(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 805 280 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.11.1997 Bulletin 1997/45

(51) Int. Cl.[6]: **F15B 20/00**

(21) Application number: **97106674.1**

(22) Date of filing: **23.04.1997**

(84) Designated Contracting States:
DE ES FI FR PT SE

(30) Priority: **02.05.1996 IT MI960858**

(71) Applicant: **G.P.A. Italia S.p.A.**
22074 Lomazzo (CO) (IT)

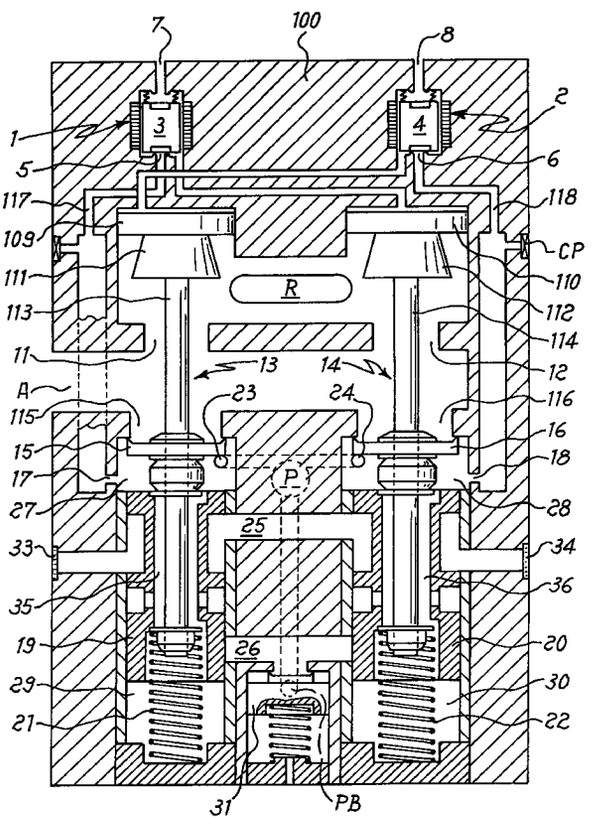
(72) Inventor: **Mota, Francisco Lopez**
08010 Barcelona (ES)

(74) Representative: **Marietti, Giuseppe**
MARIETTI e GISLON S.r.l.
Via Larga, 16
20122 Milano (IT)

(54) Safety valve for apparatus operating with pressurised fluid

(57) It is described a safety valve, of the parallel type, for an apparatus operating with pressurised fluid, comprising a pair of valve-sets (13, 14) and a pair of pilot electro-valves (1, 2) for interrupt or enable the feeding of the pressurised fluid to the pilot chambers (9, 10) containing the pistons (109, 110) for driving the valve-sets (13, 14). The valve further comprises an additional inlet port (PB) for feeding the pressurised fluid to the outlet port (A) and means for intercepting the flow of fluid between the second inlet port (PB) and the outlet port (A).

Fig.1



EP 0 805 280 A1

Description

The present invention relates to a safety valve for apparatus operating with fluid under pressure and, particularly, a valve of the double-body parallel-flow type used to control clutches and/or brakes of presses fed with compressed-air.

For instance, pneumatic presses are universally recognised as particularly dangerous machines and are therefore subject to very restrictive safety norms everywhere.

The safety valve constitutes an essential part of the organs of control of a press and must ensure that the supply of pressurised fluid in each phase of the operating cycle is stopped in the event of a malfunction of the same valve. For instance, if there is a leak in the valve, the supply of pressurised fluid to the apparatus must be stopped and provision must be made for venting the pressurised fluid in the apparatus to the atmosphere. Moreover, the resumption of the normal operation must only be possible after correct operation has been restored.

Safety valves of the double-body parallel-flow type generally comprise an inlet port for the pressurised fluid, an outlet port for the fluid going to the apparatus and an exhaust port to vent the fluid of the apparatus to the atmosphere. Inside the body there are a pair of valve-sets, each of which is fitted with a working piston, a shutter for closing the vent port to the atmosphere and a shutter for blocking the passages connecting the inlet port to the outlet port towards the apparatus. A pair of pilot electro-valves allows the fluid to be fed under pressure to both the pilot chambers when the press is required to be activated.

To guarantee the safe operation of the valve, it is necessary to reduce the section of some ducts along the run of the pressurised fluid, e.g. at the fluid inlet port.

This limits the volume of the pressurised fluid reaching the apparatus with consequent slowing of the cycle of operation of the apparatus. In fact, if the incoming volume to the apparatus is low, the nominal working pressure cannot be reached in sufficiently short time.

An object of the present invention is to produce a safety valve that allows the volume delivered to the apparatus to be increased.

