United States Patent

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[54] **PRESSURE-REDUCING VALVE**
5 Claims, 1 Drawing Fig.

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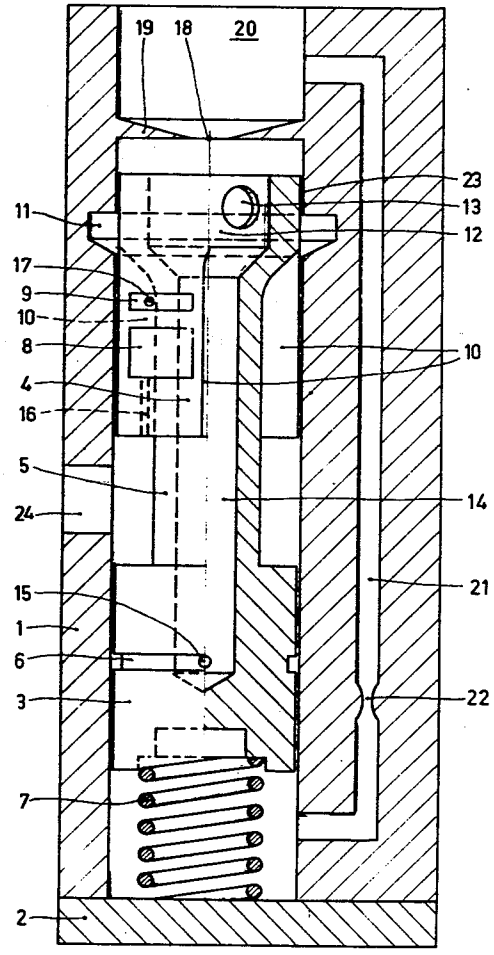
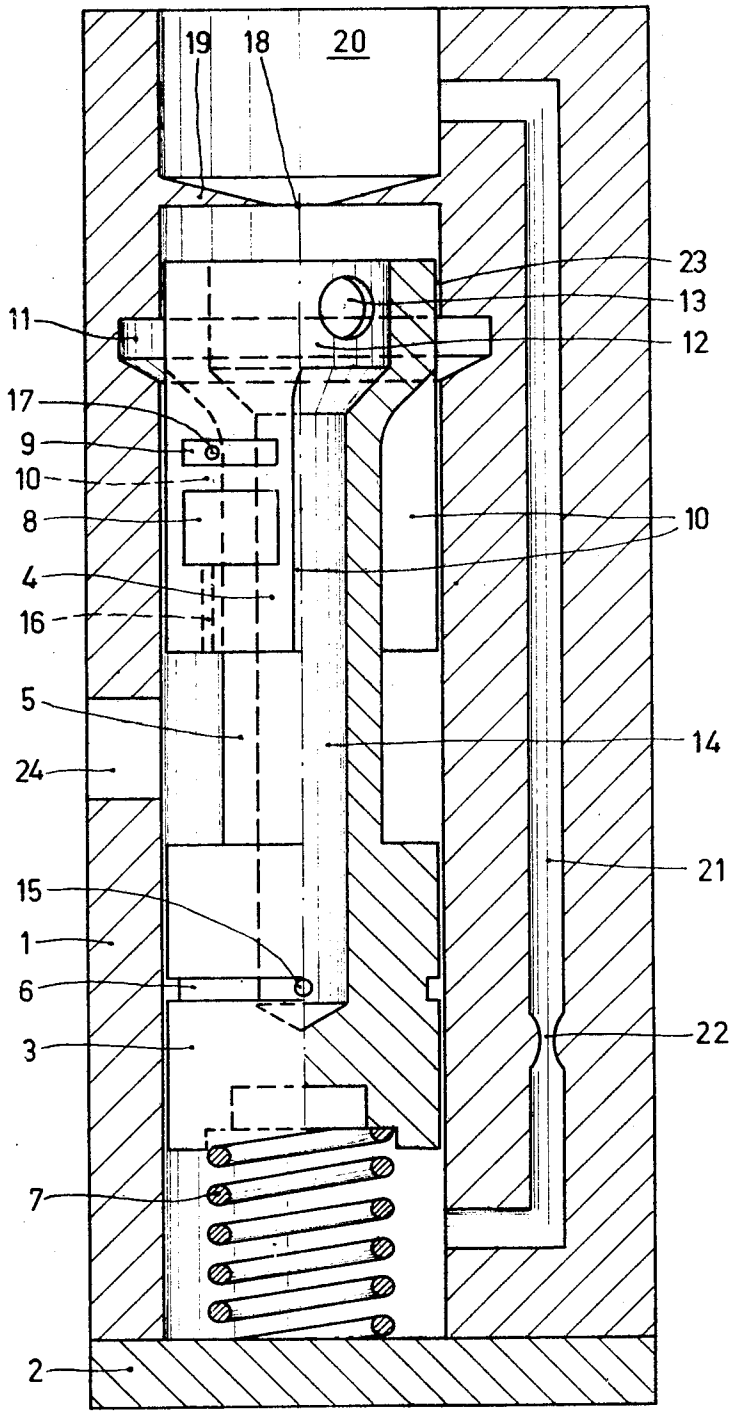
ABSTRACT: A pressure-reducing valve for obtaining a constant low-pressure flow of high volume of fluid which is supplied to the valve under high pressure. The valve comprises a pair of axially movable pistons connected by a rod within a valve-housing cylinder. The cylinder is closed at one end and a spring acts on free end of the piston assembly for urging the piston away from the closed end. The other end of the cylinder is provided with an outlet port through which the low-pressure fluid is passed from the valve and an inlet port is provided in the sidewall of the cylinder for introducing high pressure fluid to a space between the pistons. The piston assembly is hydrostatically journaled within the cylinder and is provided with a plurality of axially extending slits which vary in passageway size by the relative position of the piston within the cylinder. The high-pressure fluid is passed through the slits to a chamber on the other side of the piston and then through a turbulent-producing orifice to the outlet port.





