F. M. CARROLL.

REDUCING VALVE.

APPLICATION FILED FEB. 11, 1909.

**944,664.** Patented Dec. 28, 1909.

Fig. 1

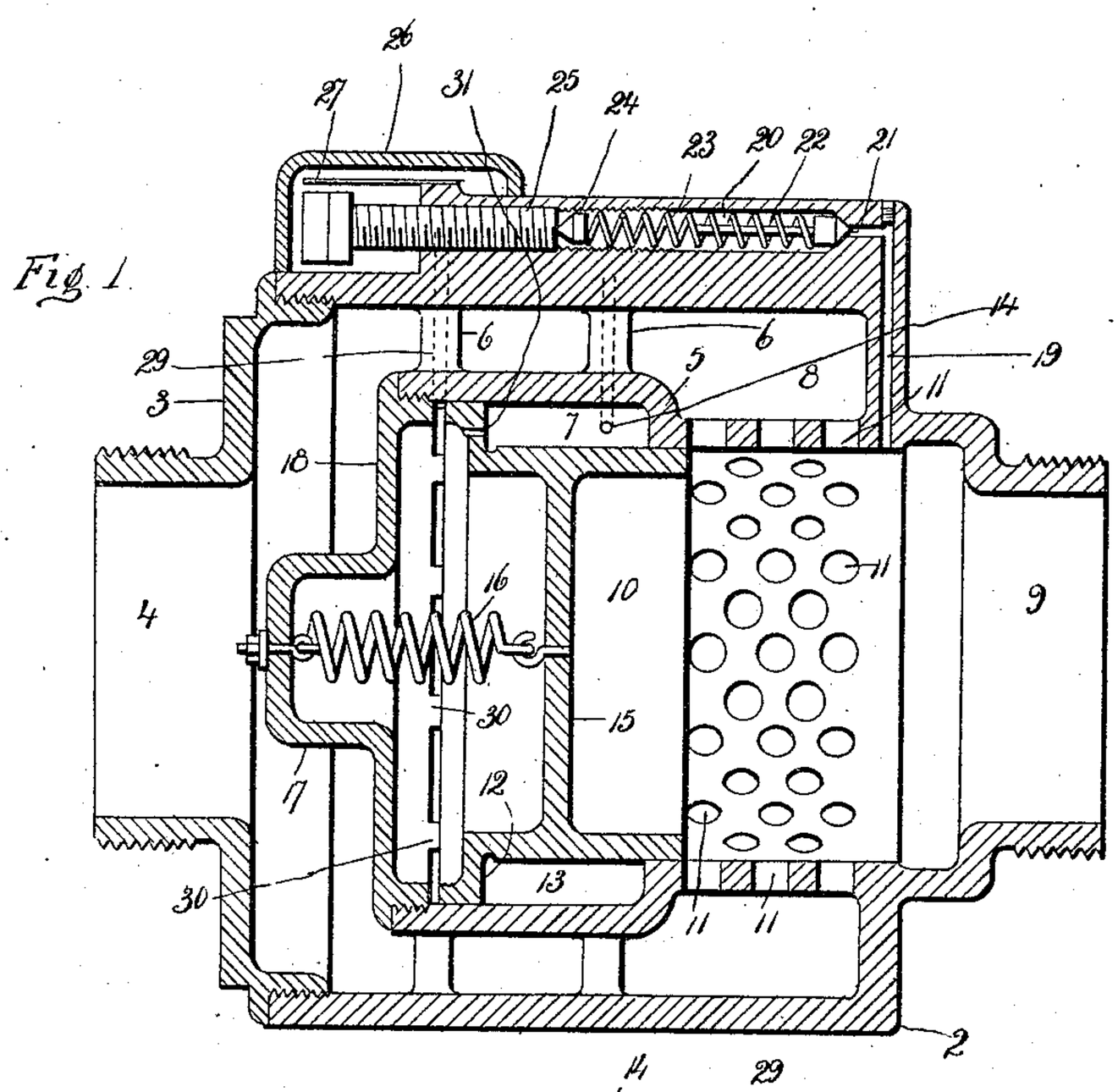



Fig. 2

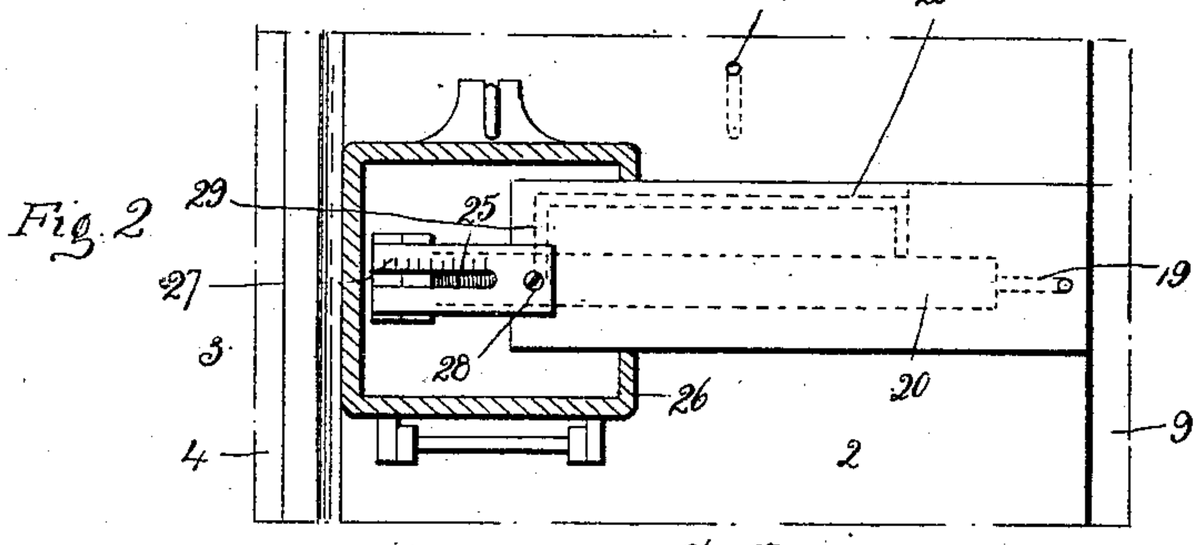



Fig. 3

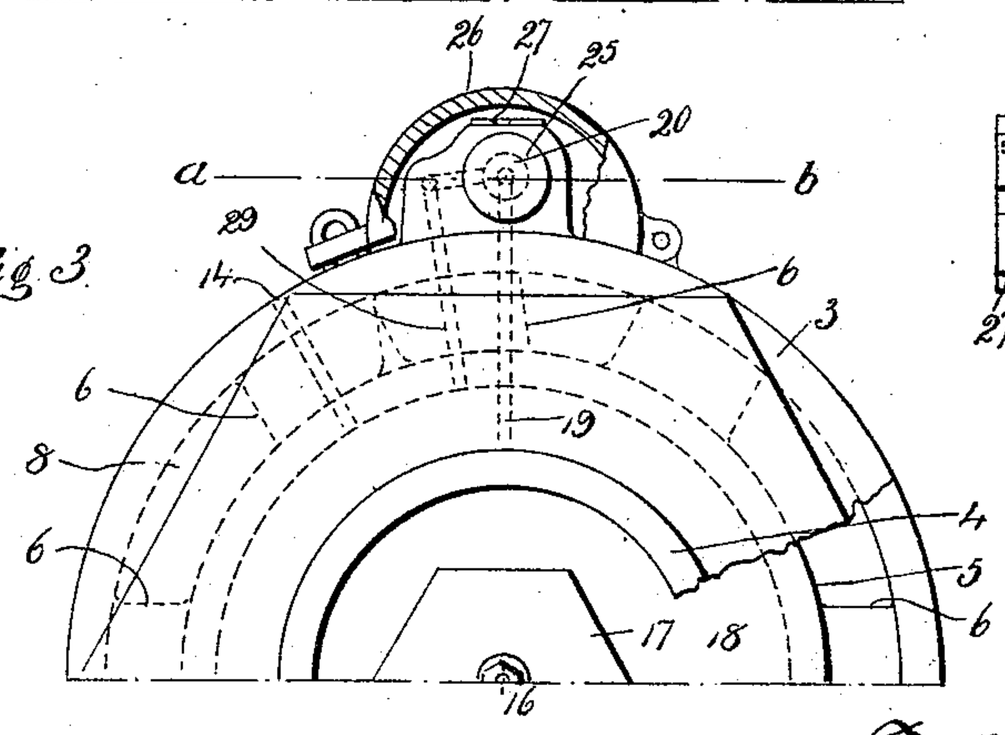
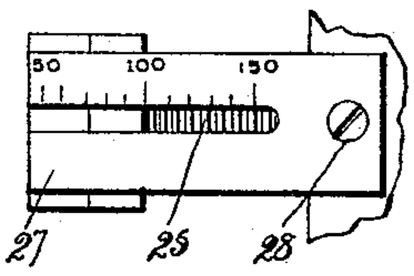



Fig. 4




Witnesses
C. J. Reed.
C. L. Reed

Inventor
Fred M Carroll
by Seymour & Earle
Attys

ANDREW. B. GRAHAM CO., PHOTO-LITHOGRAPHERS WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

FRED M. CARROLL, OF NEW HAVEN, CONNECTICUT.

