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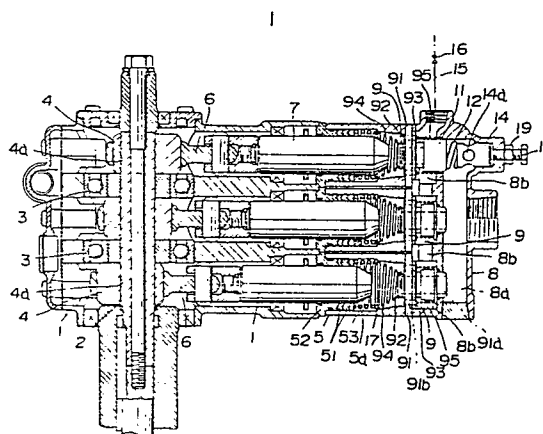
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54 RECIPROCATING PUMP.

57 A reciprocating pump having a suction valve (92), a discharge valve (93), a pressure control valve (11) including a pressure receiving surface and supported at a valve seat (91) for supporting at least one of the valves (92) and (93), the pressure receiving surface disposed on a discharge passage (8b), the valve (11) being provided in a cylinder head (8), and a control spring (12) provided in a pressure regulator (13) for urging the valve (11) toward the valve seat (91), wherein the control valve (11) is operated as relief, safety and unloading valve through a simple construction. Thus, this pump allows a reduction in the number of components and can therefore be readily assembled in a pump body so as to reduce its cost and weight.



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SPECIFICATION

Reciprocating Pump

5 FIELD OF THE ART

This invention relates to a reciprocating pump,
and more particularly to a reciprocating pump which is
provided, at the foremost end of a cylinder supporting
a plunger to be reely reciprocating, with a suction pass-
10 age, a discharge passage, a valve gear comprising a suction
valve and a discharge valve, and a pressure control valve,
so that the plunger reciprocates to actuate the suction
valve and discharge valve to thereby discharge pressure
fluid, and the pressure control valve adjusts pressure
15 within the discharge passage in a desired value.

BACKGROUND OF THE ART

Conventionally, a reciprocating pump is well-known
which is provided with a pressure control valve device so
as to adjust fluid pressure within a discharge passage in
20 a desired value.

The conventional pressure control valve device is
so constructed that a valve seat and a valve body are ass-
embled into a valve box formed separately from the main
body of the reciprocating pump, a spring housing cylinder
25 is provided within the valve box and supports a control

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spring biasing the valve body to the valve seat, and an adjuster for adjusting the biasing force of the control spring. The pressure control valve device is disposed at a halfway position within the discharge passage of the pump so that the valve box communicates at the inlet side thereof with the discharge passage and has at the outlet side of the valve box a hose open in the atmosphere.

Therefore, the pressure control valve device, which is separate from the main body of the pump, becomes complex in construction and increases in the number of parts. As a result, the pump is complicated to assemble, expensive as a whole to manufacture, and larger in size and weight.

On the other hand, a well-known pressure control valve device employs an unloader valve other than a relief valve. When in use of the unloader valve, the pressure control valve device becomes further complex in construction to lead to a high manufacturing cost.

In the light of the aforesaid problems, this invention has been designed. A main object of the invention is to provide a reciprocating pump capable of adjusting pressure within the discharge passage in a set value, thereby reducing the number of parts and facilitating its assembly.

Another object of the invention is to provide a

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reciprocating pump simple in construction and capable of immediately unloading the liquid discharged from the discharge passage when the pressure within the discharge passage reaches the set value.

5 DISCLOSURE OF THE INVENTION

The present invention is characterized in that a pressure control valve is supported to a valve seat bearing at least one of a suction valve and discharge valve actuated by reciprocation of a plunger, the control valve
10 is disposed at a discharge passage formed at a cylinder and biased to the valve seat by means of a control spring, and a pressure adjuster supporting the control spring is mounted on the cylinder in relation of being movable. The pressure control valve is adapted to be assembled by use
15 of the cylinder, thereby eliminating the aforesaid conventional problems in the assembly of valve box separate from the main body of the pump.

