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K. WERNER

HIGH PRESSURE CLOSING DEVICES

Filed March 5, 1941

Serial No.
381,815

4 Sheets-Sheet 1

Fig. 3.

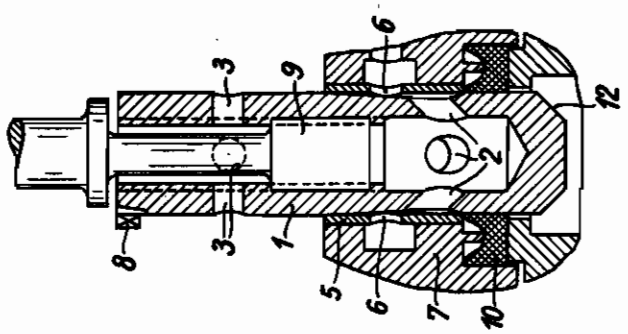


Fig. 2.

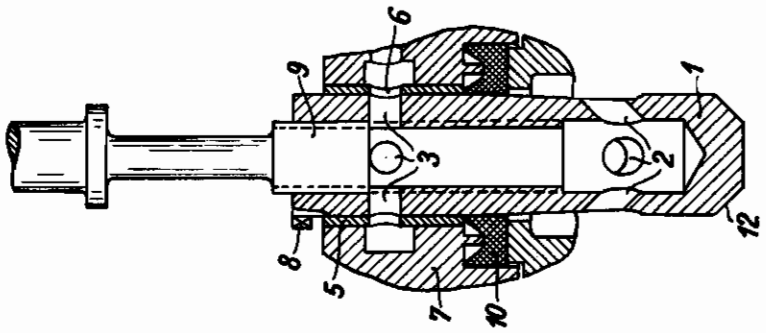


Fig. 1.

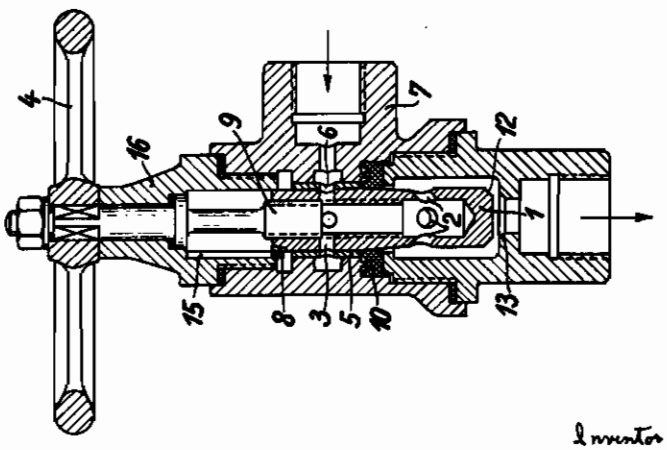


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Fig. 5.

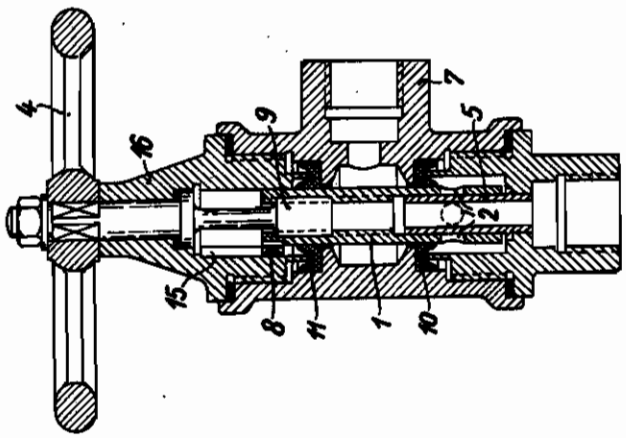


Fig. 4.

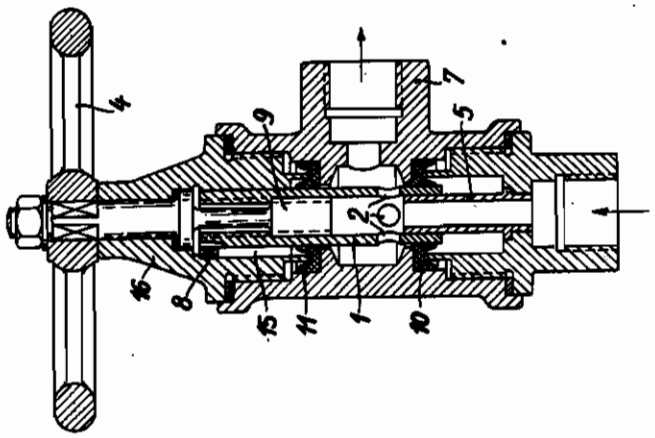


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Fig. 7.

