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(54) **CAPACITY CONTROL VALVE FOR VARIABLE DISPLACEMENT SWASH PLATE TYPE COMPRESSOR**

MENGENREGELVENTIL FÜR KUPPLUNGSLOSEN VERSTELLBAREN SCHRÄGSCHEIBEN-VERDICHTER

SOUPAPE DE RÉGULATION DE PUISSANCE POUR COMPRESSEUR À CYLINDRÉE VARIABLE DE TYPE À PLATEAU OSCILLANT

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EP 1 777 412 B1

Description

Technical Field of the Invention

[0001] The present invention relates to a displacement control valve of a variable displacement inclined plate-type compressor, and specifically, relates to a displacement control valve incorporated into a variable displacement inclined plate-type compressor which is suitable for use in a refrigeration cycle of an air conditioning system for vehicles.

Background Art of the Invention

[0002] Patent Document 1 discloses a displacement control valve of a variable displacement inclined plate-type compressor for controlling a discharge displacement of the compressor by opening and closing a valve hole formed in a communication path between a discharge chamber and a crank chamber of the compressor, the displacement control valve including the valve hole always communicating with the crank chamber, a valve body for opening and closing the valve hole, and an electromagnetic solenoid for driving the valve body. In the displacement control valve disclosed in this Patent Document 1, a force applied to the valve body at the time of valve closing is represented by the following equation (1). The following equation (1) stands on the premise that the crank chamber pressure decreases down to a pressure almost equal to a suction pressure at the time of valve closing.

$$F = f(1) - fs + (Pd - Ps)Sv + fs' \qquad (1)$$

Where,

f(1) :electromagnetic force of the electromagnetic solenoid
fs :urging force of a releasing spring of the electromagnetic solenoid
Pd :discharge pressure
Ps :suction pressure
Sv :cross-sectional area of the valve hole
fs' :urging force of a spring for pressing the valve body

Patent Document 1: JP-A-7-286581

[0003] Document EP 1 406 142 A2 discloses a displacement control valve of a variable displacement inclined plate-type compressor for controlling a discharged displacement of said compressor by opening and closing a communication path between a discharge chamber and a crank chamber of said compressor. The displacement control valve comprises a valve hole formed in said communication path and always communicating with said discharge chamber, and a valve body for opening and closing said valve hole. Said displacement control valve further comprises a support hole provided coaxially with said valve hole and an electromagnetic solenoid for driving said valve body.

[0004] Document EP 1 420 162 A2 also discloses a displacement control valve for a variable displacement inclined plate-type compressor for controlling a discharged displacement of said compressor by opening and closing a communication path between a discharge chamber and a crank chamber of said compressor. The displacement control valve comprises a valve hole formed in said communication path and always communicating with said discharge chamber and a valve body for opening and closing said valve hole. This compressor further comprises a support hole provided coaxially with said hole, a support rod slidably inserted into said support hole and connected to said valve body and an electromagnetic solenoid for driving said valve body.

Disclosure of the Invention

Problems to be solved by the Invention

[0005] However, there are the following problems in the displacement control valve disclosed in the above-described Patent Document 1.

When the valve body is closed, because a pressure difference between the discharge pressure Pd and the suction pressure Ps urges the valve body in a direction of valve closing, in order to forcibly open the valve body by degaussing of the electromagnetic solenoid, it is necessary to set the urging force fs of the releasing spring of the electromagnetic solenoid at a value of (Pd-Ps)Sv+fs' or more. In order to forcibly open the valve body in a region with a high discharge

pressure Pd, it is necessary to use a releasing spring with a great spring force fs, and it is necessary to generate a great electromagnetic force for exciting the electromagnetic solenoid and attracting a movable core against the spring force Fs of the releasing spring, and whereby, the electromagnetic solenoid becomes large.

[0006] Paying attention to the above-described problems, an object of the present invention is to provide a displacement control valve of a variable displacement inclined plate-type compressor, which can be made smaller than that disclosed in Patent Document 1.

Means for solving the Problems

[0007] To achieve the above-described object, a displacement control valve of a variable displacement inclined plate-type compressor according to the present invention is provided as a displacement control valve for controlling a discharge displacement of the compressor by opening and closing a communication path between a discharge chamber and a crank chamber of the compressor. The displacement control valve comprises a valve hole formed in the communication path and always communicating with the discharge chamber, a valve body for opening and closing the valve hole, a support hole provided coaxially with the valve hole, a support rod slidably inserted into the support hole and connected to the valve body, an electromagnetic solenoid for driving the valve body, and a pressure sensing chamber for introducing a suction pressure or crank chamber pressure of the compressor into an end section of the support rod which is on a side opposite to a side of the valve body.

[0008] In this displacement control valve, a force F applied to the valve body at the time of valve closing is represented by the following equation (2). The following equation (2) stands on the premise that the crank chamber pressure decreases down to a pressure almost equal to a suction pressure at the time of valve closing.

$$F = f(1) - fs \pm (Pd - Ps) \times (Sv - Sr) \qquad (2)$$

Where,

f(1) :electromagnetic force of the electromagnetic solenoid
fs :urging force of a releasing spring of the electromagnetic solenoid
Pd :discharge pressure
Ps :suction pressure
Sv :cross-sectional area of the valve hole
Sr :cross-sectional area of the support rod

Where, the "±" in the equation (2) is "-" when Sv>Sr, and "+" when Sv<Sr.

[0009] In such a displacement control valve according to the present invention, in order to forcibly open the valve body by degaussing of the electromagnetic solenoid, the force fs of the releasing spring of the electromagnetic solenoid may be set at (Pd-Ps)x(Sv-Sr) or more. This spring force (Pd-Ps)x(Sv-Sr) is clearly smaller than the spring force (Pd-Ps) Sv+fs' required for the displacement control valve in the aforementioned Patent Document 1. Therefore, the displacement control valve according to the present invention can be made smaller than the displacement control valve of Patent Document 1.

[0010] In the displacement control valve according to the present invention, it is preferred that a cross-sectional area of the valve hole is set nearly equal to but greater than a cross-sectional area of the support rod. Thus, if the cross-sectional area of the valve hole is set nearly equal to but greater than the cross-sectional area of the support rod, the discharge pressure operates in a valve opening direction at the time of valve closing. Therefore, by degaussing of the electromagnetic solenoid, the valve body is surely opened by the urging force of the releasing spring.

