(No Model.) 2 Sheets—Sheet 1.

J. N. PEW & T. L. SHIELDS.

GAS REGULATOR AND METER.

No. 321,136. Patented June 30, 1885.

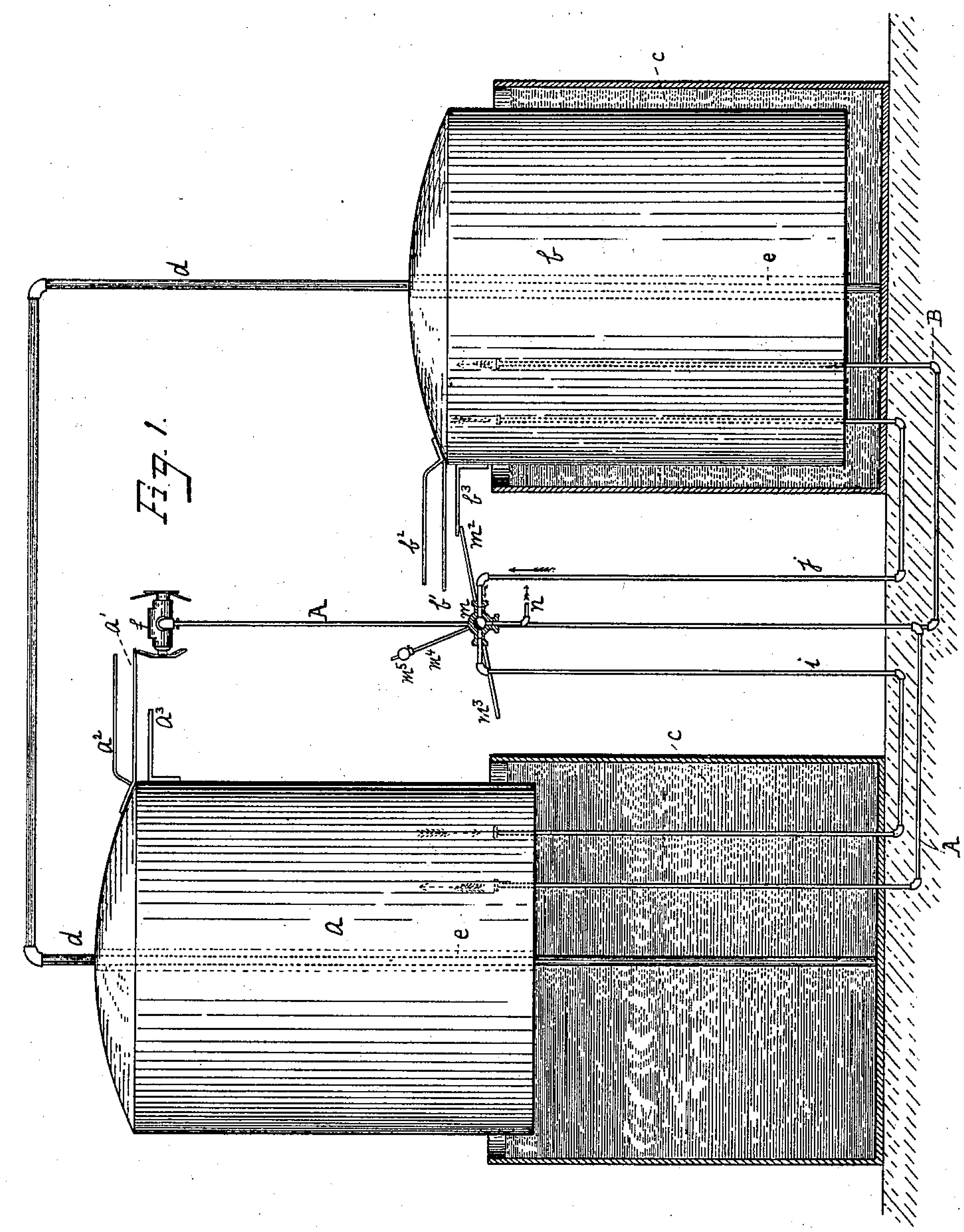

Fig. 1.

