No. 646,417. Patented Apr. 3, 1900.

R. M. DIXON.

REGULATOR.

(Application filed Aug. 25, 1897.)

(No Model.) 2 Sheets—Sheet 1.

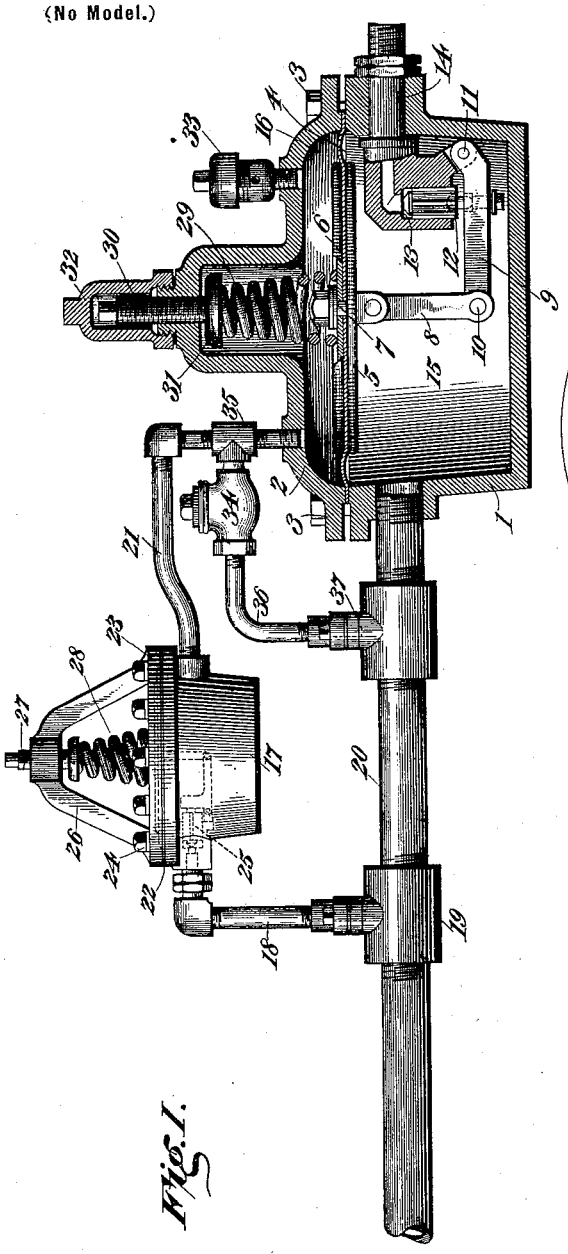

Fig. I.

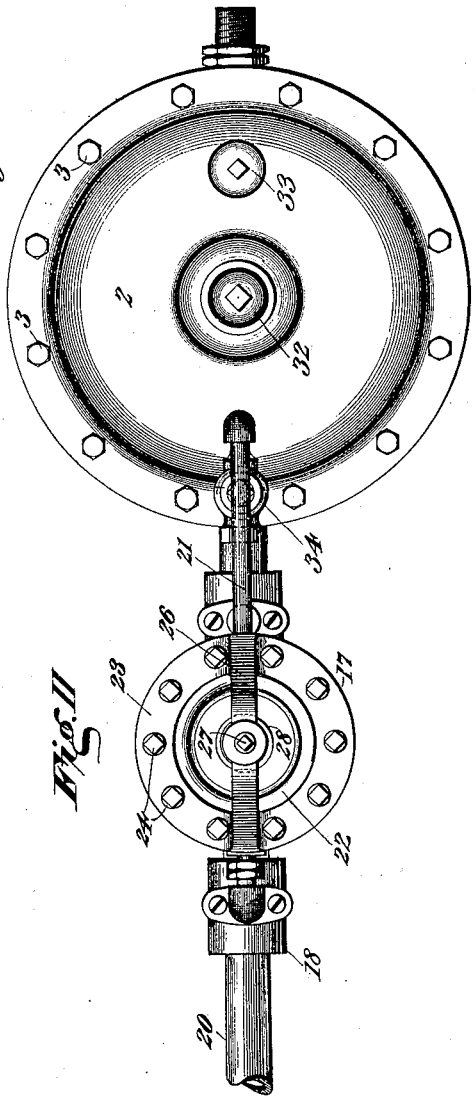

Fig. II.

