2 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.
Fluid-Pressure Regulator.

No. 225,898. Patented Mar. 23, 1880.

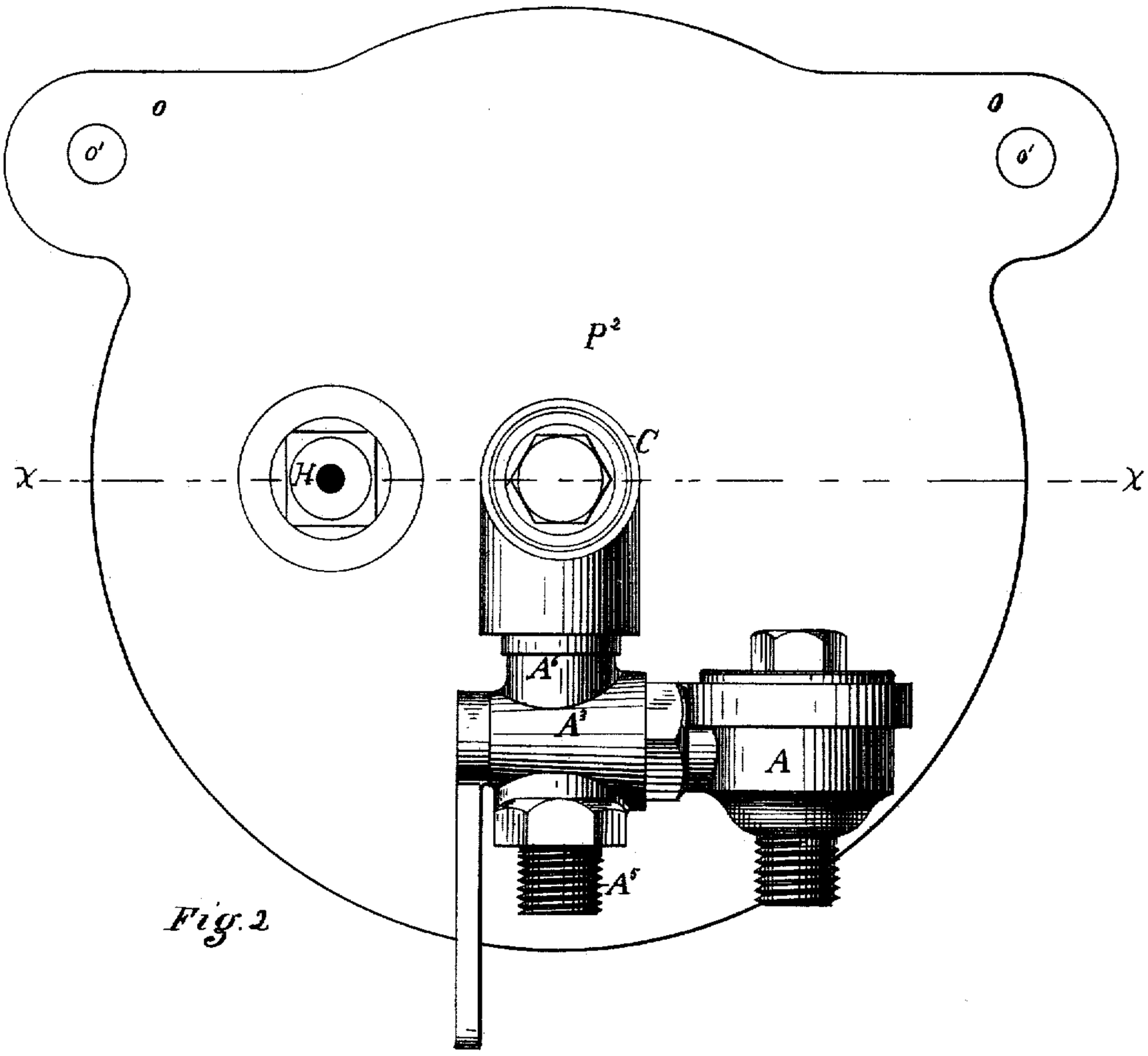

