No. 757,590. PATENTED APR. 19, 1904.

B. ZINDEL.

PRESSURE REGULATOR.

APPLICATION FILED JAN. 11, 1904.

NO MODEL.

Fig. 1.

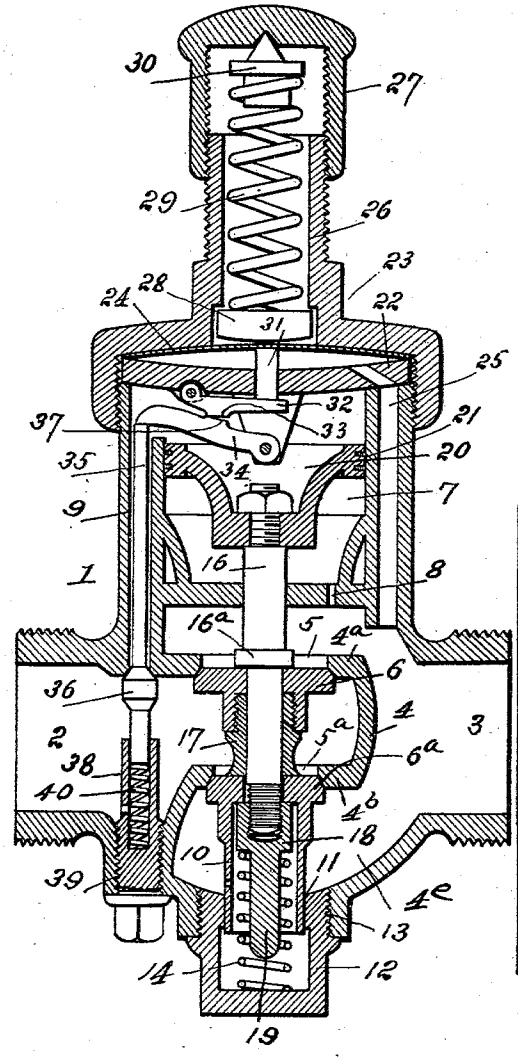
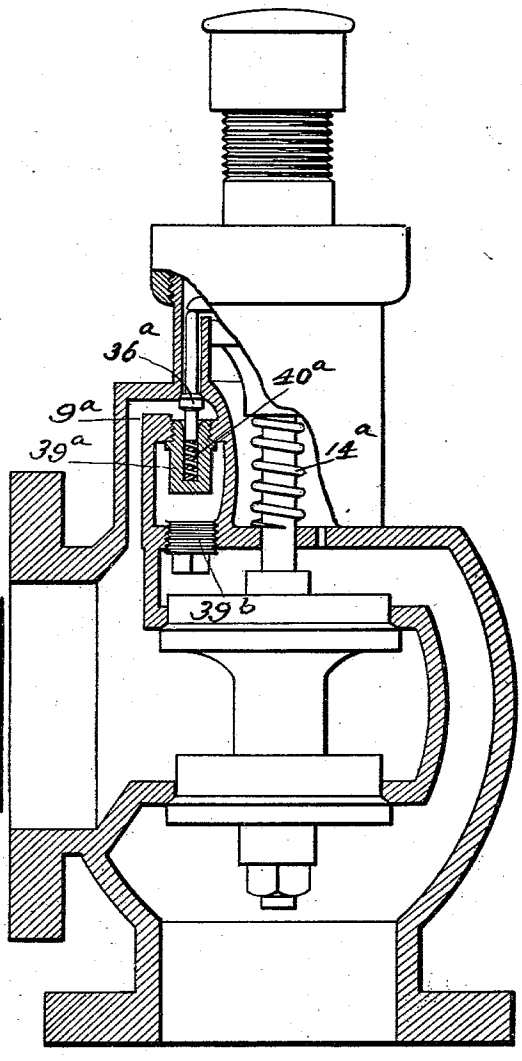


Fig. 2.



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UNITED STATES PATENT OFFICE.

BARNHARDT ZINDEL, OF GREENBAY, WISCONSIN.