[0011] Further, in the displacement control valve according to the present invention, it is preferred that a contact part of the valve hole with the valve body is made of a hard material. By making the contact part of the valve hole with the valve body, that is, the valve seat, from a hard material, abrasion of the valve seat due to repeated contact of the valve body may be suppressed.

[0012] Further, in the displacement control valve according to the present invention, it is preferred that the valve hole and the support hole are integrally formed by a hard material. By forming the valve hole and the support hole from a hard material, abrasion of the valve seat due to repeated contact of the valve body and abrasion of the support hole due to repeated slide of the support rod may be suppressed. By forming the valve hole and the support hole integrally, the structure of the displacement control valve may be simplified as compared with a case where both are formed separately.

[0013] Moreover, in the displacement control valve according to the present invention, it is preferred that a valve housing formed with the valve hole and the support hole and containing the valve body and the support rod is made

from a resin or an aluminum alloy. Thus, by making the valve housing from a resin or an aluminum alloy, the weight of the displacement control valve may be reduced.

Effect according to the Invention

[0014] In the displacement control valve of a variable displacement inclined plate-type compressor according to the present invention, the force of the releasing spring of the electromagnetic solenoid required for forcibly opening the valve body can be made smaller than the force of the releasing spring required in the displacement control valve of Patent Document 1. Therefore, the displacement control valve according to the present invention can be made smaller than the displacement control valve of Patent Document 1.

Brief explanation of the drawings

[0015]

[Fig. 1] Fig. 1 is a vertical sectional view of a variable displacement inclined plate-type compressor having a displacement control valve according to a first embodiment of the present invention.
[Fig. 2] Figs. 2A and 2B are vertical sectional views of the displacement control valve according to the first embodiment, Fig. 2A shows a valve closing condition, and Fig. 2B shows a valve opening condition.
[Fig. 3] Fig. 3A is a vertical sectional view of a displacement control valve according to a modification of the first embodiment, and Fig. 3B is an enlarged, partial, vertical sectional view thereof.
[Fig. 4] Fig. 4A is a vertical sectional view of a displacement control valve according to another modification of the first embodiment, and Fig. 4B is an enlarged, partial, vertical sectional view thereof.
[Fig. 5] Figs. 5A and 5B are vertical sectional views of a displacement control valve according to a second embodiment of the present invention, Fig. 5A shows a valve closing condition, and Fig. 5B shows a valve opening condition.

Explanation of symbols

[0016]

1: variable displacement inclined plate-type compressor
2, 3: displacement control valve
17: crank chamber
21: suction chamber
22: discharge chamber
26: concave portion
100, 200: valve part
101, 201: valve housing
102, 203: pressure sensing chamber
103, 202: valve chamber
105, 206: support hole
106, 205: valve hole
109, 209: valve body
111, 211: support rod
120, 220: electromagnetic solenoid

The Best mode for carrying out the Invention

[0017] Hereinafter, desirable embodiments of a displacement control valve of a variable displacement inclined plate-type compressor according to the present invention will be explained referring to figures.

First Embodiment

[0018] Figs. 1 and 2 depict a variable displacement inclined plate-type compressor having a displacement control valve according to a first embodiment of the present invention. As depicted in Fig. 1, a variable displacement inclined plate-type compressor 1 has a main shaft 10, a rotor 11 fixed to main shaft 10, and an inclined plate 12 supported by main shaft 10 at a condition capable of changing its inclination angle. Inclined plate 12 is connected to rotor 11 via a link mechanism 13 allowing the change of the inclination angle of inclined plate 12, and rotates synchronously with rotor 11

and main shaft 10. Piston 15 is engaged with inclined plate 12 via a pair of shoes 14 sliding on the periphery of inclined plate 12. Piston 15 is inserted into a cylinder bore 16a formed in a cylinder block 16. A plurality of pistons 15 are disposed around main shaft 10 at an interval with each other in the circumferential direction.

[0019] A crank chamber 17 containing main shaft 10, rotor 11 and inclined plate 12 is formed by cylinder block 16 and front housing 18. Main shaft 10 extends to outside through front housing 18. A shaft seal member 19 is disposed for sealing the through portion of main shaft 10 in front housing 18. A pulley 20 is fixed at a tip portion of main shaft 10. In a case where variable displacement inclined plate-type compressor 1 is a compressor used for a refrigeration cycle of an air conditioning system for vehicles, pulley 20 is connected, for example, to an engine (not shown) via a belt (not shown).

[0020] A cylinder head 23 forming a suction chamber 21 and a discharge chamber 22 is disposed at a position on a side of cylinder block 16 opposite to the side of front housing 18. Suction chamber 21 is connected to an evaporator (not shown), which is provided in an external circuit, for example, a refrigeration cycle of an air conditioning system for vehicles, via a suction port (not shown). Discharge chamber 22 is connected to a condenser (not shown), which is provided in an external circuit, for example, a refrigeration cycle of an air conditioning system for vehicles, via a discharge port (not shown).

[0021] A valve plate 24 formed with suction hole 21a and discharge hole 22a communicating with cylinder bore 16a is provided between cylinder block 16 and cylinder head 23. A discharge valve and a suction valve (not shown) are attached to the valve plate 24. Crank chamber 17 and suction chamber 21 are communicated with each other via an orifice hole 24a formed on valve plate 24.

[0022] Front housing 18, cylinder block 16, valve plate 24 and cylinder head 23 are integrally fastened by a plurality of through bolts 25 disposed at intervals along the circumference with a center of main shaft 10.

[0023] A displacement control valve 2 for controlling the discharge displacement of variable displacement inclined plate-type compressor 1 is fitted into and fixed in a concave portion 26 which is formed in cylinder head 23 at a position adjacent to discharge chamber 22. As shown in Figs. 1 and 2, displacement control valve 2 has a valve part 100 and an electromagnetic solenoid 120 connected to valve part 100.

[0024] Valve part 100 has a cylindrical valve housing 101. Three closed spaces 27a, 27b and 27c are defined around valve housing 101 by two O-rings 101 a and 101b tightly fitted onto the periphery of valve housing 101 and one O-ring 120a tightly fitted onto the periphery of the case of electromagnetic solenoid 120.

