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(54) **Compressed-air economizing device.**

(57) A device (5) for economizing on compressed air, or other fluids under pressure fed to pneumatic cylinders (1) used for example in the field of machines and machine-tools in general.

The device comprises a pressure reducing valve (12), arranged within a first passage (9, 10, 11) for feeding the fluid to the cylinder (1) to be controlled, and a single-acting valve (25) located within a second passage (22) for the return of the fluid from said cylinder (1), which passage coaxially encircles the pressure reducing valve (12), thereby achieving a device with a compact and functional structure.

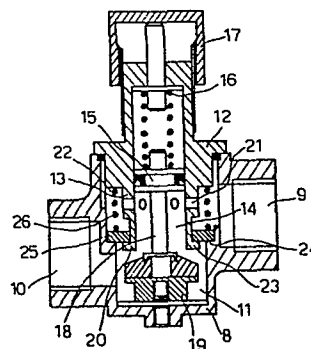


Fig. 2

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Compressed-air economizing device

This invention concerns a device for economizing on compressed air or other similar fluid used for controlling pneumatic cylinders of machine-tools or machines in general.

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Several appliances make use of pneumatic cylinders whose return stroke usually calls for a different and lower thrust power than that required for the working stroke; consequently the use of a compressed-air economizing device, arranged in the feeding circuit of such cylinders, makes it possible to carry out the return stroke of the piston, with compressed air at a reduced value; thus achieving a saving of energy which, for cylinders that carry out a considerable number of operations a day, adds up to an annual saving of thousands of litres of compressed air.

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The conventional design of a compressed-air economizing device foresees the use of a pressure reducing valve or reducer in a feeding duct of the pneumatic cylinder, parallel to which is a single-acting valve to allow the flow of the compressed air in the opposite direction to that of the pressure reducing valve. The devices known to date present a very complicated structure and consist substantially in placing a single-acting valve at the side of a pressure reducing valve. The device consequently proves to be cumbersome in size and expensive to manufacture insofar as it calls for various machining operations in order to form the passages for the fluid and the seats of the two valves within

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the same body.

This invention aims to remedy these problems by providing a compressed-air economizing device, structured in such a way as to substantially simplify its construction and to make it possible to substantially reduce its overall dimensions. The invention makes it possible moreover to optionally abolish the use of any springs whatsoever in the air flow passage thereby enabling the device itself to last longer and to function better.

Some embodiments of the compressed-air economizing device, according to this invention will be described hereunder with reference to the figures in the accompanying drawings, in which:

Fig. 1 shows a generic diagram of application of a compressed-air economizing device;
Fig. 2 shows a first possible solution for an economizer according to this invention;
Fig. 3 shows a second solution in which the single-acting valve has been modified with respect to the previous figure;
Fig. 4 shows an enlarged detail of the single-acting valve of fig. 3.

With reference to figure 1, this shows an example of application of a compressed-air economizing device for controlling a pneumatic cylinder 1, the working stroke of which must be carried out with a first value of thrust

power, by feeding for example compressed air at a pressure of approximately 5 or 6 Atm., whereas the return stroke can be carried out with a much lower value of power, for example with compressed air at a pressure of approximately 2 Atm.,
5 sufficient to overcome the friction in the system. Hence the chamber of the cylinder 1, on the opposite side to that of the rod 2, is connected directly to a source 3 of compressed air, through a distributor 4, whereas on the rod side it is connected to the aforementioned source, by means
10 of an economizing device 5 in order to avoid a pointless waste of compressed air, at high pressure, just for the return stroke of the cylinder 1. The pressure economizing device 5, in the diagram of figure 1, is schematically represented with the pressure reducer 6 inserted into a main
15 passage for feeding the fluid under pressure to the cylinder 1, parallel to which is a single-acting valve 7 for allowing the fluid to flow from the cylinder 1 towards an outlet, that is to say, in the opposite direction to that mentioned previously, during the working stroke of the cylinder.
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Figure 2 of the accompanying drawing shows a first embodiment of compressed-air economizing device, according to this invention. Such device comprises a body 8 conventionally defining an inlet 9 and an outlet 10 for the fluid.
25 Between the inlet 9 and the outlet 10 the body is provided with a cavity 11 defining a pressure reducing chamber, into which is inserted, for example, screwed in, the body 12 of an automatic pressure reducing valve, described hereunder.
30 The pressure reducing valve 12 comprises a sleeve or cylinder

drical baffle 13 which extends axially into the chamber starting from the body 12 of the valve; the sleeve 13 thus defines an internal rectilinear section 14, of the main passage for the fluid, between the inlet 9 and the outlet 10. Sliding within the sleeve 13 is a small piston 15 biased by a spring 16 the tension of which can be adjusted by acting upon a knob 17 in order to set the degree of reduction in the pressure. The piston 15 extends towards the chamber 11 by means of a stem 18 onto which is screwed or fixed a shutter 19 which is movable towards a valve seat 20 situated on the inner end of the baffle or sleeve 13, as shown.

