(No Model.) 2 Sheets—Sheet 1.

J. D. BOWMAN.

PRESSURE REGULATOR.

No. 402,392. Patented Apr. 30, 1889.

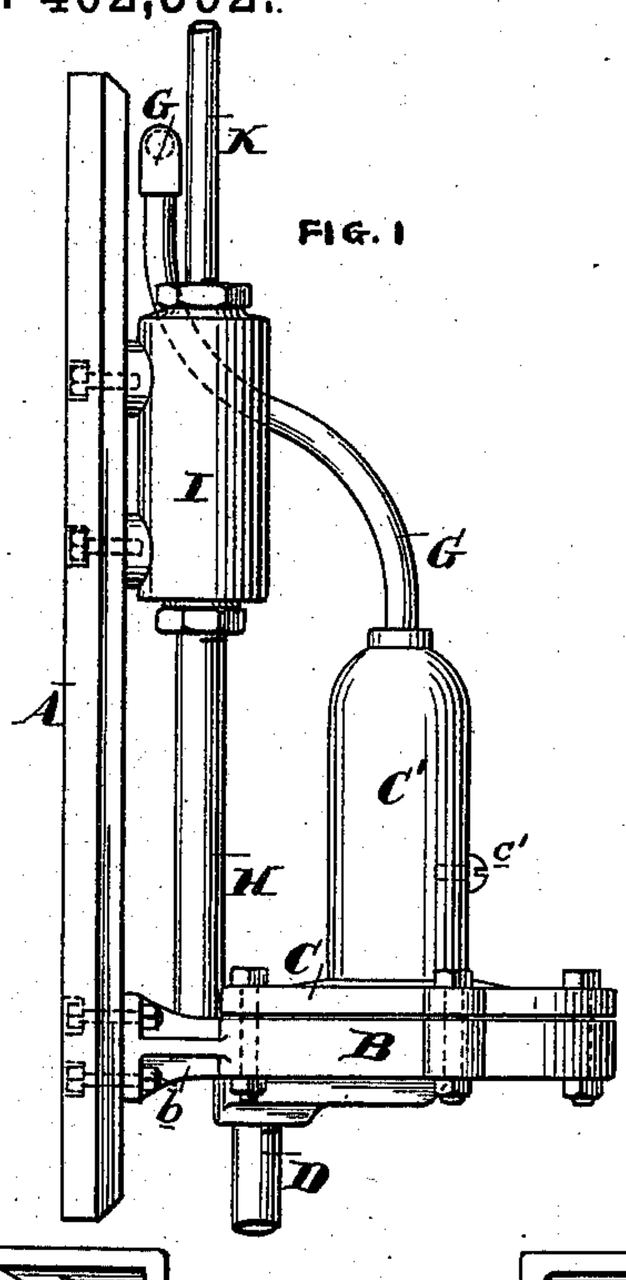


FIG. 1

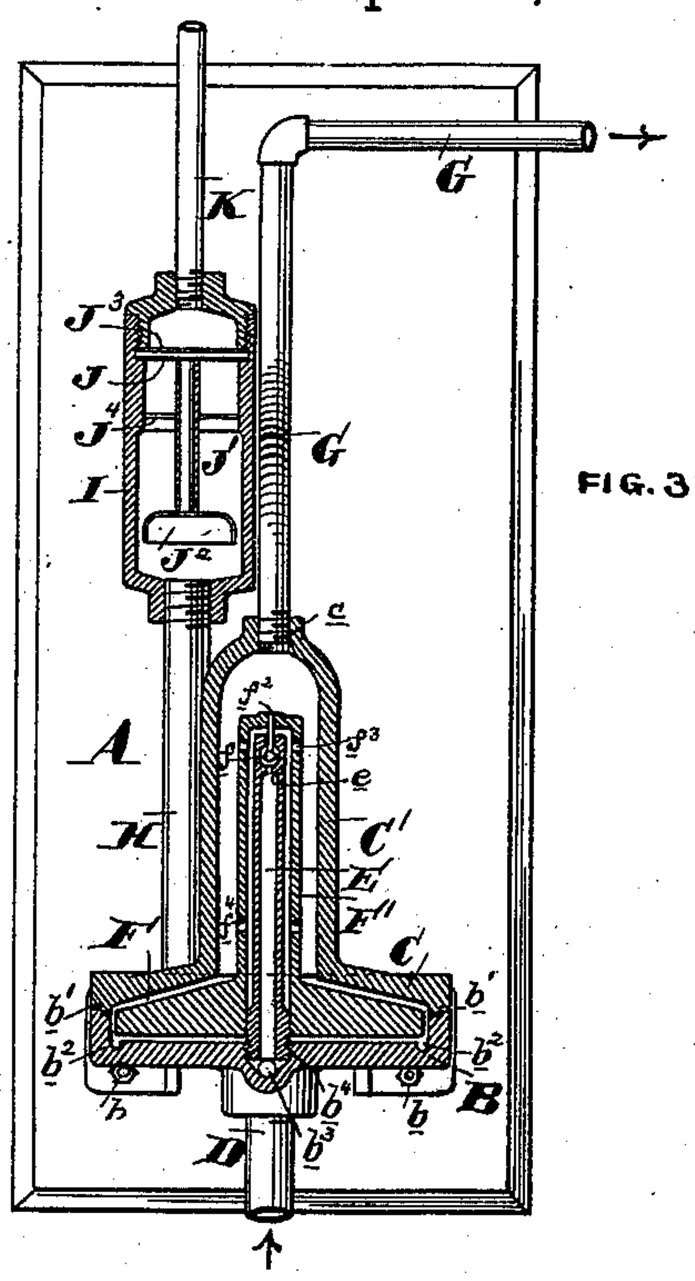


FIG. 3