Furthermore, the reciprocating pump of the invention improved as foregoing, is provided at the outer periphery of the pressure control valve with a pressure-receiving portion having a pressure-receiving area larger
20 than that of a pressure-receiving face of the control valve within the discharge passage, a pressure chamber is provided between the pressure-receiving portion and the
25 cylinder, a check valve is interposed on the way of a

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liquid delivery conduit communicating with an outlet of the discharge passage, and a by-pass conduit is provided at the liquid delivery conduit at the outlet side of the check valve so that the by-pass conduit communicates with the pressure chamber. Hence, the pressure control valve is formed into an unloader valve of simple construction.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a schematic longitudinal sectional view of an embodiment of the invention, Fig.2 is an enlarged sectional view of a principal portion thereof, and Fig.3 is an enlarged sectional view of a modified embodiment of the invention, corresponding to Fig.2.

THE BEST FORM FOR PRACTICE OF THE INVENTION

The best form for practice of the invention will be detailed in accordance with the drawings.

Referring to Figs.1 and 2, a triplex reciprocating pump has three plungers disposed in parallel. The pump is basically constructed such that a drive shaft 2 is supported rotatably to a housing 1 through bearings 3, three cylindrical cam bodies 4 each having an eccentric shaft bore 4a are mounted on the drive shaft 2, three cylinders 5 are mounted on the housing 1, three plungers 7 connected to the cam bodies 4 through rods 6 are housed within the cylinder chambers 5a in a relation of being freely reciprocating, a cylinder head 8 having a suction passage 8a and

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discharge passage 8b and three valve devices 9, are provided at the foremost ends of cylinders 5 respectively, and a pressure control valve 11 is incorporated with one cylinder 5.

5 Between the outer periphery of each plunger 7 and the inner periphery of each cylinder chamber 5a are provided a sealing member 51, a seal holder 52 supporting the sealing member 51, and a spring 53 biasing the sealing member 51 to the seal holder 52. Each cylinder 5 is sandwiched between the cylinder head 8 and the housing 1 and fixed
10 thereto by mounting bolts (not shown).

Each of the valve devices 9 comprises a valve seat 91 having at its center a suction bore 91a and at the outer peripheral portion a discharge bore 91b, a suction valve 92
15 to open and close the suction bore 91a, a discharge valve 93 to open and close the discharge bore 91b, and a first and a second valve spring 94 and 95 for biasing the suction valve 92 and discharge valve 93 to the valve seat 91. The valve seat 91 comprises a valve seat body 91c of a round
20 plate-like shape and a cylindrical portion 91d extending axially outwardly from the central portion at one side of body 91c, so that the suction bore 91a is formed of a through bore at the center of body 91c and of a space within the cylindrical portion 91d. The discharge bore 91b is
25 formed at the outer peripheral portion of body 91c. The

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body 91c is interposed at the outer-peripheral edge thereof between the foremost end face of each cylinder 5 and the cylinder head 8, and fixed together with each cylinder 5 to the housing 1 through the fixing of cylinder head 8.

5 In addition, the body 91c and cylindrical portion 91d may be integral or separate. When separated, there is advantage in that the body 91c and cylindrical portion 91d are easy to manufacture.

The suction valve 92 is disposed at the outlet
10 side of suction bore 91a, i.e., within the cylinder chamber 5a, and the discharge valve 93 is disposed at the outlet side of discharge bore 91b, i.e., within the discharge passage 8b, so that the first and second valve springs 94 and 95 bias the suction valve 92 and discharge valve 93
15 to the valve seat 91. Between the suction passage 8a of cylinder head 8 and the discharge passage 8b thereof are provided three through bores 81, 82 and 83. The cylindrical portions 91d at two of the valve seats 91 are inserted at one ends into the two through bores 81 and 82 so that
20 the suction bores 91a at the two valve seats 91 are allowed to communicate with the suction passage 8a.

One remaining valve seat 91 other than the above two, has its cylindrical portion 91d smaller in axial length than others, and the pressure control valve 11 is
25 supported to said cylindrical portion 91d at one axial end

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thereof, i.e., at the inlet side of suction bore 91a. The control valve 11 is formed of a cylindrical body larger in an outer diameter than the cylindrical portion 91d at the valve seat 91 and is provided at one axial end with a ring-
5 like shaped bottom plate about equal in an inner diameter to the cylindrical portion 91d so that the bottom plate forms a pressure-receiving face 11a.