Another object of the present invention is to produce a safety valve in parallel that allows the delivery to the apparatus to be controlled.

A further object of the present invention is to produce a valve to control the feed to pneumatic apparatus that ensures a higher degree of safety compared to the valves currently known.

These objects are achieved by the present invention, which relates to a safety valve of the double-body, parallel-flow type for apparatus operating with fluid under pressure, comprising at least a first inlet port for the pressurised fluid, at least an outlet port for the fluid going to the apparatus and at least a first exhaust port to vent the fluid of the apparatus to the atmosphere; a pair of valve-sets, the respective stems of which are fitted with respective working pistons which run in the respective pilot chambers, with respective shutters for closing the exhaust port venting to the atmosphere and with respective shutters for blocking the passages connecting the first inlet port and the outlet port towards the apparatus, the first inlet port comprising portions of duct with reduced cross-section connecting with the respective inlet chambers; and a pair of pilot electro-valves which enables or disables the fluid flow under pressure to both the pilot chambers through the respective ducts with its respective portions of reduced cross-section, characterised by comprising a second inlet port to feed fluid under pressure to the outlet port, as well as means to intercepting the flow between the second inlet port and the outlet port.

The additional feed allows an increase in the volume of pressurised fluid going to the apparatus when the valve is activated, reducing the time taken to reach the nominal operating pressure.

Particularly, the means for intercepting the flow of fluid between the second inlet port and the outlet port to the apparatus comprise a pair of distribution cursors bound respectively to the valve stems opposite to the working pistons.

The distribution cursors are bound to the common valve-sets in a such way that they don't alter the principle of operation of the same valve.

The safety valve according to the invention can also be used, if necessary, in place of any valve of known type without necessarily causing modifications to the plant for feeding the pressurised-fluid or to the apparatus controlled.

In particular, the distribution cursors run inside respective antagonist chambers in fluid communication with the respective inlet chambers through passages drilled in the respective cursors.

These latter intercept a first channel in fluid communication with the antagonist chambers, with the inlet chambers and with a pair of intermediate exhaust ports. The presence of the intermediate exhaust ports improves the safety factor of the valve since, in the case of incorrect operation, the residual pressure is further limited to below the threshold guaranteed by valves in parallel currently known.

Moreover, the distribution cursors intercept a second channel in fluid communication with the second inlet port and with the said antagonist chambers in a such way that the additional feed operates as soon as the valve is activated.

According to an advantageous aspect of the present invention, means are provided to regulate the flow of fluid between the second inlet port and the second channel. In this way, the volume of fluid of the additional feed can be regulated in a such way as to adapt to the most varied operational requirements.

In particular, the means for regulating the flow of fluid between the second inlet port and the second channel comprise a piston, running in a control cham-

ber, that intercepts a passage between the control chamber and the second channel under the combined effect of a force caused by elastic means and of a pilot pressure applied in the same chamber through a device for regulating the pilot pressure.

Further advantages and characteristics of the invention will be more evident from the description that follows, which is illustrative and not limiting and which refers to the enclosed schematic drawings, in which:

- Figure 1 is a view in section of a valve according to the invention in the non-activated or resting condition;
- Figure 2 is a view in section of a valve according to the invention in the activated or excited condition;
- Figure 3 is a view in section of a valve according to the invention in the jammed or unbalanced condition; and
- Figures 4A-4D are views in section of a detail of the means for regulating the volume of additional feeding.

Figures 1-3 show a valve according to the present invention, i.e. a valve of the double-body, parallel-flow type with dynamic control, in which a system of additional feeding has been inserted.

With reference initially to the Figure 1, the valve comprises a body 100 in which are drilled a first inlet port P of the pressurised fluid, at least one outlet port A of the fluid to the apparatus (not shown) and at least one first exhaust port R for venting the pressurised fluid to the atmosphere.

Inside the valve body 100 there are fitted a freely moving pair of valve-sets 13 and 14 with their respective stems 113 and 114 to which are bound respective working pistons 109 and 110, running in their respective pilot chambers 9 and 10 (Fig. 2).

To the stems 113 and 114 there are also bound respective shutters 111 and 112 for closing the vent to the atmosphere by obstructing the passages 11 and 12, as well as respective shutters 15 and 16 that obstruct the passages 115 and 116 connecting the first inlet port P and the outlet port A. The inlet port P comprises portions of ducts 23 and 24 with reduced cross-section (flow reducers) communicating with respective inlet chambers 27 and 28 of the pressurised fluid.