PRESSURE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 757,590, dated April 19, 1904.

Application filed January 11, 1904. Serial No. 188,578. (No model.)

To all whom it may concern:

Be it known that I, BARNHARDT ZINDEL, a citizen of the United States, residing at Greenbay, county of Brown, State of Wisconsin, have invented certain new and useful Improvements in Pressure-Regulators, of which the following is a specification, reference being had therein to the accompanying drawings, in which—

Figure 1 is a vertical sectional view, and Fig. 2 a similar view showing a slightly-different form of valve.

The main object of this invention is to provide a pressure-regulator which will automatically respond to changes in pressure at the inlet-port thereof and which, while being very sensitive and quick to act, will so act in response to such changes in pressure that the valves will not be suddenly either opened or seated nor the mechanism of the valves in any way deranged by sudden and violent variations in pressure.

Referring to the various parts by numerals, 1 designates the main-valve casing; 2, the inlet thereof; 3, the outlet therefrom, and 4 the bridge-wall, which extends across the inlet, separating it from the outlet. This wall is formed with the upper horizontal part 4^a and and the lower horizontal part 4^b, said parts being connected together at their inner ends in such manner as to form the complete bridge between the inlet and outlet ports. Below the lower wall 4^b is formed a chamber 4^e, which is in open communication with the outlet-port 3 of the casing and separated from the inlet-port thereof by the bridge-wall 4. Through the upper horizontal part 4^a of the bridge-wall is formed a port 5, and through the lower horizontal part of said wall is formed a smaller valve-port 5^a.

Formed integral with the top of the valve-casing 1 and extending upward therefrom concentric with the valve-ports 5 and 5^a is a piston-chamber 7, whose lower end is in communication with the outlet-port of the main-valve casing through a small port 8 in the bottom of said piston-chamber. The upper end of this piston-chamber is in communication with the inlet side of the main-valve casing through the long vertical port 9, formed in the wall of the piston-chamber.

The port 5 is closed by a main valve 6, which is seated against the lower side of the wall of said port, and the valve-port 5^a is closed by a smaller valve 6^a, which is seated against the lower side of the wall of the said port. These valves are mounted upon a valve-stem 16, said stem being formed with a collar 16^a, against which the valve 6 is clamped. The valve 6 is formed with a depending interiorly-threaded boss into which is screwed a sleeve 17, against the lower end of which the valve 6^a is clamped. The lower end of the valve-stem is threaded to receive a clamping-nut 18, by which the valves are clamped in position. The valve 6^a is formed with a depending tubular stem 10, which is open at its lower end and is adapted to slide vertically in an opening 11 in a hollow cap 12. This cap is screwed into the lower wall of the main-valve casing and closes an opening 13, which opening is large enough to permit the downward withdrawal of the valve 6^a when the cap is removed. To yieldingly hold the valves to their seats, a coil-spring 14 is arranged within the tubular stem, its upper end bearing against the clamp-nut 18 and its lower end resting on the bottom of the hollow cap 12. Extending downward from the clamp-nut 18 is a stem 19, which fits within the spring 14 and holds it in its upright position.

The valve-stem 16 extends upward through the bottom of the piston-chamber and carries at its upper end within said chamber a cup-shaped piston 20, which is provided with a packing-ring 21 to insure a pressure-tight joint between the piston and the wall of the piston-chamber. The upper end of the piston-chamber is closed by a plate 22, clamped in place by a cap 23, which is threaded on the upper end of the piston-chamber. This plate is concave on its upper surface to form a narrow horizontal chamber between the under side of the cap 23 and the upper surface of said plate. Extending across this chamber is a thin diaphragm 24, whose edge is clamped between the edge of the plate 22 and the bottom wall

of the cap 23. Connecting the space below the diaphragm 24 with the outlet from the main-valve casing or chamber is a port 25, said port extending through the wall of the piston-chamber and through the plate 22.

