(No Model.)

C. J. RINDERKNECHT.

FLUID PRESSURE REGULATOR.

No. 484,458. Patented Oct. 18, 1892.

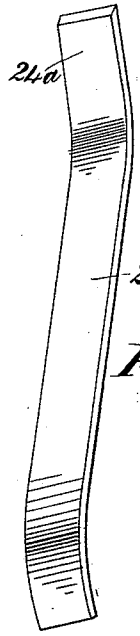

Fig 5

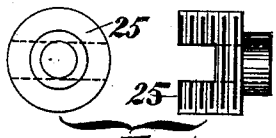

Fig 7

Fig 1

Fig 6

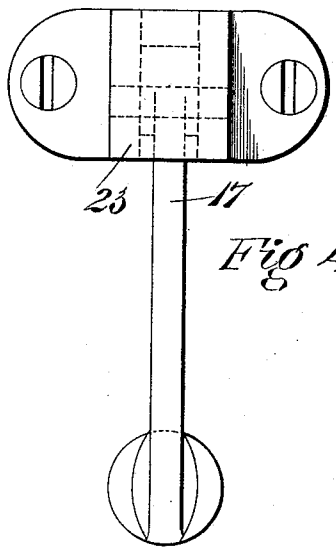

Fig 4

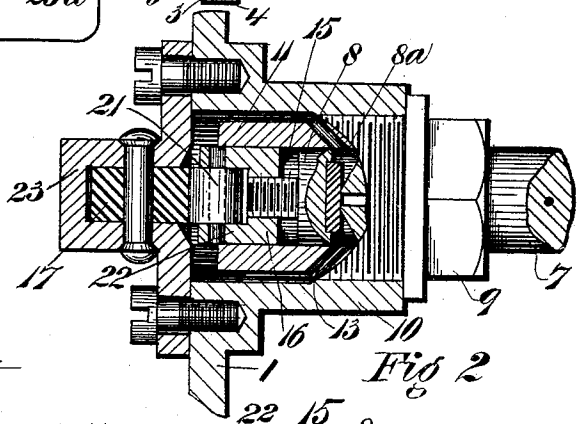

Fig 2

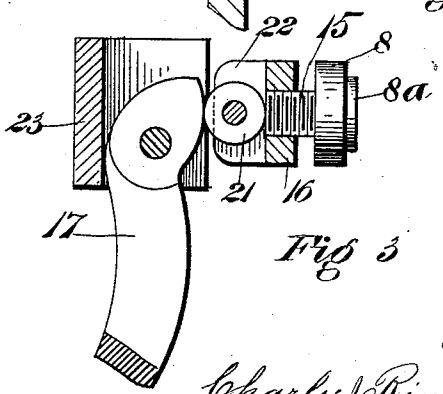

Fig 3

Witnesses

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By his Attorney

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UNITED STATES PATENT OFFICE.

CHARLES J. RINDERKNECHT, OF INDIANAPOLIS, INDIANA, ASSIGNOR TO ALBERT KOPP, LUDWIG JAEGER, JULIUS SCHULER, AND JAMES B. CURTIS.

FLUID-PRESSURE REGULATOR.

SPECIFICATION forming part of Letters Patent No. 484,458, dated October 18, 1892.

Application filed May 25, 1892. Serial No. 434,337. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. RINDERKNECHT, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented new and useful Improvements in Fluid-Pressure Regulators, of which the following is a specification.

My invention relates to improvements in fluid-pressure regulating and reducing valves, and is particularly designed for reducing the pressure of fluids, particularly carbonic-acid gas, to a fixed lower pressure.

The object of my invention is to provide a pressure regulating and reducing valve the regulating mechanism of which will be sensitive, compact, simple, and durable in its construction; also, to provide suitable means whereby the pressure-regulating lever and its valve will be readily adjusted and set without taking the apparatus apart or disconnecting it from its fittings. I attain these objects by means of the mechanism illustrated in the accompanying drawings, in which similar numbers of reference designate like parts throughout the several views.

Figure 1 is a sectional side elevation showing the reducing and pressure regulating mechanism of my apparatus. Fig. 2 is an enlarged sectional plan view of the adjustable valve and its seat. Fig. 3 is an enlarged detail view of the shorter cam-formed arm of the regulating-lever and the adjustable valve. Fig. 4 is an enlarged detail front elevation of the regulating-lever and its fulcrum-cap. Fig. 5 is a detail perspective view of the diaphragm counter-spring. Fig. 6 is an enlarged detail plan view of the pressure-spring plate, and Fig. 7 is a detail side view and plan of the adjusting-nut of the pressure-spring.