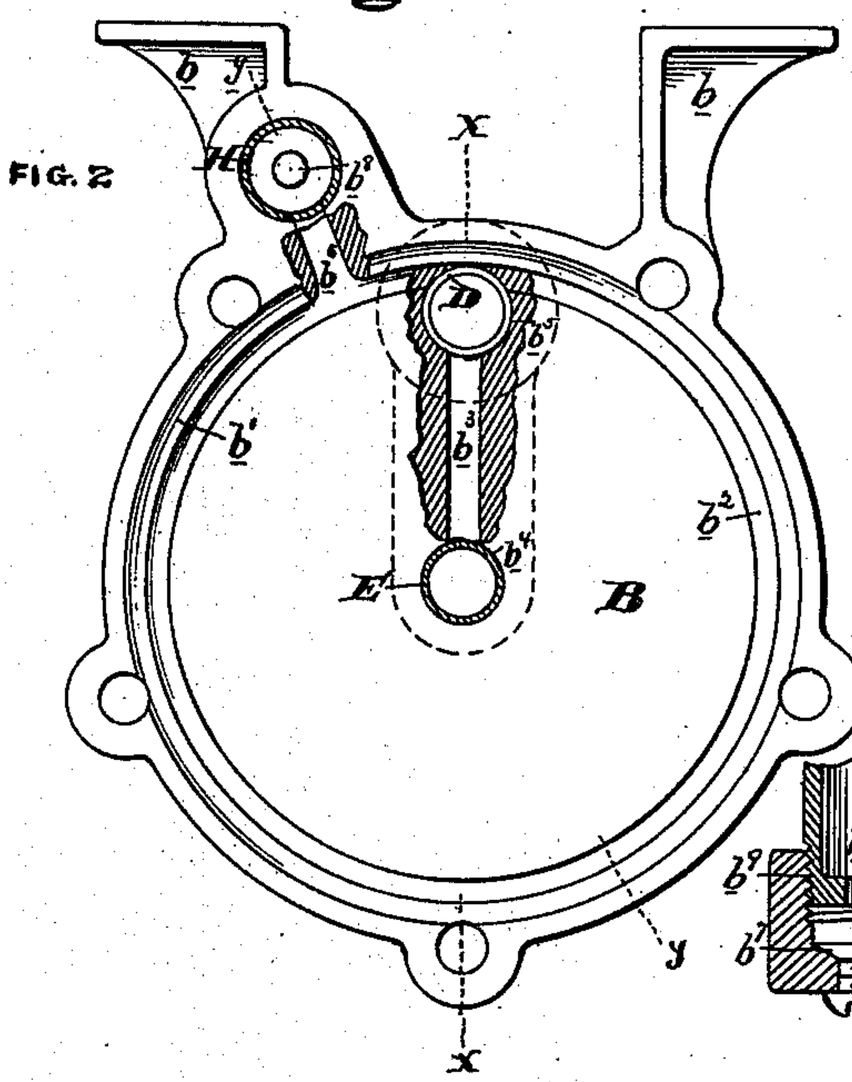


FIG. 2

FIG. 5

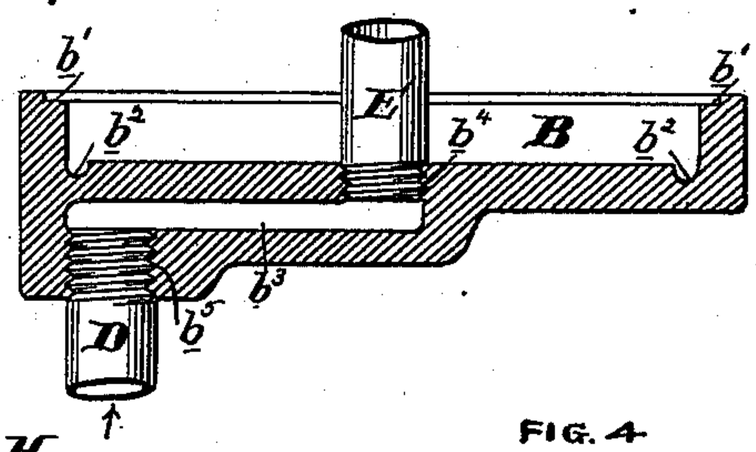


FIG. 4

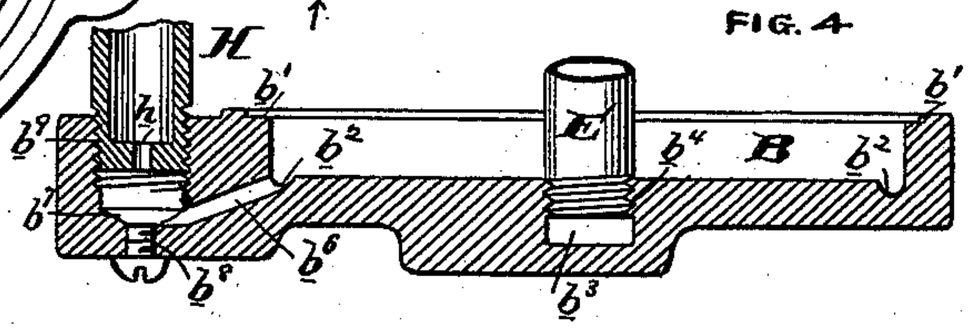


FIG. 7

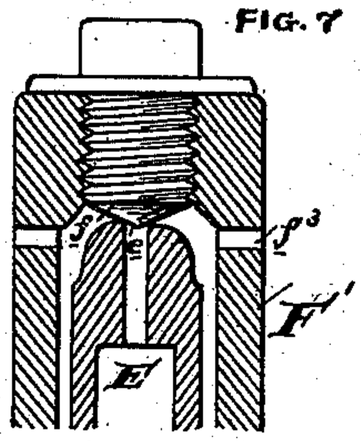
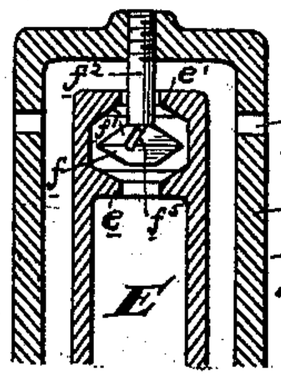


FIG. 6



Witnesses:
Henry Drury
Joshua Mallack, Jr.

Inventor:
John D. Bowman
by his attorney
Francis T. Chambers

(No Model.) 2 Sheets—Sheet 2.

J. D. BOWMAN.

PRESSURE REGULATOR.

No. 402,392. Patented Apr. 30, 1889.

