure 7 is a front view illustrating a suction valve assembly in

accordance with a second embodiment of the present invention; and

Figure 8 is a front view illustrating a suction valve assembly in accordance with a third embodiment of the present invention.

5

### **DETAILED DESCRIPTION OF THE INVENTION**

Hereinafter, the preferred embodiments a suction valve assembly of a compressor in accordance with the present invention will be described with reference to accompanying drawings.

There can be plural embodiments, herein the preferred  
10 embodiments will be described.

Figure 3 is an perspective view illustrating a suction valve assembly of a reciprocating compressor in accordance with the present invention.

The reciprocating compressor in accordance with the present  
15 invention includes a casing 6 having a certain sealed space and respectively connected suction pipe 2 for sucking a fluid and discharge pipe 4 for discharging a compressed fluid; a driving unit 8 disposed in the casing 6 to generate a reciprocating motion force when power is applied; and a compressing unit 10 for performing a compressing operation by  
20 receiving the reciprocating motion force generated in the driving unit 8.

The compressing unit 10 includes a piston 12 connected to the driving unit 8 to perform a linear reciprocating motion; a cylinder 14 for receiving the piston 12 slidably therein and forming a compression chamber 16; a suction valve 20 installed to the front of the piston 12 to

perform opening/closing operation of a fluid passage 18 of the piston 12;  
and a discharge valve assembly 22 installed to the front of the cylinder 14  
to perform opening/closing operation of a discharged fluid.

Figure 4 and 5 are an exploded perspective and a front view  
5 illustrating the suction valve assembly in accordance with the present  
invention.

The piston 12 is a cylindrical body connected to the driving unit 8 to  
perform a linear motion so as to be sealed by the inner circumference of  
the cylinder 14, a suction passage 18 for sucking a fluid is formed at the  
10 inner circumference of the piston 12 in the length direction, and plural  
suction holes 24 are formed at the front of the piston 12 for supply the fluid  
sucked in the suction passage 18 to the compression chamber 16. And, a  
flat valve seat portion 26 is formed at the front of the piston 12 so as to be  
tightly contacted to the suction valve 20 performing the opening/closing  
15 operation, and the driving unit 8 is connected to the rear of the piston 12.

Herein, the suction hole 24 is formed at regular intervals in the  
circumferential direction of the piston 12. In more detail, the suction holes  
24 can be formed freely at least they are formed in the circumferential  
direction of the piston 12 uniformly, as an embodiment, it is preferable to  
20 form eight suction holes.

The suction valve 20 formed a thin flat plate type and fixed to the  
valve seat portion 26 of the piston 12 to opening/closeing the suction holes  
24, and it is made of a material having a certain elastic force.

In the suction valve 20 having a fixed portion 28 is formed at the

center thereof so as to be fixed to the valve seat portion 26 of the piston 12 and an open/close portion is formed at the outside of the fixed portion 28 to open/close the suction holes 24.

Herein, the fixed portion 28 and the open/close portion 30 are  
5 connected with each other by the neck portion 32, the neck portion 32 is formed at regular intervals in the circumferential direction by space portions 34 formed by cutting portions between the fixed portion 28 and the open/close portion 30, and each neck portion 32 has a certain elastic force. Each space portion 34 is formed as an elliptic shape having a certain size  
10 and is formed at regular intervals in the circumferential direction.

The fixed portion 28 can have any structure at least it can fix the center of the suction valve 20 to the valve seat portion 26 of the piston 12. As an embodiment, in case of a bolt fastening structure, a through hole 38 in which a bolt 36 is passed is formed at the center of the suction valve 20,  
15 a bolt fastening groove 40 is formed at the center of the valve seat portion 26, and accordingly the bolt 36 is fastened to the bolt fastening groove 40 after passing the through hole 38.

The open/close portion 30 has an area along the whole surface of the suction valve 20 in the circumferential direction, and the area of the  
20 open/close portion 30 is greater than a diameter of the suction hole 24 of the piston 12.

