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(54) Oleo-pneumatic device for actuating electric switches

(57) An oleo-pneumatic device for actuating electric switches which comprises: a cylinder (1) inside which a free piston (2) can slide so as to define a chamber (24) which contains a working fluid (24); a pump (20) for applying pressurized oil (21) to the piston (2) in order to compress the working fluid (24); control means for stopping the pump when the compressed fluid reaches a preset volume; and means for discharging the oil (21) towards a low-pressure circuit (BP) in order to quickly release any excess stored energy. The control means comprise a microswitch (5) for stopping the pump (20), whose position is a function of the temperature of the working fluid; the microswitch (5) cooperates with a profiled actuation element (6) driven by the compression movement of the piston (2).

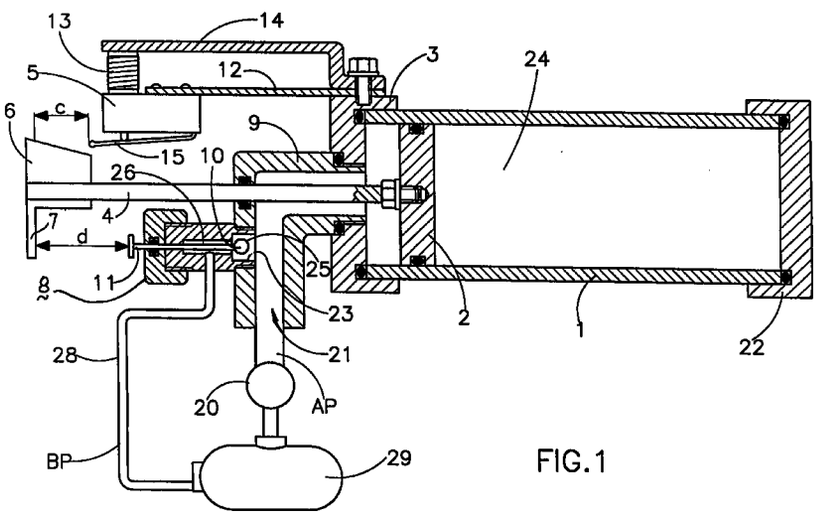

FIG.1

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Description

The present invention relates to an oleo-pneumatic device or accumulator for actuating electric switches and more particularly a control system.

Control means or actuators capable of supplying considerable amounts of mechanical energy in a very short time are required in various applications to actuate switches.

Such energy must therefore be accumulated beforehand in devices which can be recharged slowly, i.e., with a small input of mechanical energy per unit time, and are then capable of quickly delivering this energy at the time of actuation.

A well-known device of this kind comprises steel springs of various kinds which are loaded in various ways. Such a device has the fundamental drawback that its weight and bulk are very high as the energy to be accumulated increases.

Another conventional device uses oleo-pneumatic accumulators which, for the same weight and bulk, allow to store much more energy than spring-loaded devices, typically 10 to 15 times more.

However, conventional oleo-pneumatic devices have two severe limitations. First of all, the amount of energy which is slowly accumulated and the amount returned at the time of actuation are temperature-dependent.

Moreover, these devices require a system for controlling the amount of accumulated energy which has a pressure switch and a safety valve, which make the device complicated, expensive and relatively unreliable.

The aim of the present invention is to overcome the above drawbacks of the prior art and particularly to provide an oleo-pneumatic device for actuating electric switches which has a simple construction and is capable of ensuring temperature-independence of the accumulated (and released) energy.

This aim is achieved by the present invention, which consists of an oleo-pneumatic device for actuating electric switches which comprises: a cylinder inside which a free piston can slide so as to define a chamber containing a working fluid; a pump for applying pressurized oil to the piston of the cylinder in order to compress the working fluid; control means for stopping the pump when the compressed fluid reaches a preset volume; and means for discharging the oil towards a low-pressure circuit in order to quickly release the stored energy; characterized in that said control means comprise an actuation microswitch for stopping the pump, whose position is a function of the temperature of the working fluid, and in that the microswitch cooperates with a profiled actuation element driven by the piston compression movement.