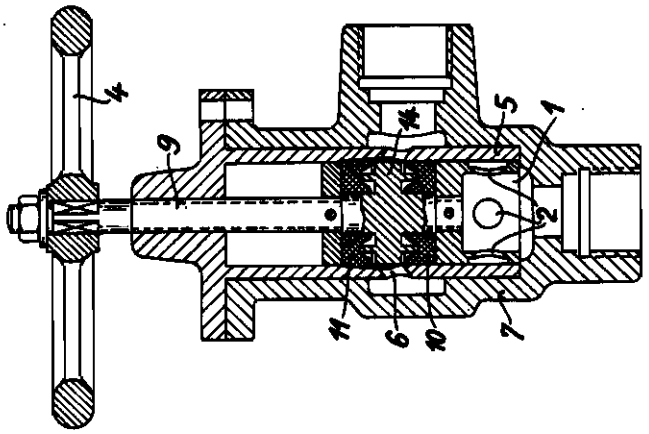


Fig. 6.

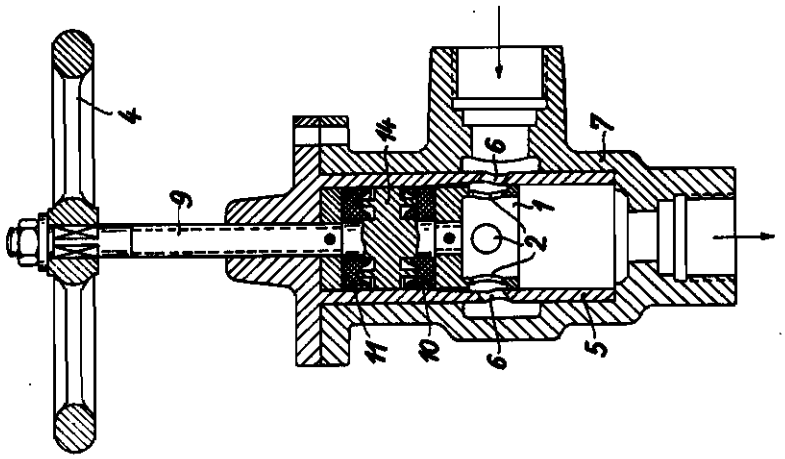


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Fig. 8.

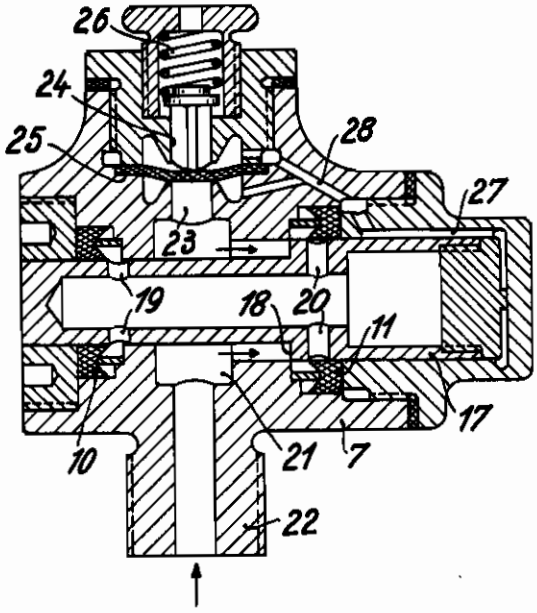
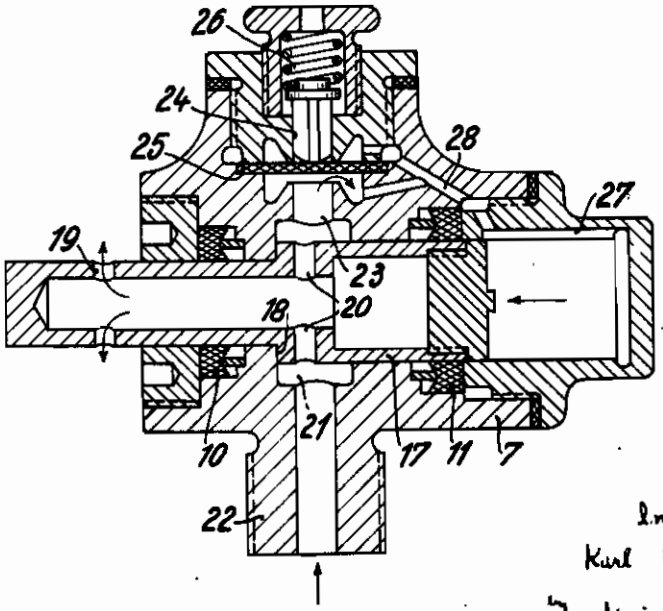



