April 17, 1928. 1,666,609

H. SÖFFGE

PRESSURE REGULATOR

Filed Feb. 11. 1927

Fig. 1.

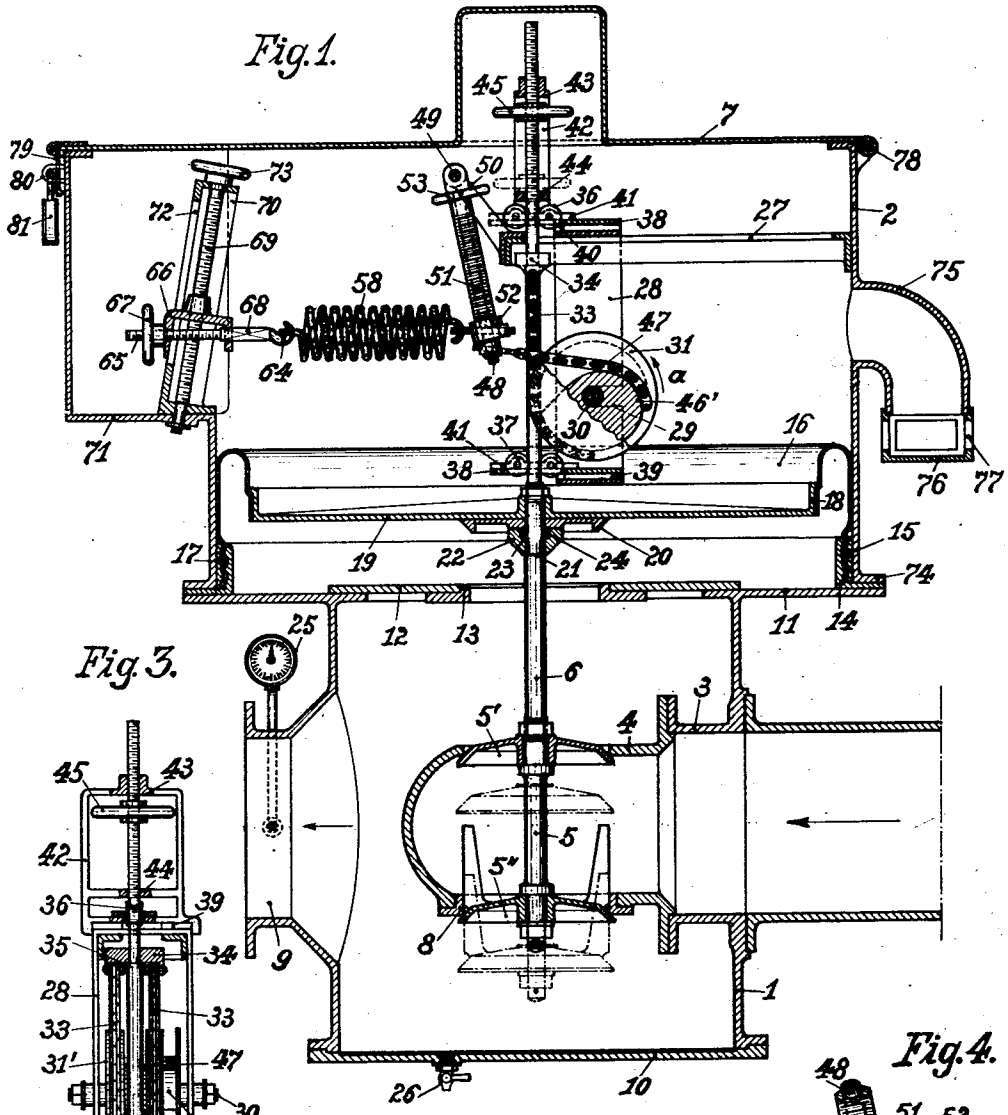


Fig. 3.

Fig. 2.