Further features and advantages will clearly appear from the appendent claims.

The device according to the invention allows to precisely control the energy returned by an oleo-pneumatic accumulator in a temperature-independent manner and at the same time to provide a high-safety, high-precision control device.

The invention is now described with reference to the accompanying drawings, which relate to preferred but non-limitative embodiments of the invention and wherein:

figure 1 is a schematic partially sectional view of the construction of a device according to a first embodiment of the present invention; and
figure 2 is a view of a second embodiment of the device according to the invention.

In both figures, the same reference numerals are used to designate identical or substantially equivalent elements.

With reference to figure 1, the device according to the invention comprises a cylinder 1 which is closed by a bottom 22 at one end and by a head 3 at the other end.

A free piston 2 can slide inside the cylinder 1 and defines, together with the bottom 22, a variable-volume chamber 24 containing a fluid (generally a gas, particularly nitrogen) in which the energy is stored. In particular, this energy depends on the pressure P and on the volume V and on the gas temperature.

A union elbow 9 is fitted to the head 3; by means of the elbow, pressurized oil 21 can be applied to the surface of the piston 2 in order to compress the gas or can be discharged in order to use the energy stored in the compressed gas.

The pressurized oil 21 arrives from a high-pressure circuit AP which comprises a pump 20 and a reservoir 29. A hole 25 is provided on the elbow 9 and a valve 8 is installed thereon; the valve comprises a T-shaped duct 26.

A needle 11 can move axially in the horizontal arm of the T-shaped duct, which is aligned with the hole 25; the needle has a ball 10 at one end, whilst the other end of the needle protrudes from the body of the valve through an appropriate seal. The vertical arm of the T-shaped duct is connected by means of a tube 28 to a low-pressure circuit BP which is connected to a reservoir 29. The diameter of the hole 25 is smaller than the diameter of the ball 10, so that the ball obstructs the hole when the ball moves to the left.

Moreover, a rod 4 is directly and rigidly connected to the free piston 2 that separates the hydraulic circuit from the energy-accumulating volume of gas; the rod passes hermetically through the union elbow 9 and has, at its outer end, a slider 6 and a vane 7.

The slider 6 is shaped like a profiled body and has the purpose of actuating a microswitch 5, which stops the pump 20 and is fitted on the head 3 by means of an elastic support 12 and an assembly consisting of a rigid support 14 and a thermostatic element 13.

The microswitch 5 is provided with a contact 15

which is opened by the profile or inclined plane of the slider 6 when, during the compression movement, the piston 2 is moved forward by an extent c with respect to the maximum expansion position.

More specifically, the rigid supporting element 14 is shaped like a bracket which is fixed to the head 3 at one end by means of a screw and is in any case in thermal contact with the head and thus with the cylinder 1.

The other end of the bracket 14 is fixed to the microswitch 5 by means of the thermostatic element 13, i.e., a temperature-sensitive component, for example a bimetallic strip. Moreover, the microswitch 5 is rigidly coupled to the head 3 by means of the element 12, which is for example shaped like an elastic spring and applies a return force to the microswitch 5.

The vertical position of the microswitch 5 is thus determined as a function of the temperature of the cylinder 1, i.e., of the temperature of the compressed gas. Accordingly, the opening of the contact 15 can be advanced or delayed as a function of the temperature both by acting on the adjustment of the thermostatic element 13 and by acting on the profile or inclined plane (or on the position) of the slider 6 or by acting on both.

The vane 7 can move the needle to the right; more specifically, when the piston 2 under compression has covered a distance d, the vane 7 pushes the needle 11 of the valve 8 to the right and the ball connects the hole 25 to 21, thus allowing fluid hydraulic connection between the cylinder and the low-pressure circuit.

In this manner, the vane 7 discharges the excess pressure into the low-pressure circuit BP.

The operation of the device according to the invention is as follows:

After an actuation (performed by the vane 6), the pump 29 for replenishing the circuit AP feeds pressurized oil into the cylinder 1, causing the movement of the piston 2, gradually reducing the volume of the chamber 24 and thus compressing the gas contained therein; the microswitch 5 stops the pump when a preset pressure is reached as a function of the temperature.