Fig. 2

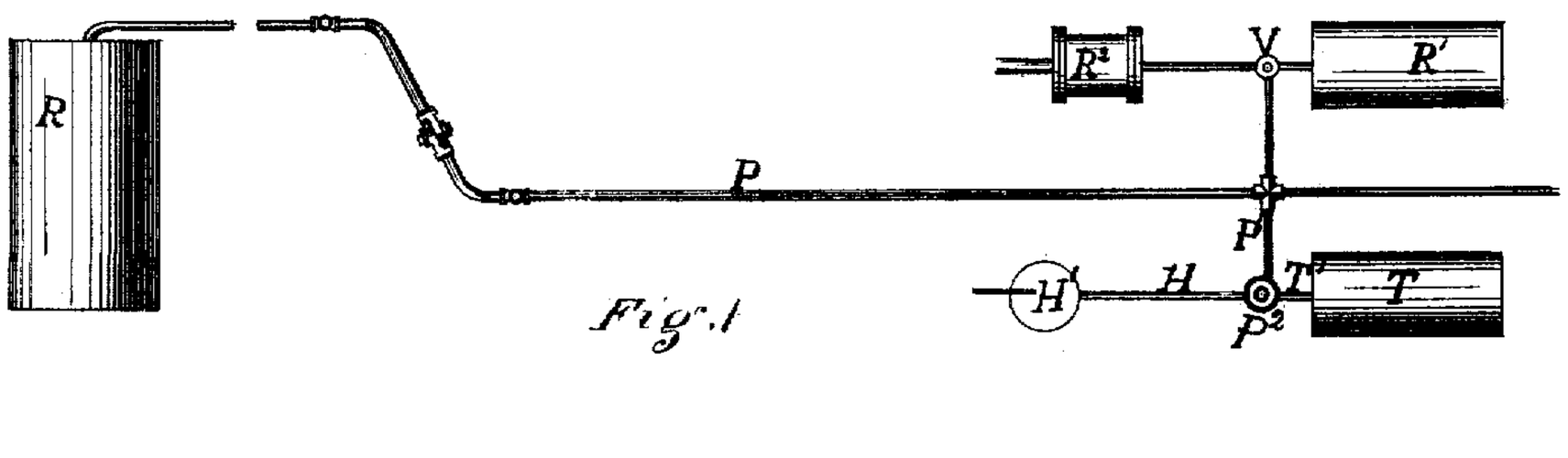

Fig. 1

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2 Sheets—Sheet 2.