1 designates the back and 2 the front casing of the regulating-valve, which (when viewed in the direction of the plane at right angles to the plane of the paper) may be either round, oval, or octagonal in form. (See Fig. 1.) On the peripheral edges of the casings 1 and 2 are formed the flanges 3 and 4, between which the diaphragm 5, preferably of rubber or other suitable resilient or flexible material, is firmly clamped and secured by the bolts 6, which are arranged at suitable distances apart to form a tight joint between said back casing and diaphragm.

The valve-seat nipple 7 is provided with a suitable coupling 8^{x}, by which the apparatus is connected to a reservoir wherein carbonic-acid gas or other fluid under pressure is confined, and has its inner end of a conical form, the blunt point of which forms a seat for the valve 8. The inner end of the nipple 7 is also threaded to accurately fit the threaded nipple or union 9, which is also threaded to fit the threads formed in the stem 10, formed integral on the top of the rear casing 1. The inner projecting end 11 of the union 9 is of a lesser external diameter than the interior diameter of the stem 10 for the purpose of permitting the free exit of the fluid escaping through the reduced bore of the nipple 7 and the openings 13, formed in the reduced end of the union 9, into the chamber 14, formed by the diaphragm 5 and the rear casing 1. The valve 8 is preferably circular in form and is adapted to move longitudinally in its guideway (formed in the inner reduced end 11 of the union 9) to open and to close the valve. The face of the valve 8 is cupped or otherwise recessed to receive a removable seat or face 8^{a}, (preferably of vulcanite, or it may be of a softer baser metal than that of the valve-seat,) which bears against the valve-seat formed on the end of the nipple 7, and thus forms a close joint to retain the flow of the fluid. On the back of the valve 8 is formed the stem 15, which is threaded to accurately fit the threads formed in the adjusting-nut 16, which also moves longitudinally in its guideway with the valve.

17 designates the regulating-lever, having its longer arm provided with the nipple 18, adapted to engage the counter-spring 19, supported in the recess 20, formed in the rear casing 1, and has its shorter arm curved eccentrically or of a cam shape to engage the friction-roller 21, journaled in the lugs 22, formed on the back of the adjusting-nut 16, said eccentric end of the regulating-lever being fulcrumed in the guide-cap 23 and secured firmly to the inner surface of the rear casing 1. It is important that the curvature of shorter arm of the regulating-lever 17 be so formed that when moved the movement of the valve 8

from or toward its seat will increase or decrease the exit-opening in regular diminutive increments in order to render the action of the valve 8 sensitive to the highest possible degree. The pressure-plate 23^a is slightly concaved on its inner surface, or the surface next the diaphragm 5, against which it bears and to which it is secured at its top end and to the counter-spring 24 of the diaphragm by a suitable rivet or other securing device. The spring 24 has its top end 24^a bent slightly for the purpose of causing the spring to press firmly against the diaphragm 5 when said bent end is clamped in position between the flanges 3 and 4 at the top of the casings 1 and 2, the lower free end of the spring 24 being slightly curved in the opposite direction for the purpose of forming a seat for the depending back end of the regulating-lever 17. I find it advantageous to make use of this form of spring in addition to the spiral counter-spring 19 from the fact that the resilient force of the diaphragm counter-spring increases very rapidly with the amount of flexure which it undergoes, in which respect it differs from the spiral springs, the resilient force of each of which is much less variable within the limits of its extension or compression. It will be observed that when the valve 8 has been drawn back beyond the passages 13 no advantage is gained by still further withdrawing the valve. Hence it is desirable that the resistance to the force producing the outward motion of the valve from its seat should increase in a very rapid ratio. This increased resistance also prevents any undue strain upon the diaphragm which would be caused by an excessive diminution of pressure within the rear casing, and at the same time the form of the diaphragm counter-spring permits a support to be afforded to the diaphragm along a more extensive area than would be given by the spiral spring alone. This form of counter-spring has therefore the twofold advantage of resisting any undue distortion of the diaphragm and of giving strength to the diaphragm to withstand the distortion that it does undergo. The pressure-regulating nut 25 is threaded to neatly fit the interior threads formed in the stem 26, cast integral on the front casing 2, and has its inner reduced end adapted to loosely fit the end coils of the pressure-spring 22, the opposite end of the latter resting in and supported in the recess 28, formed in the pressure-plate 23^a.