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Fig. III.

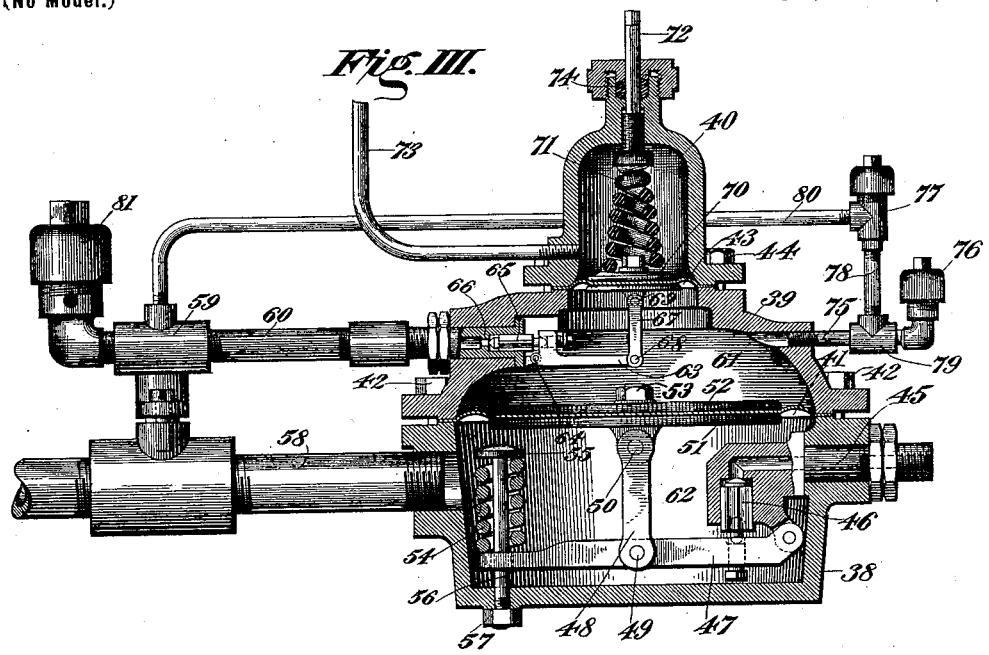
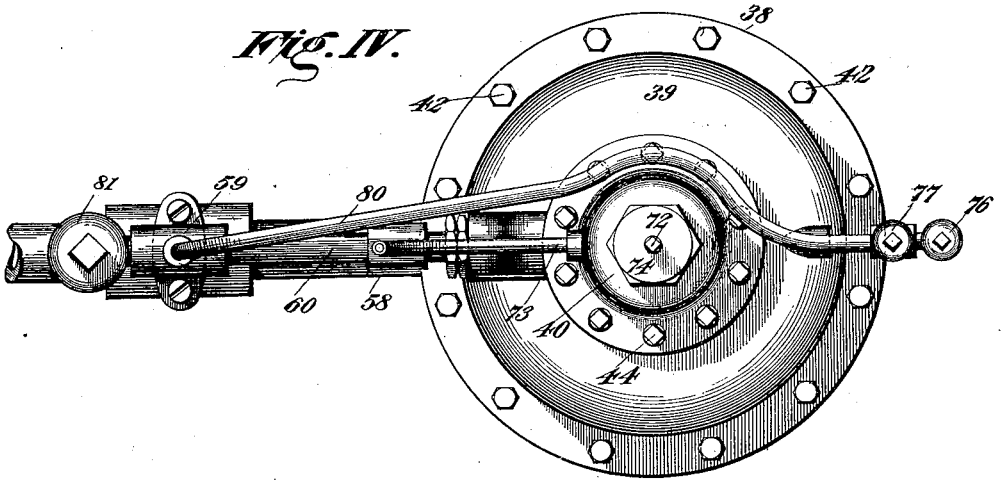


Fig. IV.