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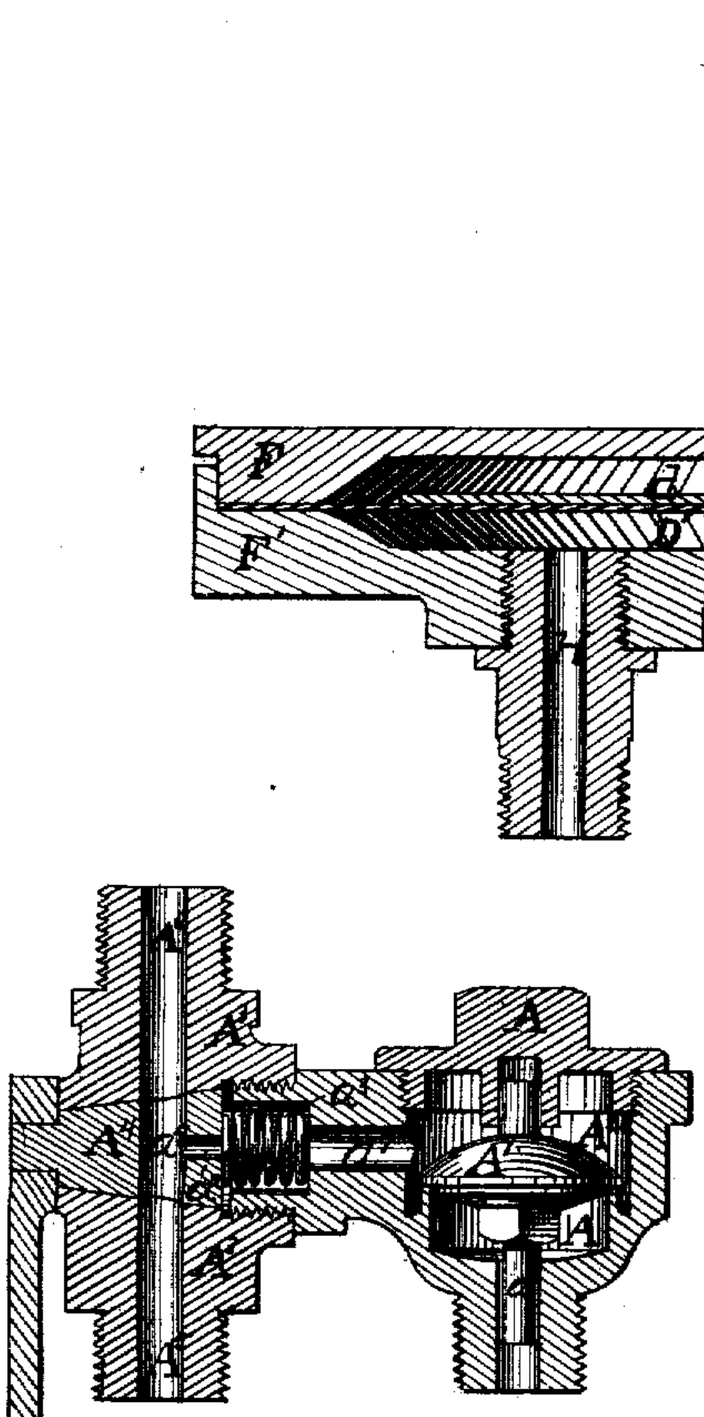
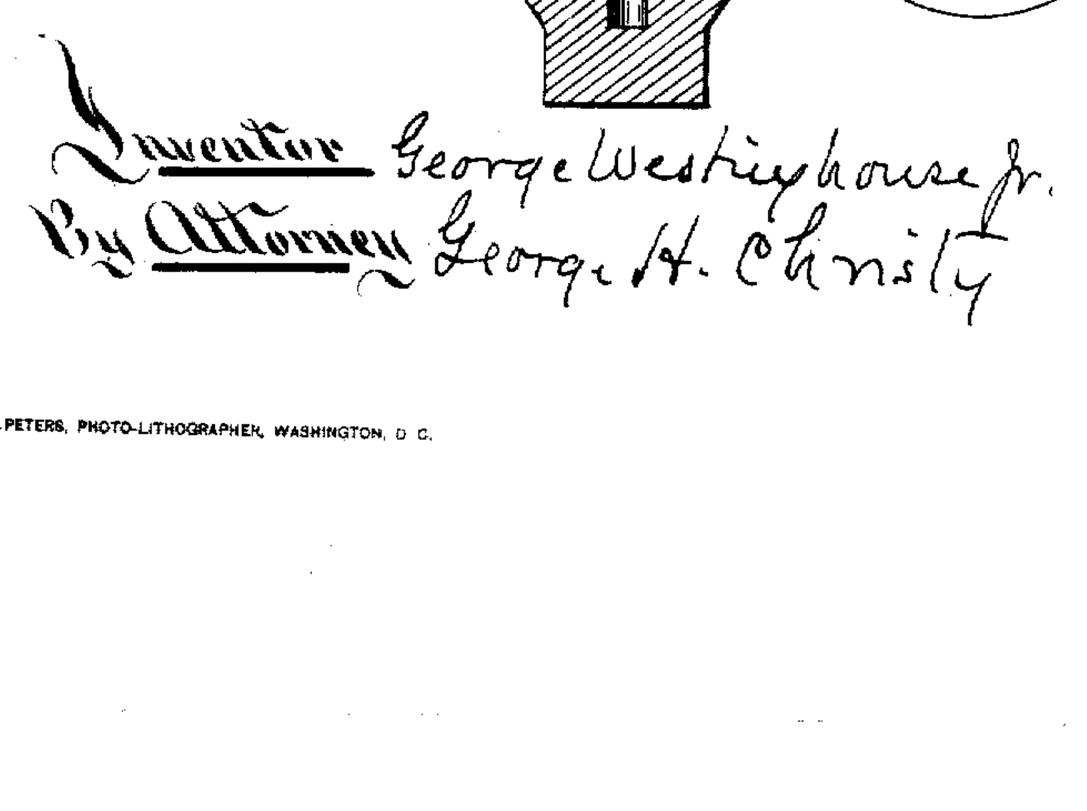


Fig. 4

Fig. 5

Fig. 3



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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

FLUID-PRESSURE REGULATOR.

