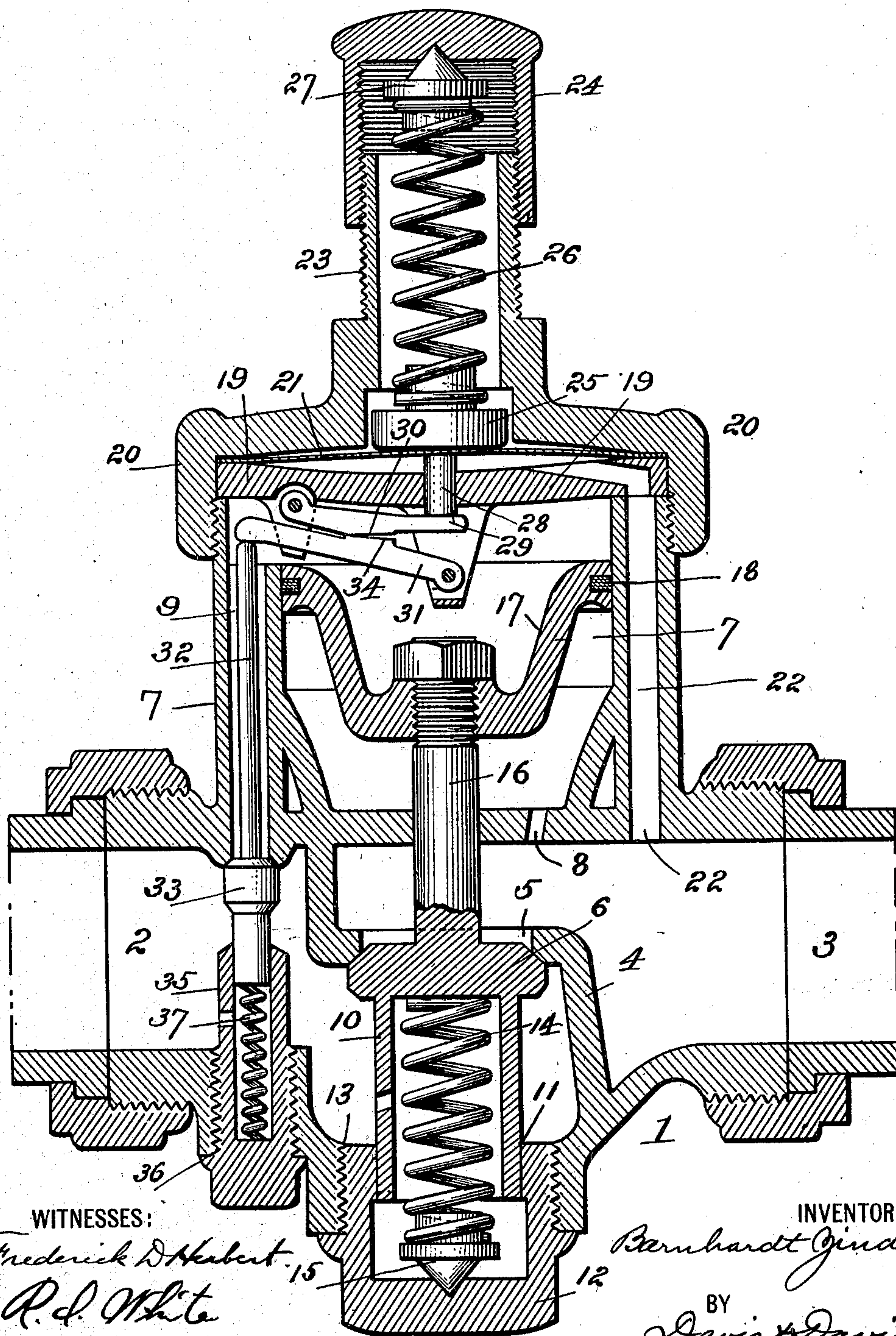


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PATENTED MAR. 17, 1903.

B. ZINDEL.  
PRESSURE REGULATOR.  
APPLICATION FILED SEPT. 23, 1901.

NO MODEL.



WITNESSES:

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# UNITED STATES PATENT OFFICE.

BARNHARDT ZINDEL, OF GREENBAY, WISCONSIN.

## PRESSURE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 723,118, dated March 17, 1903.

Application filed September 23, 1901. Serial No. 76,182. (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 drawing, in which is represented a vertical sectional view.

