

Description

The present invention relates to an arrangement for changing the pressure in pneumatic or hydraulic systems, and more specifically, although not exclusively, for changing the pressure in compressed-air diaphragm pumps of the kind set forth in the first part of Claim 1.

The invention is particularly intended to provide an arrangement which will overcome the drawbacks which occur when a medium under pressure, or pressurized medium, is supplied abruptly to a machine or like apparatus with which full pressure is not to be applied immediately. When the inlet valve for delivering such flowing pressurized media is opened, the sudden rise in pressure can result in a shock impact capable of damaging the machine and the equipment peripheral thereto. In hydraulic systems this shock impact is referred to as water hammer and in pneumatic systems as compressed-air shock. The invention, however, is not restricted to the protection of a downstream machine, but can also be applied when emptying or ventilating a pressurized system.

With regard to pneumatic systems reference is made to avoiding ventilating the system too rapidly.

Pneumatic systems can be divided into a number of categories, in which particular distinction is made between static and dynamic systems. The static systems comprise, inter alia, various cylinder arrangements, whereas the dynamic systems comprise air consuming machines, such as rotating or reciprocating machines, for example compressed-air diaphragm pumps. In the case of the static pneumatic systems, valves are commercially available which function satisfactorily, insofar as a predetermined pressure is initially built-up in the system and the inlet valve is opened fully when the pistons of respective piston-cylinder devices or like devices occupy their dead-centre positions. This avoids jerkiness and impacts in the system.

These known valves, however, do not function satisfactorily in air consuming machines, such as pumps for instance, in which it is not possible to create a pressure build-up before full pressure working conditions are permitted, since the machine will begin to operate as soon as the air under pressure passes through the inlet delivery valve and enters the machine. This applies particularly to compressed-air diaphragm pumps. Such pumps have a variable capacity and will work smoothly from a zero capacity to a 100% capacity in dependence on the volume of air delivered thereto and on the air pressure. Consequently, if an attempt is made to build-up pressure slowly in the pump, the pump will merely operate at a slow pace, without any increase in pressure.

In addition to a closing valve, the delivery pipe, of inlet pipe, of an air consuming machine will often incorporate a pressure regulator for lowering the pressure off the mains to a desired

low working pressure, or secondary pressure, and for maintaining this secondary pressure at a constant level. One known pressure regulator of this kind incorporates a delivery channel in which there is embodied a seat valve having a spindle which is connected to a diaphragm. A chamber on one side of the diaphragm communicates, via a hole, with the outlet side of the regulator. The other side of the diaphragm is spring biased. The bias asserted by the spring is adjusted by means of a setting knob or wheel, and therewith also the pressure desired on the outlet side of the regulator. A valve of this kind, however, can only be used to create a constant maximum pressure and cannot be used for supplying air to the machine while slowly increasing the supply of pressure.

EP-A-0126291 describes and illustrates a spring-biased double-acting piston. Both sides of the piston are connected to the inlet through control valves. Furthermore, the chambers defined on respective sides of the piston can be ventilated to atmosphere through pipelines which incorporate control valves. However, no piston side is connected to the outlet side of the valve and the valve setting is made irrespective of the pressure on the outlet side of the valve.

SE-B-380335 describes and illustrates a valve whose valve body or plug is actuated by a diaphragm through the valve spindle. The valve body, hereinafter referred to as the valve plug, is also actuated in its opening direction by a spring. Arranged on the inlet side of the valve is an adjustable coil spring which delimits an intermediate space on the inlet side of the valve aperture. The flow of fluid arriving from the inlet side to the intermediate space can be throttled smoothly and variably, by modifying the compression of the spring. The inlet communicates with the diaphragm through a pipe, so that the valve will be moved in its closing direction by the pressure prevailing in the inlet pipe. The intermediate space is also connected with the diaphragm through a further pipe, so that the valve will be actuated in its opening direction by the pressure prevailing in the intermediate space.

This valve is constructed differently to a pressure regulator and does not function in the same manner as the regulator. Among other things the valve plug of a pressure regulator is acted upon and moved by the valve spring and the inlet-pipe pressure in the opposite direction. Neither do pressure regulators include devices which are comparable with the aforesaid throttling coil-spring and do not achieve a corresponding effect.

Accordingly, the object of the present invention is to provide for the purpose of changing the pressure in pneumatic or hydraulic systems an arrangement which is not encumbered with the aforescribed drawbacks and which will enable the inlet pressure in dynamic, pneumatic, or hydraulic systems to be increased slowly. A further object is to achieve a slow build-up in pressure and to adjust the setting of the valve in

correspondence with the rate of pressure increase on the outlet side of the valve.

To this end the arrangement according to the invention is primarily characterized by the features set forth in the characterizing clause of claim 1.

The aforementioned publications teach a valve which is operated or controlled by a diaphragm or a piston, via a valve spindle. The respective chambers on the two mutually opposite sides of the diaphragm or piston communicate with the valve inlet passage via pipes and also possibly via control valves. These known valves, however, are not influenced by the pressure prevailing in the outlet passage of the valve. Consequently, the known valves are unable to achieve any adaptation to the rate of pressure increase occurring on the outlet side of the valve.