There are a pair of pilot electro-valves 1 and 2 in the upper part which enable or block the feeding of the pressurised fluid to the pilot chambers 9 and 10 through the respective ducts 117 and 118. The latter also comprise respective portions 17 and 18 having reduced cross-section (flow reducers) at the respective inlet chambers 27 and 28. A pair of connections CP on each of the ducts 117 and 118 allows the pressure in each duct to be measured during the operation of the valve.

The pilot electro-valves 1 and 2 comprise respective cores 3 and 4 that move with clearance in the respective housings in such a way as to allow the evacuation of the residual fluid contained in the pilot chambers 9 and 10 through the vents 7 and 8 when the same cores are in the closed position shown in Figure 1. The closed position of the cores 3 and 4 is maintained by a spring or other suitable elastic means.

According to the present invention, a second inlet port PB (shown in more detail in the Figures 4A-4D) which allows further pressurised fluid to be fed to the outlet port A in addition to the fluid that passes through the flow reducers 23 and 24.

The feed deriving from PB is intercepted by a piston 31 (described in more detail below) and by a pair of distribution cursors 19 and 20 bound to the stems 113 and 114 opposite the working pistons 109 and 110.

The distribution cursors 19 and 20 move inside respective antagonist chambers 29 and 30, in which there are moreover antagonist springs 21 and 22 which act to return the valve sets 13 and 14 in their rest position.

The cursors 19 and 20 are provided internally with passages 35 and 36 respectively, which are in fluid communication with the antagonist chambers 29 and 30 with the respective inlet chambers 27 and 28.

The distribution cursors 19 and 20 intercept a first channel 25 which can be placed selectively in fluid communication with a pair of intermediate exhaust ports 33 and 34 (as in Figure 1), or with the inlet chambers 27 and 28 (as in Figure 2). Moreover, the distribution cursors 19 and 20 intercept a second channel 26 to either close it (as in Figure 1) or for put it in communication with the passages 35 and 36 inside the same cursors (as in Figure 2).

In this way, the system of additional feeding is also operated by the same valve-sets 13 and 14, thus maintaining unchanged the original safety functions of these types of valve. In other words, as will become clear from the description of the operation below, the valve is able to vent the feeding of one valve-set if the other valve-set is not commutated simultaneously.

In the resting condition, shown in Figure 1, the pilot electro-valves 1 and 2 are not excited and the cores 3 and 4, under the pressure of the springs, close the inlets 5 and 6 setting the pilot chambers 9 and 10 (visible in Figure 2) in communication with the vents 7 and 8.

In the view of Figure 1, the valve-sets 13 and 14 are positioned to the top by the antagonist springs 21, 22 and by the pressure in the inlet chambers 27 and 28. In this way, the shutters 15 and 16 close the passages 115 and 116 respectively preventing the passage of the pressurised fluid to the outlet port A to the apparatus. The outlet port A is instead connected directly to the exhaust port R through the passages 11 and 12.

In the rest position, the inlet chambers 27 and 28 are connected respectively to the antagonist chambers 29 and 30 through the passages 35 and 36 inside the cursors 19 and 20, so as to balance the effect of the pressure on the cursors 19 and 20. With the valve-sets 13 and 14 in this position, the channel 25 is connected to the intermediate exhaust ports 33 and 34, while the channel 26, which could be connected to the port PB of

additional feeding by acting on the piston 31, remains obstructed by both the cursors 19 and 20.

Figure 2 shows the valve in an activated or excited condition. To allow the influx of air under pressure to the pneumatic apparatus through the outlet port A, both the pilot electro-valves 1 and 2 are fed electrically. In this way, the cores 3 and 4 overcome the force of the springs opening the passages of feeding 5, 6 and closing the vents 7 and 8. The existing resting pressure on the passages 5 and 6 reaches the pilot chambers 9, 10 and moves the valve-sets 13 and 14 to the lower part, by acting on the working pistons 109 and 110. These latter, lowering, close the passages 11 and 12 to the exhaust port R by means of the respective shutters 111 and 112, while the shutters 15 and 16 enable simultaneously the influx of the pressurised fluid from the flow-reducers 23 and 24 to the outlet port A connected to the pneumatic apparatus. Equally, the cursors 19 and 20 move, putting the channel 25 and the channel 26 in fluid communication with the inlet chambers 27, 28 and with the antagonist chambers 29, 30 via the passages 35, 36 inside the cursors 19, 20.

At this point, it is possible to get a desired increase of pressure acting on the position of the piston 31 in such a way as to activate the additional feeding deriving from the port PB. As will be illustrated more in detail below, the piston 31 could be activated by applying for instance a suitable pilot pressure through the duct 32.