[0025] In valve housing 101, a lateral partition wall 104 is formed for dividing the inside space of valve housing 101 into a pressure sensing chamber 102 on one end side and a valve chamber 103 on the other end side. On lateral partition wall 104, a support hole 105 communicating with pressure sensing chamber 102 and a valve hole 106 communicating with valve chamber 103 are formed. Support hole 105 and valve hole 106 are disposed on the same axis and communicated with each other. A communication hole 107 extending in the radial direction through lateral partition wall 104 is formed in lateral partition wall 104 passing through the communicating portion between support hole 105 and valve hole 106.

[0026] Pressure sensing chamber 102 communicates with suction chamber 21 via closed space 27a and a communication path 23a formed in cylinder head 23. Communication hole 107 always communicates with discharge chamber 22 via closed space 27b and a communication path 23b formed in cylinder head 23. Valve hole 106 communicating with communication hole 107 always communicates with discharge chamber 22. Valve chamber 103 communicates with crank chamber 17 via a communication hole 108 formed in valve housing 101, closed space 27c, a communication path 23c formed in cylinder head 23 and communication path 16b formed in cylinder block 16.

[0027] A valve body 109 for opening and closing valve hole 106 is disposed in valve chamber 103. A small-diameter rod 110 extending from valve body 109 is inserted into valve hole 106 at a movable condition with a gap. A support rod 111 integrally formed with the end portion of small-diameter rod 110 is slidably inserted into support hole 105. Valve part 100 is formed by a series of structures from valve housing 101 to support rod 111.

[0028] Electromagnetic solenoid 120 has a case 121. The end portion of valve chamber 103 side of valve housing 101 is press fitted into one end of case 121. As aforementioned, O-ring 120a for forming closed space 27c is fitted onto the periphery of the one end portion of case 121.

[0029] Electromagnetic solenoid 120 has a fixed core 122 disposed in case 121, a movable core 123 disposed facing its one end to one end of fixed core 122, a releasing spring 124 for urging movable core 123 in a direction apart from the fixed core, an electromagnetic coil 125 surrounding fixed core 122 and movable core 123, and a rod 126 extending from movable core 123 through fixed core 122 at a condition capable of being floated. This rod 126 is formed integrally with valve body 109. The rod insertion hole formed in fixed core 122 and a space for containing movable core 123 are communicated with valve chamber 103, and is in a condition of the same pressure as that in valve chamber 103.

[0030] Next, the operation of displacement control valve 2 will be explained.

As shown in Fig. 2A, when electromagnetic coil 125 is excited, movable core 123 is moved toward fixed core 122 against the urging force of releasing spring 124, and valve body 109 closes valve hole 106. By this closing, the communication path between discharge chamber 22 and crank chamber 17, which is formed by communication path 23b, closed space 27b, communication hole 107, valve hole 106, valve chamber 103, communication hole 108, closed space 27c, com-

munication path 23c and communication path 16b, is closed. Therefore, the high-pressure refrigerant gas in discharge chamber 22 is not supplied into crank chamber 17. Since orifice path 24a has an area enough to exhaust blow-by gas, which leaks from cylinder bore 16a to crank chamber 17 when piston 15 compresses refrigerant gas in cylinder bore 16a, into suction chamber 21, the crank chamber pressure gradually decreases. When the crank chamber pressure decreases, the inclination angle of the inclined plate increases, and the discharge displacement of variable displacement inclined plate-type compressor 1 increases.

[0031] When electromagnetic coil 125 is degaussed, as shown in Fig. 2B, movable core 123 moves in a direction apart from fixed core 122 by the urging force of releasing spring 124, and valve body 109 opens valve hole 106. By this opening, the high-pressure refrigerant gas in discharge chamber 22 is supplied into crank chamber 17 through the communication path formed by communication path 23b, closed space 27b, communication hole 107, valve hole 106, valve chamber 103, communication hole 108, closed space 27c, communication path 23c and communication path 16b. By this supply of the high-pressure refrigerant gas, the crank chamber pressure elevates, the inclination angle of the inclined plate decreases, and the discharge displacement of variable displacement inclined plate-type compressor 1 decreases.

[0032] Thus, the discharge displacement of variable displacement inclined plate-type compressor 1 is controlled to be changed by the excitation and the degaussing of electromagnetic coil 125.

[0033] In displacement control valve 2, a force F applied to valve body 109 at the time of valve closing is represented by the following equation (2). The following equation (2) stands on the premise that the pressure in crank chamber 17 decreases down to a pressure almost equal to a suction pressure at the time of valve closing and the pressure in valve chamber 103 is applied to the portion around movable core 123.

$$F = f(1) - fs \pm (Pd - Ps) \times (Sv - Sr) \qquad (2)$$

Where,

f(1) :electromagnetic force of the electromagnetic solenoid
fs :urging force of the releasing spring of the electromagnetic solenoid
Pd :discharge pressure
Ps :suction pressure
Sv :cross-sectional area of the valve hole
Sr :cross-sectional area of the support rod

Where, in the equation (2), the "±" becomes "-" when Sv>Sr, and the "±" becomes "+" when Sv<Sr.

[0034] In such a displacement control valve 2, in order to forcibly open valve body 109 by degaussing of electromagnetic solenoid 120, the force fs of releasing spring 124 of the electromagnetic solenoid may be set at (Pd-Ps)x(Sv-Sr) or more. This spring force (Pd-Ps)x(Sv-Sr) is clearly smaller than the spring force (Pd-Ps)Sv+fs' required for the displacement control valve in the aforementioned Patent Document 1. Therefore, by using a small and weak releasing spring 124, displacement control valve 2 can be made smaller than the displacement control valve of Patent Document 1.

[0035] Where, pressure sensing chamber 102 may be communicated with crank chamber 17 instead of suction chamber 21.

[0036] In the above-described displacement control valve 2, it is preferred that the cross-sectional area Sv of the valve hole is set nearly equal to but greater than the cross-sectional area Sr of the support rod. By setting the cross-sectional area Sv of the valve hole nearly equal to but greater than the cross-sectional area Sr of the support rod, the discharge pressure Pd operates in a valve opening direction at the time of valve closing. Therefore, by degaussing of the electromagnetic solenoid 120, valve body 109 is surely opened by the urging force of releasing spring 124.

[0037] As shown in a modification depicted in Fig. 3, in the above-described displacement control valve 2, a structure may be employed wherein a ring member 112 made of a stainless-group material as a hard material is press fitted into lateral partition wall 104, and a contact part of valve hole 106 with valve body 109 is formed by the ring member 112. By forming the contact part of valve hole 106 with valve body 109, that is, the valve seat, from the stainless-group material which is a hard material, abrasion of the valve seat due to repeated contact of valve body 109 may be suppressed.