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UNITED STATES PATENT OFFICE.

ROBERT MUNN DIXON, OF EAST ORANGE, NEW JERSEY.

REGULATOR.

SPECIFICATION forming part of Letters Patent No. 646,417, dated April 3, 1900.

Application filed August 25, 1897. Serial No. 649,460. (No model.)

To all whom it may concern:

Be it known that I, ROBERT MUNN DIXON, of East Orange, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Regulators, of which the following is a complete specification, reference being had to the accompanying drawings.

My invention relates to apparatus for reducing varying and high pressures of gas-supply to a constant lower pressure.

As exhibited in the present state of the art, in an apparatus of the general class above specified a flexible diaphragm is employed for operating the working parts, and the strain produced upon the diaphragm, being due to the multiplication of the pressure per square inch to the area of the diaphragm in square inches, is very great.

The object of my invention is to provide means of relieving the strain upon the diaphragm, and thereby and otherwise improve the durability and efficiency of the apparatus.

In the accompanying drawings, Figure I is a longitudinal vertical section of one form of embodiment of my regulator, some of the parts being shown in elevation. Fig. II is a top plan view of the same complete. Fig. III is a view similar to Fig. I of a modified form of regulator. Fig. IV is a top plan view of the same.

Referring to the figures on the drawings, 1 indicates a portion of a regulator-shell, which may be made of any suitable shape and dimensions. To it is united (see Figs. I and II) the cover 2, as by means of a crown of bolts 3. Secured between the parts 1 and 2 by fluid-tight joints is a flexible diaphragm 4, to which, as by means of reinforcing-disks 5 and 6, secured by a bolt 7 to its opposite sides, is united, as by a pivoted link 8, the arm 9, pivoted at one end, as indicated at 10, to the link, and at the other end, as indicated at 11, to one side of the shell 1. The arm 9 carries a valve 12, which works in a suitable seat 13, provided for it in the inner extremity of a gas-supply pipe or fitting 14. Through the cooperation of the mechanism above described a slight movement of the diaphragm 4 will suffice to open or close the valve 12. The diaphragm divides the shell and its cover into two chambers 15 and 16, the one between the diaphragm and the shell and the other between the diaphragm and the cover.

In apparatus of this class existing prior to the invention herein presented, the diaphragm being mechanically controlled to normally open the valve of the gas-supply pipe, (a valve corresponding with the valve 12 in the drawings,) the accumulation of gas within the chamber 15 actuates the diaphragm to close the valve; but, as above suggested, in apparatus of this sort, although completely operative, it subjects the diaphragm to excessive strain, and thereby abbreviates the life of the apparatus more than need be.

In order to eliminate the excessive strain upon the diaphragm induced in the manner above suggested, I provide means for balancing the pressure on both sides of the diaphragm by a controllable fluid-pressure in the chamber 16. This object may be accomplished in a variety of ways. In Figs. I and II, I illustrate for accomplishing that purpose one form of apparatus consisting of an auxiliary regulator 17 of smaller proportions, provided with an inlet-pipe 18, that communicates through a fitting 19 with the outlet-pipe 20 of the main regulator above specified and communicating through a discharge-pipe 21 with the chamber 16 of the main regulator. Inasmuch as excessive strain upon the diaphragm is occasioned, as above specified, by the multiplication of pressure per square inch to the area of the diaphragm in square inches, it is possible by reducing the proportions of the diaphragm to relieve it of all impracticable strain. The employment, therefore, of the auxiliary regulator 17 for regulating the fluid-pressure in the chamber 16 is practicable, because the office of the auxiliary regulator requires the passage through it of but a small quantity of gas, whereas the main regulator must be constructed of sufficient dimensions to accommodate the requisite flow of gas, which wherever it is employed in practice must be considerable. The auxiliary regulator 17 is of ordinary construction, being provided with a diaphragm 22 and a cap 23, securing the diaphragm in place, as by means of a crown of bolts 24. The diaphragm 22 is operatively connected in the ordinary manner with a valve 25 for the purpose of actuating it. The cap is provided with an arch 26, that carries ver-