Concentric with the axis of the spring 27 and in the concaved surface of the pressure-plate 23^a is formed the recess 29, adapted to loosely receive the plate 30, which is provided for the purpose of resisting the pressure of the counter-spring 19 and is adjusted inwardly and outwardly by the set-screw 31, screwed into the pressure-plate 23^a centrally with the plate 30. By making use of the concaved plate 23^a, which bears upon the diaphragm along its periphery only, and therefore upon portions of said diaphragm remote from the center thereof, not only am I enabled to distribute the pressure of the spring 27 upon a wider extent of surface instead of concentrating it at the center of the diaphragm, and thus to greatly reduce the danger of rupture of the diaphragm by the excess of pressure of the spring, but also by means of the plate 30, adjustably secured in the plate 23^a, I am able to regulate the pressure at the center of the diaphragm proportionately to the pressure at points distant from the center, as may be found necessary, having regard to the strength of the diaphragm. This adjusting-screw 31 is turned by a suitable screw-driver passed through the opening formed in the nut 25 and by which the pressure of the reduced fluid is adjusted to a degree of accuracy unattainable by the adjusting-nut 25 of the pressure-spring 27.

On the top of the chamber-casing 1 is formed the boss 32, which has the threaded holes 33 and 34 formed therein and adapted to receive the threaded ends of the steam-gage and safety-valve couplings.

The exit-openings 35, (see Fig. 1,) formed on the sides of the rear casing 1, are provided for the purpose of connecting the usual fittings by which the fluid is conveyed to the vessels or place where it is used.

The operation of the device is as follows: The coupling 8 being attached to a reservoir containing fluid under pressure or to a suitable compressor, the fluid under pressure is admitted through the valve-seat of the nipple 7, by reason of its pressure flows into the chamber 14, and forces the diaphragm 5 outwardly against the pressure of the spring 27. The longer arm of the lever 17, being thus released, is also moved in the same direction—that is, forward—by virtue of the pressure of its counter-spring 19 to close the valve 8 on its seat, which closure occurs immediately the fluid contained in the chamber 14 has attained the pressure required, and at which the pressure-spring 27 is adjusted to maintain, and thus as the gas is used or escapes from the chamber 14 the regulating-lever 17 is automatically operated to open and to close the valve 8 to maintain a constant fixed pressure of the fluid in the chamber 14.

Having thus fully described the nature and operation of my invention, what I claim as novel and useful, and desire to cover by Letters Patent of the United States therefor, is—

1. In a fluid-pressure regulator, the combination, with the front and rear casings thereof and an interposed diaphragm, of a regulating-lever having unequal arms and fulcrumed in said rear casing and having its longer arm operated by said diaphragm and its shorter arm provided with a cam-surface, a valve-seat secured in said rear casing and a valve thereon, a valve-adjusting nut on the stem of said valve, and an antifriction-roller, said valve being operated by the short arm of the lever through the medium of said roller and cam-

surface bearing upon said roller, and a suitable pressure-spring opposing said diaphragm and opposite said lever, substantially as described.

2. In a fluid-pressure regulator, the combination, with the front and rear casings thereof and an interposed diaphragm, of a regulating-lever having unequal arms and fulcrumed in said rear casing and having its longer arm operated by said diaphragm and its shorter arm provided with a cam-surface, a valve-seat secured in said rear casing and a valve thereon, a valve-adjusting nut on the stem of said valve, and an antifriction-roller, said valve being operated by the short arm of the lever through the medium of said roller and cam-surface bearing upon said roller, the curvature of said surface being such as to produce regular increments of distance of the valve from its seat, and a suitable pressure-spring opposing said diaphragm and opposite said lever, substantially as described.

3. In a fluid-pressure regulator, the combination, with the front and rear casings thereof and an interposed diaphragm, of a lever having unequal arms fulcrumed in said casing, a diaphragm counter-spring between said lever and diaphragm, a valve-seat secured in said rear casing and a valve on said seat, and a suitable pressure-spring opposing said diaphragm and opposite said lever, substantially as described.

4. In a fluid-pressure regulator, the combination, with the front and the rear casings thereof and their yielding interposed diaphragm, of a regulating-lever having unequal arms and fulcrumed in said casing, a diaphragm counter-spring fulcrumed between said casing and diaphragm and having its free end interposed between said diaphragm and lever, a valve-seat secured in said rear casing, a valve thereon arranged to engage the shorter arm of said lever, and a suitable pressure-spring opposing said diaphragm, substantially as described.

5. In a fluid-pressure regulator, the combination, with the front and the rear casings thereof and the yielding interposed diaphragm, of a regulating-lever having unequal arms and fulcrumed in said casing, a valve-seat secured in the rear of said casing, a valve thereon arranged to engage the shorter arm of said lever, a concaved plate, a compressed spring pressing upon said diaphragm through the medium of said plate and along the periphery thereof, opposing the fluid-pressure upon the other side of the diaphragm, a screw adjustment for the pressure of the spring, a central disk carried by said plate, abutting against the diaphragm to support the same against the central pressure thereon, and a screw adjustment for said disk, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES J. RINDERKNECHT.

Witnesses:

THOMPSON R. BELL,

JAMES B. CURTIS.