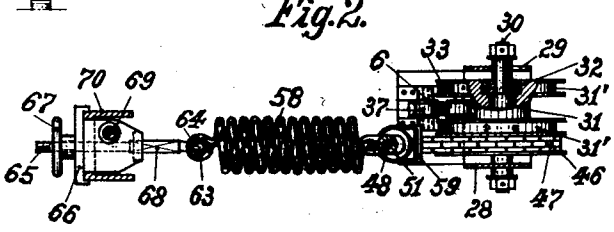
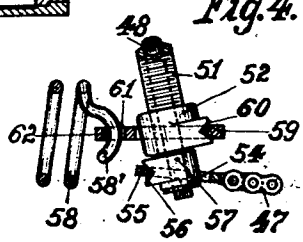


Fig. 4.



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Patented Apr. 17, 1928. 1,666,609

UNITED STATES PATENT OFFICE.

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PRESSURE REGULATOR.

Application filed February 11, 1927, Serial No. 167,499, and in Germany February 16, 1926.

Spring-actuated pressure-regulators wherein the opening-resistance of a valve is regulated by means of a cam-shaped disk in such a manner that the leverage of the spring accommodates itself to the last adjustment of the tension of the spring, are known. Pressure-regulators working thus as pressure-reducing valves were expected to keep any new pressure continuously at the same height, but this result has never been fully attained, because the configuration of the cam-shaped disk would, on account of the disproportionality of the spring, have to undergo a correction at every new adjustment of the spring when otherwise the desired result were to be fully attained. Such corrections are, however, for more than one reason impracticable.

The object of my present invention is to provide a pressure-regulator equally well adapted for gases, air, vapours and steam and capable to avoid the drawbacks pointed out above. To this end I do not simply change the tension of the spring to suit the desired new pressure of the medium under consideration, as it has hitherto been the case, but arrange the spring bodily in such a manner that the relative position of the whole spring, or the position of its points of attachment to the adjusting-mechanism, is made variable in such a manner that the ends of said spring may be moved independently of each other along on slides and secured thereto at any point. I thus regulate the moment of force transmitted by the spring to the valve not only by varying the tension of the spring but also by varying the value of the leverage thereof.

In the accompanying drawing one embodiment of my invention is illustrated by way of example.

Figure 1 is a longitudinal sectional view of my improved pressure-regulator.

Figure 2 is a plan view of the principal working elements, partly in section.

Figure 3 is an elevation of the upper part of the valve-spindle, chain-drum and other parts cooperating therewith, likewise partly in section.

Figure 4 shows details of construction on a larger scale.

My improved pressure-regulator for gases, air, steam and vapours broadly consists of a lower casing 1 and an upper casing 2 which mutually contain the necessary cooperating elements. The casing 1, preferably circular in shape, is provided with a stub inlet-pipe 3 which carries the casing 4 of a double-seat valve 5 provided with a spindle 6 passed upward through the upper casing 2 into the domed cover 7 of the latter. Of the two valve-members 5′ and 5″ the upper member is seated in the valve-casing 4 directly whereas the lower member is seated in an annular valve-seat 8 provided for a convenient introduction of the valve 5. On the opposite side of the casing 1 an outlet-pipe 9 is arranged, preferably in line with said inlet-pipe 3. The casing 1 is further provided with a detachable bottom 10 and with an annular top-flange 11 of which the inner rim projects inwardly for the support of a ring 12 provided with a valve-seat 13. Upon the outer part of said flange 11 the horizontal flange of a bottom-ring 14 is arranged the vertical flange of which is provided with an external screw-thread 15, preferably of wavy cross-section in order not to injure the lower rim of a membrane 16, composed of leather, or rubber, or a similar material when the medium passed through the regulator is a gas or air, but preferably of a metallic substance when the pressure of certain vapours or steam is to be regulated. The lower rim of the membrane shown in Figure 1 is secured to the externally threaded vertical flange of the bottom-ring 14 by means of an annular nut 17 and the upper rim of said membrane is connected with the vertical flange 18 of a ribbed disk 19 secured to the valve-spindle 6 in the manner indicated in Figure 1. To the under side of the disk 19 is secured a conical valve-body 20 adapted to close the valve-seat 13 for a purpose to be explained later on. Between said valve-body 20 and a shoulder 21 of the valve-spindle 6 a ring 22 is arranged wherein a recess 23 is provided for the reception of a suitable packing 24 to make this connection particularly gastight. It goes without saying that all the joints mentioned hitherto must be absolutely gastight as otherwise losses of gas, air and so forth would be unavoidable. For rendering such joints tight, various ways and means may be employed for which reason no particular joint is shown. The outlet-pipe 9 is provided with a pressure-gage 25 and the casing-bottom 10 with a drain-cock 26.