The cap 23 is provided with a central upward-extending tubular part 26, whose upper end is closed by the long screw-cap 27. Within this tubular part 26, at the lower end thereof, is a follower 28, which is normally forced downward by a coil-spring 29, arranged within the tubular part 26, the upper end of said spring being secured to a block 30, whose upper pointed end bears against the center of the under side of the cap 27. Sliding vertically through the central aperture in the cap 22 is a short pin 31, whose upper end is normally in engagement with the under side of the diaphragm 24 directly below the center of the plunger or follower 28. The lower end of this pin 31 engages the inner end of a horizontal lever 32, whose outer end is pivoted to the under side of the plate 21. This lever on its under side about midway its ends is formed with the substantially horizontal part 33. Below this lever 32 is arranged a second lever 34, whose pivotal point is directly below the pin 31, the outer end of this lever 34 extending to a point centrally over the port 9 and resting on the top of a stem 35 of the regulator-valve 36, this latter valve being within the casing 1, on the inlet side thereof. On the upper surface of the lever 34 and at a point directly below the part 33 of the lever 31 is formed a substantially horizontal part 37. The outer ends of the parts 33 and 37 of the levers 31 and 34 are in contact with each other when the valve 36 is seated, and from this point of contact these levers diverge slightly toward the inner ends thereof for a purpose which will hereinafter be described.

The lower end of the valve 36 fits and slides in the upper end of a tubular plug 38, which closes the opening 39 in the valve-casing 1, said opening being large enough to permit of the downward withdrawal of the valve 36 when the plug 38 is removed. Within the tubular plug 38 is arranged a coil-spring 40, which normally holds the valve 36 seated and the lever 34 in its uppermost position.

The operation of this invention may be briefly described as follows: The pressure-regulating cap 27 is screwed down on the tubular part 26 until the desired pressure is exerted on the diaphragm 24 and the pin 31 has been depressed sufficiently to open the valve 36 through the levers 31 and 34. It will be noted that when the valve 36 is seated the point of contact between the levers 31 and 33 is nearest the pivot of the lever 31 and farthest from the pivot of the lever 33. The result is that any movement imparted to the free end of the lever 31 while the valve is closed will be imparted very slowly to the lever 33, but that after the valve has been opened and the diverging parts 33 and 37 of the levers have been brought together the point of contact between these levers shifts and becomes nearer the point of applied power on lever 31 and nearer the pivotal point of lever 34. Thus the subsequent movement of lever 31 will produce a more rapid movement of the lever 34 and a consequent more rapid downward movement of the valve 36. The purpose of this is to secure a slow movement of the valve 36 upon first opening the same in order that the pressure may be gradually introduced into the piston-chamber above the piston 20 through the port 9 and to thereby secure a very gradual opening of the main valve. After the main valve has been opened slightly by the pressure above the piston 20 it is desirable that the valve 36 be quickly opened to permit the full head of pressure above the piston. It will thus be seen that by this peculiar arrangement of levers the pressure-regulating valve and the main valve will both be very gradually opened and that sharp or sudden movements of the valves in opening will be avoided. Pressure from the outlet side of the valve-casing 1 enters the chamber below the diaphragm 24 through the port 26, and when said pressure is sufficient to move the follower or plunger 28 upward the spring 40 forces upward the valve 36 and restricts the passage of pressure fluid into the port 9, and as this pressure on the outlet side of the casing also enters the piston-chamber through the port 8 and exerts an upward pressure on the piston there will be a corresponding movement of the main valves 6 and 6^a. When the pressure below the diaphragm 24 exceeds the desired pressure, the follower 28 is forced upward sufficiently to permit the spring 40 to seat valve 36, after which the valves 6 and 6^a will gradually be seated by reason of the pressure below the piston 20 and the upward pressure of the spring 14. The valves 6 and 6^a will be gradually brought toward their seats as the pressure in the piston-chamber above the piston is gradually reduced by condensation or leakage or compression. It will be thus seen that there can be no violent opening or seating of the main valve.