Hence, the section 14 of the main passage of the fluid, defined within the sleeve 13, communicates directly, on one side, with the pressure reducing chamber 11, which, in turn, opens out towards the outlet 10, whereas on the other side it communicates, by means of secondary passages, for example, by means of radial apertures 21 formed in the wall of the sleeve 13 situated above a single-acting valve, described further on, with an annular chamber 22 which coaxially encircles the sleeve 13 and which opens out towards the inlet 9.

The annular chamber 22, as mentioned previously, is in direct communication with the inlet 9, however said annular chamber is also in communication with the fluid outlet 10, for example, through the pressure reducing chamber 11 itself, thus defining a branched out passage comprising a single-acting valve operating in the previously described

manner. In the case of this invention, such single-acting valve comprises an annular seat formed by a first circular ledge 23, on the outermost edge of the cylindrical sleeve 13, and by a second circular ledge 24 within the body 8 of the device; the two ledges 23 and 24 are radially separated from each other so as to create an annular passage for the fluid. The single-acting valve is completed, in the example shown in figure 2, by an annular shutter 25, movable within the annular chamber 22; the shutter is made to close, against the seats 23 and 24, by a spring 26 and by the pressure of the fluid itself which is exerted within the chamber 22, during the passage from the inlet 9 to the outlet 10 of the fluid for controlling the working stroke of the cylinder 1. Viceversa, during the return stroke of the cylinder, when the fluid under pressure must be discharged from the stem side of the cylinder 1, the shutter 19 of the pressure reducing valve 12 is forced to close, against the seat 20, by the pressure of the fluid itself, whilst the single-acting valve 23, 24 and 25, overcoming the counter force of the spring 26, is made to open.

The concentric arrangement of the pressure-reducing valve and of the single-acting valve, makes it possible to achieve a device with a compact and highly functional structure, insofar as the dimensions of the various parts and the sectional areas of flow of the fluid can be sized according to the desired capacity, keeping the overall dimensions of the entire device to a minimum. Moreover, the device may be made from any suitable material, at a very low cost, due to the fact, for example, that the body 8 of the device can

now be moulded without calling for special machining.

The example in figures 3 and 4 shows an alternative embodiment of the device, aimed at a different embodiment of the single-acting valve; consequently the parts which remain unchanged, with respect to the previous case, bear the same numerical references. The device of figure 3 also comprises a body 8 with an inlet 9 and an outlet 10 for the fluid in the indicated direction and a pressure reducing chamber 11 within which the reducing valve 19, 20 is situated. Reference 13 indicates the cylindrical sleeve, defining the section 14 of the main passage of the fluid and the annular chamber 22, coaxial to the sleeve itself.

In the case of figures 3 and 4, the reference numbers 23 and 24 still indicate the annular ledges on the sleeve 13 and on the body 8 of the device, defining the annular seat of the single-acting valve; unlike the previous example, here the shutter of the single-acting valve is made in such a way as to eliminate the need for any biasing spring whatsoever, due to the fact that any such spring could wear out as a result of its repeated and continuous operation, and due to the fact of being in direct contact with compressed air or a fluid which generally contains corrosive substances which tend to deteriorate the spring itself. The elimination of such spring and its replacement with elastic characteristics of the element itself designed to form a seal, makes it possible to substantially improve the device, whilst still maintaining the innovatory features of the previous example. Consequently, in the case of figures 3

and 4, the shutter of the single-acting valve consists of a flexible washer, comprising a circular band 27 which fits tightly into a groove 29 formed on the outside of the cylindrical sleeve 23, from which protrudes, radially, an annular flange 28 connected to the circular band 27, by means of a portion 30 defining a flexible hinge. The flange 28 fits tightly onto the aforementioned annular seats 23 and 24. Therefore, when the upper face of the flange 28, that is to say, that facing the annular chamber 13, is subjected to a greater pressure than that exerted upon the other face, the washer is pushed tightly against the seat 24, thereby closing the single-acting valve. On the contrary, when the inlet 9 is connected to the outlet, the flange 28 is raised by the return pressure which is exerted in the chamber 11, thus enabling the flow of compressed air in the opposite direction to that of the feeding. The use of a flexible washer in the previously described single-acting valve, proves to be extremely advantageous as it totally eliminates any possible causes of breakdown or faulty functioning of the device.