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PRESSURE-REDUCING VALVE

The invention relates to a pressure-reducing valve for obtaining a constant, low-pressure flow of large volume of medium supplied to the valve under a high pressure. The density of the medium is substantially independent from the pressure. An inlet connection for the medium under pressure is provided in the wall of the circumference of a cylinder which is closed at one end. An outlet connection for conducting away the medium is provided in the open sidewall of the cylinder.

It is the object of the invention to obtain a pressure-reducing valve which can regulate a large quantity of medium in which the pressure of the supplied medium can be a few tenths of atmospheres while the volume of the flow which emerges from the valve should be constant independent of said pressure. For that purpose, a pressure-reducing valve according to the invention as described above is characterized in that a hydrostatically or pneumostatically journaled and axially movable piston is provided in the cylinder and is spring-loaded on one side limiting a first chamber on which side also the pressure of the supplies medium acts, the other side of the piston limiting a second chamber which communicates, through a gap which allows only passage of a turbulent flow, with the outlet connection. The circumference of the piston is provided with axially extending slits which provide a variable passage determined by the position of the piston for the medium from the first chamber to a groove in the cylinder wall which is in open communication with the second chamber.

In order to improve the bearing and to obtain a better surface of engagement for the spring as well as a better defined pressure surface on the piston, according to an embodiment of the invention a second piston, also hydrostatically or pneumostatically journaled, is present which is rigidly secured to the first piston by means of a piston rod, the first chamber being situated between said pistons and the spring pressing on a sidewall of the second piston.

The flow conditions in the valve and the operation are further improved if, according to a further embodiment of the invention, the bottom of the slits at the area where they open into the groove in the cylinder wall, is streamlined and the transition angle to the cylinder and the groove wall corresponding therewith encloses an angle of approximately 60° with the centerline of the cylinder.

In order to further improve the dynamic stability of the piston, according to another embodiment of the invention, a duct having a fixed resistance is present between the outlet connection of the medium and the space in which the spring is situated.

In order that the invention may be readily carried into effect, one embodiment thereof will now be described in greater detail, by way of example, with reference to the accompanying drawing, the FIGURE of which is a cross-sectional view of a pressure reducing valve.

In the drawing, reference numeral **1** denotes a cylinder which is closed at one end by a cover **2** and in which a piston assembly consisting of two pistons **3** and **4**, connected by a rod **5** is axially movable. The piston **3** has a groove **6**, and a spring **7** presses at one end thereof against piston **3** and bears against the cover **2** on its other side. On its circumference the piston **4** comprises a number of shallow bearing chambers **8** and a number of shallow bearing chambers **9**, as well as four slits **10**. The bottom of these slits **10** is streamlined at its end and finally encloses an angle of approximately 60° with the cylinder wall. This wall comprises a circumferential groove **11**, having a trapezoidal cross section, one side of said trapezoid extending at right angles to the cylinder wall and the other side also enclosing an angle of approximately 60° with the wall. The piston **4** comprises a chamber **12** which communicates, through an aperture **13**, both with a gap **23** between the piston **4** and the cylinder wall and with the groove **11**. Moreover, an open duct **14** extends from the piston **3** through the rod **5** to and through the piston **4** to chamber **12**; the groove **6** communicates with said duct through an aperture **15**.