The invention will now be described in more detail with reference to an exemplifying embodiment thereof illustrated in the accompanying drawings, in which:

Figure 1 is a schematic sectional view of an arrangement according to the invention;

Figure 2 illustrates an arrangement which corresponds to the arrangement shown in Figure 1 and which includes a compensating device in the form of a diaphragm;

Figure 3 illustrates an arrangement which corresponds to the arrangement shown in Figure 1 and which incorporates a pressure regulator for restricting the outlet pressure;

Figure 4 illustrates an arrangement which corresponds to the arrangement shown in Figure 1 and which incorporates a setting screw for restricting the maximum through-flow opening;

Figure 5 illustrates an arrangement which corresponds to the arrangement shown in Figure 1 and which incorporates a diaphragm according to Figure 2 and a setting screw according to Figure 4;

Figure 6 illustrates an arrangement which corresponds to the arrangement shown in Figure 2 and which incorporates a pressure regulator according to Figure 3 and a setting screw according to Figure 4;

Figure 7 illustrates an arrangement which corresponds to the arrangement shown in Figure 6 and which incorporates a delivery line for delivering pressure medium to a pressure regulator from a separate pressure-medium source; and

Figure 8 is a cut-away detail view of the pressure regulator illustrated in Figures 3 and 6 and of the components located in the close proximity of the regulator.

Mutually corresponding components of the various illustrated arrangements have been identified by the same reference numerals. For the sake of illustration the arrangement housing or body 1 has been shown to consist of a single monolithic block. It will be understood, however, that the housing may comprise several mutually different parts which are joined together by, e.g., pipe connections. The external configuration of

the housing is therefore arbitrary and has no bearing on the functional principles of the illustrated arrangements. A number of the arrangement components have been shown in a highly schematic form in the respective Figures. It is therefore to be understood that the housing is divided, or capable of being opened, in the locations of the various cavities intended for the installation/removal of diaphragms, valves and other components.

Figure 1 illustrates a principle basic form of an arrangement constructed in accordance with the invention, which includes a delivery channel having an inlet side 24, an outlet side 26, and a valve arrangement which is located in the delivery channel and separates the inlet and outlet sides thereof. The inlet is connected to a pipe system through which gas under pressure, or pressurized gas, is conveyed and which has connected thereto a machine for generating pressurized air or gas. Alternatively, the pressurized gas may be supplied from a gas bottle or container. The valve outlet is connected to an air consuming machine, e.g. a diaphragm pump.

Figure 1 illustrates the pressure changing arrangement in a closed, rest position. The pressurized air entering through the inlet 24 is conducted to a valve which comprises a valve seat 9, a valve plug 10, and a valve packing seal 10'. The valve plug 10 is held in position in the housing 1 by a valve hood 13, which incorporates a thrust spring 14 and seals 11, 12. The inlet 24 communicates with a chamber 6 through a channel or connecting passage 22, which incorporates a three-way valve 15, a throttle-valve seat 18 and an associated throttle-valve spindle 17. The chamber 6 is defined downwardly by a diaphragm arrangement which comprises a diaphragm 2 which is held and supported by diaphragm plates 3 and 4. The diaphragm plates are attached to a valve spindle 7 connected to the valve plug 10 in a known manner, which has not been illustrated in detail in the Figures.

When air under pressure is supplied through the inlet 24, part of the air flow will pass through the channel 22 and enter the chamber 6. As the pressure in the chamber 6 rises as a result hereof, the diaphragm assembly will move down and force down the air-valve spindle 7 and the valve plug 10. In so doing a gap is formed between the valve seat 9 and the packing 10', so that pressurized air is able to exit through the outlet 26. Part of the air exiting from the outlet 26 is able to pass through a channel or pressure equalizing passage 25 and enters a chamber 5 located beneath the diaphragm 2. This part flow of air will therewith exert on the diaphragm a counter pressure which strives to move the diaphragm upwards and therewith decrease the size of the valve through-aperture.

In the event of a rapid build-up of pressure in the outlet 26, the pressure in the chamber 5, which pressure is equal to the outlet pressure, will increase more rapidly than the pressure in the

chamber 6. When the pressure in the chamber 5 equals the pressure in the chamber 6, the valve is closed by the spring 14 and the diaphragm 2 will return to its position of equilibrium or rest. The valve and the diaphragm remain in their respective closed positions until the pressure in the chamber 6 has again been able to increase to a value which is greater than the pressure prevailing in the chamber 5, whereupon the valve is opened. This sudden build-up in pressure can be the result of a closed outlet 23 or the build-up in working pressure in a working machine. On the other hand, in the event of a very slow pressure build-up in the outlet 26, the pressure difference between the chamber 6 and the chamber 5 will be correspondingly greater. The diaphragm is then subjected to a greater force and the valve will be opened to a greater extent, which results in a more rapid increase in pressure, until the pressure on the outlet side has begun to catch up and the valve aperture has decreased to a corresponding extent. Consequently, the pressure in the outlet 26 will increase smoothly at substantially the same rate as the pressure in the chamber 6, irrespective of the conditions on the outlet side.