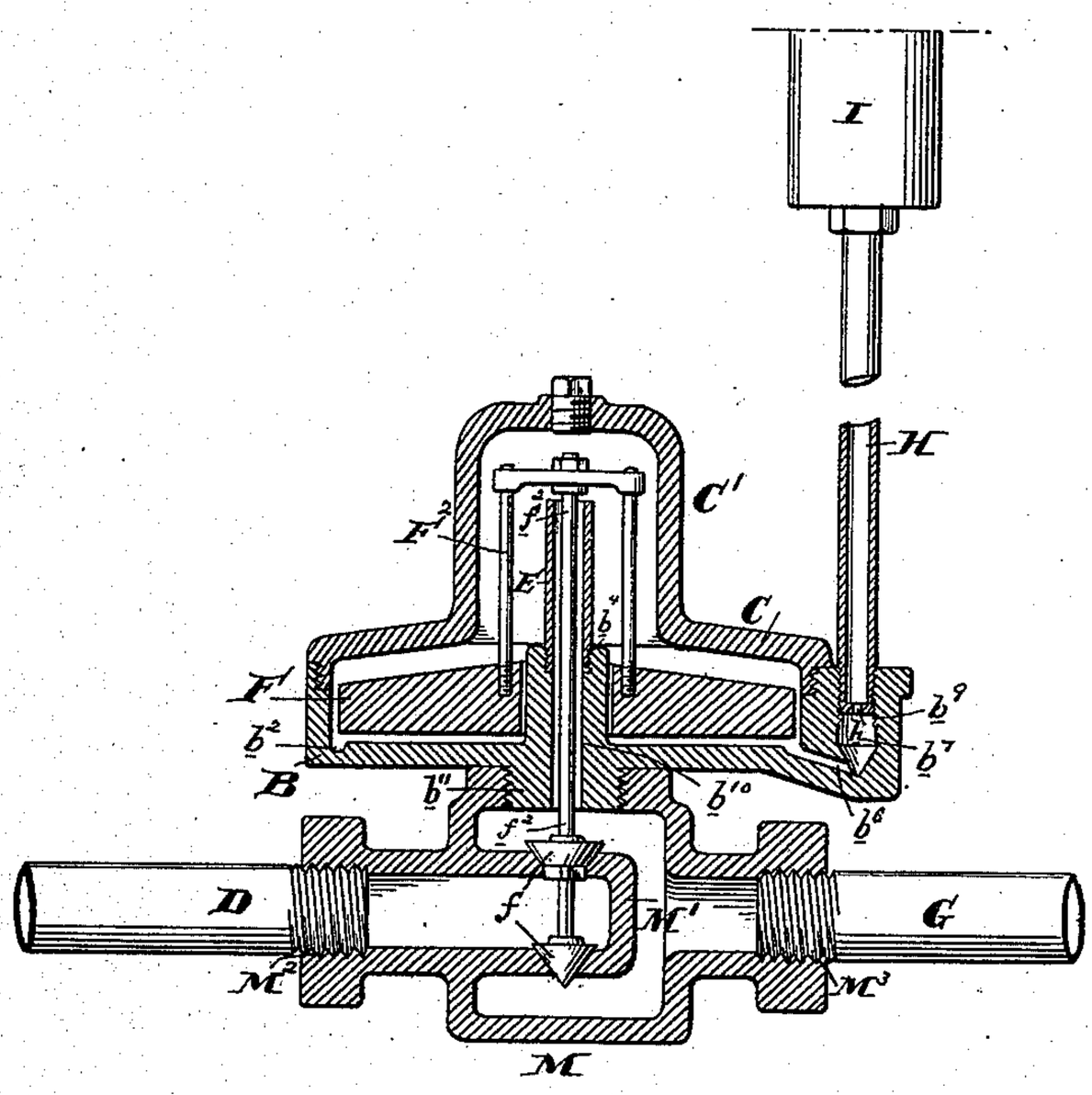


FIG. 8

Witnesses
Henry Drury
Joshua Matlack, Jr

Inventor:
John D. Bowman
by his attorney
Francis T. Chambers

UNITED STATES PATENT OFFICE.

JOHN D. BOWMAN, OF ALTOONA, PENNSYLVANIA.

PRESSURE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 402,392, dated April 30, 1889.

Application filed August 3, 1888. Serial No. 281,883. (No model.)

To all whom it may concern:

Be it known that I, JOHN D. BOWMAN, of Altoona, county of Blair, State of Pennsylvania, have invented a new and useful Improved Pressure-Regulator, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to the construction of pressure-regulators for governing the flow and pressure of fluids, and is especially, though not exclusively, adapted for use with carburetors used in the lighting system of railway-cars, my regulating device being intended to be placed in the conduit leading from the high-pressure storage-tank, containing the air, to the carburetor.