Bearing chambers **8** communicate with the space between the pistons **3** and **4** through apertures **16** and chambers **9** communicate with slits **10** through apertures **17**. An opening **24** for the supply of a medium, is present in the cylinder **2** between the pistons **3** and **4**. Behind the piston **4** in the cylinder an aperture **18** is present which is bounded by sharply tapering walls **19**. Behind this aperture, an opening **20** is present for the outlet of the medium. A duct **21** communicates the space **20** with the space between the piston **3** and the cover **2**; in this duct a resistance **22** is present.

The device shown illustrates a pressure-reducing valve for obtaining a constant low-pressure flow of large volume of medium which is supplied under a high pressure to the device. The density of this medium is only slightly dependent upon, or totally independent of the pressure. The fluids are liquids and some gases, so that the flow is constant. The pressure may be a few tenths or even hundreth of atmospheres. Both pistons are journaled hydrostatically; the piston **3** only serves as a pressure surface for the spring **7** and to obtain a better guiding of the piston assembly. Any leak flow along said piston is conducted away through the groove **6**, aperture **15** and duct **14**.

When the medium under high pressure enters the space between the pistons **3** and **4**, it will escape through the slits **10** to the groove **11** and thence through aperture **13** to chamber **12**. The aperture **18** with the bounding wall **19** are constructed so that a turbulent temperature-independent flow occurs in the aperture **18**. Owing to the volume of the groove **11** which is large in relation to the cross section of the slits **10** a pressure reduction of the medium occurs, while owing to the pressure relation between the pressure which prevails in the space between the pistons **3** and **4**, and the pressure in the chamber **12**, the piston assembly moves more or less axially in accordance with the force of the spring **7**, which preferably must have a constant stiffness; as a result of this movement a larger or smaller part of the outlet side of the slits **10** comes in open communication with the groove **11**. In the bearing chambers **8** which communicates with the high-pressure space between the pistons through apertures **16**, a comparatively high pressure prevails; any leak flow of the gap between the piston and the cylinder wall is conducted away to the slits **10** through chambers **9** and aperture **17**. The duct **21** having resistance **22** only serves to further improve the dynamic stability of the assembly; this duct with resistance **22** is not always necessary.

The device according to the invention shown serves to regulate large quantities of medium which may be under a high pressure. Moreover, the device can very simply and easily be manufactured and gives very good results in practice.

What we claim is:

1. A pressure-reducing valve for obtaining constant low-pressure flow of large volume of medium, the density of said medium being independent of the pressure applied thereto comprising, a cylinder forming a valve housing being closed at one end thereof, inlet means through the circumferential wall of said cylinder for supplying medium under pressure to said valve, outlet means through an end wall of said cylinder for passing medium away from said valve, first and second pistons hydrostatically journaled for axial movement within said cylinder, a piston rod connecting said first piston to said second piston, a first chamber formed between the inner end faces of said first and second pistons, said inlet means communicating with said first chamber so that medium under pressure is supplied thereto, a second chamber formed between the outer end face of said first piston and an orifice, said orifice communicating with said outlet means for permitting turbulent flow of medium from said second chamber to said outlet, a circumferential groove on the inner wall of said cylinder, said groove being in open communication with said second chamber, a plurality of axially extending slits provided on the surface of said first piston for passing medium from said first chamber to said groove, the amount of available passageway through said slits being variable depending upon the axial position of said piston, a compression spring within a third chamber acting on the outer end face of said second piston, a duct within the cylinder wall communicating between said

outlet means and said third chamber, and a restriction within said duct.

2. A pressure-reducing valve for obtaining constant low-pressure flow of medium comprising a valve housing being closed at one end thereof, an outlet port located at the other end, an inlet port located in a sidewall of said housing for supplying medium under pressure to said valve, piston means hydrostatically journaled for axial movement within said housing, a compression spring acting on one side of said piston means for urging said piston means away from said closed end, a first chamber communicating with said inlet port so that medium under pressure acts on said piston means, a second chamber formed between the other side of said piston means and said outlet port, an orifice for producing turbulent flow therethrough communicates between said second chamber and said outlet port, a groove in the inner surface of said housing in open communication with said second chamber, a plurality of slits longitudinally extending along the circumferential surface of said piston means, said slits communicating with said groove and providing a variable size passageway for said medium thereto, the size of said passageway dependent upon the position of said piston means within said housing.

3. The pressure reducing valve according to claim 2 wherein said piston means comprises a pair of pistons, a rod connecting said pair of pistons, said first chamber being formed between said pair of pistons, and said spring acting on the free end face of one of said pistons.

4. The pressure-reducing valve according to claim 3 wherein said slits have a streamlined bottom surface, said slits having a transition portion at the point of communication with said groove, said transition portion forming an angle of 60° with respect to the longitudinal axis of said piston.

5. The pressure-reducing valve according to claim 4 further comprising a duct in the valve-housing body communicating at one end thereof with said outlet and at the other end thereof with the space in which said spring is located, and a restriction within said duct.