The control valve 11 constructed as foregoing has the bottom plate disposed within the discharge passage 8b
10 and abutting against the cylindrical portion 91d, and is inserted at the open end into the bore 83 at the cylinder head 8 in a relation of being axially movable, whereby the suction bore 91a formed at the remaining cylindrical portion 91d communicates with the suction passage 8a through
15 the control valve 11.

A control spring 12 acts on the control valve 11 to thereby bias the pressure-receiving face 11a of the bottom plate to the foremost end face of cylindrical portion 91d. A pressure adjuster 13 is screwed with the cyl-
20 inder head 8 and provided with a spring holder 14 having liquid-circulation bore 14a, so that the spring holder 14 supports one end of the spring 12 which is seated at the other end onto the inside of the bottom plate of control valve 11.

25 Hence, the adjuster 13 is operated to elastically

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transform the control spring 12 to thereby adjust the biasing force of control valve 11 applied to the valve seat 91. The adjustment of biasing force can adjust liquid pressure when the control valve 11 opens, and set liquid pressure
5 within the discharge passage 8b in a desired value.

In the aforesaid construction, the drive shaft 2 rotates to reciprocate the plunger 7. When the plunger 7 moves backward, the discharge valve 93 closes and the suction valve 92 opens, whereby liquid stored within a tank
10 or the like is taken into the suction passage 8a through an inlet thereof and then into the cylinder chamber 5a through the suction passage 8a and suction bore 91a. When the plunger 7 moves forward, the suction valve 92 closes and the discharge valve 93 opens, whereby the liquid taken
15 into the cylinder chamber 5a is applied with pressure and then discharged into the discharge passage 8b. The liquid discharged into the discharge passage 8b is controlled under pressure set by biasing the control valve 11 to the valve seat 91, thereby being discharged into a liquid de-
20 livery conduit 15 through the outlet of discharge passage 8b. For example, when a gate valve provided in the vicinity of an outlet of the liquid delivery conduit 15 closes or a load connected thereto increases to thereby raise the liquid pressure within the discharge passage 8b more than the set
25 value , a pushing-up force applied to the pressure-receiving

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face 11a at the control valve 11 exceeds the biasing force applied to the valve seat 91 by the control valve 11, whereby the pushing-up force opens the control valve 11 to allow the pressurized liquid within the discharge passage
5 8b to flow into the suction passage 8a through the control valve 11, thus keeping the liquid pressure within the discharge passage 8b in the set value.

In addition, the aforesaid embodiment is provided with the valve seat 91, which has the suction bore 91a and
10 discharge bore 91b, bears the suction valve 92 and discharge valve 93, and supports the pressure control valve 11. Alternatively, the control valve 11 may be supported to a valve seat which is adapted to have the suction bore and bear the suction valve 92 only, or supported to a valve
15 seat having the discharge bore and bearing the discharge valve 93 only.

In Fig.1, reference numeral 17 designates a holder for the spring 53 biasing the sealing member 51, 18 designates a guide tube for the second valve spring 95 biasing
20 the discharge valve 93, and 19 designates a lock nut.

In the aforesaid embodiment, the pressure control valve 11, which functions as a relief valve or safety valve, can, alternatively, be constructed to function as an unloader valve as shown in Fig.3.

25 A modified embodiment of the invention shown in

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Fig.3 is basically the same as the former embodiment in Fig.1, in which each member indential in construction with that in Fig.1 is represented by the same reference numeral.

5 The construction shown in Fig.3 is different from that of Fig.1 in that; a pressure control valve 110 is formed of a stepped cylindrical member and has at one axial end of a smaller diameter portion a ring-like shaped bottom plate to thereby form a first pressure-receiving face 110a,
10 and at the intermediate shoulder a second pressure-receiving face 110b larger in a pressure-receiving area than the first pressure-receiving face 110a; a pressure chamber 20 is provided at the suction passage 8a side of through bore 83 formed at the cylinder head 8; a check valve 21 is inter-
15 posed on the way of the liquid delivery conduit 15 communicating with the outlet of discharge passage 8b; and a bypass conduit 22 is connected to the liquid delivery conduit 15 at the outlet side of check valve 21 and communicates with the pressure chamber 20. In addition, the embodiment
20 in Fig.3 may not have the pressure adjuster 13.