The nature and construction of my improved regulator are hereinafter fully described in connection with the drawings, and the parts thereof claimed by me as new are specifically set out in the claims, reference being now had to the drawings which illustrate my invention, and in which—

Figure 1 is a side elevation of a regulating device embodying my improvement; Fig. 2, a plan view of the lower casting forming a part thereof, sectioned so as to show its interior passages; Fig. 3, a vertical elevation showing the important parts of the device in section; Fig. 4, a section through the lower part or casting of the regulator on the line *y y* of Fig. 2; Fig. 5, a section through the same casting on the line *x x* of Fig. 2; Fig. 6, a sectional view of my preferred form of regulating-valve proper; Fig. 7, a view of a modified and simpler form of said valve, and Fig. 8 a sectional elevation showing a modified arrangement of my device.

A indicates a frame or support, to which the regulator, as shown in Figs. 1 to 7, is secured.

B is a casting forming the lower part of the valve-chamber. As shown in Figs. 1, 2, and 3, it is secured to the frame by means of brackets *b*, cast with it, while in Fig. 8 it is attached to a valve-box, M. This casting is dish shape, as shown, its upper edge, *b'*, being properly formed to make a tight joint with the casting C, which forms the upper part of the valve-chamber. Around the inner edge of the dish-shaped casting B a shallow groove or gutter, b^2, is formed.

b^3, Figs. 1 to 5, is a passage formed in the under side of the casting B, opening in the center of said casting through a threaded perforation, b^4, having also an opening on the under side of the casting through a threaded perforation, b^5.

b^6 is a narrow passage-way formed in the casting B and running from the groove b^2 into a larger chamber or passage, b^7, the upper portion, b^9, of which is threaded, as shown.

b^8 indicates an opening closed by a screw in the bottom of chamber b^7.

C C′ is a casting forming the upper portion of the valve-chamber and having, preferably, the form shown—to wit, the dome-shaped center C′, with an annular flange, C, extending around its bottom and fitting on the edge *b'* of the casting B.

As shown in Figs. 1, 2, and 3, which illustrate a construction in which the gases actually traverse the valve-chamber, an opening, *c*, is left in the top of the dome C′ for the insertion of a pipe, and a small opening, *c'*, closed by a screw, is formed in its side.

D is a pipe leading from the reservoir of compressed air or gas under high pressure, and should be, of course, provided with proper cut-off valves. The storage-tank and valves, forming no part of my invention, are not shown in the drawings. As shown in Figs. 1, 2, 3, and 5, the pipe D is connected with the perforations b^5; while in Fig. 8 a modified connection is shown.

E is a short pipe, which is secured in the threaded perforation b^4, and projects upward centrally from the dish-shaped casting B.

As shown in Figs. 1 to 7, at the top of pipe E, I provide a valve-seat, *e*, and preferably form a second valve-seat turned in the opposite direction above this valve-seat *e*, as is shown at *e'*, Fig. 6. This plan of forming the valve-seat at the top of tube E and virtually making the regulator-chamber a part of the conduit I have found entirely satisfactory where a comparatively small quantity of gas is to be controlled, as in a carburetor system. Where, however, the volume of gas is large—as, for instance, in a natural-gas conduit—larger valves would be desirable than could

conveniently be placed in the regulator-chamber, and for such uses I propose to construct the regulator as is shown in Fig. 8, where the regulator-chamber is connected with but is not a part of the conduit. The regulating-valve being of course situated in the conduit, is necessarily removed from the regulator-chamber; but, as shown, is connected with and actuated by the regulating-float in the same way as in the construction first shown.

In Fig. 8 I have shown the regulating-valve as constructed on the well-known balanced-valve principle; but of course either of the constructions shown in Figs. 6 and 7 could be used.

F is an annular float preferably made of cast-iron, and formed so as to be free in the space between the flange C and the dish-shaped casting B. The float F is continued upward as a tube, F′, or by yoke F^2, Fig. 8, to the top of which is secured directly, as in Fig. 7, or through a rod, f^2, as in Figs. 6 and 8, a valve, *f*, which may be arranged to fit on the valve-seat *e*, as shown in Fig. 7, or to serve as a balanced valve in a conduit, as in Fig. 8, but is preferably secured, as shown in Fig. 6, to a stem, f^2, and provided with a second valve-face, *f′*, with a small slot, f^5, in it.

f^3 and f^4 are perforations in the tube F′.