When the outlet side is connected to a compressed-air consuming machine and there occurs a slow increase in load, the pressure will rise slowly in the chamber 6 and with a slight delay to almost an equal extent in the chamber 5 and the outlet 26. The difference comprises the pressure drop over the valve. The time taken to bring the chamber 6 to full working pressure is determined with the aid of the throttle-valve 17, 18. This time corresponds to the loading time, i.e. the time taken to raise the inlet pressure to full working pressure from the first moment of starting-up the air consuming machine.

The air consuming machine is shut down with the aid of the three-way valve 15, which to this end is adjusted to a positional setting in which the chamber 6 is connected to an outlet channel 23. This results in rapid ventilation of the chamber 6 via a non-return valve connected in parallel with the throttle valve and comprising a valve seat 19, a valve plug 20 and a holding spring 21. Naturally, part of the gas will exit, at the same time, through the throttle valve 17, 18. When air leaves the chamber 6, the pressure in the chamber 5 will be greater than that in the chamber 6 and the valve plug 10 will be moved subsequently to its valve closing position. The valve then remains closed. When the machine is again started-up, the three-way valve 15 is adjusted to the illustrated setting, therewith initiating a smooth re-start as aforescribed. The three-way valve 15 may be, for instance, a manually operated valve, a magnetic valve, or a pneumatic valve. The last-mentioned valves may be remote-control valves.

The described pressure changing arrangement incorporates a number of seals, such as a seal 16 provided around the throttle-valve spindle 17 for example. The seal 8 which embraces the air-valve spindle 7 is, in principle, not needed for sealing

purposes and serves more to guide the movement of the valve spindle 7. The valve hood 13 has provided centrally therein a cavity into which the valve plug enters. This cavity is sealed, primarily to prevent an excessive pressure across the valve, since otherwise a greater force would be required to open the valve, due to the fact that the full inlet pressure lies on the entire undersurface of the valve plug.

The loading time, i.e. the time taken to bring the chamber 6 to the desired working pressure, is controlled essentially with the aid of the throttle valve 16, 17, but can also be varied by commensurate modification to the volume of the chamber 6.

In accordance with the invention, the diaphragm 2 of the illustrated pressure changing arrangement can be replaced with a piston and sealing system. The use of a piston will enable greater lengths of stroke to be obtained with chambers 5 and 6 of small external dimensions. The use of a piston, however, is encumbered with sealing problems, and a diaphragm will afford the simplest and cheapest solution in the case of a number of applications.

In the case of the arrangement illustrated in Figure 1, a given pressure drop will always prevail over the valve, thus a pressure difference between the inlet side 22 and the outlet side 26, depending on the force exerted by the spring 14. This can be counteracted by providing the valve with a further diaphragm system 29, 30, 31 with associated chambers 32, 33, as illustrated in Figure 2. In this arrangement the forces acting on the upper face of the diaphragm are much greater than those which act on the bottom face thereof, due to the fact that full working pressure prevails in the two downwardly acting chambers 6 and 32. An upwardly directed, full working pressure also prevails in the chamber 5. The undersurface of the diaphragm 29, on the other hand, is exposed to ambient atmospheric pressure, since the chamber 33 is in communication with the ambient surroundings through a channel 34. The upper valve spindle 27 of the arrangement is provided with a seal 28 which seals the chamber 6 from the chamber 33.

The force exerted by the spring 14 is overcome with the aid of the forces acting on the diaphragm system 29, 30, 31. In this way, there is obtained a valve arrangement in which, subsequent to a smooth starting-up period, there is practically no pressure drop over the valve while retaining, at the same time, the possibility of a smooth start with a slow pressure increase.

The use of the three-way valve 15 affords an important advantage, since it is possible in this way to control a very large flow of gas with a very small three-way valve. A three-way valve having a through-passage diameter of, e.g. 2 mm can be used to operate valves which have a delivery channel or main through-passage of, e.g., 150—200 mm in diameter.

The three-way valve 15 and the channel 23 can be omitted when the flow is cut-off upstream of the inlet 24 in some other way and the system is

evacuated downstream of the location at which the flow is cut-off. This can be achieved, for example, with a three-way valve located upstream of the inlet 24, this three-way valve when closed resulting in the evacuation of the system downstream of the valve.

The arrangement illustrated in Figures 1 and 2 is able to produce a slow increase in pressure during a start, but cannot limit the maximum pressure of the system. Thus, this arrangement assumes the presence of a pressure regulator at some other location in the system, e.g. an upstream location, or assumes that it is not necessary to limit the maximum pressure.

Figure 3 illustrates an embodiment of the invention which will also enable the pressure to be restricted on the outlet side. The system illustrated in Figure 3 corresponds to the system illustrated in Figure 1, with the exception that there is incorporated in the channel 22, upstream of the three-way valve 17, a conventional pressure regulator 37 by means of which the maximum pressure in the chamber 6 can be limited to a lower value than the pressure that prevails in the inlet 24. The pressure in the outlet 26 is thereby correspondingly restricted at the same time. The pressure regulator 37 is described in more detail hereinafter with reference to Figure 8.