tically above the center of the diaphragm a tension-regulating screw 27, by which the tension of a coil-spring 28 may be regulated for controlling the fluid-pressure within the regulator 17. By means of the screw 27 a required degree of the fluid-pressure may be transmitted through the pipe 21 to the chamber 16. The pressure so communicated may be regulated to be approximately equal to, but somewhat less than, the required delivery-pressure from the chamber 15 to the pipe 20. In order, therefore, to impart against the diaphragm 4 additional pressure, so as to insure the opening of the valve 12 in case the pressure in the chamber 15 should be slightly reduced because of the larger draft on the volume of gas passed by the main regulator, I provide between the cover 2 and the diaphragm 4 a spring 29. The contour of the cover 2 is preferably made so as to provide a case for the spring 29. In the top of the cover I provide a tension-screw 30, that carries upon its inner end a dish-shaped member 31, within which the head of the spring 29 is seated. The projecting end of the screw 30 may be, if preferred, protected by a screw-cap 32. 33 indicates a safety-valve designed to allow any gases under pressure to escape from the chamber 16 rather than accumulate therein in case the valve 25 should leak. 34 indicates a check-valve communicating at one end, through a fitting 35, with the pipe 21, and thereby with the chamber 16, and at the other end, through a pipe 36 and a suitable connection 37, with the interior of the pipe 20. The valve 34 is constructed so as to allow pressure from the chamber 16 to escape into the pipe 20 in case the pressure in the chamber 15 becomes less than that in the chamber 16. By this means strain upon the diaphragm which would be occasioned by the reduction of pressure in the chamber 15 is automatically relieved.

The operation of the above-described apparatus is as follows: A fluid under a high pressure being admitted through the pipe 14 finds the valve 12 open, due to the tension of the spring 29 upon the diaphragm 4. Finding vent through the open valve 12 the fluid enters the chamber 15, accumulating therein and in the pipe 20. From the pipe 20 the fluid, at a pressure developed within the chamber 15, passes through the auxiliary regulator 17 and the pipe 21 into the chamber 16, where it operates upon the diaphragm 4, against pressure within the chamber 15, to keep the valve open. As soon as the pressure within the pipe 21 reaches the force to which the auxiliary regulator 17 has been previously adjusted the regulator 17 prevents the passage of more fluid, which accumulates in the pipes 18 and 20 and the chamber 15, where it tends to raise the diaphragm 4 and close the valve 12.

In consequence of the proportionately-large area of the diaphragm 4 a slight variation of pressure in the chamber 15 will operate upon the diaphragm 4 through the lever 9, to which it is connected, as above specified, and produce the effect of absolutely closing with great force the valve 12.