G is a pipe leading from the regulator to the carburetor. In Figs. 1 and 3 it runs from the perforation *c* in the top of the dome C′ to the carburetor, (not shown in the drawings,) while in Fig. 8 the regulator does not, as in the first figures, form a part of the conduit, but merely connects with it. The perforation b^4, in which the tube E is secured, is continued directly through the casting B, as is indicated at b^{10}, and a threaded projection, b^{11}, is provided to secure the casting B to a valve-box, M, having the usual construction, as indicated at M′, to permit the use of a balanced valve, and connecting by its ends M^3 and M^2 with the pipes G and D. The rod f^2 passes from the head of yoke F^2 through E, b^4, and b^{10} into box M, where it is attached to valves *f*, as shown.

It is of course apparent that there is no substantial difference in the construction and mode of operation of the devices shown, the difference being such as would fit the device to various conditions of use.

H is a pipe secured in the threaded end b^9 of chambers b^7. Preferably I make the opening at the bottom of this pipe small, as shown at *h*.

I is an enlarged chamber secured on the upper end of pipe H. In this chamber I secure at its upper end a disk, J, of perforated tin, or two perforated disks may be here placed one upon the other. Dependent from the disk J is a rod, J′, at the end of which an inverted cup, J^2, is situated immediately above the opening of pipe H. On the top of the disk or disks J, I secure one or more disks, J^3, of chamois-skin, and, preferably, I secure another disk, J^4, of perforated tin, in the chamber I between the disk J and the inverted cup J^2.

K is a pipe leading from the top of chamber I and open to the air.

The operation of my device is as follows: The parts being secured together, as shown in the drawings, I pour mercury into the pipe H either through the top of pipe K or by unscrewing said pipe or the cap of the chamber I, or by a passage especially provided for the purpose. The mercury is allowed to flow into the pipe H and through the chamber b^7 and passage b^2 into the valve-chamber formed by the castings B and C C′ until it comes to the level of the opening *c′* or to the desired height, which may be ascertained in any convenient way. The mercury being properly adjusted, the apparatus is ready for work, and if now the gas from the reservoir (not shown) be permitted to pass through pipe D it will, in the construction shown in sheet 1, pass through passage b^3 and pipe E, the valve-seat *e*, and thence through the passages f^3 and f^4 in the sleeve or tube *f′* into the valve-chamber, and pass from the said valve-chamber through the pipe G to the carburetor or other point of use. In the construction illustrated in Fig. 8 the gas will pass from pipe D through passage b^{10} b^4 into the valve-chamber and at the same time into pipe G. In both cases the pressure of the gas admitted into the valve-chamber is of course transmitted directly to the mercury in said chamber, and mercury is pushed downward in the valve-chamber and up in the pipe H. As the mercury is pressed out of the gas-chamber the heavy float F of course falls with it, and valve *f*, secured to the upper end of the sleeve F′, or its equivalent, the yoke F^2, approaches the valve-seat and finally seats itself upon it, when the pressure in the valve-chamber is sufficient to overcome the pressure of the rising column of mercury in the pipe H. This pressure is of course carefully calculated in the construction of the apparatus so that said pressure shall be the maximum pressure permitted to pass the regulator. As the pressure diminishes in the valve-chamber, the mercury will of course flow back, raise the float and the valve, and permit more gas to issue from the pipe D leading to the reservoir. In effect, the gas coming from the reservoir will be permitted to flow into the pipe G in a continuous flow of reduced and regulated pressure.

If from any cause—such as a sudden increase of pressure—a body of gas should be thrown into the valve-chamber at a higher pressure than that allowed for the normal working of the regulator, the effect will be to force all of the mercury out of the said valve-chamber into the pipe H, and the gas will then pass through the narrow channel b^2 into the chamber b^7 and the pipe H, and thence through the vertical column of mercury in pipe H into the chamber I and escape through

the open pipe K. To prevent such escaping gas from carrying any of the mercury with it, I arrange the chamber I with the before-described appliances secured in it. The escaping gas from the pipe H will first be deflected by the inverted cup J^2 and freed from some portion of the mercury which it may carry with it. It will then impinge against the perforated tin disk J^4 and part with an additional quantity of the mercury, and will then impinge against a disk or disks, J, with a chamois-skin covering, J^3, the disk serving to free the gas from some portion of the mercury and the chamois-skin J^3 permitting the gas to pass through it freely, but being perfectly impervious to the small quantity of mercury which it would carry with it at this point.