Advantageously, the pressure regulator 37 can be very small with a small through-flow aperture and may be of low capacity, since the chamber 6 has a small volume and the rise in pressure therein is effected slowly in order to achieve a gentle or soft start. At the same time, the through-flow aperture, i.e. the capacity, of the actual soft-start valve 9, 10 may be very large. The pressure regulator 37 need not necessarily be incorporated in the housing 1, but may be arranged at a location remote from the housing, e.g. on a control panel or some like device. The control panel may also incorporate means for adjusting the positional setting of the three-way valve 15, or may even incorporate the actual three-way valve itself. In this case the pressure regulator 37 is connected to the channel 22 in the housing 1 by means of pipes or pressure hoses.

Figure 4 illustrates an embodiment of the invention corresponding to the arrangement illustrated in Figure 1, although with the exception that the valve hood 13 of the Figure 1 embodiment has been replaced with a valve hood 35 that presents a screw-threaded central hole which accommodates a setting screw 36. This setting screw is effective for restricting the downward movement of the valve plug 10 and therewith the extent to which the valve can be opened, thereby restricting and controlling the amount of air that passes between the valve seat 9 and the packing seal 10'.

Thus, there is provided a soft-start valve with which the main flow can be throttled initially while maintaining maximum working pressure. When the screw 36 is tightened down to its fullest extent, no medium can pass through the valve

and an inexpensive closing valve has been obtained.

Figure 5 illustrates an embodiment which combines the embodiments of Figures 2 and 4. The embodiment illustrated in Figure 5 works analogously with the previously described embodiments and affords corresponding advantages.

Figure 6 illustrates an inventive embodiment which comprises a combination of the embodiments illustrated in Figures 3 and 4.

The embodiment illustrated in Figure 7 corresponds substantially to the embodiment illustrated in Figure 6, with the exception of a separate supply of pressure-gas to the pressure regulator 37. This gas serves as control air and is delivered to the pressure regulator 37 through a pipe 38 and continues from the regulator 37 through a passage 39 corresponding to the air passage 22. This system can be used when the regulated main flow is a liquid, a suspension, or an expensive, poisonous, explosive or inflammable gas. It will be understood that all of the embodiments aforescribed with reference to Figures 1-6 can be provided with a similar supply of control air taken from a separate source of pressure gas.

Figure 8 illustrates part of an arrangement according to the invention in which a pressure regulator 37 is incorporated in the passage 22, in accordance with the illustration of Figures 3 and 6. The pressure regulator 37 comprises a housing 50 which incorporates an inlet channel 51 and an outlet channel 52, which channels are separated by a valve which comprises a valve seat 53 and a valve plug 54. The valve plug is spring biased with the aid of a thrust spring 55 abutting a valve hood 56. The valve spindle 57 abuts a lower diaphragm plate 58 which has a hole located centrally therein. The diaphragm plate 58 is attached to a diaphragm 59 and an upper diaphragm plate 60. The diaphragm plate 60 is loaded by a spring 61, the bias or pre-tension of which can be adjusted with the aid of a setting knob or wheel 62. A chamber 63 located on the underside of the diaphragm communicates with the outlet channel 52 through a passage 64.

The pressure desired on the outlet side is set by means of the setting knob 62. The diaphragm and the valve plug are pressed downwards and the valve consequently opened. The pressurized medium is now able to pass to the outlet side and through the passage 64, into the chamber 63, where the medium exerts on the diaphragm a counter-pressure which acts in the closing direction of the valve. When the desired outlet pressure is reached, the pressure in the chamber 63 will balance the pre-set spring pressure in the valve-closed position. If the pressure on the outlet side is too high, the diaphragm and the lower diaphragm plate are lifted from the spindle 57, so as to expose the central hole in the diaphragm plate. Pressure gas can now be evacuated through the central hole until again reaching the desired pre-set pressure on the outlet side.

A manometer for sensing the pressure on the inlet side 24 can be mounted on the arrangement,

for the purpose of controlling the pressure in the system.

The secondary pressure can be detected at the outlet 26 or in the chamber 6, since the pressure therein shall be practically equal to the outlet pressure.

In the case of the embodiments illustrated in Figures 3, 6 and 7 it is preferred to measure the secondary pressure at a location between the pressure regulator 37 and the three-way valve 15, since the desired secondary pressure can then be set, with the aid of the pressure regulator 37, before the main delivery channel of the arrangement is opened, by opening the three-way valve 15.

The aforescribed exemplifying embodiments of the arrangement according to the invention include a valve which comprises a valve plug and an opposing valve seat. The invention is not, of course, restricted to this particular type of valve, and it will be understood that any suitable type of valve or throttling device can be used for decreasing the through-flow area and therewith to lower the pressure in a pipe. The manner in which movement of the diaphragm 2 is transmitted mechanically to the valve is adapted to the manner in which the valve operates, e.g. rectilinear movement, rotational movement or hydraulic throttling of a rubber-sleeve section.

The valve according to the invention may also be provided with a spring in the chamber 6 corresponding to the spring 61 of the Figure 8 embodiment. This spring counter-acts the spring 14 in a manner such that the valve will be partially open when in its rest position. This may be desirable in certain applications to which the pressure changing arrangement according to the invention is put. This embodiment, however, assumes that the system includes a separate closing device, preferably upstream of the valve.

The use of an arrangement according to the invention is not restricted to dynamic, pneumatic or hydraulic machines, since the arrangement can also be used in other contexts in which a slow pressure increase to full pressure is desired, e.g. when depressurizing or evacuating a pressurized system.