The discharge valve assembly 22 includes a valve cover 50 installed at the front of the cylinder 14 to have a discharge hole 46 for discharging a fluid; a discharge valve 48 placed in the valve cover 50 so as

to be tightly contacted to the front of the cylinder 14 in order to perform opening/closing operation of a fluid compressed in the compression chamber 18; and a valve spring 52 interposed between the discharge valve 48 and an internal wall of the valve cover 50 to provide a certain elastic  
5 force to the discharge valve 48.

In more detail, when a pressure inside the compression chamber 16 reaches a certain degree, the discharge valve 48 is retreated by overcoming the elastic force of the valve spring 52, the fluid compressed in the compression chamber 16 is discharged to the outside through the  
10 discharge hole 46.

The operation of the suction valve assembly of the reciprocating compressor in accordance with the present invention will be described.

Figure 6 is a sectional view illustrating an operational state of a suction valve in accordance with the present invention.

15 First, when power is applied to the driving unit 8, the driving force of the driving unit 8 is transmitted to the piston 12, according to that, when the piston 12 is retreated, by the pressure difference of the fluid and the retreating inertia of the piston 12, the neck portion 32 of the suction valve 20 is bent, the open/close portion 30 is separated from the valve seat  
20 portion of the piston 12, the suction hole 24 is open, and accordingly the fluid is supplied to the compression chamber 24.

Herein, because the suction hole 24 is formed at the front of the piston 12 at regular intervals in the circumferential direction, the fluid is sucked through the plural suction holes 24. Because, the neck portion 32

of the suction valve 20 is formed at regular intervals, it is possible to reduce an opening angle of the suction valve 20 and decrease concentrated stress acting on the neck portions 32.

In that state, when the driving unit 8 is operated in the backward  
5 direction, the piston 12 moves forward, the fluid filled in the compression chamber 16 is compressed, when a pressure inside the compression chamber 16 reaches a certain degree, the discharge valve 48 is retreated by overcoming the elastic force of the valve spring 52 and is separated from the front of the cylinder 14, the fluid compressed in the compression  
10 chamber 16 is discharged to the outside through the discharge hole 46 formed at the valve cover 50.

Herein, by the pressure of the compression chamber 16 and the elastic force of the suction valve 20, the open/close portion 30 of the suction valve 20 is tightly contacted to the valve seat portion 26 of the  
15 piston 12, and accordingly it is possible to prevent the fluid inside the compression chamber 16 from flowing backward into the suction hole 24.

Figure 7 is a front view illustrating a suction valve assembly in accordance with a third embodiment of the present invention.

In a suction valve 58 in accordance with the second embodiment of  
20 the present invention having a fixed portion 60 having a through hole 62 is formed at the center thereof so as to be fixed to the valve seat portion 26 of the piston 12, an open/close portion 64 formed at the outside of the fixed portion 60 for performing an opening/closing operation of the suction hole 24, and plural neck portions 66 connected between the fixed portion 60

and the open/close portion 66.

Herein, the plural neck portions 66 are radially connected through space portions 68 formed by cutting portions between the fixed portion 60 and the open/close portion 64. It is preferable to form four neck portions 66, and the number of neck portions can be adjusted according to a pressure of the fluid.

Figure 8 is a front view illustrating a suction valve assembly in accordance with a third embodiment of the present invention.

In a suction valve 70 in accordance with the third embodiment of the present invention having a fixed portion 72 is formed at the center so as to be fixed to the valve seat portion 26 of the piston 12, an open/close portion 74 formed at the outside of the fixed portion 72 for performing opening/closing operation of the suction hole 24, and plural neck portions 76 connected between the fixed portion 72 and the open/close portion 74. And, a guide groove 78 is formed at the circumference of the open/close portion 74 in order to make the fluid passing the suction hole 24 be discharged smoothly.

Herein, the guide groove 78 having a certain width is formed at the outer circumference of the suction valve 70 at regular intervals.

20

### **INDUSTRIAL APPLICABILITY**

Advantages of a suction valve assembly of a reciprocating compressor in accordance with the present invention will be described as

following.

In the suction valve assembly of the reciprocating compressor in accordance with the present invention, because a suction hole of a piston is formed at regular intervals in the circumferential direction, a fluid is  
5 uniformly sucked in the circumferential direction, load acting on a whole surface of the suction valve is uniform, it is possible to reduce an opening angle of the suction valve, concentrated stress acting on a neck portion of the suction valve can be reduced, and accordingly it is possible to minimize damage of the suction valve.