[0038] Further, as shown in another modification depicted in Fig. 4, a structure may be employed wherein a ring member 113 of a stainless-group material, formed on its wall with a through hole 113a communication with communication hole 107, is press fitted into lateral partition wall 104, and valve hole 106 and support hole 105 are integrally formed. By forming valve hole 106 and support hole 105 from the stainless-group material which is a hard material, abrasion of the valve seat due to repeated contact of valve body 109 and abrasion of support hole 105 due to repeated slide of support rod 111 may be suppressed. By integrally forming valve hole 106 and support hole 105 by ring member 113, the structure

of displacement control valve 2 may be simplified as compared with a case where both are formed separately.

[0039] Moreover, valve housing 101 may be made from a resin or an aluminum alloy. By making valve housing 101 from a resin or an aluminum alloy, the weight of displacement control valve 2 may be reduced.

Second Embodiment

[0040] Fig. 5 shows a displacement control valve of a variable displacement inclined plate-type compressor according to a second embodiment of the present invention. As shown in Fig. 5, a displacement control valve 3 comprises a valve part 200 and an electromagnetic solenoid 220 connected to valve part 200.

[0041] Valve part 200 has a cylindrical valve housing 201. Three closed spaces 27d, 27e and 27f are defined around valve housing 201 by two O-rings 201a and 201b tightly fitted onto the periphery of valve housing 201 and one O-ring 220a tightly fitted onto the periphery of the case of electromagnetic solenoid 220.

[0042] In valve housing 201, a lateral partition wall 204 is formed for dividing the inside space of valve housing 201 into a valve chamber 202 on one end side and a pressure sensing chamber 203 on the other end side. On lateral partition wall 204, a valve hole 205 communicating with valve chamber 202 and a support hole 206 communicating with pressure sensing chamber 203 are formed. Valve hole 205 and support hole 206 are disposed on the same axis and communicated with each other. A communication hole 207 extending in the radial direction through lateral partition wall 204 is formed in lateral partition wall 204 passing through the communicating portion between valve hole 205 and support hole 206.

[0043] Pressure sensing chamber 203 communicates with suction chamber 21 or crank chamber 17 via a communication hole formed in valve housing 201, closed space 27d and a communication path (not shown) formed in cylinder head 23. Communication hole 207 communicates with discharge chamber 22 via closed space 27e and communication path 23b formed in cylinder head 23. Valve hole 205 communicating with communication hole 207 always communicates with discharge chamber 22. Valve chamber 202 communicates with crank chamber 17 via closed space 27f, a communication path (not shown) formed in cylinder head 23, and a communication path (not shown) formed in cylinder block 16.

[0044] A valve body 209 for opening and closing valve hole 205 is disposed in valve chamber 202. A small-diameter rod 210 extending from valve body 209 is inserted into valve hole 205 at a movable condition with a gap. A support rod 211 integrally formed with the end portion of small-diameter rod 210 is slidably inserted into support hole 206. Valve part 200 is formed by a series of structures from valve housing 201 to support rod 211.

[0045] Electromagnetic solenoid 220 has a case 221. The end portion of pressure sensing chamber 203 side of valve housing 201 is press fitted into one end of case 221. As aforementioned, O-ring 220a for forming closed space 27d is fitted onto the periphery of the one end portion of case 221.

[0046] Electromagnetic solenoid 220 has a fixed core 222 disposed in case 221, a movable core 223 disposed facing its one end to one end of fixed core 222, a releasing spring 224 for urging movable core 223 in a direction apart from the fixed core, an electromagnetic coil 225 surrounding fixed core 222 and movable core 223, and a rod 226 extending from movable core 223. This rod 226 is formed integrally with support rod 211. The space forming the end portion of support rod 211 at the side apart from valve body 206 via rod 226 and containing movable core 223 is communicated with pressure sensing chamber 203. Therefore, the pressure in pressure sensing chamber 203, namely, the suction pressure or the crank chamber pressure is applied to movable core 223.

[0047] In displacement control valve 3, a force F applied to valve body 209 at the time of valve closing is same as the force F applied to valve body 109 at the time of valve closing in displacement control valve 2 of the first embodiment. Therefore, by using a small and weak releasing spring 224, displacement control valve 3 can be made smaller than the displacement control valve of the aforementioned Patent Document 1.

Industrial Applications of the Invention

[0048] The present invention can be applied broadly for displacement control valves of variable displacement inclined plate-type compressors.

Claims

1. A displacement control valve (2) of a variable displacement inclined plate-type compressor (1) for controlling a discharge displacement of said compressor (1) by opening and closing a communication path (23b, 27b, 107, 106, 103, 108, 27c, 23c, 16b) between a discharge chamber (22) and a crank chamber (17) of said compressor (1), said displacement control valve (2) comprising:

   a valve hole (106) formed in said communication path and always communicating with said discharge chamber (22);

a valve body (109) for opening and closing said valve hole (106);
a support hole (105) provided coaxially with said valve hole (106) and arranged in a valve body's closing direction of the valve hole (106);
an electromagnetic solenoid (120) for driving said valve body (109) by exerting an electromagnetic force (f(1));
a releasing spring (124) for urging the valve body (109) in a direction opening said valve hole (106) against the electromagnetic force (f(1));
characterised in that the control valve (2) comprises:

a support rod (111) inserted to be slidable in a valve body's opening and closing direction into said support hole (105), arranged in a valve body's closing direction of the valve hole (106); and connected to said valve body (109);
and
a pressure sensing chamber (102) for introducing a suction pressure (Ps) or crank chamber pressure of said compressor (1) into an end section of said support rod (111) which is on a side opposite to a side of said valve body (109), such that the suction pressure (Ps) or crank chamber pressure is applied so as to push the end section of said support rod (111) in the valve body's opening direction.

2. The displacement control valve (2) of a variable displacement inclined plate-type compressor (1) according to claim 1, wherein a cross-sectional area of said valve hole (106) is set nearly equal to but greater than a cross-sectional area of said support rod (111).

3. The displacement control valve (2) of a variable displacement inclined plate-type compressor (1) according to claim 1 or 2, wherein a contact part of said valve hole (106) with said valve body (109) is made of a hard material.

4. The displacement control valve (2) of a variable displacement inclined plate-type compressor (1) according to any of claims 1 to 3, wherein said valve hole (106) and said support hole (105) are integrally formed by a hard material.