Within the upper casing 2, preferably likewise circular in shape, a bracket 27 is arranged which carries in close proximity

to said valve-spindle a hanger 28 rectangular in shape. This hanger retains in its slots 29 the stationary shaft 30 of a chain-drum 31 provided with ball-bearings 32 to reduce the frictional resistance of said drum to a minimum. The latter is also provided with two chain-rims 31′ adapted to receive and guide chains 33. Each of said chains is secured at the one end in one of said chain-rims and at the other end to a cross-head 34 rotatably seated upon a shoulder 35 of said valve-spindle. These chains 33 are preferably in shape and construction similar to bicycle-chains or flat link-chains.

The valve-spindle 6 moves between said chain-rims 31′ and is guided by the two sets of guide-rollers 36 and 37, of which each set is arranged upon one of the platforms 38 elevated on the horizontal members of said hanger 28 by intermediate blocks 39 to assure the free rotation of said guide-rollers on their axles 40 which are held in position by bearing-caps 41 secured to said platforms 38. A bracket 42 integrally or otherwise firmly connected with the upper platform 38 is provided with two abutments 43 and 44 respectively for an internally threaded hand-wheel 45 seated upon the threaded upper end of said valve-spindle, as shown in Figures 1 and 3.

The chain-drum 31 is also provided with a third chain-rim 46 the bottom 46′ of which is cam-shaped and does not run concentrically to the axis of the chain-drum. This cam-shaped part 46′ has an outline more or less in conformity with the evolute line in order to satisfy a demand more fully to be explained later on. At or near the point of this curve most remote from the axis of said chain-drum a chain 47 of a construction similar to that of the chains 33 is secured in any suitable manner and is then led to the free end of a lever 48 adapted to swing on a shaft 49 journalled in a bracket 50 attached to the free end of said bracket 27, as shown in Figure 1. Upon this lever 48 is seated an externally threaded sleeve 51 adapted to be screwed into an annular nut 52 by means of a hand-wheel 53 integrally or otherwise firmly connected with said threaded sleeve. The chain 47 is attached to the free end of the lever 48 by means of a stirrup 54 whose straight cross-bar 55 enters with its knife-shaped edge into an angular notch 56 of an eye 57 loosely seated on a reduced end of said lever 48 whereon it is held in place by a washer and a pin, as shown more clearly on a larger scale in Figure 4. In a similar manner the inwardly directed end of a cylindrical spiral-spring 58 is connected with said annular nut 52 by means of a stirrup-shaped link 59 which enters with its straight knife-edged cross-bar into an angular notch 60 of said nut and receives in its eye 61, provided with a wedge-shaped rib 62, the hooked end 58′ of said spring 58, as likewise more clearly shown in Figure 4. All the points of contact shown in Figure 4 are thus executed to reduce the friction at these points of contact to a minimum. The outwardly directed end of said spring 58 is provided with an eye 63 for the reception of the hook 64 of a tension-screw 65. This screw passes through a flanged nut 66 and is provided with a hand-wheel 67. A rotation of the screw 65 and a simultaneous torsion of the spring 58 during the slackening or tensioning of the latter is prevented by the square or rectangular portion 68 of said screw which passes through a pending member of the nut 66. The latter is seated on an adjusting-screw 69 journalled in a bracket 70 arranged at an angle to the bottom of a lateral extension 71 of the upper casing 2. The flanged nut 66 is guided in a slot 72 of the bracket 70 and is kept in facial contact with the latter by the tension of the spring 58. The adjusting-screw 69 is held against longitudinal displacement by the hub of the hand-wheel 73 and by an externally arranged washer and pin, as indicated in Figure 1.