Figure 3 shows the valve in the unbalanced condition, a condition in which the feeding of air under pressure to the outlet port of A must be prevented. In the illustrated case, the hypothesis is that only the pilot electro-valve 1 is excited or, in an equivalent way, that only pilot electro-valve 2 is not excited. In this case, the core 4 closes the passage of inlet 6 and opens the vent 8 evacuating the fluid from the chamber 9.

The valve-set 13 moves to the top under the pressure of the spring 21 and of the pressure on the shutter 15. The passage 115 is obstructed while the passage 11 is opened to the exhaust port R. The valve-set 14 holds instead, the excited position.

The pressurised fluid deriving from the flow-reducer 24 only is conveyed to the exhaust port R through the passage 11, therefore preventing the necessary pressure developing at the outlet port A to activate the apparatus connected to the valve. The fluid deriving from the flow-reducer 24 is conveyed moreover to the intermediate exhaust port 33 through the channel 25, as well as the fluid deriving from the additional feeding port PB that flows through the channel 26, through the passage 36 and through the channel 25 up to the exhaust port 33.

The presence of an further exhaust port 33 (or 34) operated by the same valve-sets of the valve improves the safety factor of the valve according to the invention compared to the currently known valves.

The pressure on the duct 6, that could be measured at the connections CP, also can be vented in a few tenths of a second through the flow-reducer 18 through the runs already described above. Therefore, when this interval of time has elapsed, any further excitation of the pilot electro-valve 2 produces no effect for lack of the necessary pneumatic energy to operate the working piston 109 in the chamber 9.

The valve remains therefore jammed in this position. The unlocking of the valve from the unbalanced position is only possible after both the valve-sets are restored to the position rest (as in Fig. 1) to allow the inlet pressure in the inlet chamber 28 and in the duct 6 to stabilise again.

As pointed out above, the valve according to the invention is equipped with means for regulating the flow of fluid between the second inlet port PB and the second channel 26.

Figs. 4A and 4B show schematic views in section of the said means of regulation in the position of exclusion of the additional feeding deriving from the inlet port PB, while Figs. 4C and 4D show the same means in condition of activation of the additional feeding.

The means of regulation comprise a piston 31, moving in a control chamber 131, that opens and closes a passage of communication 126 between the chamber 131 and the channel 26.

The piston 31 is positioned inside the chamber 131 under the combined effect of the pressure of a force caused by the spring 231 and of a pilot pressure applied in the control chamber 131, through a duct 32, from a pilot pressure regulating device.

In function of the position assumed by the piston 31 in the corresponding chamber 131, the volume of fluid deriving from the additional feeding port PB is regulated and directed to the channel 26. It is thus possible to modulate the volume sent by the additional feeding to allow a gentle approach of the actuator controlled by the valve.

Claims

1. Safety valve of the double-body, parallel-flow type for apparatus operating with fluid under pressure, comprising at least a first inlet port (P) for the pressurised fluid, at least an outlet port (A) for the fluid going to the apparatus and at least a first exhaust port (R) to vent the fluid of the apparatus to the atmosphere; a pair of valve-sets (13, 14), the respective stems (113, 114) of which are fitted with respective working pistons (109, 110) which run in respective pilot chambers (9, 10), with respective shutters (111, 112) for closing the corresponding passages (11, 12) for the fluid to the first exhaust port (R), as well as with respective shutters (15, 16) to block the connecting passages (115, 116) between the said first inlet port (P) and the said outlet port (A), said first inlet port (P) comprising portions of duct (23, 24) with reduced cross-section connecting with respective inlet chambers (27, 28); and a pair of pilot electro-valves (1, 2) which enables or disables the flow of fluid under pressure to

both said pilot chambers (9, 10) through respective ducts (117, 118) with respective portions of reduced cross-section (17, 18), characterised by comprising a second inlet port (PB) to feed fluid under pressure to said outlet port (A), as well as means to intercept the flow between said second inlet port (PB) and said outlet port (A).

2. A valve according to Claim 1, characterised in that said means for intercepting the flow of fluid between said second inlet port (PB) and said outlet port (A) comprise a pair of distribution cursors (19, 20) bound respectively to said stems (113, 114) opposite to said working pistons (109, 110).

3. A valve according to Claim 1 or 2, characterised by said distribution cursors (19, 20) moving inside of respective antagonist chambers (29, 30) in fluid communication with the respective inlet chambers (27, 28) through passages (35, 36) in the said respective cursors (19, 20).

4. A valve according to any of the preceding Claims, characterised by said distribution cursors intercepting a first channel (25) to set it selectively in fluid communication with said inlet chambers (27, 28) or with a pair of intermediate exhaust ports (33, 34).

5. A valve according to any of the preceding Claims, characterised by said distribution cursors (19, 20) intercepting a second channel (26) to close it or to set it in fluid communication with said passages (35, 36).