5. The displacement control valve (2) of a variable displacement inclined plate-type compressor (1) according to any of claims 1 to 4, wherein a valve housing (101) formed with said valve hole (106) and said support hole (105) and containing said valve body (109) and said support rod (111) is made from a resin or an aluminum alloy.

Patentansprüche

1. Verdrängungssteuerventil (2) eines Taumelscheibenkompressors (1) zum Steuern einer Auslaßverdrängung des Kompressors (1) durch Öffnen und Schließen eines Verbindungswegs (23b, 27b, 107, 106, 103, 108, 27c, 23c, 16b) zwischen einer Auslaßkammer (22) und einer Kurbelkammer (17) des Kompressors (1), wobei das Verdrängungssteuerventil (2) aufweist:

ein Ventilloch (106), das in dem Verbindungsweg ausgebildet ist und immer mit der Auslaßkammer (22) in Verbindung steht;
einen Ventilkörper (109) zum Öffnen und Schließen des Ventillochs (106);
ein Unterstützungsloch (105), das koaxial zu dem Ventilloch (106) vorgesehen ist und in einer Ventilkörperschließrichtung des Ventillochs (106) angeordnet ist;
ein elektromagnetisches Solenoid (120) zum Antreiben des Ventilkörpers (109) durch Ausüben einer elektromagnetischen Kraft (f(1));
eine Freigabefeder (124) zum Drängen des Ventilkörpers (109) in eine Richtung, in der das Ventilloch (106) gegen die elektromagnetische Kraft (f(1)) geöffnet wird;
dadurch gekennzeichnet, daß das Steuerventil (2) aufweist:

einen Trägerstab (111), der so eingebracht ist, daß er in einer Ventilkörperöffnungs- und -schließrichtung verschiebbar in das Unterstützungsloch (105) ist, das in einer Ventilkörperschließrichtung des Ventillochs (106) angeordnet ist; und mit dem Ventilkörper (109) verbunden ist;
und
eine Druckmeßkammer (102) zum Einführen eines Ansaugdrucks (Ps) oder eines Kurbelkammerdrucks des Kompressors (1) in einen Endabschnitt des Trägerstabs (111), der an einer Seite gegenüber einer Seite des Ventilkörpers (109) ist, so daß der Ansaugdruck (Ps) oder der Kurbelkammerdruck so ausgeübt ist, daß der Endabschnitt des Trägerstabs (111) in die Ventilkörperöffnungsrichtung gedrückt wird.

2. Verdrängungssteuerventil (2) eines Taumelscheibenkompressors (1) gemäß Anspruch 1, wobei eine Querschnittsfläche des Ventillochs (106) nahezu gleich, jedoch größer als eine Querschnittsfläche des Trägerstabs (111) eingestellt ist.

3. Verdrängungssteuerventil (2) eines Taumelscheibenkompressors (1) gemäß Anspruch 1 oder 2, wobei ein Kontaktteil des Ventillochs (106) mit dem Ventilkörper (109) aus einem harten Material hergestellt ist.

4. Verdrängungssteuerventil (2) eines Taumelscheibenkompressors (1) gemäß einem der Ansprüche 1 bis 3, wobei das Ventilloch (106) und das Unterstützungsloch (105) integral aus einem harten Material gebildet sind.

5. Verdrängungssteuerventil (2) eines Taumelscheibenkompressors (1) gemäß einem der Ansprüche 1 bis 4, wobei ein Ventilgehäuse (101) mit dem Ventilloch (106) und dem Unterstützungsloch (105) ausgebildet ist und den Ventilkörper (109) enthält und der Trägerstab (111) aus einem Kunststoff oder einer Aluminiumlegierung hergestellt ist.

Revendications

1. Soupape (2) de commande de déplacement d'un compresseur (1) à déplacement variable du type à plateau incliné pour commander le déplacement de refoulement de ce compresseur (1) en ouvrant et fermant une voie de communication (23b, 27b, 107, 106, 103, 108, 27c, 23c, 16b) entre une chambre de refoulement (22) et une chambre de manivelle (17) de ce compresseur (1), cette soupape (2) de commande de déplacement comprenant :

   un orifice de soupape (106) formé dans la voie de communication et communiquant en permanence avec la chambre de refoulement (22),
   un corps de soupape (109) permettant d'ouvrir et de former l'orifice de soupape (106),
   un orifice support (105) situé coaxialement à l'orifice de soupape (106) et situé dans la direction de fermeture du corps de soupape de l'orifice de soupape (106),
   un solénoïde électromagnétique (120) pour commander le corps de soupape (109) en exerçant une force électromagnétique (f(1)),
   un ressort de libération (124) pour solliciter le corps de soupape (109) dans la direction d'ouverture de l'orifice de soupape (106) contre la force électromagnétique (f(1)),
   caractérisée en ce que
   la soupape de commande (2) comporte
   une tige support (111) logée de manière à pouvoir glisser dans la direction d'ouverture et de fermeture du corps de soupape dans l'orifice support (105), montée dans la direction de fermeture du corps de soupape de l'orifice de soupape (106) et reliée au corps de soupape (109), et
   une chambre de détection de pression (102) pour introduire une pression d'aspiration (Ps) ou la pression de la chambre de manivelle du compresseur (1) dans la partie d'extrémité de la tige support (111) qui est située à l'opposé d'un côté du corps de soupape (109) de sorte que la pression d'aspiration (Ps) ou la pression de la chambre de manivelle soit appliquée pour pousser l'extrémité de la tige support (111) dans la direction d'ouverture du corps de soupape.

2. Soupape de commande de déplacement (2) d'un compresseur (1) du type à plateau incliné à déplacement variable conforme à la revendication 1, dans laquelle la section transversale de l'orifice de soupape (106) est réglée approximativement égale mais supérieure à la section transversale de la tige support (111).

3. Soupape de commande de déplacement (2) d'un compresseur (1) du type à plateau incliné à déplacement variable conforme à la revendication 1 ou 2, dans laquelle la partie de l'orifice de soupape (106) en contact avec le corps de soupape (109) est réalisée en un matériau dur.

4. Soupape de commande de déplacement (2) d'un compresseur (1) du type à plateau incliné à déplacement variable conforme à l'une quelconque des revendications 1 à 3, dans laquelle l'orifice de soupape (106) et l'orifice support (105) sont intégralement réalisés en un matériau dur.

