No. 868,599.

PATENTED OCT. 15, 1907.

C. J. COLEMAN.

PRESSURE REDUCING VALVE.

APPLICATION FILED JAN. 12, 1907.

Fig.1

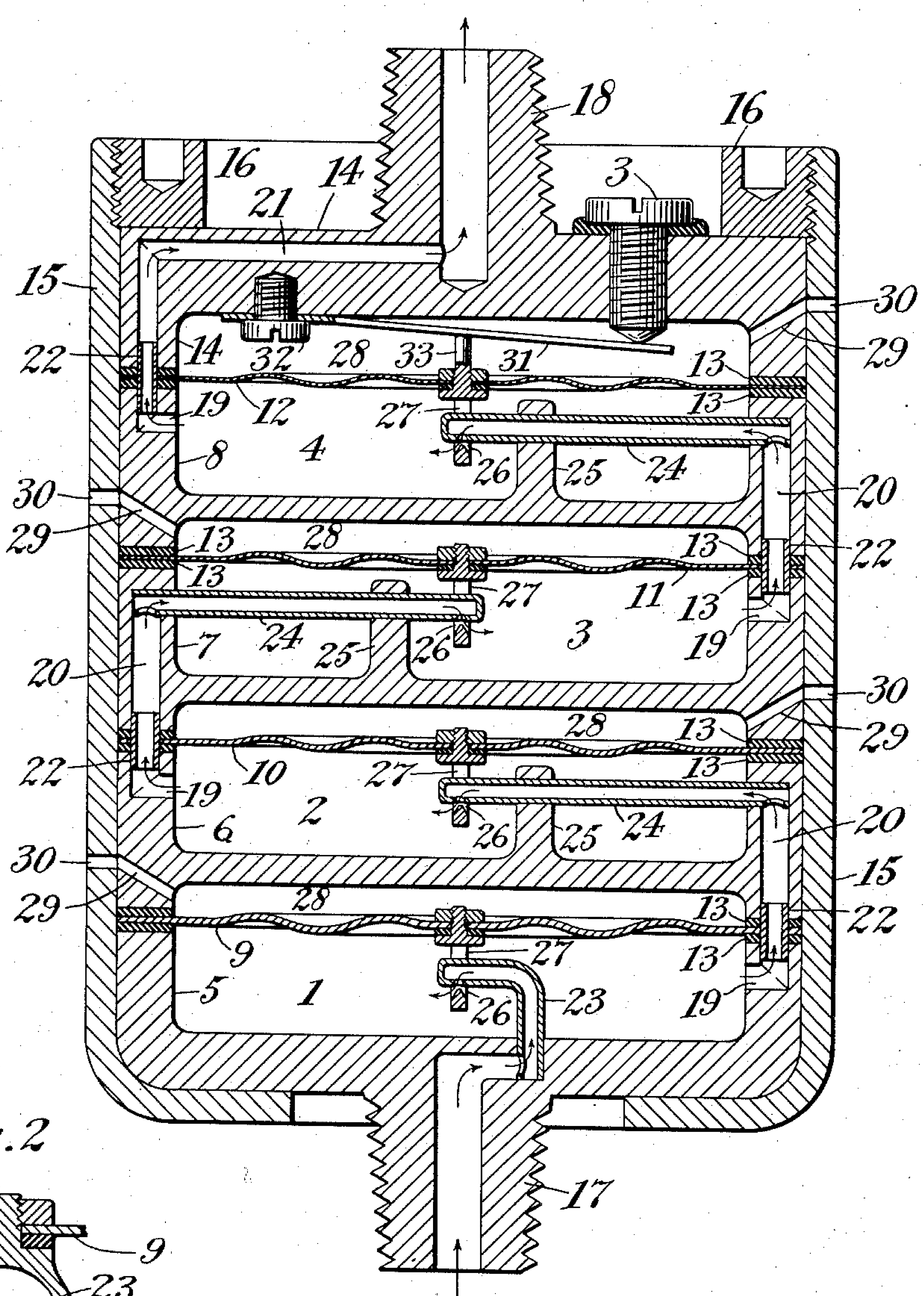
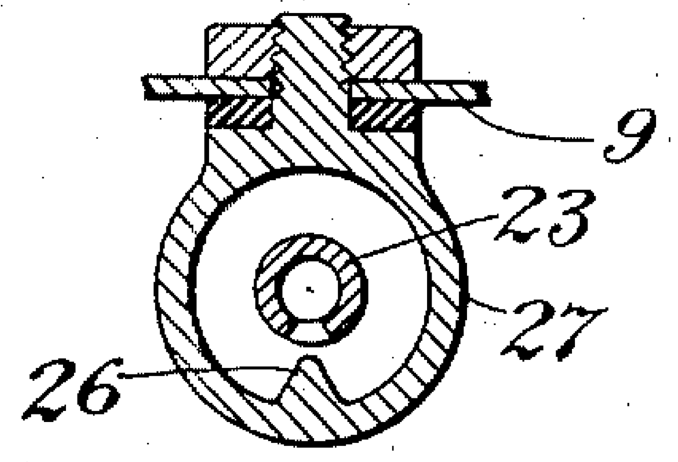