Fig. 9.

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# ALIEN PROPERTY CUSTODIAN

## HIGH PRESSURE CLOSING DEVICES

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Application filed Mareh 5, 1941

This invention relates to an improved high pressure closing device.

It is a fact well-known with high-pressure valves, particularly with those used for compressed air, and in which, in the closed state, sealing is effected by pressing metallic surfaces and edges upon each other, that they remain air-tight for a short period only, even if they be finished according to the best methods and the material be carefully selected. This is mainly due to the fact that the air passes along the seating surfaces at a very high velocity, especially when the valve cone is but slightly open, so that the sealing surfaces and edges quickly become scored by the action of solid particles, or, as experience has shown, even of water droplets, carried along by the compressed air.

To avoid this, the attempt has already been made to obtain the necessary tight sealing by seating the valve cone or disc on a somewhat softer or elastic material, such as special alloys of white metal, ebonite, cellon, and the like, and by pressing such cone or disc against such material by means of a high closing pressure. But even this method has proved unsatisfactory in the long run, because in this case the afore-mentioned scoring of the seating surfaces also takes place, quite apart from the fact that the seating surfaces finally become crushed as a consequence of their frequent and excessive compression. Most of the high pressure valves, therefore, present the disadvantage of becoming leaky in use after a certain period of service. The economic efficiency of the plant therefore suffers as a consequence of the constant loss of compressed air which in certain cases must absolutely be avoided.

Now, the construction of the device forming the subject of my invention follows a line deviating from the methods used heretofore. It consists in that, when closing the device, first a preliminary shut-off of the high-pressure line is accomplished by means of a slide valve which, on its own account and as experience has shown, does not produce a reliable seal. Furthermore, a lipped seal, e. g. a "Simmerit Grooved Ring Sleeve Packing", which, while inadequate as a direct packing for high-pressure valves yet has given highly satisfactory results with high pressure stuffing boxes, is provided at the points of leakage in question, located between the inlet and the outlet side, and is so arranged, similarly to the sealing surfaces of the preceding preliminary shut-off, as to lie outside the current of the high-pressure medium, thus eliminating damage due to the unrestrained action of said medium, and securely retaining such quantities of the leaking pressure medium, as might have penetrated thereto.

The accompanying drawings show four embodiments of the new closing device.

The embodiment according to Figs. 1 to 3 comprises a straight guided, tubular slide valve **1** closed at the bottom and having two rows of ports **2** and **3**. In Figs. 2 and 3 the same valve is represented on a larger scale. This tubular slide valve has an internal thread engaging with the thread of a spindle **9** which can be turned by a hand-wheel **4** but cannot be displaced axially. By turning the hand-wheel **4**, the tubular slide valve **1** may thus be screwed up and down in the stationary bushing **5** fitted into the three-part housing **7**. The bushing **5** has ports **6** with which the ports **3** of the tubular slide valve may be brought to coincide.

When it is intended to close the device represented in the opened state in Figs. 1 and 2, the tubular slide valve **1** is raised by turning the hand-wheel **4**. In doing so, its row of ports **3** moves away from the formerly coinciding row of ports **6** of the bushing **5**, passing the upper portion of the latter, which is not broken by openings. From this moment onwards, the current of high-pressure air which is admitted laterally through the branch of the housing **7** and escapes at the bottom end of the valve, is cut off, and only very little air is still allowed to penetrate between the bushing **5** and the periphery of the slide valve, which may be supposed to move therein with a sliding fit, as well as through the threaded connexion between the slide valve and the spindle, and thus to pass on to the outlet side. This leakage air which would escape and be lost if only the preliminary shut-off existed, is prevented from escaping according to my invention by the provision of a sleeve **10** of the grooved-ring type, encircling the tubular slide valve. This stuffing-box packing, which is in itself well-known, is fitted between the lower and the medium part of the housing **7** with a small axial play. When closing the slide valve (Fig. 3), the air pressure firmly presses the inner edge of the lips of the sleeve **10** to the outer cylindrical surface of the lower part of the slide valve, thus creating a reliable seal.