The arrangement according to the invention can be used for transporting both gases and liquids in the main channel or delivery channel. A compressible medium, on the other hand, i.e. a gas, should be delivered to the chamber 6 through the throttle valve 17, 18, so as to achieve the desired slow rise in pressure. Alternatively, the chamber 6 may have enclosed therein a given quantity of gas capable of producing the same effect. This gas is preferably enclosed in a rubber bladder or the like, of the kind used, inter alia, in closed expansion vessels in heating systems.

Claims

1. An arrangement for changing the pressure in pneumatic or hydraulic systems, particularly compressed-air diaphragm pumps, in which a

pressurized medium is supplied through a delivery channel which incorporates an inlet (24) and an outlet (26) and a closing and throttling device (9, 10) having a closing body (10), which is located between and mutually separates said inlet (24) and outlet (26) and which has a controlling influence on the pressure of the pressurized medium, and in which the closing and throttling device (9, 10) is actuated, via a setting means, e.g. a valve spindle (7), by a diaphragm (2), a piston or some corresponding device, with chambers (5, 6) on both sides of the diaphragm (2), i.e. one chamber (5) and another chamber (6), the other chamber (6) on the one side of the diaphragm (2) communicating through a connecting passage (22) with a source of pressurized medium (24), which throttling device (9, 10) is acted upon on the one side thereof in an opening direction and is acted upon on the other side thereof in a closing direction, by causing the one chamber (5) on said other side to communicate with said outlet (26), via a passage (25), and delivering pressurized medium having the same pressure as the outlet pressure, characterized in that the diaphragm (2), piston or corresponding device is actuated pneumatically or hydraulically on said one side by delivering to the other chamber (6) on said one side a pressurized medium taken from the source of pressurized medium (24, 38) via the connecting passage (22, 39) that incorporates a flow restricting section, e.g. a throttle valve (17, 18) which is operative in effecting time-delayed equalization of the pressure between said other chamber (6) and said source of pressurized medium (24, 38).

2. An arrangement according to Claim 1, characterized in that the pressurized medium is delivered from said inlet (24) or from a separate pressure medium inlet (38) and/or in that the other chamber (6) for producing a valve closing movement is evacuated to the surrounding atmosphere via a three-way valve (15), wherewith the pressure medium is preferably caused to flow from the other chamber (6) at greater speed through the flow restricting section (17, 18) and through a non-return valve (19—21) arranged parallel therewith.

3. An arrangement according to Claim 1 or 2, characterized in that the flow restricting section comprises a preferably adjustable throttle valve (17, 18) and/or a permanent constriction in the form of a narrower section in the connecting passage (22, 39) and/or in the form of a connecting passage which has a very small through-flow area along at least a part of its length.

4. An arrangement according to any of Claims 1—3, characterized in that the other chamber (6) is connected to the inlet (24) through said connecting passage (22).

5. An arrangement according to any of Claims 1—4, characterized in that the connecting passage (22, 39) incorporates a three-way valve (15) which when set to a first position connects the other chamber (6) on one side of the diaphragm (2) with the inlet (24) or the separate pressure medium inlet (38), and which when set to a second



for the purpose of controlling the pressure in the system.

The secondary pressure can be detected at the outlet 26 or in the chamber 6, since the pressure therein shall be practically equal to the outlet pressure.

In the case of the embodiments illustrated in Figures 3, 6 and 7 it is preferred to measure the secondary pressure at a location between the pressure regulator 37 and the three-way valve 15, since the desired secondary pressure can then be set, with the aid of the pressure regulator 37, before the main delivery channel of the arrangement is opened, by opening the three-way valve 15.

The *aforedescribed* exemplifying embodiments of the arrangement according to the invention include a valve which comprises a valve plug and an opposing valve seat. The invention is not, of course, restricted to this particular type of valve, and it will be understood that any suitable type of valve or throttling device can be used for decreasing the through-flow area and therewith to lower the pressure in a pipe. The manner in which movement of the diaphragm 2 is transmitted mechanically to the valve is adapted to the manner in which the valve operates, e.g. rectilinear movement, rotational movement or hydraulic throttling of a rubber-sleeve section.

The valve according to the invention may also be provided with a spring in the chamber 6 corresponding to the spring 61 of the Figure 8 embodiment. This spring counter-acts the spring 14 in a manner such that the valve will be partially open when in its rest position. This may be desirable in certain applications to which the pressure changing arrangement according to the invention is put. This embodiment, however, assumes that the system includes a separate closing device, preferably upstream of the valve.

The use of an arrangement according to the invention is not restricted to dynamic, pneumatic or hydraulic machines, since the arrangement can also be used in other contexts in which a slow pressure increase to full pressure is desired, e.g. when depressurizing or evacuating a pressurized system.

The arrangement according to the invention can be used for transporting both gases and liquids in the main channel or delivery channel. A compressible medium, on the other hand, i.e. a gas, should be delivered to the chamber 6 through the throttle valve 17, 18, so as to achieve the desired slow rise in pressure. Alternatively, the chamber 6 may have enclosed therein a given quantity of gas capable of producing the same effect. This gas is preferably enclosed in a rubber bladder or the like, of the kind used, *inter alia*, in closed expansion vessels in heating systems.