## REDUCING-VALVE.

944,664. Specification of Letters Patent. Patented Dec. 28, 1909.

Application filed February 11, 1909. Serial No. 477,430.

*To all whom it may concern:*

Be it known that I, FRED M. CARROLL, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented a new and useful Improvement in Reducing-Valves; and I do hereby declare the following, when taken in connection with the accompanying drawings and the characters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1 a view in central longitudinal section of a reducing valve constructed in accordance with my invention. Fig. 2 a broken view of the valve, partly in plan and partly in horizontal section on the line *a*—*b* of Fig. 3. Fig. 3 a view in elevation of the upper half of the high-pressure end of the device with the head of the outer casing broken away, the guard or housing of the micrometer-screw being shown in vertical section. Fig. 4 a detail plan view showing the graduated scale located above the micrometer-screw.

My invention relates to an improvement in "reducing valves," as valves constructed to reduce liquids or fluids from high to low pressures are commonly called, the object being to produce a simple, compact, reliable and effective device constructed with particular reference to dispensing with the flexible diaphragm commonly employed in such valves as well as other parts delicate in their nature and liable to derangement.

While my improved reducing valve is adapted for reducing air, gases, steam and liquids from high to low pressure, it is particularly adapted for use in reducing water from high to low pressure, as for instance, water supplied at high pressure to fire hydrants from which it must be taken at a low pressure.

With these ends in view my invention consists in the construction and combination of parts to be hereinafter described and pointed out in the claims.

In carrying out my invention as herein shown, I employ a casing consisting of a substantially cylindrical outer shell 2 provided at its inner or high-pressure end with a flanged threaded head 3 which, when removed, affords access to the interior of the casing. The said head 3 is provided with a concentric threaded intake hub 4 with which the supply pipe, whatever it may be, is connected. The outer shell 2 contains a concentric inner shell 5 cast integral with and supported by radial webs 6 joining the inner face of the outer shell 2, whereby the interior of the casing is divided, as it were, into a low-pressure or reducing chamber 7, and a concentric high-pressure chamber 8 which latter is in direct communication with the hub 4. At its outer or low-pressure end the outer shell 2 is formed with an integral threaded hub 9 concentric with the hub 4 and provided for the attachment of the low-pressure or service pipe whatever it may be. The inner shell 5 is made larger at its inner than at its outer end and consequently the inner end of the low-pressure chamber 7 is made larger than the outer end thereof.

Within the low-pressure chamber 7 I locate, as shown, a sliding reducing-valve 10 the outer end of which opens and closes a series of radially arranged ports 11 leading through the outer end of the inner shell 5 from the high-pressure chamber 8 into the smaller outer end of the low-pressure chamber 7, which at its extreme outer end opens directly into the hub 9 aforesaid. At its extreme inner end the valve 10 is provided with an outwardly extending annular flange 12 fitting the enlarged inner end of the low-pressure chamber 7 and moving back and forth in a concentric clearance space 13 formed between the middle portion of the said valve and the middle portion of the enlarged inner end of the shell 5 as the result of differentiating the diameter of the shell 5 so as to make its inner end larger than its outer end. This construction secures a larger area for pressure upon the inner end of the valve than upon its outer end. The said clearance-space 13 is connected directly with the atmosphere by means of a small vent 14 which maintains atmospheric pressure in the said space 13. The two ends of the valve 10 are separated by means of a partition 15 to which is attached one end of a helical spring 16 the other end of which is attached to a hollow nut-like boss 17 formed at the center of a flanged and threaded cap 18 employed to close the inner end of the inner shell 5, and when removed, affording access to the interior thereof.

A radial passage 19 leads from the outer end of the low-pressure chamber 7 through the outer end wall of the outer shell 2 and merges into the reduced outer end of a small

cylindrical valve-chamber 20 formed in the periphery of the said shell, extending parallel with the longitudinal axis thereof, and containing a small pilot-valve 21 having a stem 22 encircled by a spring 23 the opposite end of which abuts against a plunger 24 one end of which is made conical for coaction with a micrometer screw 25 located within a housing 26 hinged to the periphery of the said shell as shown by Fig. 3. A graduated scale 27 attached to the shell 2 by a screw 28 is located directly over the micrometer-screw 25 and provides for the adjustment of the same as may be required to set the spring 23 to cause the pilot valve 21 to be operated at a predetermined pressure.