During the closing operation, i. e. while the tubular slide valve **1** is moving upward, the row of ports **2** passes through the grooved ring **10**, and care has to be taken not to injure the lip edge of the latter, as this is made of india-rubber and therefore easily damaged. For this purpose, the surface of the tubular slide valve **1** is recessed conically over its entire circumference above and

below the row of ports 2, and the edges of the ports 2 are rounded off. Furthermore, for the same reason the ports 2 are drilled in an angle to the axis, rising towards the outer side, i. e. in a direction coinciding with the position of the packing-lips. This ensures that the leakage air continuing to escape during the closing operation tends to separate the delicate lip-edge of the grooved ring from the tubular slide valve, which action also protects the grooved ring against damage.

The lower end of the tubular slide valve 1 is designed in the form of a valve cone 12 which, by turning the hand-wheel 4, can be screwed down to the seating 13 arranged in the housing. Thus, in case of emergency, the second seal between the inlet and the outlet side can also become operative at least for a short period, and the installation be kept working temporarily if, at any time, the grooved ring should exceptionally happen to fail, whereupon it will have to be replaced at the next opportunity.

Since the life of grooved-ring sleeves of such design has in numerous cases been tested and found satisfactory when applied to stuffing-boxes, their application, as described above, creates a shut-off device suitable for opening and closing, which distinguishes itself advantageously from the conventional types of valves, particularly on account of its reliability under very high pressures. It is also suitable for special conditions where the time allowable for repairs is frequently short, and only simple auxiliary means can be resorted to.

The second embodiment illustrated in Figs. 4 and 5 also comprises the straight guided tubular slide valve 1 which is provided with an internal thread and can be screwed up and down by means of the hand-wheel 4. With the slide valve 1 fully open (Fig. 4), the compressed air coming from the container—in this case from below—flows through the stationary bushing 5, which projects into the tubular slide valve 1, and passes out laterally through the openings 2 to the place of consumption. On screwing down the tubular slide valve 1, the bushing 5 covers the range of holes 2, constituting a preliminary shut-off of the current of compressed air (Fig. 5). Any leakage air escaping from between the tubular slide valve 1 and the bushing 5 as well as through the thread of said valve, thus putting the housing under internal pressure, is prevented from reaching the space in direct communication with the outlet pipe by the grooved ring 10 sealing below, and by a second grooved ring 11 sealing above said space. In this case the compressed air once again presses the edges of the lips of the grooved rings tightly against the outer surface of the tubular slide valve 1, sealing said surface. In the examples according to Fig. 1 to 5, the tubular slide valves 1 have lugs 8 guided in grooves 15 cut in the cap 16 of the housing 7, which lugs 8 serve to prevent turning the tubular slide valve 1 during its vertical movement.

The arrangement adopted for preventing damage to the grooved ring 10 during the passage of the row of ports 2 is similar to that of the first embodiment.

In the third embodiment, illustrated in Figs. 6 and 7, the current once more follows the direction shown in the example first described, namely from top to bottom. The slide valve serving as a preliminary shut-off of the compressed air, is however of a somewhat different design as it has a piston-shaped part 14 fitted with two grooved rings 10 and 11, the lips of which face each other, while its lower end is fitted with a short tubular part 1, open at the bottom and provided with ports 2. In addition, this example differs from the two others in that the slide valve, on turning the hand-wheel 4, rotates with the spindle 9 which, in turn, engages with the thread of the housing 7, in which it moves up and down.

When the device is open (Fig. 6), the compressed air can flow from the cylinder to the place of consumption, passing through the ports 6 of the stationary bushing 5 and the ports 2 of the tubular slide valve 1. On screwing down the piston 14, the non-perforated wall located in the lower part of the bushing 5 provides a preliminary shut-off for the ports 2. In this final position of the slide valve, the grooved rings 10 and 11 are situated on both sides of the ports 6 of the bushing 5. Consequently, when the compressed air has reached the piston 14 it cannot escape either towards the top or the bottom of the valve, as the air firmly presses the outer lips of the grooved rings against the inner wall of the bushing 5, thus ensuring an entirely reliable seal.