 When the plunger 7 reciprocates to discharge in the discharge passage 8b liquid applied with pressure within the cylinder chamber 5a and deliver the liquid toward the liquid delivery conduit 15, and if a gate valve 16
25 provided in the vicinity of the outlet of liquid delivery

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conduit 15 is closed, or a load connected thereto increases, to make the pressures within the discharge passage 8b and liquid delivery conduit 15 equal to the set value, the pressure of pressure chamber 20 also reaches the set value.

5 Hence, the first and second pressure-receiving faces 110a and 110b at the pressure control valve 110 are subjected to the pushing-up force larger than that applied to the first and second faces 110a and 110b in normal, whereby the larger pushing-up force instantaneously opens the control valve 110

10 to flow the pressurized liquid out of the discharge passage 8b into the suction passage 8a.

This flow-out of liquid lowers pressure within the discharge passage 8b, but pressure within the pressure chamber 20 is kept in the set value or more unless the gate

15 valve 16 is opened or the load is reduced. Consequently, the control valve 110 is kept open to enable the plunger 7 to work in no load.

When the gate valve 16 opens or the load decreases so that the pressure within the liquid delivery conduit 15

20 at the outlet side of check valve 21 lowers until the set value or less, the pressure in the pressure chamber 20 also lowers and the control spring/biases the control valve 110 to be closed so that the liquid discharged from the

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cylinder chamber 5a into the discharge passage 8b is delivered toward the liquid delivery conduit 15 under pressure of

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the set value or less.

The aforesaid embodiment is the triplex reciprocating pump. Alternatively, this invention may be applied to a single, double, or four or more cylinder type pump.

5 As clearly understood from the aforesaid description, the reciprocating pump of the invention is so constructed that the pressure control valve is supported to the valve seat bearing the suction valve or discharge valve and disposed at the discharge passage, and the pressure
10 adjuster is provided at the cylinder, thereby being adjustable of liquid pressure, and being simpler in construction and reducible in the number of parts in comparison with the conventional pump. In other words, there is no need of using a valve seat for the pressure control valve only,
15 a valve box supporting the valve seat, and a cylinder housing therein a control spring and supporting the pressure adjuster. Furthermore, pressure control can be executed by returning the discharge liquid toward the suction passage to thereby require no hose, resulting in
20 that the pump becomes simple to that extent in construction and is of a small number of parts.

 Therefore, the pump, which is simple in construction and of a small number of parts, is easy to assemble, considerably inexpensive to manufacture, and is small-sized,
25 and lightweight. Furthermore, the aforesaid construction

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is utilizable to form the pressure chamber to thereby
constitute the unloader valve, thus simplifying the construction and reducing the number of parts. As a result,
the pump also is easy to assemble, considerably inexpensive
5 sive to produce, and compact in size and light in weight.

POSSIBILITY OF UTILIZATION FOR INDUSTRY

As seen from the above, the reciprocating pump of
the invention is useful for a hydraulic pump for machine
tools, pump for sprinkling a liquid medicine over the
10 crops, high pressure water pump for flushing a hull or the
like, or fire pump loaded on a motor fire engine, and especially suitable for a pump having a gate valve incorporated
ed with the liquid delivery conduit.

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CLAIMS

1. A reciprocating pump which is provided with a suction passage, a discharge passage and a valve device, at the foremost end of a cylinder supporting therein a plunger in relation of freely reciprocating, so that said plunger reciprocates to actuate a suction valve and a discharge valve at said valve device, said pump being characterized in that a pressure control valve having a pressure-receiving face is supported to a valve seat bearing at least one of said suction valve and discharge valve, said pressure-receiving face of said control valve being disposed within said discharge passage, said control valve being biased to said valve seat through a control spring, and a pressure-adjusting member supporting said control spring is provided movably at a cylinder head provided at the foremost end of said cylinder.
2. A reciprocating pump according to claim 1, being characterized in that; a valve seat, which has at the central portion thereof a suction bore and at the outer peripheral portion a discharge bore, is formed, said valve seat being provided at the outlet side of said discharge bore with a discharge valve, at the outlet side of said suction bore with a suction valve, and at the inlet side of said suction bore with a pressure control valve; and

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at said pressure control valve is provided a through bore through which said suction bore communicates with said suction passage.