SPECIFICATION forming part of Letters Patent No. 225,898, dated March 23, 1880.

Application filed January 24, 1880.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Fluid-Pressure Regulators; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

Figure 1, Sheet 1, is a plan view illustrative of the arrangement of my improved regulator with an automatic air-pressure brake apparatus and a carbureter, the combined devices being designed for use in car-lighting. Fig. 2 shows, in enlarged view, a side elevation of the regulator with the check-valve chamber and stop-cock in front. Fig. 3, Sheet 2, is a vertical sectional view of the regulator in the plane of the line *x x*, Fig. 2. Fig. 4 is a like view through the stop-cock and check-valve chamber; and Fig. 5 is a view similar to Fig. 3, but showing a larger diaphragm and diaphragm-chamber, and a lever arrangement between the regulating-valve and diaphragm, as hereinafter described.

My present invention relates to an improved regulator designed for use as a part of an apparatus through which fluid is passed, and in which a pressure practically constant or subject to but slight variations is desired at the place where the fluid is to be used, while the supply-pressure is variable or liable to become variable, or even intermittent; and while I include as within the scope of my invention all the uses to which it is applicable, I have designed it chiefly as a regulator for carbureters in connection with a pump, fan, or other air-compressing apparatus by which air is compressed, and, under pressure, is passed through the carbureter.

The use I will first describe is that wherein the apparatus is used for car-lighting, the air for the purpose being taken from the air-brake pipes, or from a pump or reservoir on some part of the train.

In the diagram, Fig. 1, I have shown at P a section or part of an air-brake pipe; at R, the main reservoir, usually arranged on the locomotive; at R′, an auxiliary reservoir, one such being arranged on each car; at R^2, a brake-cylinder, and at V a triple valve, these devices being such as are in common use as parts of the Westinghouse automatic brake.

It is one of the peculiar features of this brake that the air-conduit or brake pipes P are always, when the train is running, or in running order, kept charged with compressed air, and for ordinary purposes of braking such pressure rarely varies more than from one to five per centum, and never need vary more than from ten to fifteen per centum as a maximum. At the same time my present inventions make provision for even greater variations where they occur.

From such an air-brake pipe I take a branch, P′, to my improved regulator P^2, the details of which are shown in the other figures. The pipe P′ opens into a valve chamber or case, A, Fig. 4, beneath a check-valve, A′, which is of any convenient construction, except that its stem *a* does not entirely fill the bore of the nut in which it works; but by being flattened on one side, or grooved, or turned small, room is left for the air to flow past it in limited quantities, the maximum amount of such flow being a little more than the maximum exhaust or discharge at the place or places of use. By this means an approximate regularity in the amount of supply is maintained.

The air-pressure in chamber A raises this valve A′, and air passes it to chamber A^2. The case inclosing this check-valve is screwed into the side of a stop-cock case, A^3, having a plug or valve, A^4, for opening and closing communication through its length. The plug A^4 is held in position by a spring, a^3. Passages a' and a^2 permit air to pass from chamber A^2 to the port or passage a^1 in the plug A^4, and by properly shifting the plug an air-passage may be had to either or both ends of the stop-cock, as desired. The end A^5 of this cock is connected by a pipe, T′, with an air-reservoir, T, Fig. 1, the purpose of which will be presently described. The other branch or end, A^6, screws into the case C of a chamber, C′, and affords an air-supply passage to such chamber. Within this chamber is a regulating-valve, *c*, having, by preference, an elastic face, which is seated by a spring, *c′*, against the end of a bushing, C^2, and thereby closes a pas-

sage, c^2, leading from chamber C′ to the diaphragm or regulating-chamber E. A stem, c^3, on one side of the regulating-valve guides its movements, while a winged or angular stem or push-rod, c^4, extends from the other side of valve c, through passage c^2, to and abuts against a bow-spring, e, which is attached to one disk, e', of the clasp E′, so that through this spring the stem c^4 has a bearing against one side of a flexible diaphragm, D, but has no mechanical connection or attachment thereto. This diaphragm may be made of rubber, leather, or equivalent flexible material, and its periphery is secured between the rims of the two parts F and F′ of the diaphragm-case, which parts may be bolted or otherwise secured together, by preference so that they may be readily taken apart and the inclosed devices examined and repaired, if need be.