The upper casing 2 is connected by means of its bottom-flange 74 with the bottom-ring 14 and the top-flange 11 of the lower casing and is provided with an elbow 75 to which a baffler 76 with lateral windows 77 is secured. The domed cover 7 of the casing 2 is hinged to the latter at 78 and furnished with a latch 79 adapted to be pushed over a staple 80 of the casing 2 in order to secure said cover to the latter by means of a padlock 81 and thus prevent any unauthorized admission to the adjusting elements contained in the casing 2.

My improved pressure-regulator operates as follows:—To open a passage for the medium (gas, air, vapour or steam) whose pressure for one reason or another is to be lowered and maintained at this lower pressure, the double-seat valve 5 is removed from its seats by means of the hand-wheel 45 which is screwed upward until it bears against the upper abutment 43 after which said hand-wheel is rotated until the valve-members 5′ and 5″ have approximately attained the positions indicated in dotted lines in Figure 1. After this the hand-wheel 45 is screwed downward to provide sufficient longitudinal play for the valve 5. During this preliminary adjustment of the valve the chains 33 as well as the chain 47 will be kept taut by the action of the spring 58, whereby the chain-drum 31 is rotated in the direction of the arrow *a*. Now, to equalize the upwardly acting force created by the pressure of the medium on the ribbed disk 19 and on the membrane 16 and always ready to raise the double-seat valve 5, the spring 58 must be tensioned until the force exerted by it on

the chain 47 and through it on the chain-rim 46 equals the upwardly acting force. At the moment when the equilibrium of these forces is attained the pressure-gage 25 will show the pressure at which the medium leaves the casing 1 on its way to the place where it is to be used.

According to the position of the valve 5 determined by the tension of the spring 58 the free sectional area of the passages for the medium from the inlet-pipe 3 to the outlet-pipe 9 is fixed and simultaneously therewith the height of the desired new pressure given. The same pressure which predominates in the interior of the casing 1 will also be found in the upper chamber 2 beneath the membrane 16. When increases in the pressure of the medium contained in the inlet-pipe 3 take place, they will be immediately transmitted to the membrane 16 and raise it. The result of this upward motion of the membrane 16 and the ribbed plate 19 connected thereto will be a reduction of the area of the passage for the medium. The spring 58 will hereby be stretched to a certain extent and thereby the tension of the spring increased. But since simultaneously with the upward motion of the valve-spindle 6 the chain-drum 31 will be rotated too, the last point of contact between the chain 47 and the cam-shaped portion 46′ of the chain-rim 46 will travel sufficiently to reduce the distance between this new point of contact and the axis of the chain-drum 31 and thus compensate for the increase of power gained by the stretching of the spring, so that a counter-pressure of always the same value is assured. The curvature of the cam-shaped portion 46′ of the chain-rim 46 of the chain-drum is designed with a view to obtain a resistance which shall be the same for every position of the valve 5. By means of this property a most delicate regulation of the pressure is made possible so that even the smallest variations in the primary pressure of the medium contained in the inlet-pipe will be equalized automatically.

When for instance it is desirable to let the medium pass from the casing 1 into the outlet-pipe 9 at a lower pressure than considered above, the ends of the spring 58 will be drawn upward on the bracket 70 and on the lever 48 which oscillates on the shaft 49. This is accomplished in the first instance by means of the screw 69 and in the second instance by the externally threaded sleeve 51. Both devices may be regarded as slides on which the ends of the spring 58 can be held stationary at any desirable point. Through this transposition of the spring the active length of the lever 48, i. e. the distance between the point of attachment of the spring 58 and the axis of the axle 49, will be diminished and simultaneously the tension of the spring reduced, since the bracket 70 which hereby acts as a slide is arranged at a certain angle to the bottom of the extension 71. The reduction of the force exerted by the spring indirectly on the membrane 16 and necessary to obtain the desired lower pressure in the outlet-pipe 9 is in the present instance partly obtained by a reduction of the leverage of the spring and partly by a diminution of the tension thereof. By the selection of the correct angle of inclination for the stationary slide, i. e. the bracket 70, and by the determination of the distance to which the spring 58 must be raised parallel to itself, the condition under which the equilibrium of this lower pressure of the medium can likewise be readily induced, notwithstanding the disproportionality of the spring 58; since the counterforce exerted upon the membrane 16 remains constant during all variations in the position of the valve 5.