6. A valve according to any of the preceding Claims, characterised by said distribution cursors (19, 20) setting said first channel (25) in fluid communication with both said intermediate exhaust ports (33, 34) and obstructing the fluid communication between said second channel (26) and said antagonist chambers (29, 30) when both the valve-sets (13, 14) are in deactivated or rest position.

7. A valve according to any of the preceding Claims, characterised by said distribution cursors (19, 20) setting said first channel (25) and said second channel (26) in fluid communication with said chambers (27, 28, 29, 30) when both the valve-sets (13, 14) are in activated or excited position.

8. A valve according to any of the preceding Claims, characterised by said distribution cursors (19, 20) setting said first channel (25) said second channel (26) and any of the said chambers (28, 30; or 27, 29) in fluid communication with at least one intermediate exhaust port (33; or 34) when one of the said valve-sets (13; or 14) is in deactivated or rest position, while the other of said valve-sets (14; or 13) is in activated or excited position.

9. A valve according to any of the preceding Claims, characterised by comprising means for regulating the flow of fluid between said second inlet port (PB) and said second channel (26).

10. A valve according to Claim 9, characterised by said means for regulating the flow of fluid between said second inlet port (PB) and said second channel (26) comprising a piston (31), movable in a control chamber (131), acting to intercept a passage (126) between said chamber (131) and said second channel (26) under the combined effect of a force caused by elastic means (231) and of a pilot pressure applied in said control chamber (131) through a device for regulating the pilot pressure.