The ball 10 is pushed so as to obstruct the duct 26 by the pressure of the oil 21 if the pump fails to stop.

When the chamber 24 reaches the chosen minimum allowed volume, the vane 7 pushes the ball 10 to the right, allowing pressure limitation by discharging the oil through the valve 8 into the reservoir 29. The pressure P of the compressed fluid is a function of the stroke of the piston 2 and therefore of the stroke c, which in turn depends on the vertical position of the microswitch 5 determined by the temperature of the compressed fluid.

By suitably configuring the profile of the slider 6 and by choosing the characteristics of the thermostat 13, it is possible to vary the pressure P so as to make the returned energy temperature-independent.

Moreover, as a safety measure, the hydraulic circuit AP is preferably provided with the pressure limiting valve 8, which is connected to the reservoir 29 and opens if the pressure in the circuit AP exceeds a safety value.

In the embodiment of the invention illustrated in figure 2, in which the same reference numerals have been used for identical or in any case functionally corresponding parts, the connection between the piston and an actuation rod 23 is provided by means of a traction element 16, i.e., an element capable of transmitting only traction forces but not compression forces, instead of by means of a rigid rod. The traction element 16 advantageously consists of a metal wire or chain. There is also provided a curved duct 17, which covers an angle between 0 and 180°, between the head 3 and a union 9 (similar to the union of figure 1) which is connected to the high-pressure circuit AP (not shown). The chain or wire rests against the inner surface of the curved duct. The other components, apart from some marginal changes in position or structure, are identical to those already shown with reference to the embodiment of figure 1.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. An oleo-pneumatic device for actuating electric switches, comprising: a cylinder (1) inside which a free piston (2) can slide so as to define a chamber (24) which contains a working fluid (24); a pump (20) for applying pressurized oil (21) to the piston (2) in order to compress the working fluid (24); control means for stopping said pump when the compressed fluid reaches a preset volume; and means for discharging the oil (21) towards a low-pressure circuit (BP) in order to quickly release the stored energy; characterized in that the control means comprise an actuation microswitch (5) for stopping the pump (20), whose position is a function of the temperature of the working fluid, and in that the microswitch (5) cooperates with a profiled actuation element (6) driven by a compression movement of said piston (2).

2. A device according to claim 1, characterized in that the microswitch (5) is fixed to the cylinder (1) by means of a thermostatic element (13) connected to a rigid supporting element (14) so as to provide a heat-exchange relation with the cylinder (1).

3. A device according to claim 2, characterized in that the microswitch (5) is rigidly coupled to the cylinder (1) also by means of an elastic return element (12).

4. A device according to claims 1 to 3, characterized in that the profiled actuation element is constituted by a slider (6) which has a shaped profile and is connected to a rod (4, 23) driven by the piston (2).

5. A device according to claim 4, characterized in that said slider (6) is mounted on a rod (4) which is directly and rigidly connected to the piston (2).

6. A device according to claims 2 to 5, characterized in that a union elbow (9) is fitted on the head (3) and is connected to a source of pressurized oil (21) which arrives from a high-pressure circuit (AP) comprising a pump (20) and a reservoir (29).

7. A device according to claim 6, characterized in that a hole (25) is provided in the union (9), a valve (8) for discharging the pressurized oil (21) towards a low-pressure circuit (BP) being provided in said hole (25).

8. A device according to claim 7, characterized in that the oil discharge valve (8) comprises a T-shaped duct (26) with an arm which is aligned with the hole (25) of the union (8)and in which a needle (11) can move axially, said needle having a ball (10) at one end, the other end of said needle (11) protruding from the body of the valve (8); in that the other arm of the valve (8) is connected, by means of a tube (28), to the low-pressure circuit (BP); and in that the diameter of the tube (26) is smaller than the diameter of the ball (10).

9. A device according to claim 8, characterized in that the outer end of the rod (4) is provided with a vane (7) which cooperates with the needle (11) to discharge the excess pressure into the low-pressure circuit (BP).