10 In addition, by forming the suction hole of the piston at regular intervals in the circumferential direction and forming the open/close portion of the suction valve in the circumferential direction, there is no need to adjust a position of the suction valve in an assembly process, and accordingly assembly efficiency can be improved.

15

### CLAIMS

1. A valve assembly of a reciprocating compressor comprising:

5 a piston having a valve seat portion at the front and plural suction holes for sucking a fluid at regular intervals in the circumferential direction; and

a suction valve arranged at the valve seat portion to perform opening/closing operation of the suction holes;

10 wherein the suction valve includes a fixed portion fixed to the valve seat portion of the piston; an open/close portion formed at the outside of the fixed portion to perform opening/closing operation of the suction holes; and plural neck portions formed between the fixed portion and the open/close portion at regular intervals.

15

2. The valve assembly of claim 1, wherein the fixed portion formed between the central portion of the suction valve and the center of the valve seat portion of the piston.

20 3. The valve assembly of claim 1, wherein the neck portion is formed between space portions formed by cutting portions between the fixed portion and the open/close portion at regular intervals.

4. The valve assembly of claim 3, wherein the space portions

are formed as elliptic shapes symmetrical with each other.

5           5.       The valve assembly of claim 1, wherein the neck portion is radially formed between space portions formed by cutting partial portions  
5       between the fixed portion and the open/close portion.

          6.       The valve assembly of claim 5, wherein the space portions are formed by cutting portions between the fixed portion and the open/close portion as circular band shapes.  
10

          7.       The valve assembly of claim 1, wherein the plural neck portions are formed between the fixed portion and the open/close portion at regular intervals.

15           8.       The valve assembly of claim 1, wherein a guide groove on which a fluid passing the suction hole is discharged is formed at the circumference of the open/close portion at regular intervals.

          9.       The valve assembly of claim 8, wherein the guide groove  
20       having a certain width is formed at the edge of the open/close portion.