From about midway the length of the chamber 20 a passage 29 leads, as shown in Fig. 2, to the inner end of the low-pressure chamber 7 as shown in Fig. 1. To prevent the inner end of the passage 29 from being closed by the flange 12 of the reducing-valve 10, I provide the cap 18 with abutments 30 with which the flange 12 engages, as shown in Fig. 1.

If desired to hasten the opening of the valve 10, I may provide its flange 12 with a relief-opening 31 extending from the inner end of the reducing-chamber 7 into the clearance space 13 which is at atmospheric pressure. The passages 19, valve-chamber 20 and passage 29 form in effect a continuous passage between the ends of the low-pressure chamber 7 but for convenience of description are designated as passages 19, chamber 20 and passage 29. In the claims these features are collectively called a passage which in effect they are.

I may also state that the total area of the ports 11 should be in excess of the total cross-sectional area of the low-pressure or service outlet 9.

For convenience of description, the operation of the device will be described as for reducing water from high to low pressure. It should be understood, in the first place, that the function of the spring 16 is to normally maintain the reducing valve 10 in its full open position at the inner end of the low-pressure chamber 7, whereby all of the radial ports 11 will be left open. If now water at high pressure is admitted into the high-pressure chamber 8, it will pass through the ports 11 into the outer end of the low-pressure chamber 7, and thence into the low pressure or service outlet 9. The water will continue to flow, gradually rising in pressure in the service outlet 9 and hence in the passage 19, until the accumulation of pressure in the said passage 19 passes the predetermined point at which the pilot valve 21 has been set. The pilot-valve 21 will now open and a portion of the water will flow through the valve-chamber 20 and the passage 29 to the enlarged inner end of the low-pressure chamber 7 so as to act upon the flanged inner end of the sliding valve 10 which will now be gradually moved outward so as to gradually close the ports 11 against the back-pressure in the outer end of the same chamber and against the tension of the spring 16. This closing movement of the reducing-valve 10 continues until an equilibrium of pressure has been established, or in other words, until the pressure in the outer or low pressure end of the low-pressure chamber 7 corresponds to the pressure required to open the pilot valve 21. In case the pressure falls in the outer end of the low-pressure chamber 7, the reducing valve 10 will move inward and so gradually open, owing to leakage around the flange 12 from the enlarged inner end of the low-pressure chamber 7 into the space 13 which opens to the atmosphere through the vent 14. This opening movement of the reducing valve 10 will continue until the said valve is fully open, providing the pressure continues to fall at the outer end of the low-pressure chamber 7. On the other hand, should the pressure in the outer end of the low-pressure chamber 7 rise enough after the valve 10 has closed, to establish an equilibrium, as before described, the pilot valve 21 will again be opened to permit a portion of the water to flow through the valve-chamber 20 and passage 29 to the enlarged inner end of the low-pressure chamber 7. The valve 10 will then be gradually closed, and so on.

It will be understood from the foregoing that the pilot-valve 21 is ready at all times to respond to any increase of pressure in the outer end of the low-pressure chamber above a predetermined point and by virtually transmitting this increase of pressure to the enlarged inner end of the reducing-valve 10, cause the same to be sufficiently closed to offset the increase, whatever that may be.

In practice the pilot-valve 21 is set so as to be sensitive to slight changes in the increase of pressure and operates so as to maintain the pressure in the outer end of the low-pressure chamber 7 at a constant point within narrow limits of variation.

If desired ordinary pressure-gages may be applied to the device so that any variation of pressure within the device may be readily observed.

The pilot-valve 21 which controls the operation of the reducing-valve 10 does so by being located, as may be said, in a continuous passage tapping the opposite ends of the low-pressure chamber, this passage comprising the passages 19 and 29 and the small passage-like valve-chamber 20 containing the pilot-valve 21 as already explained.

By arranging the high and low-pressure chambers so that one surrounds the other, and by locating them in line with the water inlet and outlet, I secure a construction which is compact, simple and easy to manu-

facture since concentric parts are easy to produce and fit, while the use of a plurality of radially arranged ports gives my improved reducing valve a large capacity for work,—the number of ports enables a large amount of water to be transmitted and their arrangement constricts and retards the water but little.

I claim:—

1. In a reducing valve, the combination with a high and a low-pressure chamber one surrounding the other, of radial ports leading from the former to the latter, a valve sliding in one of the said chambers to open and close the said radial ports and having one of its ends larger than the other, an atmospheric vent located between the ends of the chamber containing the valve, and a passage leading from the smaller to the larger end of the valve.