Fig.2



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PRESSURE-REDUCING VALVE.

No. 868,599. **Specification of Letters Patent.** **Patented Oct. 15, 1907.**

Application filed January 12, 1907. Serial No. 352,023.

To all whom it may concern:

Be it known that I, Clyde J. Coleman, a citizen of the United States, residing at the borough of Manhattan, city of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Pressure-Reducing Valves, of which the following is a specification, reference being had therein to the accompanying drawing, forming a part thereof.

My invention relates to pressure reducing valves, and has for its objects delivery of fluid at a uniform reduced pressure, avoidance of freezing of the fluid while its pressure is being reduced, and provision for reduction from a very high to a very low pressure; and has as its further objects compactness of construction, convenience of assembling, and economy of operation.

My invention includes means for reducing fluid pressure by successive stages or graduated steps.

My invention also includes the provision of a plurality of valve-actuative devices responsive respectively to variations in pressure of the low pressure fluid at the corresponding successive stages of pressure reduction and respectively in control of the admission ports at such stages.

My invention further includes certain details of construction hereinafter described.

A valve embodying my invention is, among its other applications, particularly well adapted for reducing the pressure of acetylene or other gas for lighting purposes, especially when used upon automobiles. Such gas is usually stored in receivers at a very high pressure, and must be reduced to a very low pressure for use in the lamps, for example, from a pressure of 1200 pounds to a pressure of 2 ounces.

I will now describe the construction shown in the accompanying drawings embodying my invention and will thereafter point out my invention in claims.

Figure 1 is a central longitudinal section of the complete device. Fig. 2 is an enlarged central sectional detail of one of the diaphragm controlled valves, the section being taken on a plane at right angles to the plane of section in Fig. 1 and longitudinally of the device.

The embodiment of my invention shown in the accompanying drawings includes a plurality of successively arranged or superposed valve-controlled pressure chambers 1, 2, 3 and 4. The pressure chambers are formed by hollowed-out or cup-shaped chamber sections 5, 6, 7 and 8, closed respectively by valve-actuative diaphragms 9, 10, 11 and 12, each diaphragm forming one end of the corresponding chamber and being controlled by the pressure in the chamber for actuating the inlet valve for that chamber. The diaphragms 9, 10 and 11 are bound or clamped at their peripheries between the adjacent chamber sections with interposed packing-rings 13, and the last diaphragm 12 is retained in place by a cup-shaped cover-cap 14 with interposed packing rings 13. The packing-rings may be of any suitable material, as for example, celluloid. The successive chamber sections, diaphragms and the cover-cap fit within a cup-shaped casing 15 and are retained therein and firmly bound or clamped together by a clamping-ring 16 screwed into the mouth of the casing.

Each of the chamber sections 6, 7 and 8 has, as shown, a downwardly extending peripheral flange for forming clearance spaces 28 on the outside of the diaphragms 9, 10 and 11, and the cover-cap 14 has a similar, slightly larger, downwardly extending peripheral flange forming a clearance space 28 for the diaphragm 12. The first or lower chamber section 5 has a screw-threaded connecting-boss or inlet-nipple 17 which protrudes downward through an opening in the bottom of the casing, and the cover-cap 14 is provided with a similar upwardly extending connecting-boss or outlet-nipple 18. These clearance spaces 28 have communication with the atmosphere through passages 29 leading therefrom and registering with openings 30 in the casing 15, and thus the diaphragms are permitted to act freely under the upward pressures in their respective chambers opposed to downward pressure of the atmosphere and the resistance of the diaphragms. The high pressure fluid enters through the nipple 17 and, after passing through the device and undergoing the several stages of reduction in pressure, emerges through the nipple 18, the course of the fluid being indicated by arrows.