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FIG. 1

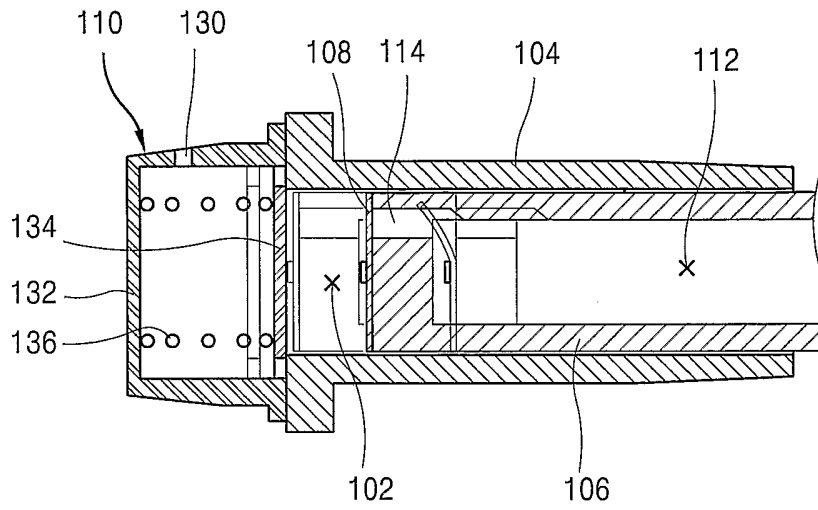


FIG. 2

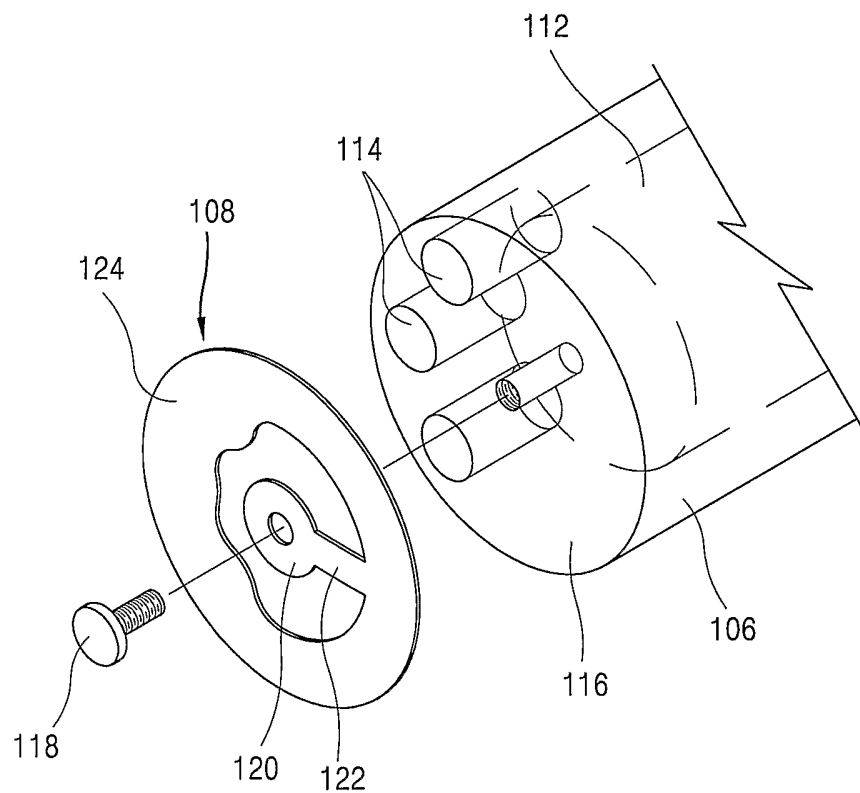
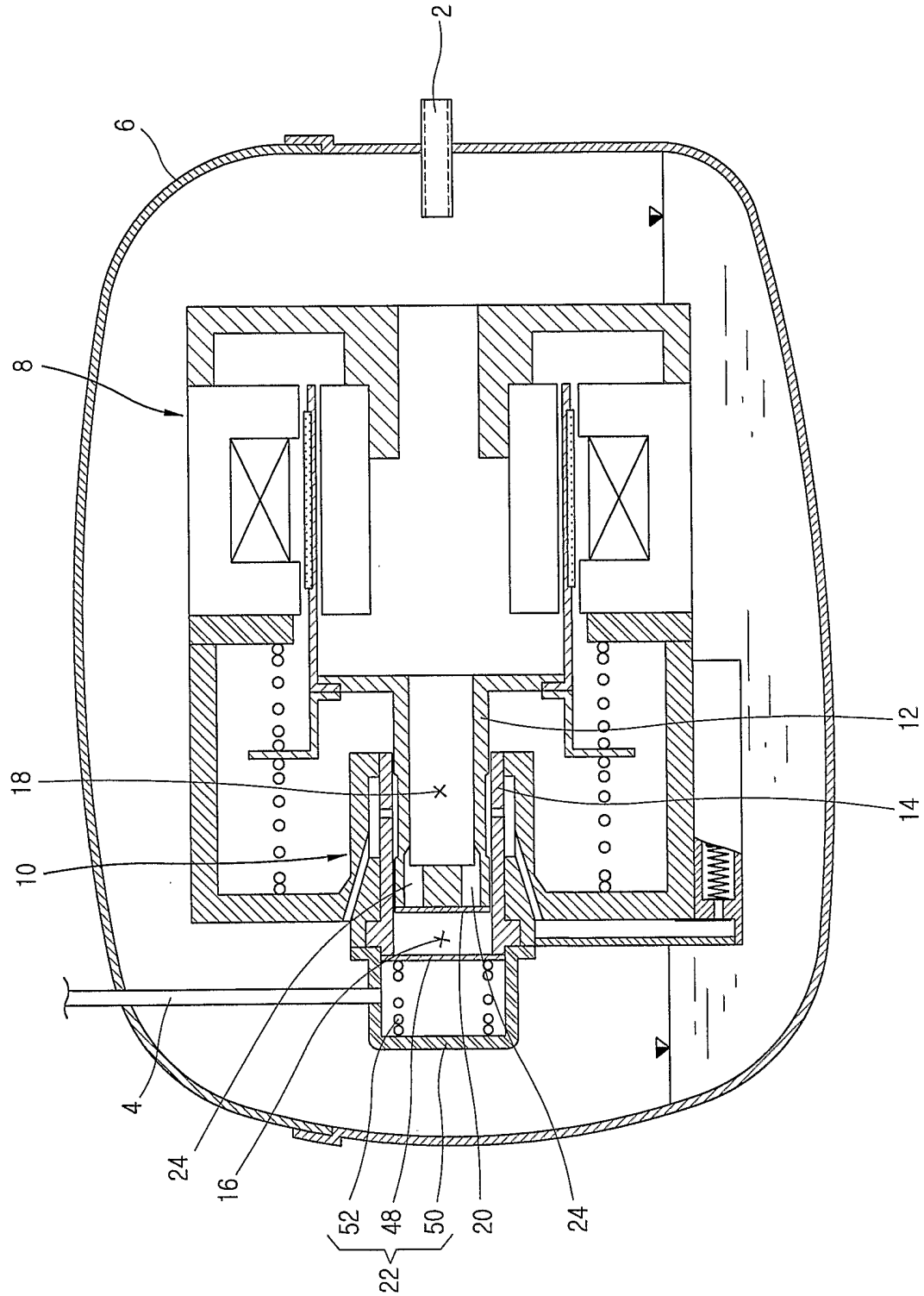