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pressurized medium is supplied through a delivery channel which incorporates an inlet (24) and an outlet (26) and a closing and throttling device (9, 10) having a closing body (10), which is located between and mutually separates said inlet (24) and outlet (26) and which has a controlling influence on the pressure of the pressurized medium, and in which the closing and throttling device (9, 10) is actuated, via a setting means, e.g. a valve spindle (7), by a diaphragm (2), a piston or some corresponding device, with chambers (5, 6) on both sides of the diaphragm (2), i.e. one chamber (5) and another chamber (6), the other chamber (6) on the one side of the diaphragm (2) communicating through a connecting passage (22) with a source of pressurized medium (24), which throttling device (9, 10) is acted upon on the one side thereof in an opening direction and is acted upon on the other side thereof in a closing direction, by causing the one chamber (5) on said other side to communicate with said outlet (26), via a passage (25), and delivering pressurized medium having the same pressure as the outlet pressure, characterized in that the diaphragm (2), piston or corresponding device is actuated pneumatically or hydraulically on said one side by delivering to the other chamber (6) on said one side a pressurized medium taken from the source of pressurized medium (24, 38) via the connecting passage (22, 39) that incorporates a flow restricting section, e.g. a throttle valve (17, 18) which is operative in effecting time-delayed equalization of the pressure between said other chamber (6) and said source of pressurized medium (24, 38).

2. An arrangement according to Claim 1, characterized in that the pressurized medium is delivered from said inlet (24) or from a separate pressure medium inlet (38) and/or in that the other chamber (6) for producing a valve closing movement is evacuated to the surrounding atmosphere via a three-way valve (15), wherewith the pressure medium is preferably caused to flow from the other chamber (6) at greater speed through the flow restricting section (17, 18) and through a non-return valve (19—21) arranged parallel therewith.

3. An arrangement according to Claim 1 or 2, characterized in that the flow restricting section comprises a preferably adjustable throttle valve (17, 18) and/or a permanent constriction in the form of a narrower section in the connecting passage (22, 39) and/or in the form of a connecting passage which has a very small through-flow area along at least a part of its length.

4. An arrangement according to any of Claims 1—3, characterized in that the other chamber (6) is connected to the inlet (24) through said connecting passage (22).

5. An arrangement according to any of Claims 1—4, characterized in that the connecting passage (22, 39) incorporates a three-way valve (15) which when set to a first position connects the other chamber (6) on one side of the diaphragm (2) with the inlet (24) or the separate pressure medium inlet (38), and which when set to a second



position enables the other chamber (6) on one side of the diaphragm to be evacuated through an outlet (23), for example to atmosphere.

6. An arrangement according to at least one of Claims 1—5, characterized in that there is arranged between the other chamber (6) on said one side of the diaphragm (2) and the three-way valve (15) a non-return valve (19—21) which is connected in parallel with the flow restricting section, e.g. the throttle valve (17, 18) for quickly relieving the pressure in the other chamber (6) located on said one side of the diaphragm.

7. An arrangement according to at least one of Claims 1—6, characterized in that a pressure regulator (37) is arranged in the connecting passage (22, 39) and/or that the other chamber (6) is connected via the connecting passage (39) to a pressure medium inlet (38) from a separate pressure medium source.

8. An arrangement according to at least one of Claims 1—7, characterized in that the maximum opening position of the closing body (10) of the closing and throttling device is determined by an adjustable setting screw (36) and/or in that the position of the closing body (10) is determined by a further diaphragm (27), therewith a chamber (32) on one side of the further diaphragm (29) communicates with the inlet side (24) and an opposing chamber (33) communicates freely with the surrounding atmosphere.

9. An arrangement according to at least one of Claims 1—8, characterized in that the arrangement includes means for determining the pressure on the outlet side (26) of said arrangement, and/or means for determining the pressure in the other chamber (6) or in its connecting passage (22, 39) and/or that the arrangement includes means for remotely controlling the three-way valve (15) and/or the pressure regulator (37).

Patentansprüche

1. Einrichtung zur Druckänderung in pneumatischen oder hydraulischen Systemen, insbesondere druckluftbetriebenen Membranpumpen, wobei ein unter Druck gesetztes Medium durch einen Speisekanal zugeführt wird, welcher einen Einlass (24) und einen Auslass (26) sowie eine Schliess- und Drosselvorrichtung (9, 10) besitzt, wobei ein Schliesskörper (10) vorhanden ist, welcher zwischen Einlass (24) und Auslass (26) angeordnet ist und diese voneinander trennt, und welcher einen Regeleinfluss auf den Druck des unter Druck gesetzten Mediums ausübt, und wobei die Schliess- und Drosselvorrichtung (9, 10) über ein Einstellmittel, z.B. eine Ventilspindel (7), von einer Membran (2), einem Kolben oder einer entsprechenden Vorrichtung mit Kammern (5, 6) auf beiden Seiten der Membrane (2), d.h. einer Kammer (5) und einer anderen Kammer (6), betätigbar ist, wobei die andere Kammer (6) auf der einen Seite der Membrane (2) durch eine Verbindungspassage (22) mit einer Quelle für unter Druck gesetztes Medium (24) kommuniziert,