5. Soupape de commande de déplacement (2) d'un compresseur (1) du type à plateau incliné à déplacement variable conforme à l'une quelconque des revendications 1 à 4,
   caractérisée en ce que
   le boitier de soupape (101) réalisé avec l'orifice de soupape (106) et l'orifice support (105) et renfermant le corps

de soupape (109) et la tige support (111) est réalisé en une résine ou en un alliage d'aluminium.

FIG. 1

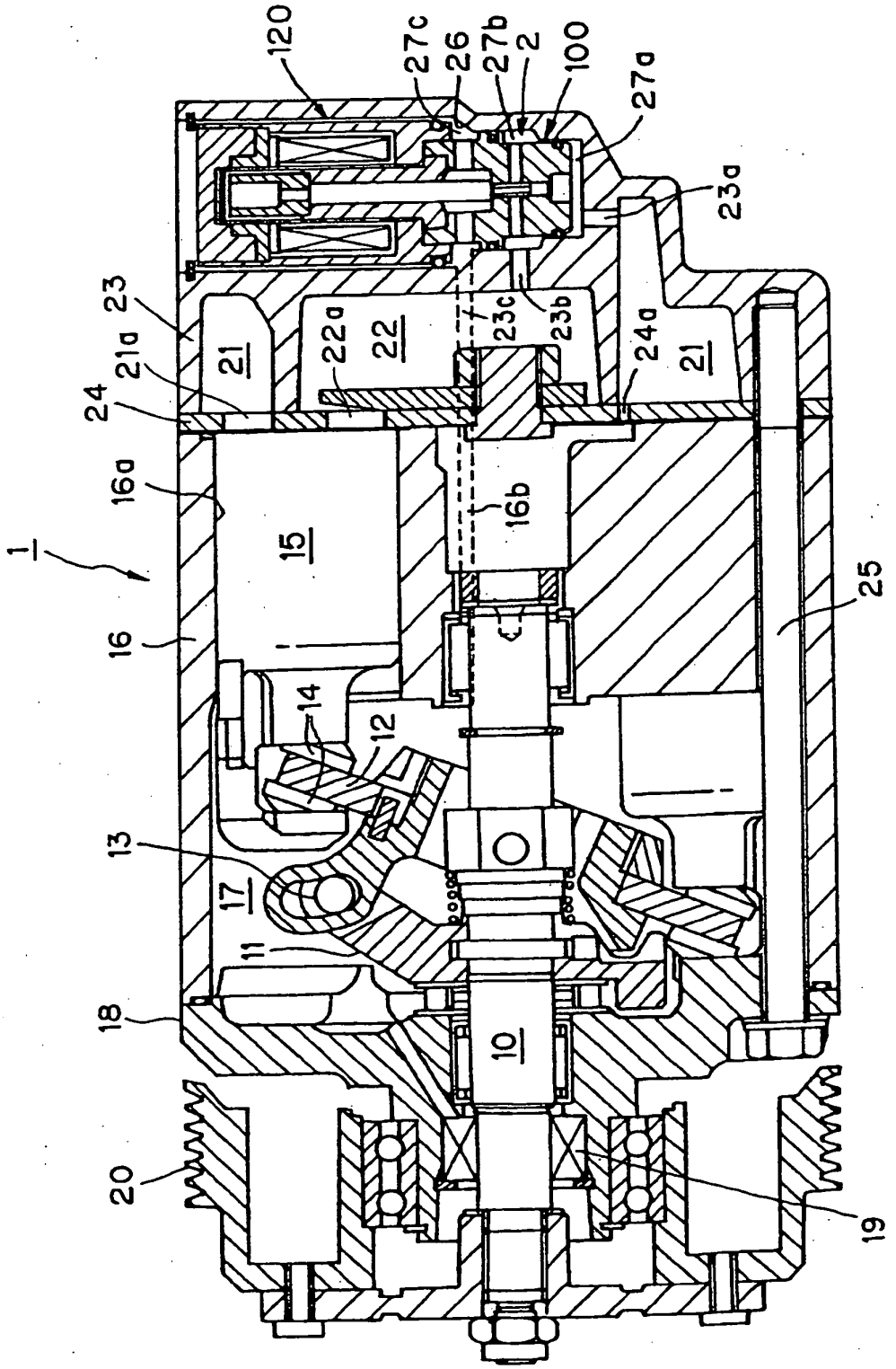

120
27c
26
27b
2
100
27a
23a
23
21a
24
16a
1
16
15
16b
25
14
12
13
17
11
18
10
20
19
21
22a
22
23c
23b
24a
21

FIG. 2B

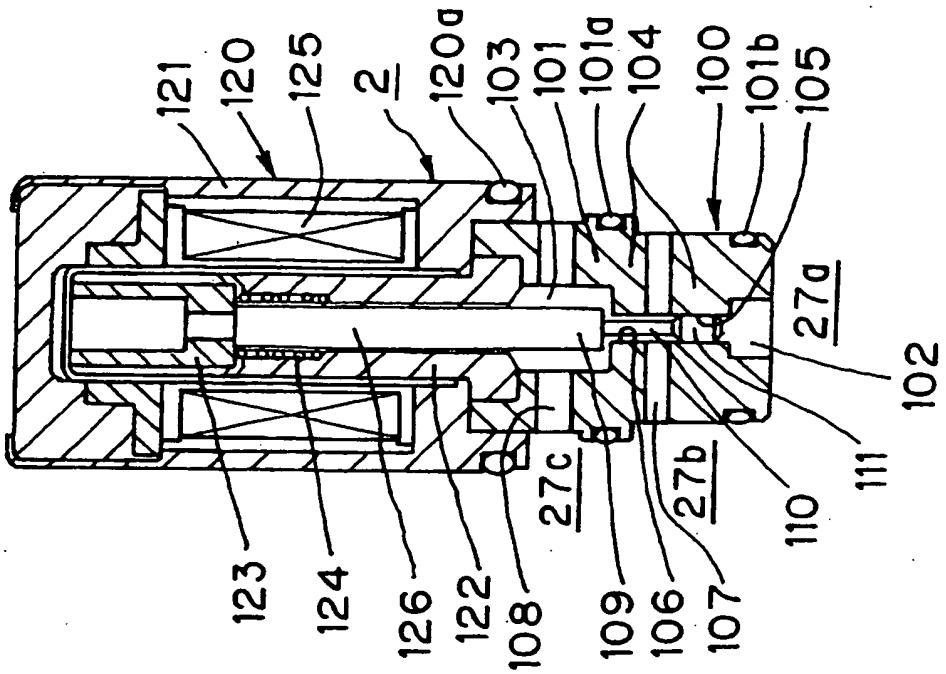

121
120
125
2
120a
103
101
101a
104
100
101b
105
27a
102
111
110
27b
27c
123
124
126
122
108
109
106
107