Claims

1. Compressed-air economizing device, comprising a body (8) defining a first main passage, from an inlet (9) to an outlet (10) for the fluid under pressure, in which passage is arranged a pressure reducing valve (6), and a second passage, parallel to the first, in which is arranged a single-acting valve (7) to enable the flow of fluid in an opposite direction to that of the aforesaid reducing valve (6), characterized by the fact that the body (8) of the device presents a cavity in which is situated a cylindrical sleeve (13) defining an internal section (14) of the main passage of the fluid, and formed with the seat (20) of the pressure reducing valve; said section (14) of the main passage defined by the cylindrical sleeve (13) communicates on one side, through secondary passages, with an annular chamber (22) encircling the aforementioned sleeve (13) which opens out towards the fluid inlet (9), whereas on the other side said section (14) of the passage communicates, through the reduction valve, with a pressure reducing chamber (11) which opens out towards the fluid outlet (10), said annular chamber (22) being moreover in communication with said outlet (10) through a branched off passage comprising a single-acting valve defined by an annular seat (23, 24) concentrically arranged to the reduction valve seat (20), and by an annular seal element (25, 28) within the chamber (22), which is pushed open, or closed, against the aforementioned seat (23, 24), by the pressure of the fluid itself.

2. Device as claimed in claim 1, characterized by the fact

that said seal element (25, 28) of the single-acting valve consists of an annular shutter (25) movable axially within the chamber (22) and biased towards the annular seat (23, 24) of the valve itself.

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3. Device as claimed in claim 1, characterized by the fact that said seal element of the single-acting valve consists of a seal having an elastically flexible portion of flange (28), which adheres tightly to the valve seat (23, 24).

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4. Device as claimed in claim 3, characterized by the fact that said seal is radially fixed, to a circular band (27), seated in a groove made on the outer surface of the cylindrical sleeve (13).

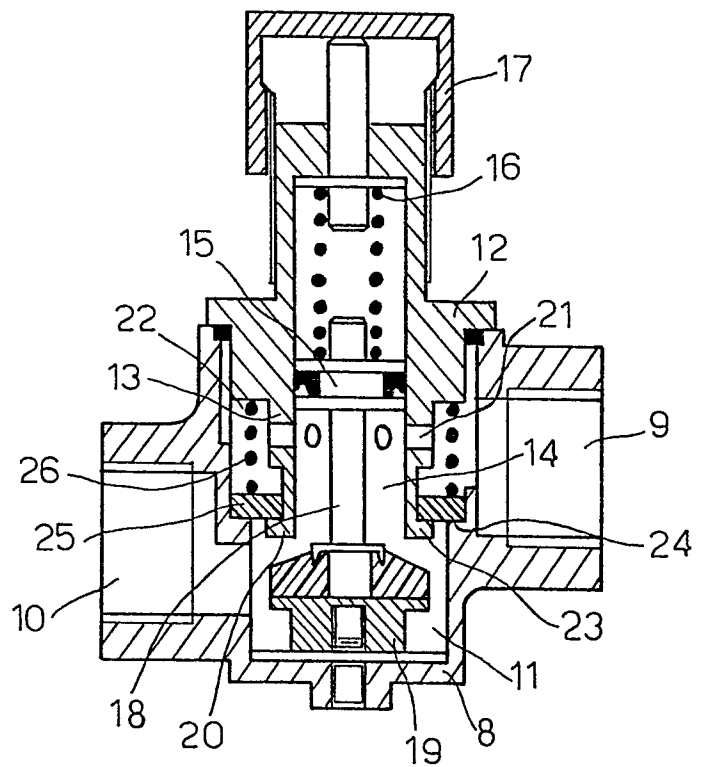
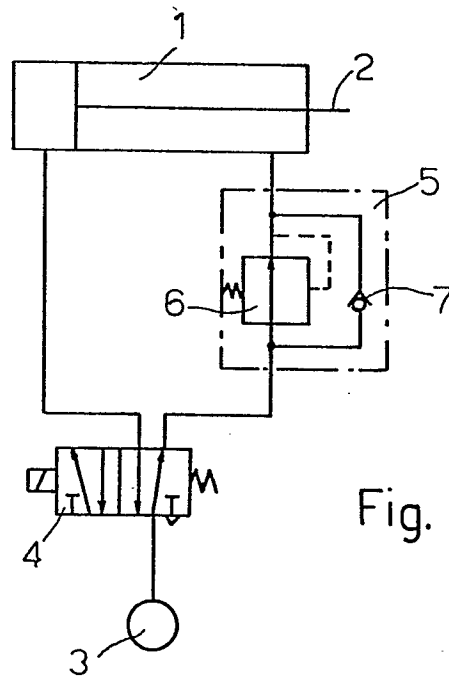
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5. Device as claimed in claim 1, characterized by the fact that said secondary passages (21) consist of radial apertures in the cylindrical sleeve (13), made above the single-acting valve seat (23, 24).