Each of the chamber sections has in its peripheral wall an outlet passage 19 for the corresponding pressure chamber, and each of the chamber sections 6, 7 and 8 has in its peripheral wall an inlet passage 20. The outlet and inlet passages of adjacent pressure chambers communicate with each other, and the outlet passage of the last chamber 4 communicates with a final outlet passage 21 in the wall of the cover-cap, this last-named passage communicating with the bore of the outlet-nipple 18. The respective coöperating outlet and inlet passages are retained in alinement with each other and more securely sealed together by short metal tubes 22 telescoped thereinto and acting in a similar manner to dowel pins. Because of limited space, the pairs of coöperating outlet and inlet passages are located at diametrically opposite points of the chambers.

The pressure chambers are provided respectively with rigid valve-controlled admission conduits or admission tubes. The admission tube 23 for the first or lower chamber 1 is carried by the chamber section 5 and is of an inverted **L**-shape and communicates with the bore of the inlet-nipple 17. The admission tubes 24 for the chambers 2, 3 and 4 are arranged radially of the respective chambers and each such tube communicates with its corresponding inlet passage 20. The tubes 24 are rigidly supported and strengthened by supporting-lugs 25 near their inner ends and formed integral with the respective chamber sections.

The admission tubes are closed at their inner ends and each tube is provided, at a point thereon substantially diametrically opposite to the corresponding diaphragm, with a valve-opening or port as shown, such valve-opening being about in alinement with the center of the diaphragm. The valve-opening for the first chamber in the succession forms an initial inlet, and the remaining valve-openings form communications between adjacent chambers. Each valve-opening is controlled by a coöperating conical valve 26 carried by and formed integral with a ring-shaped valve-support or stud 27 which encircles the corresponding admission tube. The studs 27 are respectively carried by the diaphragms 9, 10, 11 and 12, each stud having a threaded stem passing through the center of the corresponding diaphragm, the studs being secured in place by nuts as shown, and the joints of the studs with the diaphragms being made fluid tight by packing-rings as shown.

Normally, and as shown in the drawings, the valves 26 are not seated in the valve-openings, thus allowing the fluid to pass through the valve openings or ports. The diaphragms are circularly ridged or fluted as shown to impart to them a greater resiliency or spring effect and to adapt each diaphragm to yield and close its valve 26 when acted upon by sufficient fluid pressure within the corresponding pressure chamber and then to spring back and open such valve when the pressure within the chamber becomes sufficiently reduced. The pressure of the fluid will be reduced by successive stages. The high pressure fluid enters the first chamber 1 through the inlet-nipple 17 and admission tube 23 and passes successively from chamber to chamber until it finally escapes through the final outlet passage 21 and outlet-nipple 18, the pressure being reduced step-by-step from any one chamber to the next in succession. Closure of the valves 26 is further resisted by the pressure of the fluid in the admission tubes upon such valves. The spring action of the diaphragms, atmospheric pressure in the clearance spaces 28 and the pressure of the fluid in the admission tubes coöperate to tend to open the valves while the pressure of the fluid in the pressure chambers tends to close the valves. To secure the proper ratio of reduction in pressure from stage to stage, that is, from chamber to chamber, it is necessary that the sizes of the valve-openings and the degrees of flexibility or amount of resistance to pressure of the corresponding diaphragms should bear a certain relation to each other. The pressure-resisting power of a diaphragm should bear a relation to the size of its valve-opening corresponding to the amount of difference in pressure at opposite sides of the valve. For lower pressures the valve should be actuatable correspondingly more easily, that is to say, there should be correspondingly less resistance to closure of the valve. The diaphragms are conveniently all of the same size, and with a given size of diaphragm the above-named result as to valve-actuation may be accomplished by successively varying the thickness of the diaphragms relatively to the sizes of the corresponding valve-openings.

As shown in the drawings the valve-openings are all of the same size and the diaphragms are of successively graduated thicknesses. Thus the first diaphragm 9 is the thickest, to correspond to the high valve-closing pressure to which it is subjected, while the next diaphragm 10 in the series is thinner, to compensate for the decreased pressure, and so on successively to the last diaphragm 12 which is the thinnest of all and is therefore adapted to be actuated by a comparatively very low fluid pressure.