FIG. 2A

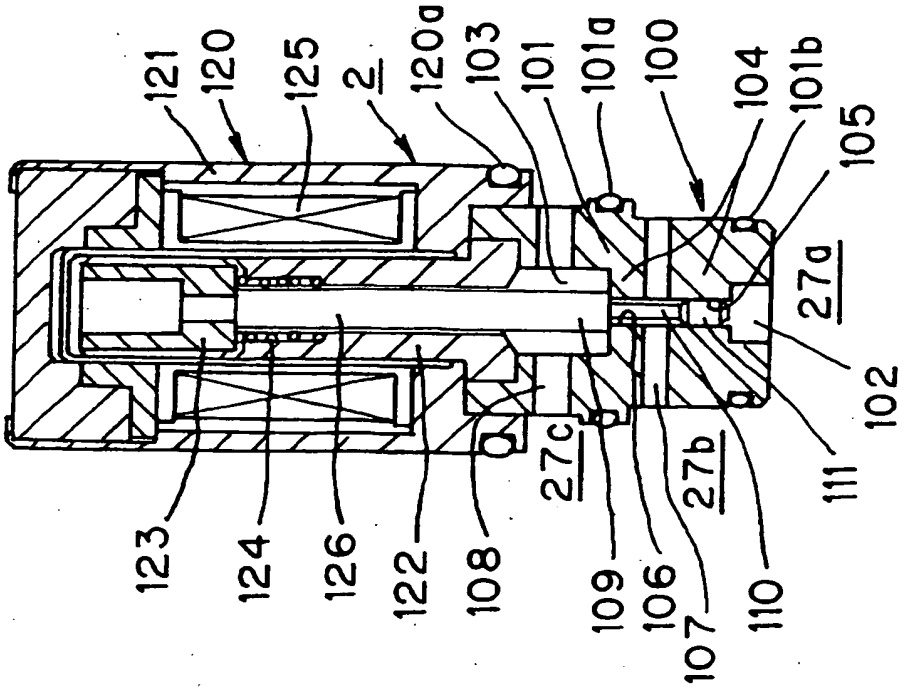

121
120
125
2
120a
103
101
101a
100
104
101b
105
27a
102
111
110
27b
27c
123
124
126
122
108
109
106
107