welche Drosselvorrichtung (9, 10) auf ihrer einen Seite in Öffnungsrichtung und auf ihrer anderen Seite in Schliessrichtung beeinflussbar ist, indem die eine Kammer (5) auf der genannten anderen Seite zum Kommunizieren mit genannten Auslass (26) über eine Passage (23) und zum Liefern von unter Druck gesetztem Medium mit dem gleichen Druck wie der Auslassdruck veranlasst wird, dadurch gekennzeichnet, dass die Membrane (2), der Kolben oder eine entsprechende Vorrichtung pneumatisch oder hydraulisch auf der genannten einen Seite betätigbar ist zum Fördern an die andere Kammer (6) auf der genannten einen Seite von unter Druck gesetztem Medium von einer Quelle (24, 38) hierfür über die Verbindungspassage (22, 39), welche einen Strömungsdrosselabschnitt besitzt, z.B. ein Drosselventil (17, 18), welches vorgesehen ist, einen zeitverzögerten Ausgleich des Druckes zwischen der genannten anderen Kammer (6) und der genannten Quelle für unter Druck gesetztes Medium (24, 38) zu bewirken.

2. Einrichtung nach Anspruch 1, dadurch gekennzeichnet, dass das unter Druck gesetzte Medium von genannten Einlass (24) oder von einem separaten Druckmediumeinlass (38) lieferbar ist, und/oder dass die andere Kammer (6) zum Erzeugen einer Ventilschliessbewegung an die umgebene Atmosphäre über ein Dreiwegeventil (15) entleerbar ist, wobei das Druckmedium vorzugsweise veranlasst wird, von der anderen Kammer (6) durch den Strömungsdrosselabschnitt (17, 18) und durch ein dazu parallel angeordnetes Rückschlagventil (19—21) unter grösserer Geschwindigkeit zu schliessen.

3. Einrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass der Strömungsdrosselabschnitt ein vorzugsweise einstellbares Drosselventil (17, 18) enthält und/oder eine permanente Verengung in Form eines engeren Abschnittes in der Verbindungspassage (22, 39) und/oder in Form einer Verbindungspassage, welche eine sehr kleine Durchflussfläche auf wenigstens einem Teil ihrer Länge aufweist.

4. Einrichtung nach einem der Ansprüche 1—3, dadurch gekennzeichnet, dass die andere Kammer (6) an den Einlass (24) über genannte Verbindungspassage (22) angeschlossen ist.

5. Einrichtung nach einem der Ansprüche 1—4, dadurch gekennzeichnet, dass die Verbindungspassage (22, 39) ein Dreiwegeventil (15) besitzt, welches bei Einstellung in einer ersten Lage die andere Kammer (6) auf der einen Seite der Membrane (2) mit dem Einlass (24) oder separaten Druckmediumeinlass (38) verbindet, und welches bei Einstellen einer zweiten Lage die Evakuierung der anderen Kammer (6) auf der einen Seite der Membrane durch einen Auslass (23) an z.B. die Atmosphäre ermöglicht.

6. Einrichtung nach wenigstens einem der Ansprüche 1—5, dadurch gekennzeichnet, dass zwischen der anderen Kammer (6) auf der einen Seite der Membrane (2) und dem Dreiwegeventil (15) ein Rückschlagventil (19—21) angeordnet ist, welchen zum Strömungsdrosselabschnitt, z.B.



dem Drosselventil (17, 18), parallelgeschaltet ist, zur schnellen Druckentlastung in der anderen Kammer (6) auf der genannten einen Seite der Membrane.

7. Einrichtung nach wenigstens einem der Ansprüche 1—6, dadurch gekennzeichnet, dass ein Druckregulator (37) in der Verbindungspassage (22, 39) angeordnet ist, und/oder dass die andere Kammer (6) über die Verbindungspassage (39) an einen Druckmediumeinlass (38) von einer separaten Druckmediumquelle angeschlossen ist.

8. Einrichtung nach wenigstens einem der Ansprüche 1—7, dadurch gekennzeichnet, dass die maximale Öffnungslage des Schliesskörpers (10) der Schliess- und Drosselvorrichtung von einer Einstellschraube (36) gebildet ist, und/oder dass die Lage des Schliesskörpers (10) von einer weiteren Membrane (29) bestimmbar ist, wobei eine Kammer (32) auf der einen Seite der weiteren Membrane (29) mit der Einlassseite (24) und einer entgegengesetzten Kammer (33) frei mit der umgebenen Atmosphäre kommuniziert.

9. Einrichtung nach wenigstens einem der Ansprüche 1—8, dadurch gekennzeichnet, dass die Einrichtung Mittel zur Bestimmung des Druckes auf der Auslassseite (26) der genannten Einrichtung und/oder Mittel zur Bestimmung des Druckes in der anderen Kammer oder in der Verbindungspassage (22, 39) besitzt, und/oder dass die Einrichtung Mittel zur Fernregulierung des Dreiwegeventiles (15) und/oder des Druckregulators (37) aufweist.