The application of a like arrangement ensuring particular and reliable cooperation between the slide valve and the grooved ring packing, is also possible in connection with automatic valves. Thus, as the fourth embodiment, Figs. 8 and 9 show a safety valve, the reference numbers of which correspond, in part, to those of the embodiments already described. In the housing 7 is mounted a slide valve 17 designed as a hollow differential piston, which on both sides of its shoulder 18 and within range of the smaller and greater diameters is provided each with a series of slots 19, 20 and surrounded each by an elastic grooved ring 10, 11. Communicating with an annular space 21, encircling the slide valve 17, is on the one side the connecting branch 22 of the pressure line, and on the other a bore 23 the wall of which in the opposite direction tapers down to edge-like form. Between the latter and an identical edge located a certain distance apart therefrom, but in opposite direction, of a coaxial bore 24 open to the atmosphere, there is a membrane 25 which by the action of a tensioned spring 26 lies against the edge of the bore 23. Extending to the outer end of the bore receiving the greater step of the slide valve 17, and arranged thereon, is a longitudinal groove 27 connected with a bore 28 bifurcating one each branch to either side of the membrane 25.

So long as the pressure to be controlled in the respective container, tube or the like remains at normal height or below the admissible limit, the membrane 25, according to Fig. 8, seals the bore 23. At the same time, the greater face of the slide valve 17 is relieved by the communication of the groove 27 with the atmosphere, so that the slide valve 17 is subjected to the action of the pressure medium at its shoulder 18 only and is thereby held in closed position.

As, however, the pressure on the valve becomes excessive, the membrane 25, against the action of the adjustably loaded spring 26, is brought into the position according to Fig. 9, in which the groove 27 is shut off from the bore 24 open to the atmosphere, and is, in exchange, connected with the bore 23 being under pressure. The pressure medium now can also impinge upon the greater face of the slide valve 17, pushing the same to the left into its opened position, in which the annular shoulder serves as a stop for limiting the stroke. At this point, however, the slide valve

17 will only remain until the pressure of the medium, owing to its issuing into the atmosphere by way of the slots 20, 19, has decreased to an amount somewhat below the admissible maximum limit. The preponderance of the spring load acting upon the membrane 25 then re-establishes the state shown in Fig. 8. The faces arranged in the interior of the slide valve 17 are acted upon by the pressure medium with equal force in opposite directions.

Inversely, a valve of this character may also be used in closing a normally open connection, when the pressure falls below an admissible lower limit. In such a case, the valve only seals upon the occurrence of an undesired working condition. It may then in certain circumstances be useful in the design of the slots in the slide valve to take cognisance of the necessity of adapting the throttling effect due to the passage of the air through the slide valve, to the conditions prevailing in each case. Furthermore, an arrangement of substantially similar character may likewise be used in automatic closing and automatic opening, upon surpassing, or falling below, a predetermined pressure. It is only necessary to this effect to modify the arrangement of the slots, bores, etc. in a suitable manner. Finally, in order to protect the inner sealing lips of the two grooved rings, similar measures may be taken as in the case of the other embodiments.

The combination of a main and an auxiliary regulating member, of which the latter only is spring-pressed, is well-known in itself with other types of valves. The advantage it offers and which resides in the fact that the opening and the closing movements of the main regulating member, which movements should be accomplished at the critical moment with the greatest possible celerity, are not restrained by an increasing spring tension, still enhances the suitability of the present device. But even if for some reason or other, for example in order to avoid the stepped arrangement of the slide valve, its normal position is more conveniently maintained or re-established by a tensioned spring rather than by the pressure medium acting upon its shoulder, this object is achievable by means of a relatively weak spring which only need overcome the frictional resistance due to the displacement of the slide valve, but no counter-pressure.

The above described four embodiments of the novel closing device are therefore in conformity with each other in that, when closing, a preliminary shut-off is first accomplished by means of a slide valve, and that subsequently thereto a final shut-off of the compressed air having an action similar to that of a stuffing-box is obtained by using grooved rings known in themselves (for example in the nature of the well-known "Simmerit Grooved Ring Sleeve Packing"). All the elements are so arranged that the surfaces and/or parts contributing to effect tightness, lie outside the main path followed by the pressure medium. Provisions are also made to prevent the delicate edge of the lips of the grooved rings from being damaged on passing the ports.

KARL WERNER.