It will be noted that the valve 6 is within the inlet-passage and is exposed to the pressure of the fluid on the inlet side of the valve, while the valve 6^a is in the outlet-passage and is exposed to the pressure therein, the upper side of this latter valve, however, being also exposed to the pressure in the inlet side of the valve. It will thus be noted that the pressure on the inlet side of the valve will tend to hold the valve 6 against its seat while at the same time exerting a pressure on the valve 6^a to force it from its seat. It will also be noted

that the valve 6 is larger in diameter than the valve 6^a, thereby insuring that the two valves will be held against their seats until moved therefrom by means of the piston in the piston-chamber. The spring 14 assists in holding said valves to their seats and opposes the tendency of the fluid-pressure to unseat the valve 6^a.

The advantage of providing two valves 6 and 6^a is that the capacity of the valve-opening in the bridge-wall is thereby nearly doubled, so that it will only be necessary for the piston in the piston-chamber to have a very slight movement. It will also be noted that by reason of so arranging the valves that the fluid-pressure at the inlet side of the valve will tend to unseat the smaller valve less power will be required to open said valves, the action of the piston being assisted by the pressure of the fluid on the upper side of the valve 6^a, as will be manifest.

In Fig. 2 is shown a slightly-different arrangement of the mechanism of the valve. It will be noted that the regulator-valve 36^a is arranged in a compartment at the side of the piston-chamber, said compartment being in communication with the inlet side of the valve by means of a passage 9^a, this passage being connected to the port 9 and the valve 36^a acting to close the port 9, as in the form shown in Fig. 1. The hollow plug 39^a, in which is fitted the spring 40^a, may be removed through an opening in the bottom of this compartment, said opening being normally closed by a screw-plug 39^b. This arrangement of the regulator-valve leaves the inlet-passage of the main-valve chamber free and unobstructed. It will also be noted that the spring 14^a is arranged within the piston-chamber below the piston. This makes it possible to have the outlet from the main-valve chamber at the bottom thereof, said outlet being unobstructed. The operation of this form of valve is the same as the form shown in Fig. 1, as will be readily understood.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a pressure-regulator the combination, of a main-valve casing formed with inlet and outlet ports, a bridge-wall separating said ports and formed with two horizontal portions one above the other and provided with openings therein, a pair of valves in said casing, adapted to close said ports, the upper valve being on the inlet side of the said wall and formed with a depending internally-threaded boss, the lower valve being on the outlet side of said wall and formed with an upward-extending sleeve threaded at its upper end into the boss of the upper valve, a stem carrying said valves and formed with a collar against which the upper valve is clamped, a nut screwed on the lower end of said valve-stem to hold the valves in place and formed with a depending stem, a spring surrounding said stem and yieldingly holding the valves against their seats, a piston-chamber above the valves into which the valve-stems project, a piston on said stem within the chamber, a regulator-valve controlling an inlet to the top of the piston-chamber, a diaphragm exposed to the pressure at the outlet of the main-valve casing, means for exerting an opposed pressure on said diaphragm, and a lever mechanism operated by the movement of the diaphragm to control the movement of the regulator-valve.

2. In a pressure-regulator, the combination of a main-valve casing formed with inlet and outlet ports, a bridge-wall separating said ports and formed with two horizontal portions one above the other and provided with openings therein, a pair of valves in said casing adapted to close said openings in the bridge-wall, the upper valve being on the inlet side of the said wall and the lower valve being on the outlet side of said wall, means for rigidly connecting said valves together, means for yieldingly holding said valves to their seats, a piston-chamber, a stem connected to said valves and extending into the piston-chamber, a piston on said stem within the chamber, a valve-compartment at one side of the piston-chamber above the passage through the main-valve casing, the upper end of the piston-chamber being in communication with said compartment through a suitable port, a regulator-valve for said port, a port between said compartment and the inlet-port of the main-valve casing, and mechanism controlled by the pressure at the outlet of the main casing to move the regulator-valve to admit pressure to above the piston.

In testimony whereof I hereunto affix my signature, in the presence of two witnesses, this 26th day of December, 1903.

BARNHARDT ZINDEL.

Witnesses:
H. R. ALBERT,
AUGUST BRAUNS.