My reason for preferring the double-valve arrangement shown in Fig. 6 is that by its means I secure greater safety against the escape of gas under certain dangerous accidental conditions. For instance, supposing that the pipe G directly or by intermediate mechanism—such as a carburetor—connects with a number of gas-burners, and that all of such burners are turned on, then in case there should be an accidental stoppage of the gas-supply, or through any other cause a sudden diminution of pressure in the valve-chamber, the float F will rise as the mercury flows back into the valve-chamber from the pipe H, and the valve f' would seat itself on the valve-seat e', in which case a small quantity of gas could still pass through the slot f^5, but no sudden stop would be put upon the apparatus.

The passage b^2 should be made of small diameter to check any rapid flow of mercury through it, as it is preferable that the motion of the valve should be gradual. As I have already stated, the float F should nearly fill the lower part of the valve-chamber. Of course room must be left for its extreme upward and downward position, and a little made in addition to this, as the float should never rest in actual contact with the casting B. It is very desirable that the edges of the annular float should come very close to the edge or rim of the casting B. In this way but a small quantity of mercury is required, and, in addition, the apparatus is made more steady and the float and its sustained valve prevented from any considerable movement with respect to the valve-chamber and the valve-seat *e*. The importance of this when the device is used on a railway-car will be at once understood.

As I have already stated, I prefer to make the float F of cast-iron, which will float freely in mercury. It is not essential, however, that cast-iron should be used, and other fluids of less density may be used in place of mercury. The important point of course is that the weight of the float should be sufficient to hold the valve to its seat against the maximum pressure of the gas or air to which it is exposed; but as the orifice in the valve-seat is small, or else balanced, as in Fig. 8, no great weight is required for this purpose.

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

1. In a pressure-regulator, the combination, with a conduit, of a regulator-valve situated therein, a chamber adapted to contain mercury and made of two sections, B and C C′, a central tube, E, extending upward in the chamber from the lower section, B, and opening into the conduit, a passage, b^6, leading from the bottom of the chamber, an upright pipe connecting with said passage and open to the air, an annular float, F, fitting in the enlarged bottom of the chamber, as described, a tube, F′, or its equivalent, extending from said float along and above the tube E, and a connecting device securing the tube F′ to the regulating-valve.

2. In a pressure-regulator, the combination of a chamber adapted to contain mercury and made of two sections, B and C C′, with a central tube, E, having a valve-seat at its top and extending upward in the chamber from the section B, a passage, b^3, leading through section B to the tube E, by which said tube is connected with a supply-pipe, a narrow passage, b^6, leading from the bottom of the chamber, an upright pipe connecting with said passage and open to the air, a pipe, G, leading from the chamber, an annular float, F, fitting in the enlarged bottom of the chamber, as described, a tube, F′, or its equivalent, extending from said float along and above the tube E, and a valve secured to the end of tube F′ and above the valve-seat *e*, all substantially as and for the purpose specified.

3. In a pressure-regulator, the combination of a chamber adapted to contain mercury and made of two sections, B and C C′, with a central tube, E, having double valve-seats, *e e*, facing each other at its top and extending upward in the chamber from the section B, a passage, b^3, leading through section B to the tube E, by which said tube is connected with a supply-pipe, a narrow passage, b^6, leading from the bottom of the chamber, an upright pipe connecting with said passage and open to the air, a pipe, G, leading from the valve-chamber, an annular float, F, fitting in the enlarged bottom of the chamber, as described, a tube, F′, or its equivalent, extending from said float along and above the tube E, and a double-faced valve, $f\,f'$, secured between the valve-seats $e\,e'$ by means of a rod, f^2, extending from the end of tube F′, all substantially as and for the purpose specified.

4. In a pressure-regulator, the combination of a chamber adapted to contain mercury and made of two sections, B and C C′, with a central tube, E, having a valve-seat at

its top and extending upward in the chamber from the section B, a passage, b^3, leading through section B to the tube E, by which said tube is connected with a supply-pipe, a narrow passage, b^6, leading from the bottom of the regulator-chamber, an upright pipe connecting with said passage and open to the air, a chamber, I, secured to said pipe and provided with devices, as described, for intercepting mercury, a pipe, G, leading from the regulator-chamber, an annular float, F, fitting in the enlarged bottom of the regulator-chamber, as described, a tube, F′, or its equivalent, extending from said float along and above the tube E, and a valve secured to the end of the tube F′ and above the valve-seat *e*, all substantially as and for the purpose specified.

JOHN D. BOWMAN.

Witnesses:
S. A. WOOD,
FRANCIS T. CHAMBERS
LISLE STOKES.