In case the membrane 16 has to be repaired or renewed the conical valve-body 20 is pressed upon the valve-seat 13 to exclude the medium from the casing 2, to which end the hand-wheel 45 is screwed against the abutment 43. When the valve 5 has to be shut said hand-wheel is screwed against the abutment 44 as indicated in dotted lines in Figure 1.

It is expedient to position the stationary bracket 70 as an inclined plane, as shown in Figure 1, since in doing so it is only necessary to raise the spring parallel to itself into a new position to obtain any desirable new pressure in the pipe 9. This construction I prefer at present to others but I am aware that it would be possible to arrange the bracket 70 vertically and bring the necessary diminution of the tension of the spring 58 about by means of the hand-wheel 67 and to determine the leverage of said spring as explained above. Another possibility to attain the desired end in view is, to arrange the right-hand end of the spring 58 movable on the sleeve 51 and keep the left-hand end thereof stationary, in which case it would be necessary to alter the leverage of the spring by the aid of the hand-wheel 53 and lessen the tension of the spring 58 by means of the hand-wheel 67. In view of these facts I do not desire to limit myself to the embodiment of my invention shown but wish it to be understood that I shall consider all pressure-regulators working in the manner explained above as to fall within the scope of my present invention.

I claim:—

1. A pressure-regulator comprising a casing with an inlet and an outlet for the medium, a double-seat valve for admitting the medium at primary pressure into said casing, a spindle on said valve, a disk seated on said valve-spindle, a membrane arranged

between the walls of the casing and said disk and adapted to move said valve in one direction jointly with said disk when acted upon by the admitted medium, a rotary body, pliant means connecting said rotary body with said valve-spindle, a spiral spring adapted to move said valve in the opposite direction and hold it in equilibrium, pliant means connecting said rotary body with said spring, adjustable means for bodily displacing said spring for determining any desired new pressure of the medium, and means for indicating the new pressure.

2. A pressure-regulator comprising a casing with an inlet and an outlet for the medium, a double-seat valve for admitting the medium at primary pressure into said casing, a valve-spindle extending longitudinally in said casing, a disk seated on said valve-spindle, a membrane connected with one of its rims to said disk and with the other rim to the casing and adapted to raise said valve jointly with said disk when exposed to the action of the admitted medium, a chain-drum, chains connecting said chain-drum with said valve-spindle, a spiral spring, a bracket, a nut adjustably mounted in said bracket and connected with one end of said spring, an oscillating lever, an annular nut adjustably mounted on said lever and connected with the other end of said spring, a cam-shaped body on said chain-drum, and a chain connecting said cam-shaped body of said chain-drum with the free end of said lever to oppose the force jointly created by said disk and said membrane and keep it in equilibrium by the force created by said spring.

3. A pressure-regulator comprising a subdivided casing provided with an inlet and an outlet for the medium, a double-seat valve for regulating the admission of the medium at primary pressure into the lower part of said casing, a valve-spindle extending longitudinally upward in said casing, an annular division-plate, a disk seated on said valve-spindle, a bottom-ring provided with a vertical flange, a membrane connected with its inner rim to said disk and with its outer rim to said bottom-ring, a chain-drum, a cam-shaped body on said chain-drum, a cross-head on said valve-spindle, chains connecting said chain-drum with said cross-head, a spiral-spring, an inclined slotted bracket, a nut slidingly arranged in said bracket, an adjusting-screw adapted to move and retain said nut at any point in said slot, a second adjusting-screw passing through said nut and connected with the one end of said spring, an oscillating-lever, an externally threaded sleeve mounted on said lever, an annular nut seated on said sleeve, a stirrup-shaped link connecting said nut with the other end of said spring, an eye seated on the free end of said lever, a chain attached at the one end with said cam-shaped body of said chain-drum and at the other end to said eye to oppose the upwardly directed force created by said membrane and said disk cooperating therewith and keep it in equilibrium by the downwardly directed force created by said spring.