10. A device according to one or more of the preceeding claims, characterized in that the slider (6) is fitted on a rod (4) connected to the piston (2) by means of a traction component (16), and in that there is provided a curved duct (17) between the head (3) and the union (9), which is connected to the high-pressure circuit (AP).

11. A device according to claim 10, characterized in that the traction component rests on the inner surface of the curved duct (17).

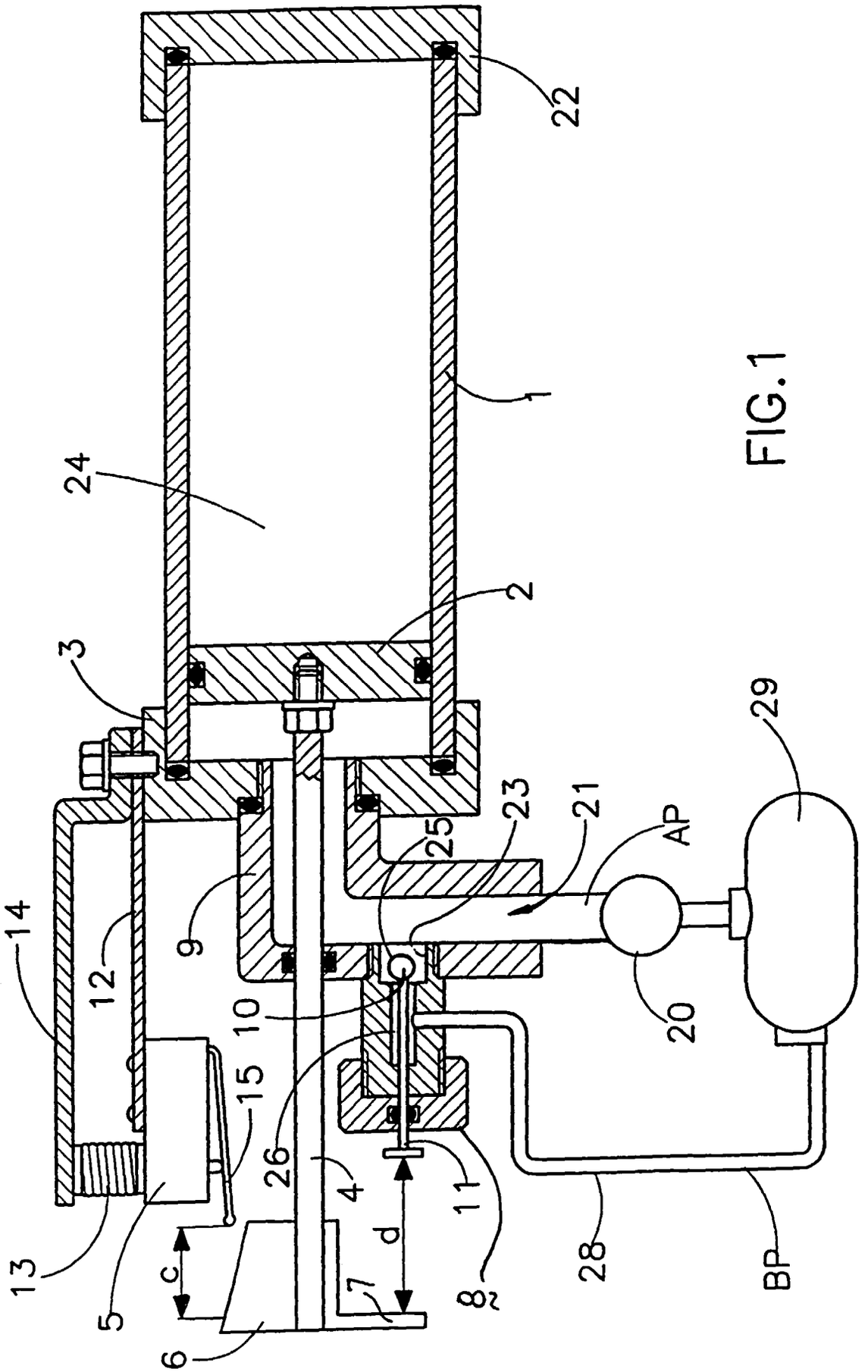

FIG. 1

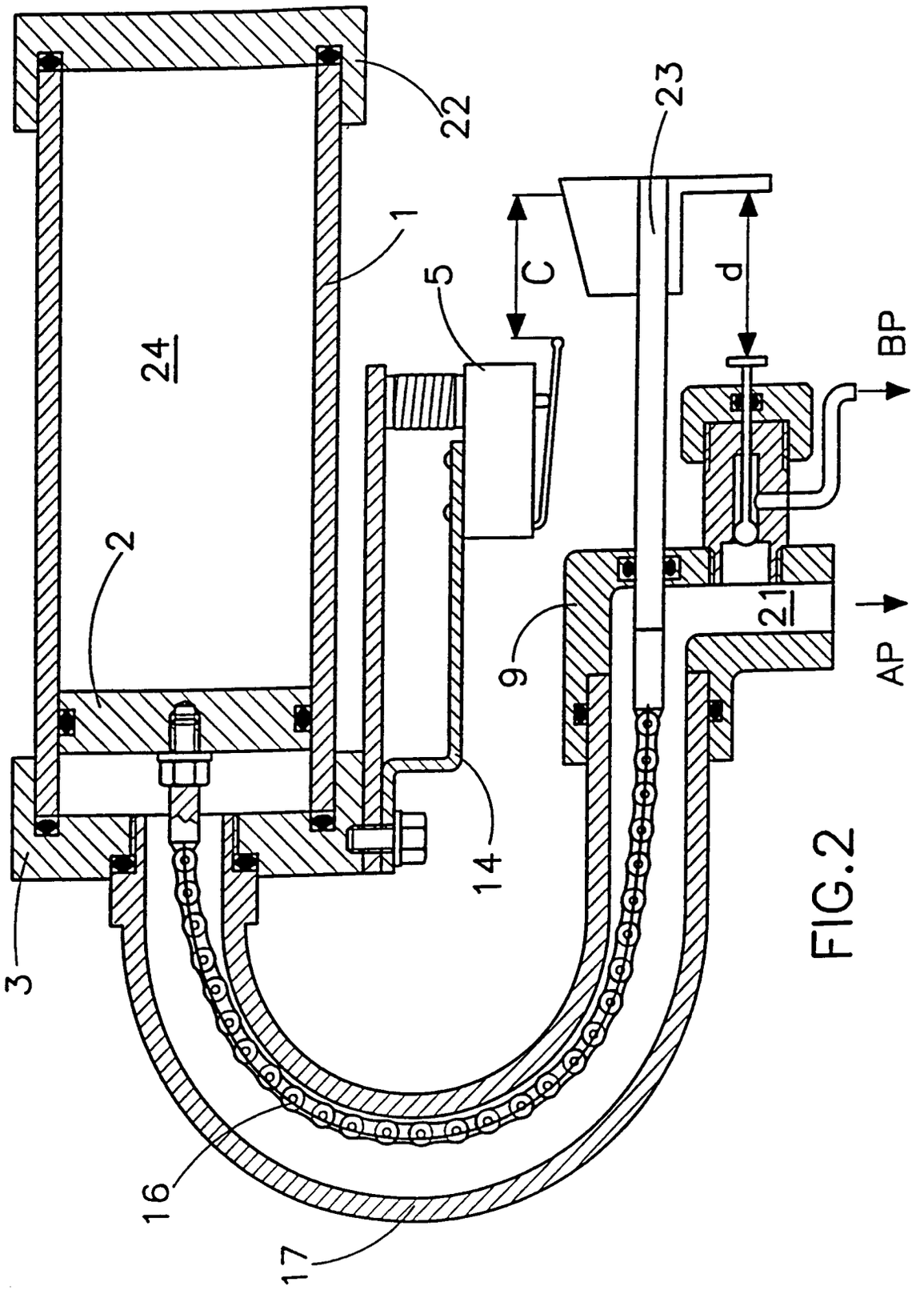

FIG.2