2. In a reducing valve, the combination with a high and a low pressure chamber one surrounding the other, of radial ports leading from the former to the latter, a valve located in the low-pressure chamber, sliding to open and close the said radial ports and having one end enlarged, an atmospheric vent located between the ends of the said low-pressure chamber, and a passage leading from the smaller to the larger end of the valve and a spring connected with the said valve and tending to move the same so as to open the said radial ports.

3. In a reducing valve, the combination with a high and a low pressure chamber one surrounding the other, of a circular series of radial ports connecting the said chambers, a valve located in one chamber and operating to open and close the said ports, means operating the said valve by low-pressure, and an atmospheric vent so situated as to allow the valve to operate.

4. In a reducing valve, the combination with a high and a low-pressure chamber one surrounding the other, of a circular series of radial ports connecting the said chambers, a sliding valve located in one of the said chambers, operating to open and close the said ports and larger at one end than the other, a spring connected with the said valve and tending to move the same so as to open the said ports, means operating said valve by low-pressure including a pilot-valve, a micrometer screw located in the outer wall of the outer chamber for the adjustment of the said pilot-valve, and an atmospheric vent so situated as to allow the valve to operate.

5. In a reducing valve, the combination with a high and a low-pressure chamber the former surrounding the latter, of a circular series of radial ports leading from the said high pressure chamber to the said low pressure chamber, a sliding valve located in the low-pressure chamber, operating to open and close the said radial ports and larger at one end than at the other, a passage leading from the outer to the inner end of the said low-pressure chamber, and formed in the outer wall of the said high pressure chamber, a pilot-valve located in the said passage and responding to the accumulation of pressure in the outer end of the low-pressure chamber, and a vent to the atmosphere located between the ends of the low-pressure chamber.

6. In a reducing valve, the combination with a high-pressure chamber, of a concentric low-pressure chamber surrounding the said high-pressure chamber, radial ports leading directly from the former to the latter, a passage leading from the outer end of the low-pressure chamber into the inner end thereof, a valve located in the low-pressure chamber, sliding to open and close the said radial ports and exposing a larger area to pressure at its inner than at its outer end, a pilot-valve located in the said passage and responding to the accumulation of pressure in the outer end of the low pressure chamber, and a vent to the atmosphere located between the ends of the low-pressure chamber.

7. In a reducing valve, the combination with a high-pressure chamber, of a low-pressure chamber located concentrically within the said high-pressure chamber and larger in diameter at its inner than at its outer end, a circular series of radial ports connecting the said chambers, a passage leading from the outer to the inner end of the low-pressure chamber through the outer wall of the high-pressure chamber, a sliding valve located in the low-pressure chamber and formed at its inner end with a flange extending into the enlarged inner end of the low-pressure chamber, a pilot-valve located in the said passage responding to the accumulation of pressure in the outer end of the low-pressure chamber, and a vent from the enlarged inner end of the low-pressure chamber to the atmosphere.

8. In a reducing valve, the combination with an outer shell, of a removable head closing the inner end thereof, a concentric inner shell having its outer end perforated, a removable cap closing the inner end of the said inner shell, the space between the two shells forming a high-pressure chamber and the inner shell inclosing a low-pressure chamber the ends of which are connected by a passage; of a sliding reducing-valve located in the said low pressure-chamber and at its inner end exposing a larger area to pressure than at its outer end, a pilot-valve located in the said passage and adapted to be set to respond to any predetermined accumulation of pressure in the outer end of the low-pressure chamber, and a vent to the atmosphere from the enlarged inner end of the low-pressure chamber.

9. In a reducing valve, the combination with a high-pressure chamber, of a concentric low-pressure chamber surrounded by the said high-pressure chamber, a circular series of radial ports leading from the former to the latter, a passage leading from the outer to the inner end of the low-pressure chamber through the outer wall of the said high-pressure chamber, a valve in the low-pressure chamber, a pilot-valve located in the said passage and responding to the accumulation of pressure in the outer end of the low-pressure chamber, a micrometer-screw for the adjustment of the pilot-valve located in the said passage and arranged parallel with the axis of the said chambers, and a housing or guard for protecting the micrometer-screw.

10. In a reducing valve, the combination with an inlet, of an outlet concentric therewith, high and low-pressure chambers interposed between the said inlet and outlet and arranged concentric therewith, one of the said chambers surrounding the other, radial ports leading from one chamber to the other, a valve located in one chamber and operating to open and close the said ports, means operating the said valve by low-pressure, and an atmospheric vent situated to allow the valve to operate.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

FRED M. CARROLL.

Witnesses:
GEORGE DUDLEY SEYMOUR,
CLARA L. WEED.