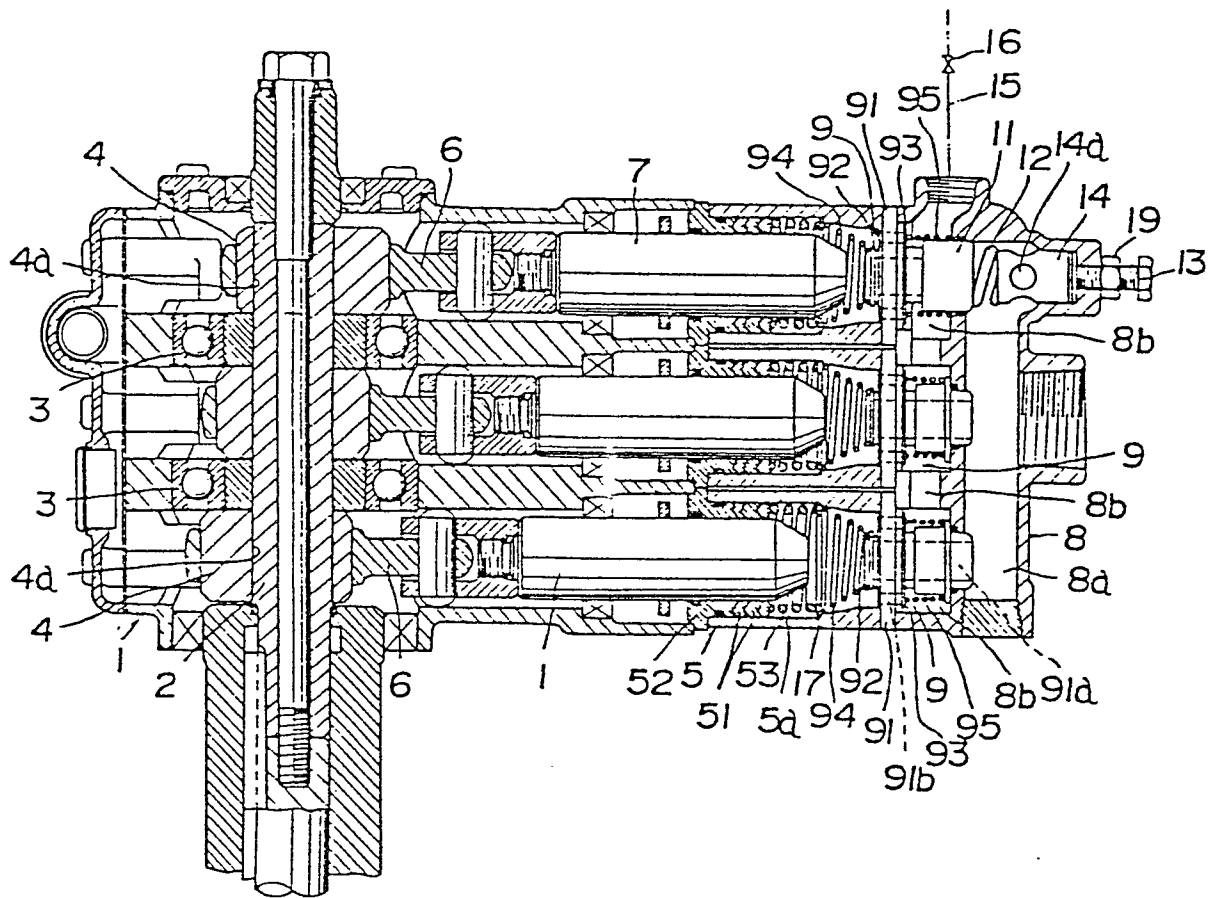
3. A reciprocating pump according to claim 1 or 2,
5 being characterized in that; a pressure control valve is provided with two first and second pressure-receiving faces, said second pressure-receiving face being made larger in a pressure-receiving area than said first pressure-receiving face, said first pressure-receiving
10 face being disposed within said discharge passage; a pressure chamber is provided at said cylinder head so that said second pressure-receiving face is disposed within said pressure chamber; a check valve is interposed in a liquid delivery conduit communicating with the out-
15 let of said discharge passage; and a by-pass conduit is provided at said liquid delivery conduit at the outlet side of said check valve, so that said by-pass conduit communicates with said pressure chamber.