Revendications

1. Dispositif de modification de pression dans des systèmes pneumatiques ou hydrauliques en particulier des compresseurs d'air à diaphragme, dans lesquels un milieu sous pression est amené par un canal d'alimentation qui comprend une entrée (24) et une sortie (26) et un dispositif de fermeture et d'étranglement (9, 10) comportant un corps de fermeture (10), qui est logé entre, l'entrée (24) et la sortie (26) et les séparant mutuellement et qui exerce une influence de commande sur la pression du milieu sous pression, dispositif dans lequel le dispositif (9, 10) de fermeture et d'étranglement est commandé par l'intermédiaire de moyens de réglage, par exemple une queue de soupape (7), par un diaphragme (2), un piston ou un dispositif correspondant, des chambres (5, 6) étant situées de part et d'autre du diaphragme (2), c'est-à-dire, une chambre (5) et une autre chambre (6), l'autre chambre (6) située d'un côté du diaphragme (2), étant en communication par un passage de connexion (22) avec une source de milieu sous pression (24), ledit dispositif d'étranglement (9, 10) étant commandé d'un côté du diaphragme en position ouverte et de l'autre côté du diaphragme en position fermée, en créant la communication de la chambre (5) de l'autre côté avec ladite sortie (26), par un passage (25), et fournissant le milieu sous pression à la même pression que la pression de sortie, caractérisé en ce que le diaphragme (2), le piston, ou le dispositif

correspondant, est actionné de façon pneumatique ou hydraulique sur ledit côté en fournissant à l'autre chambre (6) sur ledit côté un milieu sous pression, à partir de la source de milieu sous pression (24, 38), par le passage de connexion (22, 39) qui comprend une section d'étranglement de flux, par exemple une vanne d'étranglement (17, 18), qui fonctionne avec un retard d'égalisation de la pression entre ladite autre chambre (6) et la source de milieu sous pression (24, 38).

2. Dispositif suivant la revendication 1 caractérisé en ce que le milieu sous pression est fourni par ladite entrée (24) ou l'entrée du milieu sous pression séparée (38) et/ou en ce que l'autre chambre (6) pour produire un mouvement de fermeture de vanne est vidée vers l'atmosphère environnante par une vanne à trois voies (15), le milieu sous pression provoque l'écoulement à partir de l'autre chambre (6) à plus grande vitesse au travers de la section d'étranglement de flux (17, 18) et au travers d'un clapet anti-retour (19, 21) disposé en parallèle avec elle.

3. Dispositif suivant l'une quelconque des revendications 1 ou 2 caractérisé en ce que la section de restriction de flux comprend une vanne d'étranglement préférentiellement ajustable (17, 18) et/ou un rétrécissement permanent en forme d'une section plus étroite dans le passage de connexion (22, 39) et/ou en forme d'un passage de connexion possédant une très petite section de passage le long d'au moins une partie de sa longueur.

4. Dispositif suivant l'une quelconque des revendications 1 à 3 caractérisé en ce que l'autre chambre (6) est reliée à l'entrée (24) par ledit passage de connexion (22).

5. Dispositif suivant l'une quelconque des revendications 1 à 4 caractérisé en ce que le passage de connexion (22, 39) comprend une vanne à trois voies (15) qui, lorsqu'elle est mise en une première position relie l'autre chambre (6) d'un côté du diaphragme (2) avec l'entrée (24) ou l'entrée (38) de milieu sous pression séparée, et lorsqu'elle est mise dans une seconde position, permet à l'autre chambre (6) du côté du diaphragme d'être vidée par une sortie (23) par exemple vers l'atmosphère.

6. Dispositif suivant l'une quelconque des revendications 1 à 5 caractérisé en ce qu'un clapet anti-retour (19, 21) est disposé entre l'autre chambre (6) d'un côté du diaphragme et la vanne à trois voies (15), ce clapet anti-retour étant connecté en parallèle avec la section de restriction de flux, par exemple la vanne d'étranglement (17, 18), pour réduire rapidement la pression dans l'autre chambre (6) disposée sur ledit côté du diaphragme.

7. Dispositif suivant l'une quelconque des revendications 1 à 6 caractérisé en ce qu'un régulateur de pression (37) disposé dans le passage de connexion (22, 39) et/ou l'autre chambre (6) est réunie par le passage de connexion (39) à une entrée de milieu sous pression (38) d'une source de milieu sous pression séparée.

8. Dispositif suivant l'une quelconque des revendications 1 à 7 caractérisé en ce que la position d'ouverture maximum du corps de fermeture (10) du dispositif de fermeture et d'étranglement est



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définie par une vis ajustable en position (36) et/ou dans lequel la position du corps de fermeture (10) est définie par un autre diaphragme (29), dans lequel une chambre (32) sur un côté de l'autre diaphragme (29) communique avec le côté d'entrée (24) et une chambre opposée (33) communique librement avec l'atmosphère environnante.

9. Dispositif suivant l'une quelconque des

revendications 1 à 8 caractérisé en ce qu'il comprend des moyens pour déterminer la pression sur l'orifice de sortie (26), et/ou des moyens pour déterminer la pression dans l'autre chambre (6) où dans son passage de connexion (22, 35), ou ce dispositif comprend des moyens pour commander à distance la vanne à trois voies (15) et/ou le régulateur de pression (37).

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