Pressure fluctuations are effectually damped out or corrected by the successive stages of reduction in pressure to which the fluid is subjected. For example, the pressure could vary to a great extent in the first or second pressure chambers without appreciably disturbing the final or delivery pressure of the fluid. Also if freezing and consequent "spitting", which is liable to take place when fluids are reduced from extremely high pressures, should occur at the first or second stages of reduction, the final delivery pressure will remain substantially uniform.

The final pressure or pressure of delivery may be regulated by manually-controllable resisting means adapted to act upon the inlet valve of the last chamber in the succession in opposition to the valve-closing fluid pressure in such chamber. Such means are shown as comprising a plate spring 31 secured at one of its ends to the inner side of the cover-cap 16 by an attaching screw 32. The spring 31 bears at its middle portion upon a pin 33 carried by the diaphragm 12 such pin being shown as forming an integral extension from the screw-threaded attaching-stem of the ring-shaped valve-carrying stud 27 for this diaphragm. An adjusting screw 34 passes from the outside inward through the cap 16 and bears against the free end of the spring 31. A sealing washer 35 of readily yieldable resilient material, such, for example, as soft rubber, surrounds the screw 34 and is compressed beneath the head thereof, where, by reason of its expansibility, it effects a seal while permitting a considerable range of adjustment of the screw. If the adjusting or regulating screw 34 be turned inward, the pressure at which the fluid is delivered will be increased, owing to the increased resistance of the spring 31 which coöperates with the diaphragm in opposing the fluid-pressure within the chamber 4. If the adjusting screw be turned outward, the tension of the spring will be lessened and correspondingly less fluid pressure will be required within the chamber 4 to impart a valve-closing movement to the diaphragm 12. The embodiment of the invention shown in the drawings is adapted to reduce pressures approximately from 1200 lbs. to 2 oz. The pressures in chambers 1, 2, 3 and 4 respectively would be approximately 100 lbs., 10 lbs., 1/2 lb., and 2 oz., this latter of course being the final or delivery pressure.

It is obvious that various modifications may be made in the construction shown and above particularly described within the principle and scope of my invention.

I claim:—

1. A pressure reducing device comprising a plurality of pressure chambers belonging to successive stages of pressure reduction, with valve-openings forming communications between adjacent chambers and an initial valve-opening for the first chamber in the succession, a valve in control of each valve-opening, such valves constituting inlet valves for the successive chambers, and a diaphragm for each chamber and controlled by the pressure in the

chamber for actuating the inlet valve for that chamber, such diaphragm being exposed on one side to the pressure within the chamber and exposed on its other side to the pressure of the atmosphere.

2. In a pressure reducing valve, the combination of a plurality of cup-shaped sections and interposed diaphragms means for binding the sections and diaphragms together to form chambers, the sections being provided with passages connecting adjacent chambers and the outer sections each being provided with a passage leading to the outside and constituting respectively inlet and outlet passages, and a valve for each chamber controlled by the corresponding diaphragm and controlling the inlet passage for such chamber.

3. In a pressure-reducing valve, the combination of a casing, a plurality of cup-shaped sections secured in the casing and comprising each a transverse partition, a cylindrical pressure-chamber wall projecting in one direction from the partition and an atmospheric-chamber wall projecting in the opposite direction, diaphragms interposed between said sections and dividing the spaces between them into pressure chambers and atmospheric chambers, passages connecting the pressure chambers, and valves connected with the diaphragms and controlling said passages.

4. In a pressure-reducing valve, the combination of a casing, a plurality of cup-shaped sections secured in the casing, diaphragms interposed between said sections and forming pressure chambers therewith, passages connecting the pressure chambers and formed by registering openings in contiguous portions of the cup-shaped sections, and valves connected with the diaphragms and controlling said passages.

5. In a pressure-reducing valve, the combination of a plurality of pressure chambers connected together in series by passages, valves controlling the passages, a diaphragm connected with and controlled by the pressure in each chamber, and valves connected with the diaphragms and controlling said passages, the diaphragms being all of substantially the same diameter but of successively decreasing thicknesses in proportion to the different pressures in the successive chambers.

In testimony whereof I have affixed my signature in presence of two witnesses.

CLYDE J. COLEMAN.

Witnesses:
WM. ASHLEY KELLY,
ALBERT V. T. DAY.