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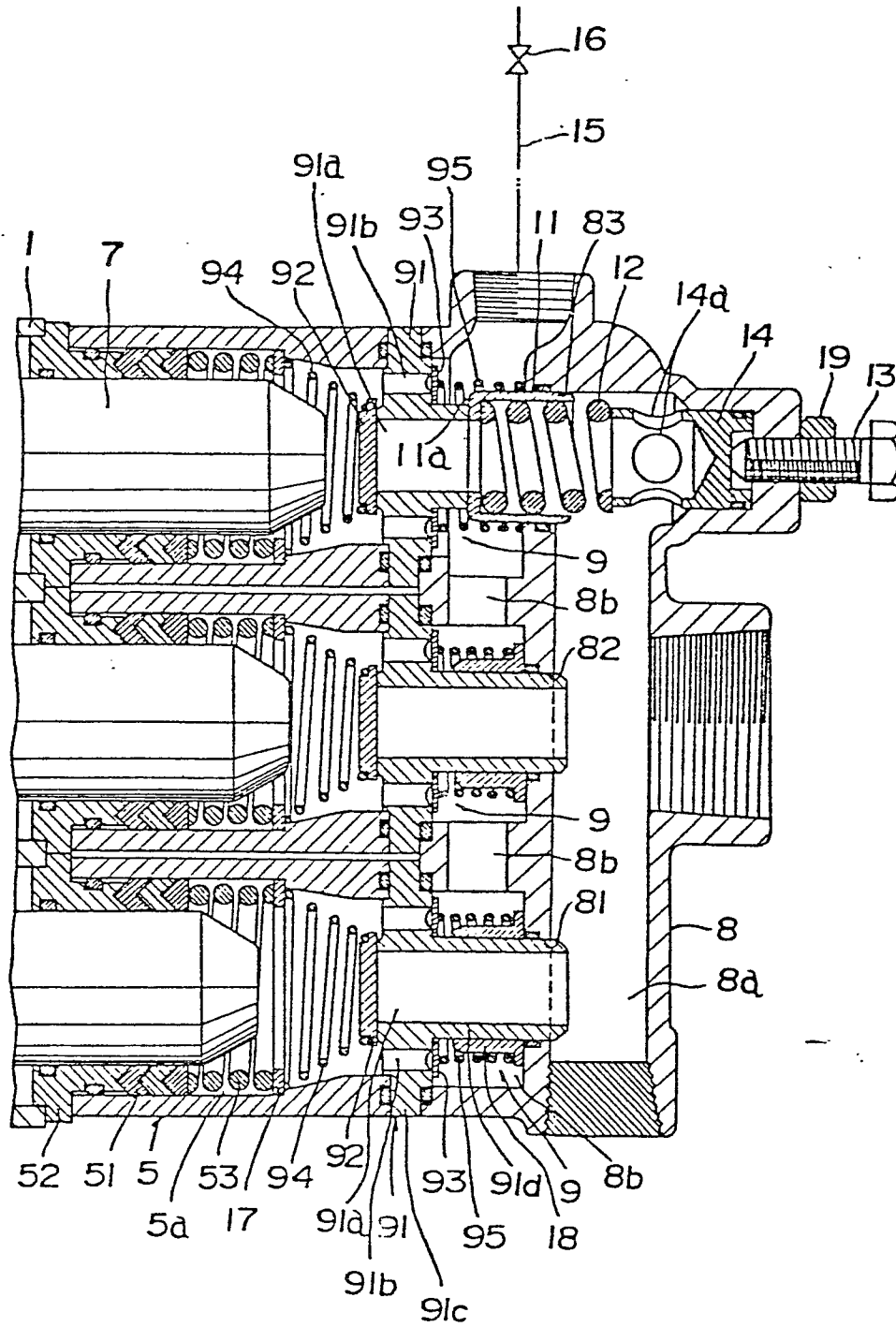
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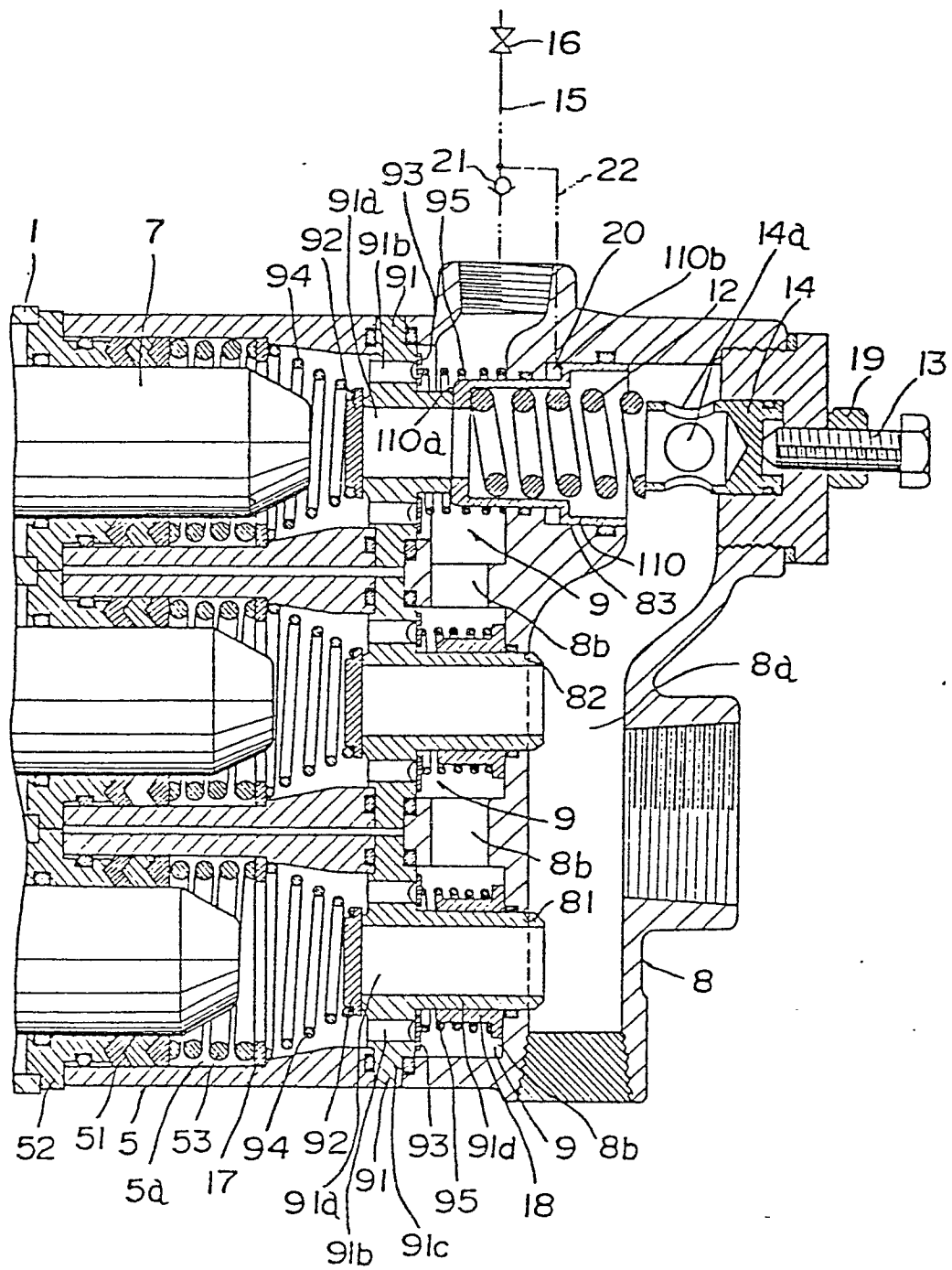
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INTERNATIONAL SEARCH REPORT

0035569

International Application No PCT/JP80/00009

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ²		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. ³ F04B21/02		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
I P C	F04B9/00 - 9/12, F04B21/02, F04B49/02 F16K17/18 - 17/196	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
Jitsuyo Shinan Koho 1926 - 1979 Kokai Jitsuyo Shinan Koho 1971 - 1979		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁶	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	JP, U, 49-108104, 1974-9-14 Sanrin Seiki Kabushiki Kaisha	1 - 3
A	JP, Y1, 42-16714, 1967-9-26 Mori Hajime	1 - 3
* Special categories of cited documents: ¹⁵ "A" document defining the general state of the art "E" earlier document but published on or after the international filing date "L" document cited for special reason other than those referred to in the other categories "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but on or after the priority date claimed "T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention "X" document of particular relevance		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ³	
May 10, 1980 (10.05.80)	May 26, 1980 (26.05.80)	
International Searching Authority ¹	Signature of Authorized Officer ²⁰	
Japanese Patent Office		