4. A pressure-regulator comprising a subdivided casing provided on its lower part with a medium-inlet and a medium-outlet, a double-seat valve for regulating the admission of the medium at primary pressure into the lower part of said casing, a spindle of said double-seat valve extending upwardly through said casing, an annular division-plate, a valve-seat carried by said division-plate, a disk carried by said valve-spindle and provided with a vertical flange, a bottom-ring held between the two divisions of said casing and provided with an externally threaded vertical flange, a hood-shaped membrane secured with its inner rim to said disk, an annular nut adapted to fasten the outer rim of said membrane to said externally threaded flange, a bracket radially arranged in said casing, a hanger supported by said bracket, a chain-drum arranged in said hanger, a cross-head carried by said valve-spindle, chains connecting said chain-drum with said cross-head, guide-rollers for said valve-spindle, an overhanging bracket on said radial bracket, an oscillating lever carried by said overhanging bracket, an externally threaded sleeve on said lever, an annular nut an said sleeve, a spiral spring with a hook on its inner end, a stirrup having an eye with an edged rib for said hook and a knife-edged cross-bar adapted to enter into a notch of said annular nut, a guide-bracket arranged at an incline, a flanged nut movably seated in said guide-bracket, an adjusting-screw adapted to move said nut in said bracket and retain it therein at any point, a second adjusting-screw passed through the same nut and connected to the outer end of said spring, an eye rotatably seated on the free end of said lever, a cam-shaper body on said chain-drum having its working face shaped to keep the moment of force of said spring constant, a chain passed at the one end over said cam-shaped body and attached at the other end by a stirrup-shaped link to said eye to oppose the force created by said membrane and said disk cooperating therewith and keep it in equilibrium by the force created by said spring.

5. A pressure-regulator comprising a subdivided casing with an inlet and an outlet for the medium, a double-seat valve for admitting the medium at primary pressure into said casing, a valve-spindle extending upwardly in said casing, an annular division-plate provided with a valve-seat, a disk carried by said valve-spindle and carrying on its under-side a valve-body in register with

said valve-seat, a membrane connected with its inner rim to said disk and with its outer rim to said casing and adapted to raise said valve in conjunction with said disk when exposed to the admitted medium, a radially arranged bracket, a hanger carried by said bracket, a chain-drum supported in said hanger, chains connecting said chain-drum with said valve-spindle, a spiral spring, a stationary bracket arranged at an angle, a nut slidably and adjustably arranged in said bracket and adjustably connected with the adjacent end of said spring, an oscillating lever, an externally-threaded sleeve on said lever, a nut on said sleeve and connected with the inner end of said spring, an eye seated on the free end of said lever, a cam-shaped body arranged on said chain-drum, a chain attached to said eye and said chain-drum whereby it passes over said cam-shaped body, rollers for guiding said valve-spindle, a hand-wheel on the threaded end of said valve-spindle, a bracket with abutments for said hand-wheel, a cover hinged to said casing and provided with locking-means, and a baffle on the upper division of said casing for a quiet exit of air from said casing.

6. A pressure regulator comprising a casing, a valve for admitting a medium at primary pressure into said casing, a membrane adapted to move said valve in one direction, a spring adapted to move said valve in the other direction until equilibrium is established, an oscillating lever, means connected with said spring and adjustably mounted on said lever for varying the leverage of the spring, a cam-shaped body connected by a pliant element with said lever for transmitting the resistance of the spring invariably to said valve, and means for shifting said spring for obtaining any desired ratio between the primary pressure and the obtained lower pressure of the medium.

In testimony whereof I affix my signature.

HERMANN SÖFFGE.