FIG. 3A

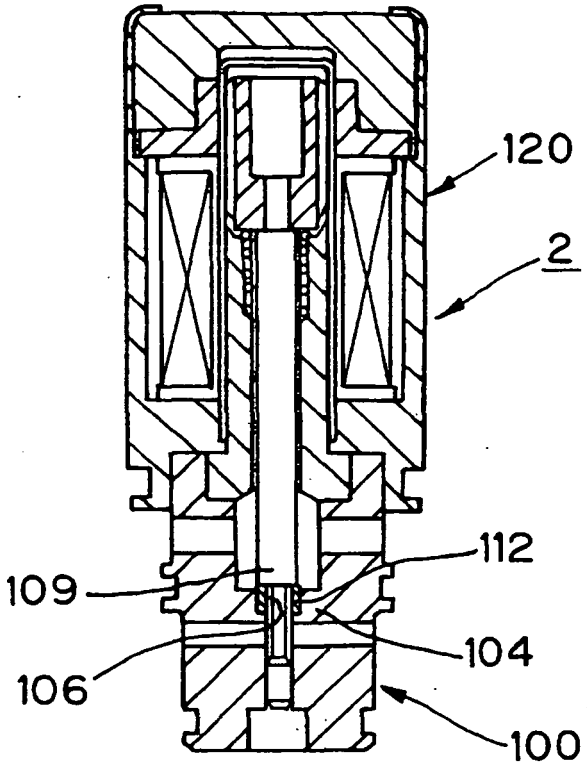


FIG. 3B

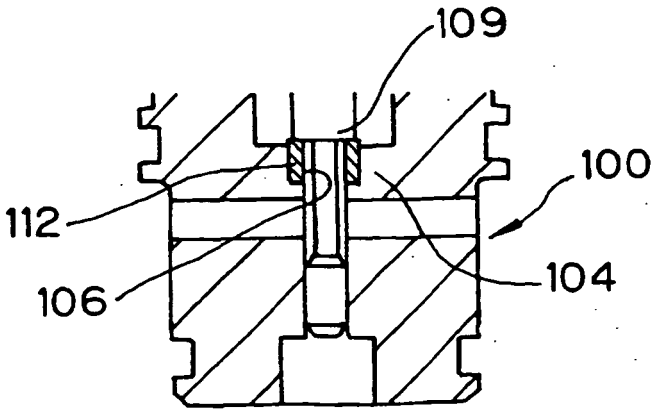


FIG. 4A

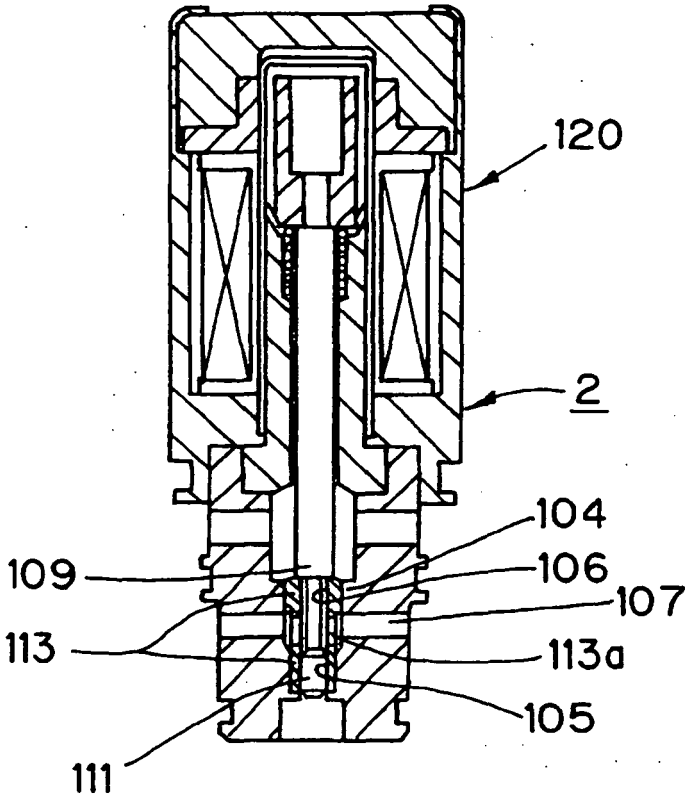


FIG. 4B

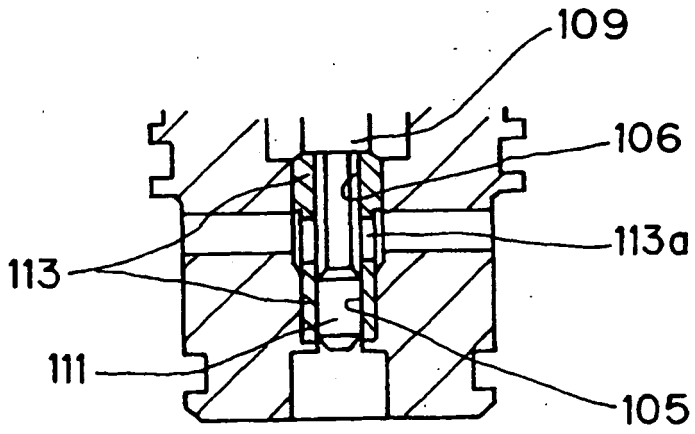


FIG. 5B

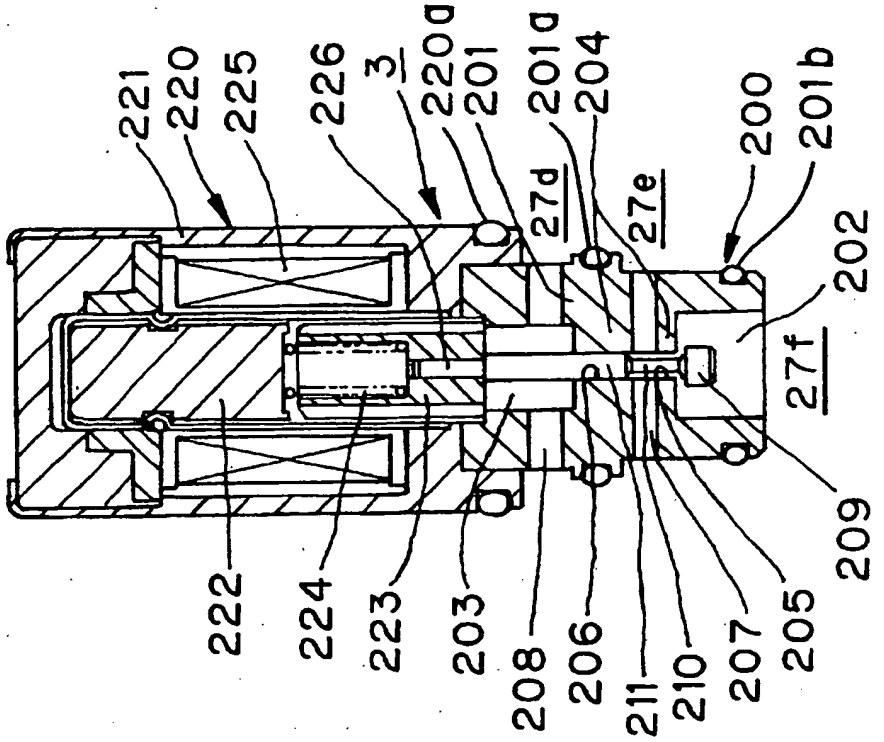
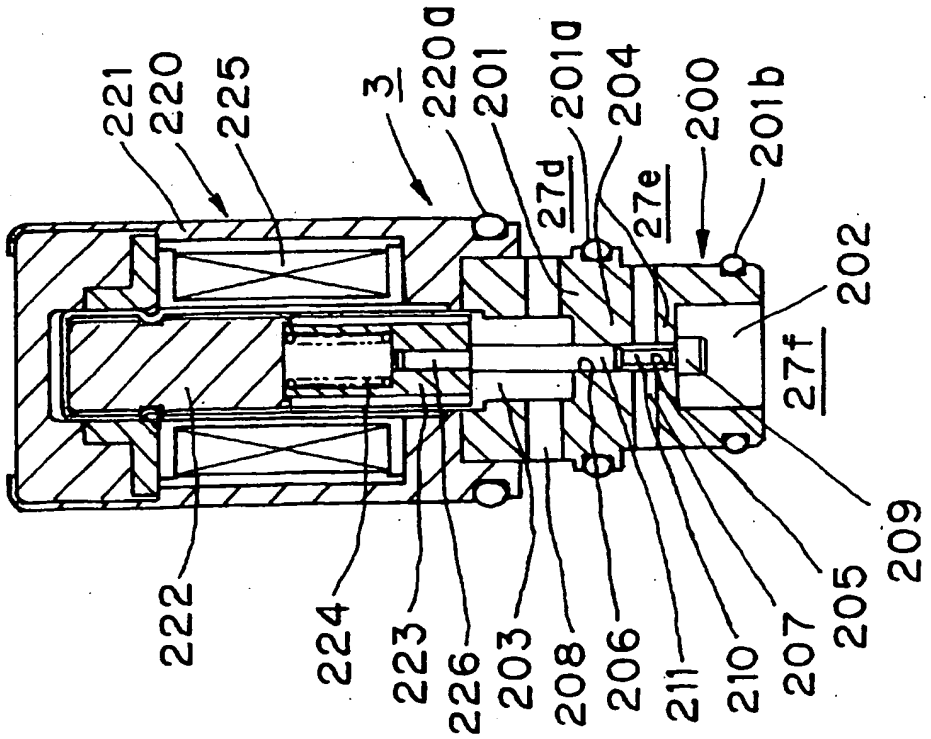

221
220
225
226
3
220d
201
201d
204
27d
27e
200
201b
202
27f
209
222
224
223
203
208
206
211
210
207
205

FIG. 5A


221
220
225
3
220d
201
201d
204
27d
27e
200
201b
202
27f
209
222
224
223
226
203
208
206
211
210
207
205

REFERENCES CITED IN THE DESCRIPTION

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- EP 1406142 A2 **[0003]**
- EP 1420162 A2 **[0004]**