In Figs. III and IV, I illustrate another form of embodiment of my invention from that previously described. In those figures, 38 indicates the shell of the main regulator, 39 an intermediate cover, and 40 the cap. The main diaphragm 41 is secured between the shell 38 and cover 39, as by a crown of bolts 42, while an auxiliary diaphragm 43 is secured between the cover 39 and the cap 40, as by a crown of bolts 44. 45 indicates the inlet-pipe corresponding to the pipe 14. 46 indicates a valve corresponding to the valve 12, and 47 an arm corresponding to the arm 9. A link 48, pivoted, as indicated at 49, to the arm 47, and, as indicated at 50, to a disk 51, operatively unites the diaphragm 41 to the arm 47 in the same manner in which the diaphragm 4 is connected with the arm 9. The disk 51 is secured to the diaphragm 41, as by means of a corresponding disk 52 and a bolt-and-nut connection 53. The only change in this form of embodiment of my invention over the one previously described, so far as the parts enumerated are concerned, consists in the prolongation of the arm 47 beyond the pivotal connection 49, in order to accommodate a spring 54, corresponding in function to the spring 29. The spring 54 is seated at one end against the prolongation of the arm 47 and at the other end against the head 55 of a bolt 56, which passing through a loosely-fitting aperture in the arm 47 and an opening in the shell 38, is adjustably secured to the shell and in operative relation with the arm 47, as by means of a nut 57, working upon its threaded end. 58 indicates an outlet-pipe between which and the interior of the cover 39, as through a four-way fitting 59, a pipe 60 establishes communication. The interior of the cover 39 defines the chamber 61, corresponding with the chamber 16, previously described, while the chamber 62 corresponds with the chamber 15, above specified. 63 indicates a bell-crank lever pivoted, as indicated at 64, to a suitable support provided for it upon the interior of the cover 39. Upon its short arm the lever 63 carries a valve 65, which, coöperating with a valve-seat 66 in the discharge end of the pipe 60, corresponds in function to the valve 25, above specified. The valve 65 is actuated through the lever 63, as by means of a link 67, pivoted, as indicated at 68, to the long arm of the lever 63 and, as indicated at 69, to the lower one of a pair of disks 70, secured upon opposite sides of the diaphragm 43. The diaphragm 43 is normally impelled to open the valve 65, as by means of a spring 71, corresponding in function to the spring 28, previously specified, and which, similarly to the spring 28, is controllable by means of a screw 72, working in the cap 40. In connection with the spring 71 I also provide a pipe 73, which, communicating with the interior of the cap 40, affords means for

producing additional pressure upon the diaphragm 43. The pipe 73 may be connected directly or indirectly with the inlet-pipe 45 or with any other source of fluid-pressure and may be employed for increasing the pressure in the chambers 61 and 62 and the pipe 58 if for any special use such increase of pressure should be desired. When the pipe 73 is employed, a stuffing-box 74 should be employed around the screw 72 in order to render the cap 40 air-tight. 75 indicates a pipe communicating with the chamber 61, to which a safety-valve 76, corresponding to the valve 33, and a check-valve 77, corresponding to the valve 34, are connected. The check-valve may be connected with the pipe 75, as by means of a pipe 78 and a T-fitting 79, and with the pipe 58 through the four-way fitting 59, as by means of a pipe 80. 81 indicates a safety-valve for the outlet of the large regulator.

The operation of that form of embodiment of my invention illustrated in Figs. III and IV is substantially the same as the operation of the apparatus illustrated in Figs. I and II and may be briefly described as follows: Fluid at high pressure enters the chamber 62, the valve 46 being open. From the chamber 62 it passes into the pipe 58, and thence through the pipe 60 enters the chamber 61. Within the chambers 61 and 62 the pressure therein developed operates upon the diaphragms 41 and 43, respectively, and through their actuation of the valves 46 and 65, respectively, operates to regulate the pressure similarly to the manner previously described. As previously specified, they are merely modified forms of embodiment of the same invention; but as between the two forms of embodiment that described in the last two figures exhibits a preferable compactness of structure and directness of operation.

What I claim is—

1. The combination with a main regulator and its diaphragm dividing the same into two chambers, of an auxiliary regulator operatively connecting the two chambers, means of communication between the two chambers independent of the auxiliary regulator, and a check-valve therein, substantially as set forth.

2. The combination with a regulator, its inlet and outlet openings, of a diaphragm dividing the regulator into two chambers, mechanism for opening and closing the inlet operatively connected with said diaphragm, a second diaphragm completing one of the chambers of the regulator, means of communication between the two chambers, a valve controlling such means of communication and operatively connected with the second diaphragm, and means for regulating the tension upon the second diaphragm, substantially as set forth.

3. The combination with a regulator, its inlet and outlet openings, of a diaphragm dividing the regulator into two chambers, mechanism for opening and closing the inlet operatively connected with said diaphragm, a second diaphragm completing one of the chambers of the regulator, means of communication between the two chambers, a valve controlling such means of communication and operatively connected with the second diaphragm, and pneumatically-operated means for regulating the tension upon the second diaphragm, substantially as set forth.

In testimony of all which I have hereunto subscribed my name.

ROBERT MUNN DIXON.

Witnesses:
E. W. BULKLEY,
WM. BARRINGTON.