The main objects of this invention are to provide a pressure-regulator which will automatically respond to changes in pressure at the inlet-port thereof and which will so act in response to such changes that the valves will not be either suddenly opened or seated or the mechanism of the valve in any way deranged by sudden and violent variations in pressure.

A further object of the invention is to provide pressure-regulators of simple and efficient construction, wherein the valves and other inferior parts will be easy of access for the purpose of cleaning and repair.

Referring to the various parts by numerals, 1 designates the main-valve casing; 2, the inlet-port thereof; 3, the outlet therefrom, and 4 the bridge-wall separating the inlet from the outlet and extending across the main-valve chamber. Through the horizontal part of this wall is formed the port 5, which is closed by the main valve 6. Formed integral with the top of the valve-casing 1 and extending upward therefrom concentric with the main-valve port is a piston-chamber 7, whose lower end is in communication with the outlet-port of the main-valve casing through the small port formed in the top wall of the casing 1. The upper end of this piston-chamber is in communication with the inlet side of the main-valve casing through the port 9, formed in the vertical wall of the piston-chamber.

The main valve 6 is seated against the lower side of the wall of the main-valve port 5 and is formed with the depending tubular stem 10, which is open at its lower end and is adapted to slide vertically in the opening 11 of the hollow cap 12. This cap is screwed into the lower wall of the main-valve casing and closes the opening 13, which opening is large enough to permit the downward with-

drawal of the valve 6 from the casing 1 when the cap is removed. To yieldingly hold this valve to its seat, a coil-spring 14 is arranged within the tubular stem, its upper end bearing against the valve and its lower end resting on a centering-block 15, whose lower pointed end bears against the bottom of the cap 12. Extending upward from the valve 6 is a vertical stem 16, which enters the piston-chamber 7 at the center thereof and carries at its upper end a cup-shaped piston 17, whose lower central portion is considerably smaller in horizontal section than the piston-chamber and whose upper portion bears against the inner surface of said chamber, a packing-ring 18 being provided to make a pressure-tight joint between the piston and the wall of the piston-chamber. The upper bearing portion of the piston is connected to the lower central portion by an inward and downward inclined web, which extends at an angle to the axial line of the piston. The area of the piston-surface in contact with the inner surface of the piston-chamber is made as small as possible, while at the same time securing a pressure-tight joint. The object of this peculiar shape of the piston is to prevent the same sticking or binding in the piston-chamber because of the expansion of the piston. The upper end of the piston-chamber is closed by a plate 19, clamped in place by the cap 20, 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 20 and the upper surface of said plate. Extending across this chamber is a thin diaphragm 21, whose edge is clamped between the edge of the plate 19 and the bottom wall of the cap 20. Connecting the space below the diaphragm 21 with the outlet from the main-valve casing or chamber is a port 22, said port extending through the wall of the piston-chamber and through the plate 19.

The cap 20 is provided with a central upward-extending tubular part 23, whose upper end is closed by the long screw-cap 24. Within this tubular part 23, at the lower end thereof, is a follower 25, which is normally forced downward by a coil-spring 26, arranged within the tubular part 23, the upper end of said spring being secured to a block 27, whose up-



per pointed end bears against the center of the under side of the cap 24. Sliding vertically through the central aperture in the cap 19 is a short pin 28, whose upper end is normally in engagement with the under side of the diaphragm 21, directly below the center of the plunger or follower 25. The lower end of this pin 28 engages the inner end of a horizontal lever 29, whose outer end is pivoted to the underside of the plate 19. This lever on its underside about midway its ends is formed with the substantially horizontal part 30. Below this lever 29 is arranged a second lever 31, whose pivotal point is directly below the pin 28, the outer end of this lever 31 extending to a point centrally over the port 9 and resting on the top of the stem 32 of the regulator-valve 33, this latter valve being within the casing 1 on the inlet side thereof. On the upper surface of the lever 31 and at a point directly below the part 30 of the lever 29 is formed a substantially horizontal part 34. The outer ends of the parts 30 and 34 of the levers 29 and 31 are in contact with each other when the valve 33 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 33 fits and slides in the upper end of a tubular plug 35, which closes the opening 36 in the valve-casing 1, said opening being large enough to permit of the downward withdrawal of the valve 33 when the plug 35 is removed. Within the tubular plug 35 is arranged a coil-spring 37, which normally holds the valve 33 seated and the lever 31 in its uppermost position.