FIG. 3



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FIG. 4

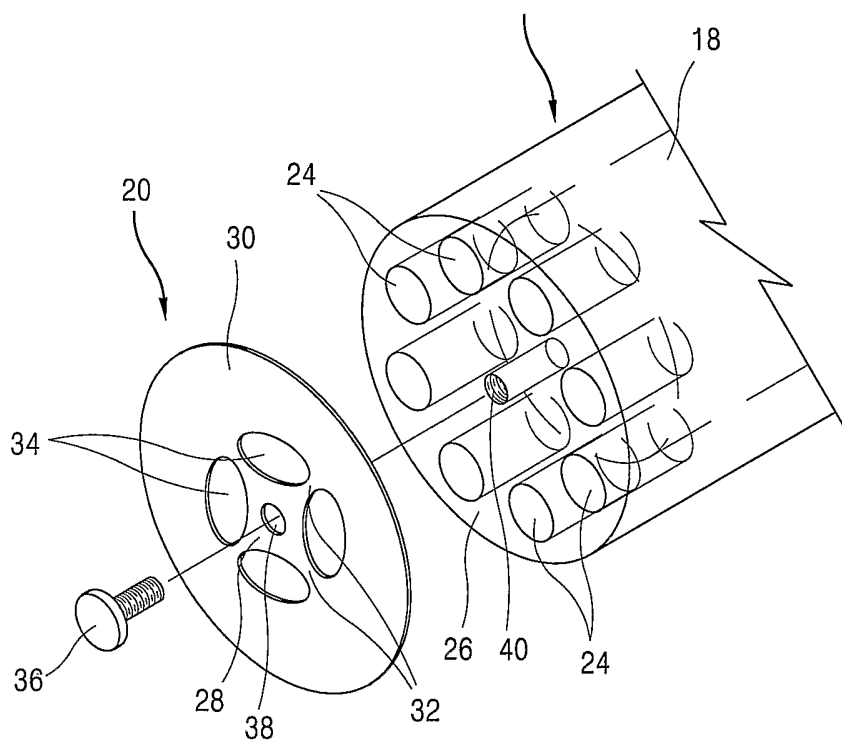
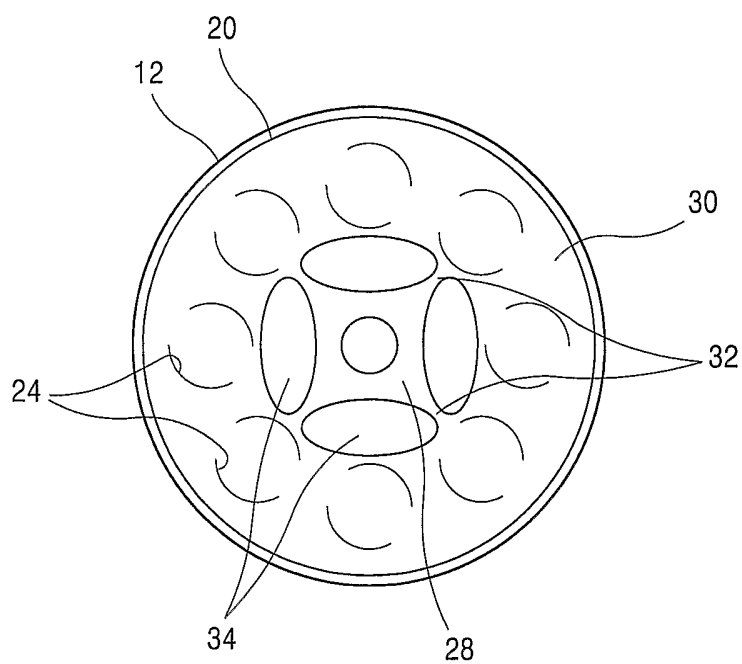
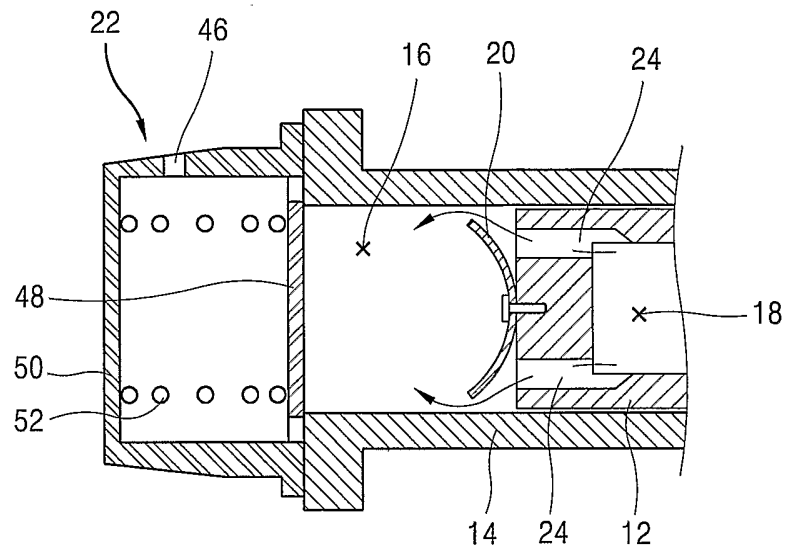