Fig.1

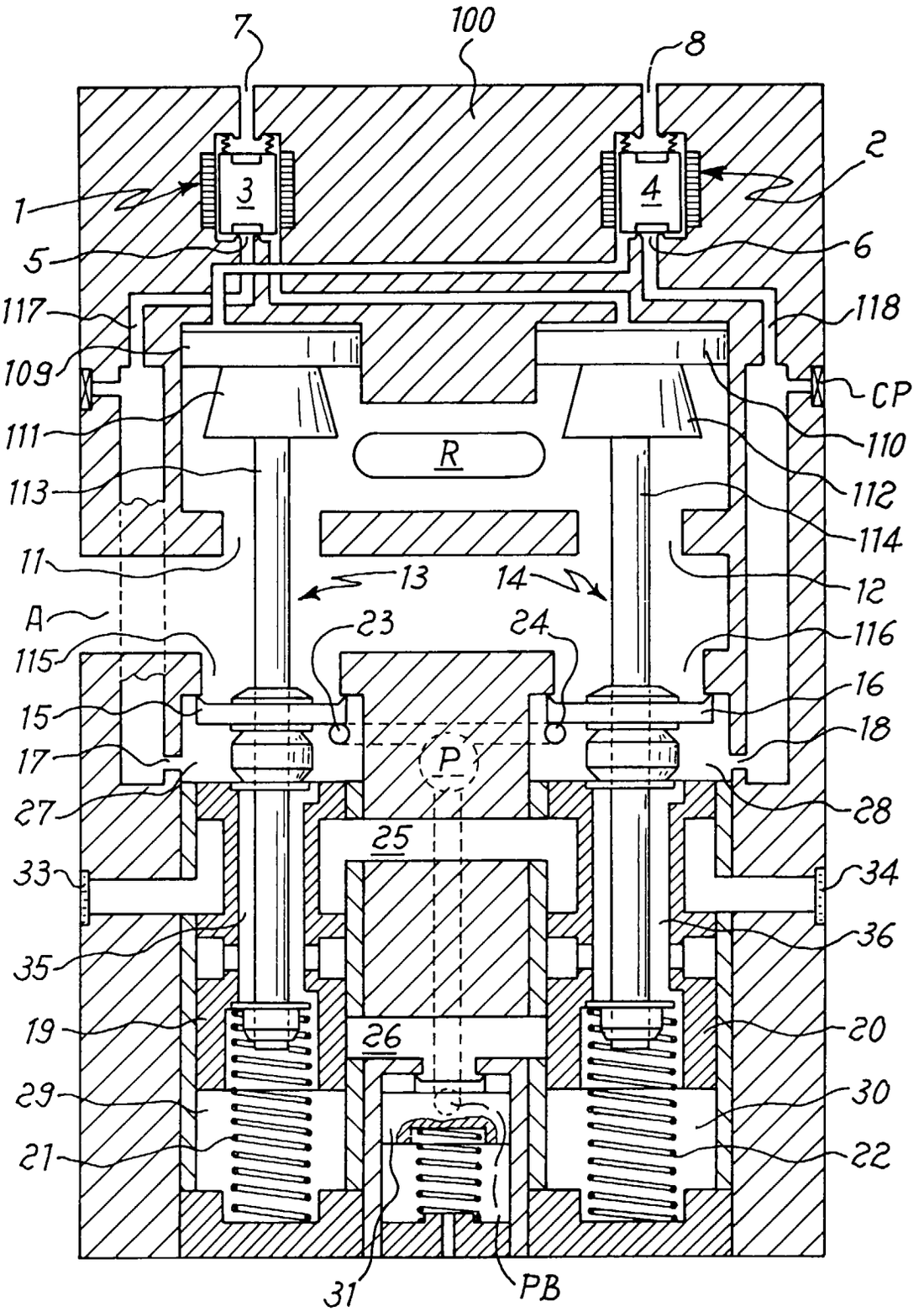

7
100
8
2
1
3
4
5
6
117
118
109
CP
111
110
R
113
112
114
11
13
14
12
A
23
24
116
115
16
15
18
17
P
27
28
25
33
34
36
35
19
26
20
29
30
21
22
31
PB