The diaphragm D is also backed over the major part of its surface by a metallic disk, d, the two being bound together at their common center by the disks e' and e^2 of the clasp E′, but leaving, however, an annular ring around the periphery of the diaphragm that is not thus backed, and therefore is free to yield or bend in response to pressure upon the diaphragm, causing it to move. This movement is guided by a stem, b, which moves or plays in the hollow nut B. A spring, b', bearing against this nut and against clasp E′, holds the diaphragm in place as against a given pressure in chamber E. The tension of this spring b' may be varied by screwing down or up the nut B, and thus the normal pressure of air in chamber E may be changed, as presently described. A jam-nut, B′, secures the nut B in the desired position of adjustment. The tension or power of spring b' is thus made equal to or slightly in excess of the normal or desired pressure of air in chamber E plus the power or pressure of spring c', so that spring b', acting through the stem c^4, shall hold valve c open, or from its seat, and allow air to pass to chamber E, and thence, through pipe H, to any suitable carbureting apparatus, H′, or other place of use. When the air-pressure in chamber E is increased from any cause above the normal degree, as by closing the discharge or increasing the pressure of the supply, then such excess acting against spring b' will compress it and allow the spring c' to move the regulating-valve c to or toward its seat sufficiently to reduce the supply of air, and thereby restore the normal pressure in E. On the other hand, if the pressure in E falls below the desired amount, then the excess of power in spring b' will open the valve and admit more air.

When the discharge is wholly closed the tendency to accumulate pressure in E by a continuation of the supply will cause valve c to be seated, and the device will be in condition to perform its assigned function as a regulator when wanted; but if a slight leak should exist past the valve c, then the pressure in chamber E would slowly accumulate, unless an equivalent escape were provided, and such accumulation would render the device inoperative as a regulator until the pressure in E was reduced to or near its normal degree.

In view of the difficulty of making a valve perfectly free from leakage, even with the best of workmanship, I prefer to arrange an automatically-operated vent, which may open and prevent accumulation of pressure in chamber E when valve c is closed. For this purpose I make use of the spring e, before mentioned. To the inner face of this spring I secure, by bolts or otherwise, a plug or valve, s, which, upon the compression of the spring, is adapted to seat and close a passage, s', leading through the clasp E′ from chamber E to chamber E². A port, S, provides an escape from this latter chamber to the open air.

The spring e is made lighter than spring c', so that when valve c is open the spring c', acting through stem c^4, will seat the valve s and prevent waste; but when valve c is seated its seat will take the pressure of spring c'; then, if the diaphragm D be further moved and the spring b' compressed by a slight accumulation of pressure in E, the spring e, being relieved of the pressure of c', will open valve s sufficiently to afford an escape and arrest further accumulation. As the normal pressure in E is thus restored, the spring e will again be compressed by bearing against stem c^4 and the escape be closed.

It will be observed that this escape-valve s is both opened and closed by springs, and not directly by the pressure of air upon the surface of the valve; I thus secure better and more prompt working of the valve. Also, that the spring e, when compressed, acts equally upon or against the springs b' and c', and therefore its action was not mentioned when describing the relative action of springs b' and c' in maintaining uniform pressure when the passage H is open. This spring e may be made quite light, so that it will take but little from the effective force of the other springs, and still be sufficient to do the work assigned to it.

It will also be observed that the diaphragm D and regulating-valve c are simply in contact through the abutting stem c^4, and are not rigidly connected, as has heretofore been customary in regulators of this class. In my improved construction the diaphragm is relieved of the load or work of raising and holding valve c to its seat, this work being performed by the spring c'. The diaphragm is thus made more sensitive, and at the same time provision is made for automatically operating the escape-valve by spring-power, as before described.