The operation of this invention may be briefly described as follows: The pressure-regulating cap 24 is screwed down on the tubular part 23 until the desired pressure is exerted on the diaphragm 21 and the pin 28 has been depressed sufficiently to open the valve 33 through the levers 29 and 31. It will be noted that when the valve 33 is seated the point of contact between the levers 29 and 31 is nearest the pivot of the lever 29 and farthest from the pivot of the lever 31. The result is that any movement imparted to the free end of the lever 29 while the valve is closed will be imparted very slowly to the lever 31; but after the valve has been opened and the diverging parts 30 and 34 of the levers have been brought together the point of contact between these levers shifts and comes nearer the point of applied power on lever 29 and nearer the pivotal point of lever 31, so that the subsequent movement of lever 29 will produce a more rapid movement of the lever 31 and a consequent more rapid downward movement of the valve 33. The purpose of this is to secure a slow movement of the valve 33 upon first opening the same in order that the pressure may be gradually introduced into the piston-chamber above the piston 17 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 17 it is desirable that the valve 33 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 21 through the port 22, and when said pressure is sufficient to move the follower or plunger 25 upward the spring 37 forces upward the valve 33 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 valve 6. When the pressure below the diaphragm 21 exceeds the desired pressure, the follower 25 is forced upward sufficiently to permit the spring 37 to seat valve 33, after which the valve 6 will gradually be seated by reason of the pressure below the piston 17 and the upward pressure of the spring 14. The valve 6 will be gradually brought toward its seat as the pressure in the piston-chamber above the piston is gradually reduced by condensation or leakage or compression. It will thus be seen that there can be no violent opening or seating of the main valve.

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 main valve therein between said ports, means for yieldingly holding said valve to its seat, a stem connected to said valve and extending into a piston-chamber, a piston on said stem within the chamber, the upper end of the said chamber being in communication with the inlet of the main casing and the lower end thereof being in communication with the outlet-port of said chamber, a regulator-valve controlling the 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 mechanism operated by the movement of said diaphragm to control the movement of the regulator-valve.

2. In a pressure-regulator, the combination of a main-valve casing, a main valve therein, a piston-chamber, a piston therein and connected with the main valve, a regulator-valve controlling the movement of the piston, a diaphragm exposed to the pressure at the outlet of the main-valve casing, means for exerting an opposed pressure on the diaphragm, a lever for opening the regulator-valve, a lever moved by the diaphragm and contacting with and operating the regulator-valve lever, said



levers extending in opposite direction and having a shifting point of contact.

3. In a pressure-regulator, the combination of a main-valve casing, a main valve therein, 5 a piston-chamber, a piston therein and connected to the main valve, a cap closing the open end of the piston-chamber and formed with a tubular extension, a diaphragm-chamber being formed between said cap and the 10 piston-chamber, a diaphragm therein, a follower-block in the cap, a spring in the tubular extension of the cap and yieldingly pressing the block against the diaphragm, a cap closing the ends of the tubular extension and 15 adapted to be adjusted to vary the pressure of the block on the diaphragm, the opposite side of the diaphragm being exposed to the pressure at the outlet of the main casing, a regulator-valve and means operated by the 20 movement of the diaphragm for controlling said valve.

4. In a pressure-regulator, the combination of a main valve, a regulator-valve, a diaphragm, a lever moved by the diaphragm, a 25 lever operating the regulator-valve and moved by the diaphragm-lever, said levers being in

contact with each other their point of contact shifting in operation from a point near the pivot of the diaphragm-lever to a point near the pivot of the valve-operating lever, substantially as described and for the purpose 30 set forth.

5. In a pressure-regulator, the combination of a main-valve casing, a main valve therein, a piston-chamber, a piston therein formed 35 with a narrow bearing-surface carrying a packing-ring, an inward-inclined web extending at an angle to the axial line of the piston and connecting the narrow bearing portion with the central portion of the piston, where- 40 by the bearing portion and the central portion are in different transverse planes, a stem connecting the central portion of the piston to the main valve, a regulator-valve for controlling the movement of the piston, and 45 means operated by variations in pressure at the outlet of the main casing for controlling the movement of the regulator-valve.

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Witnesses:

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A. BRAUNS.