Fig.2

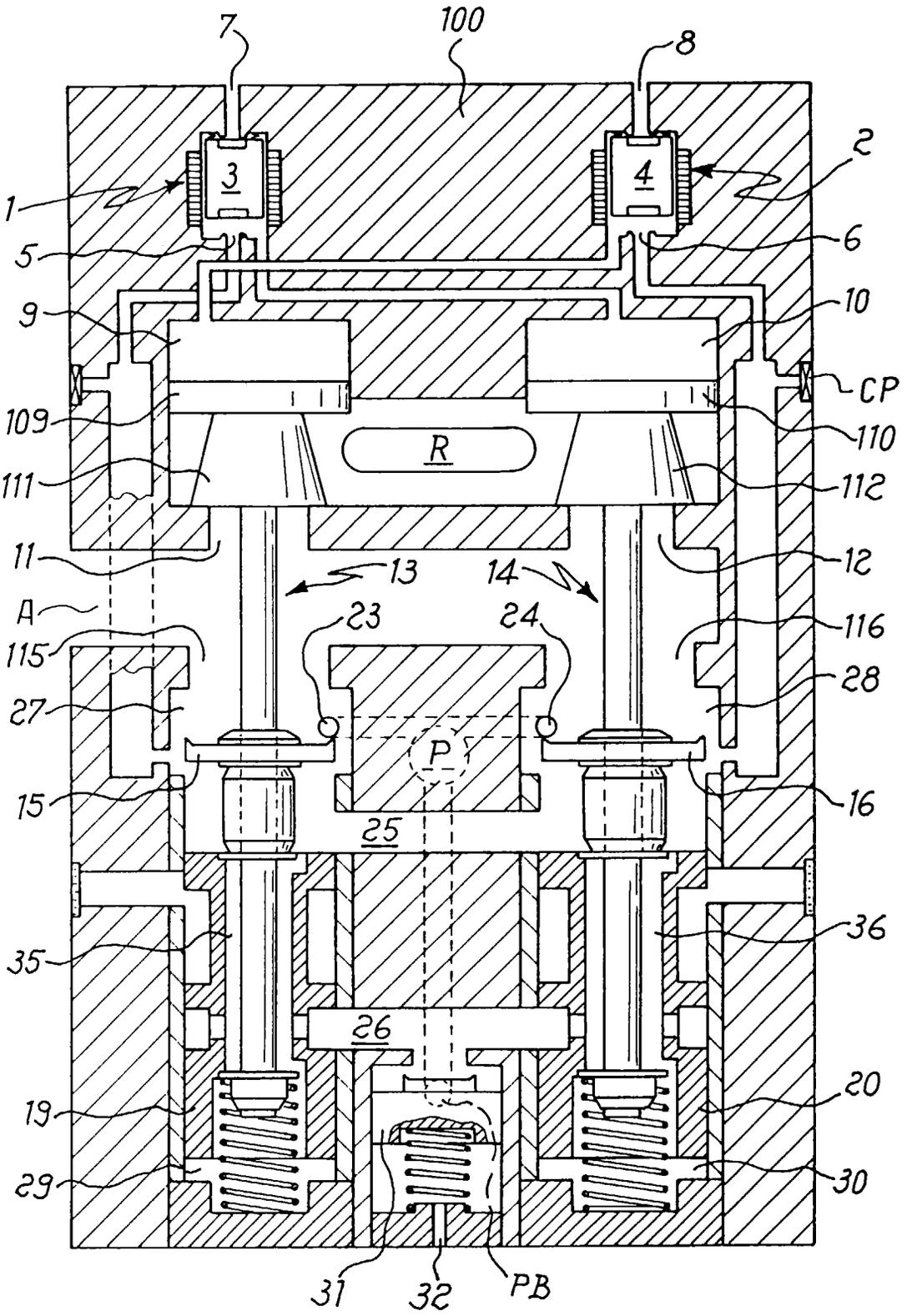

7
100
8
2
1
3
4
5
6
9
10
CP
109
110
R
111
112
11
12
13
14
A
23
24
116
115
28
27
P
15
16
25
35
36
26
19
20
29
30
31
32
PB

Fig. 3

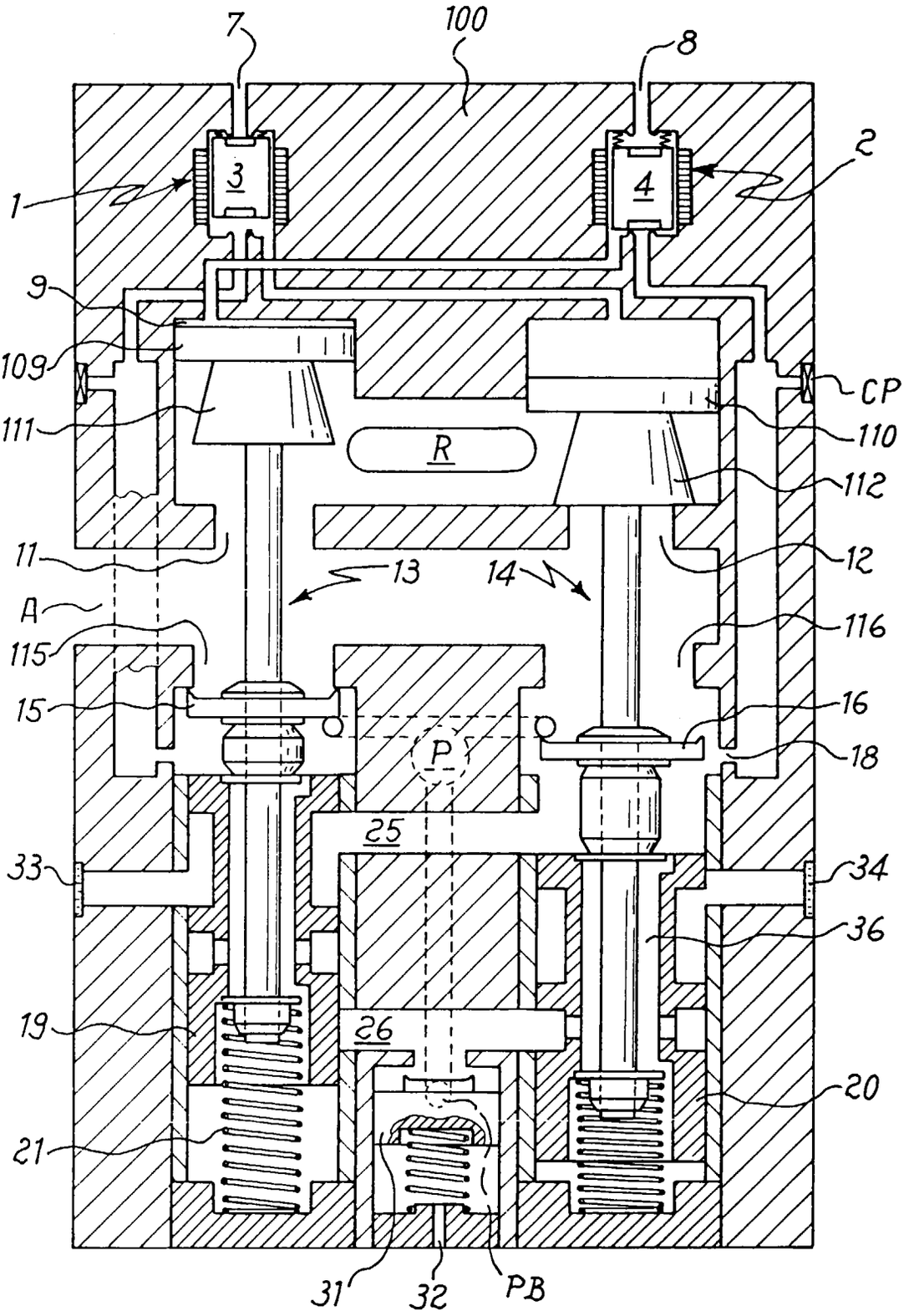

7
100
8
2
1
3
4
9
109
CP
111
110
R
112
11
13
14
12
A
116
115
15
16
P
18
25
33
34
36
19
26
20
21
31
32
PB

Fig.4A

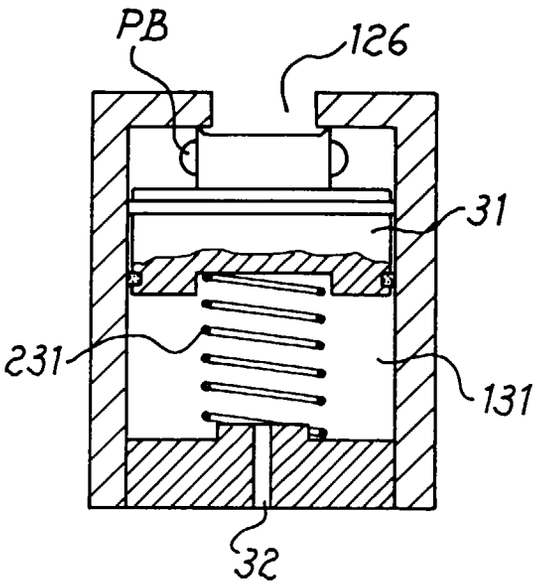


Fig.4B

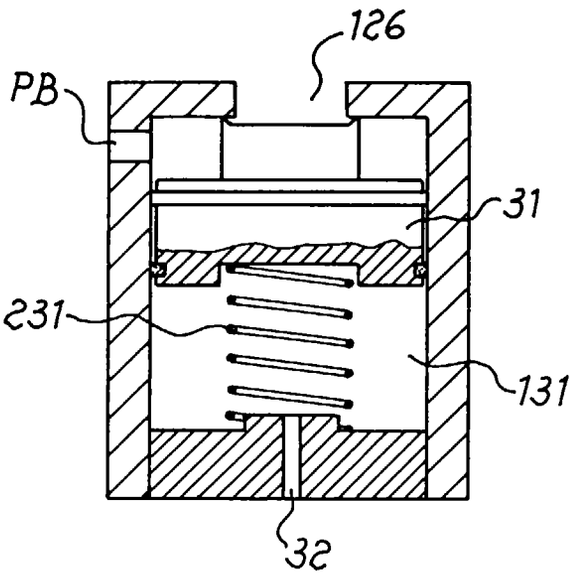


Fig.4C

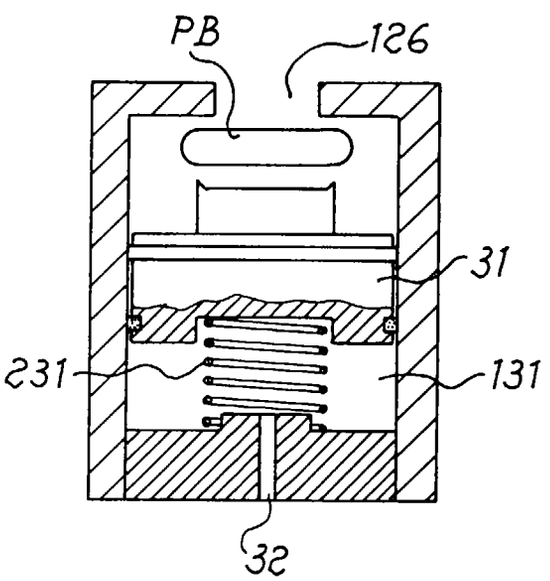
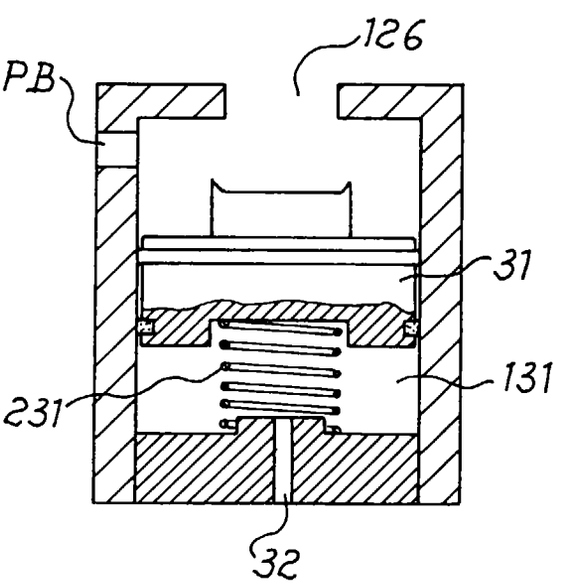


Fig.4D



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 6674

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	FR 2 388 151 A (TECHNOMATIC AG) 17 November 1978 * figure 1 *	1	F15B20/00
A	US 3 283 862 A (WARNOCK) * figure 3 *	1	
A	GB 2 137 737 A (ROSS OPERATING VALVE CO) 10 October 1984 * figure 1 *	1	
A	DE 90 14 789 U (HERION) 7 February 1991 * figures 1-3 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 August 1997	Lokere, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)