FIG. 5



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FIG. 6





## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/KR 03/01702-0

## CLASSIFICATION OF SUBJECT MATTER

IPC<sup>7</sup>: F04B 39/00, F04B 53/12, F16K 15/14

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)

IPC<sup>7</sup>: F04B, F16K

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

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

EPODOC, WPI, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages        | Relevant to claim No. |
|----------|-------------------------------------------------------------------------------------------|-----------------------|
| Y        | US 5993178 (PARK) 30 November 1999 (30.11.99)<br><i>the whole document.</i>               | 1,2,3,5,7             |
| Y        | US 5171135 A (GANNAWAY) 15 December 1992 (15.12.92)<br><i>the whole document.</i>         | 1,2,3,5,7             |
| A        | EP 0554927 A1 (GENERAL MOTORS CORPORATION)<br>11 August 1993 (11.08.93)<br><i>fig. 2.</i> | 1-4                   |
| A        | EP 0325696 A2 (TECUMSEH PRODUCTS COMPANY)<br>2 August 1989 (02.08.89)<br><i>fig. 10.</i>  | 1-3                   |
| -----    |                                                                                           |                       |



Further documents are listed in the continuation of Box C.



See patent family annex.

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Information on patent family members

International application No.

PCT/KR 03/01702-0

| Patent document cited<br>in search report |   |         | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---|---------|---------------------|----------------------------|---------------------|
| EP                                        | A | 325696  |                     | none                       |                     |
| EP                                        | A | 554927  |                     | none                       |                     |
| US                                        | A | 5171135 |                     | none                       |                     |
| US                                        | A | 5993178 |                     | none                       |                     |