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6. Device as claimed in the previous claims, characterized by the fact that the pressure reducing valve and the single-acting valve are held on a single valve body (12) screwed into the cavity in the pressure reducing chamber (11), formed in the body (8) of the economizing device.

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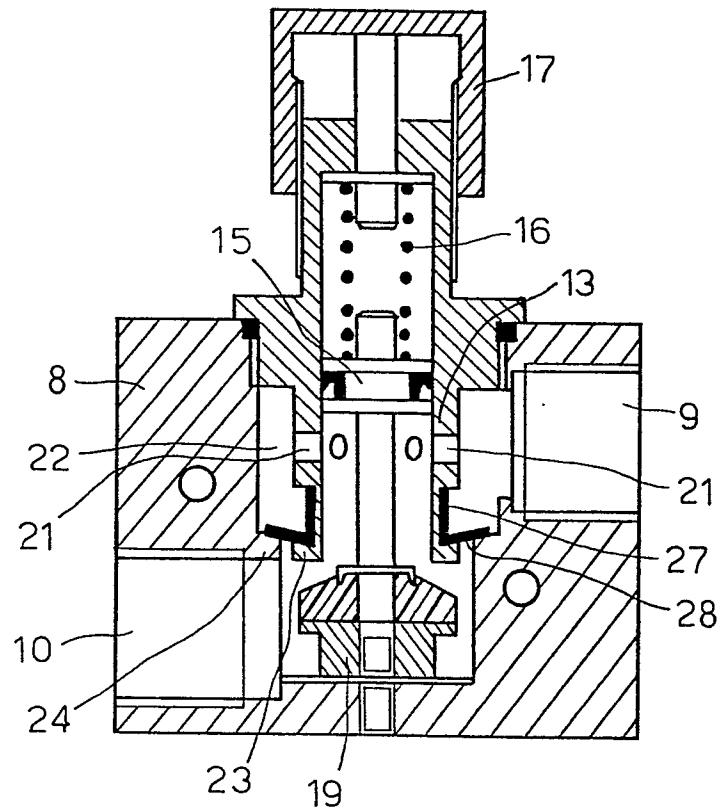


Fig. 3

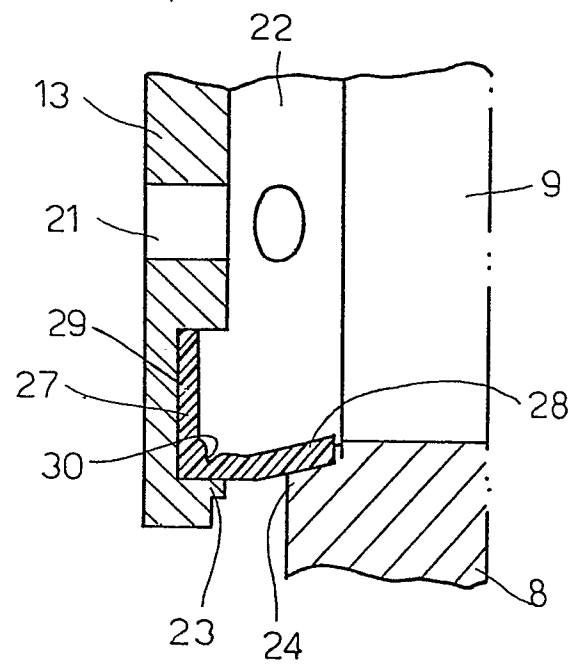


Fig. 4