Various modifications may be made in the details of these features of construction without departing from my invention—as, for example, instead of arranging the stem c^4 to bear directly against the spring e, as in Fig. 3, it

may bear against the side of a lever, *r*, Fig. 5, one end of which is secured by any suitable flexible connection to the case, as at *r'*, while its other end bears against the spring *e*. By this arrangement I lessen the range of motion of the regulating-valve *c* for a given movement of the diaphragm; but, at the same time, the effective power of the diaphragm, or rather of spring *b'* acting against the diaphragm to open the regulating-valve, is increased through the leverage obtained. This regulator may be secured in place, by preference, in the position shown in Fig. 2, by bolts passing through holes *o'* in the flange or plate *o*.

I have already stated that the branch or end A^5 of the stop-cock is connected with an air-reservoir, T. This reservoir is, by preference, made of considerable capacity, and it is intended to supply compressed air to the carbureter during intermissions in the supply from the brake-pipe, which may likely occur. For this purpose I arrange the ports in the stop-cock as before described, so that by shifting the plug A^4 air from the brake-pipe may pass either to the regulator or to the reservoir, or to both, or may be shut off from either or both, as desired.

By this arrangement the reservoir may be filled at any convenient time when such work will least interfere with the operation of the brakes or train, or, when lights are not required, the cock may be wholly closed, and thus waste be prevented.

If the supply from the brake-pipe should fail, or the pressure in such pipe should fall below the accumulated pressure in reservoir T, the plug A^4 being in proper adjustment, then the excess of pressure in T would seat check-valve A', and air would pass from the reservoir through the regulator P^2 to maintain the supply, so that this cock, with its ports leading to different sources of supply, in combination with such supplies and with the check-valve, constitute a regulator subordinate to and combined with the regulator P^2, by means of which the variations in the pressure of air which is supplied to the main regulator P^2 are practically confined within narrow limits, although pressure in the brake-pipes may vary considerably or at times cease. A steady and uniform flame can thus be secured at the burners, which, in car-lighting, is a matter attended with peculiar difficulties; and, furthermore, by combining and arranging this regulating apparatus in the manner described, I bring it in the line of air-supply before it reaches the carbureter, and thus I am enabled to use material in the flexible diaphragm which otherwise would be soon injured or destroyed by the carbureted air.

Instead of the brake-pipe P, any suitable air-supply or compressing mechanism may be substituted, as a pump or fan, and the regulating apparatus herein described may, when desired, be used for other purposes than car-lighting.

I claim herein as my invention—

1. In a fluid-pressure regulator, the combination of a flexible diaphragm arranged across or inclosing the regulating-chamber, a valve adapted to open and close a supply-passage to such chamber, the stem of such valve abutting directly or indirectly against the diaphragm, but unconnected therewith, a spring, *b'*, arranged to resist pressure upon the diaphragm from within the regulating-chamber, and spring *c'*, arranged to move the valve to or toward its seat when spring *b'* is compressed, substantially as set forth.

2. In a pressure-regulator, a flexible diaphragm, D, having an escape-passage, *s'*, through the same, and spring *e* and valve *s*, attached thereto, such valve being adapted by movement of the spring to open and close the escape-passage, in combination with springs *b'* and *c'* and valve *c*, the latter having either direct or indirect contact with spring *e*, substantially as described, whereby the escape *s'* will be closed when valve *c* is open, and upon further compression of spring *b'*, after the seating of valve *c*, such escape will be opened.

3. The combination of diaphragm D, having an escape-passage, *s'*, through the same, spring *e*, attached to the inner face of the diaphragm, valve *s*, operated by spring *e*, valve *c*, having its stem abutting against spring *e*, and spring *c'*, adapted to compress spring *e* and close the escape when valve *c* is unseated, substantially as set forth.

4. The regulator P^2, having a stop-cock supply-passage leading thereto, such cock having a three-ported valve or plug, A^4, in combination with reservoir T, communicating with one port of the valve, a brake-pipe or equivalent source of supply, P, communicating with another port of such valve, and check-valve A', arranged in the line of communication between the brake-pipe and stop-cock valve, substantially as and for the purposes set forth.

5. The combination of cock A^3, reservoir T, brake-pipe or supply P, and check-valve A', the same constituting a subordinate regulator, as described, with main regulator P^2 and carbureter II', the main regulator being arranged between the air-supply and the carbureter, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:
R. H. WHITTLESEY,
C. L. PARKER.