Witnesses.

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Fig. 2.

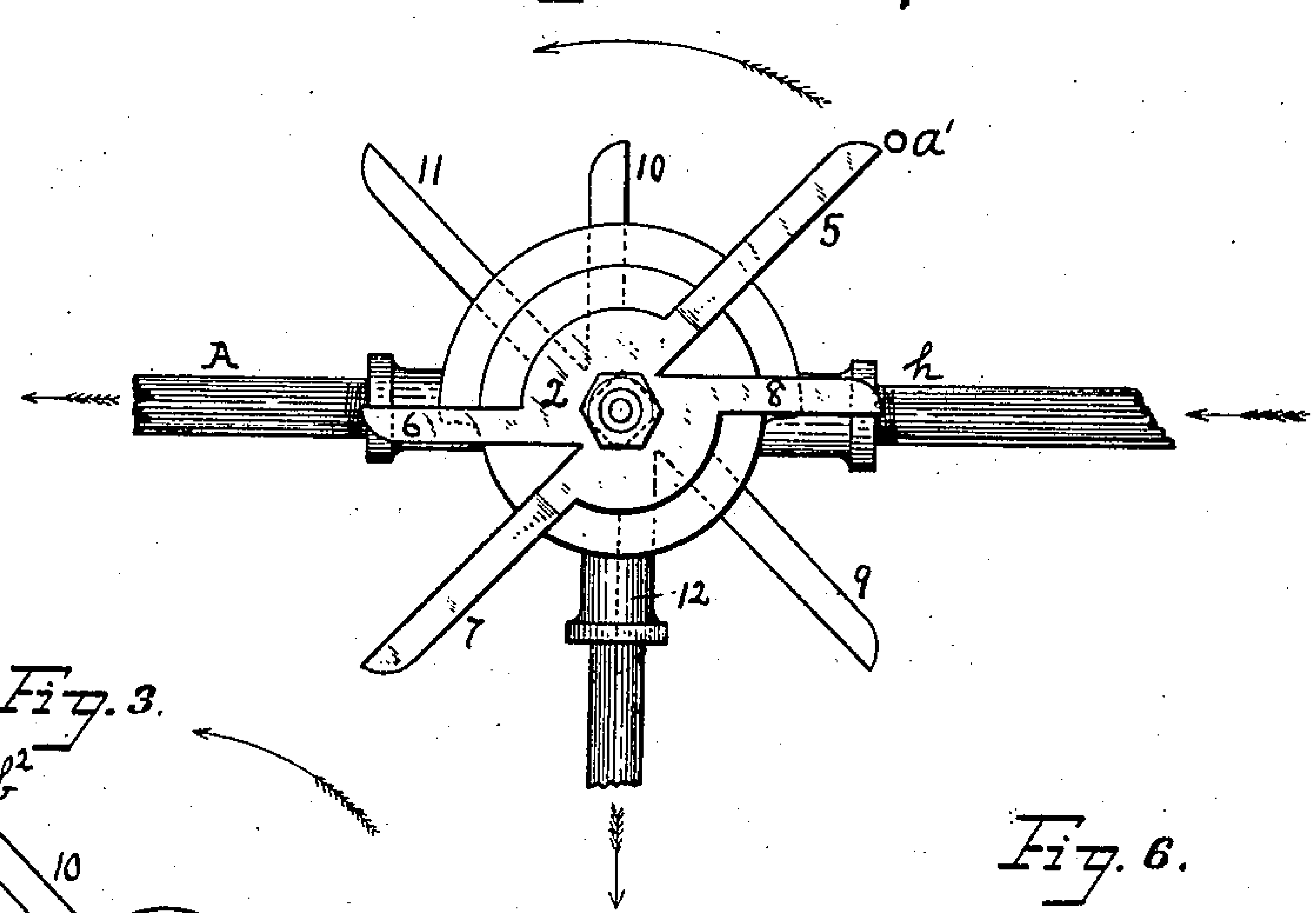


Fig. 3.

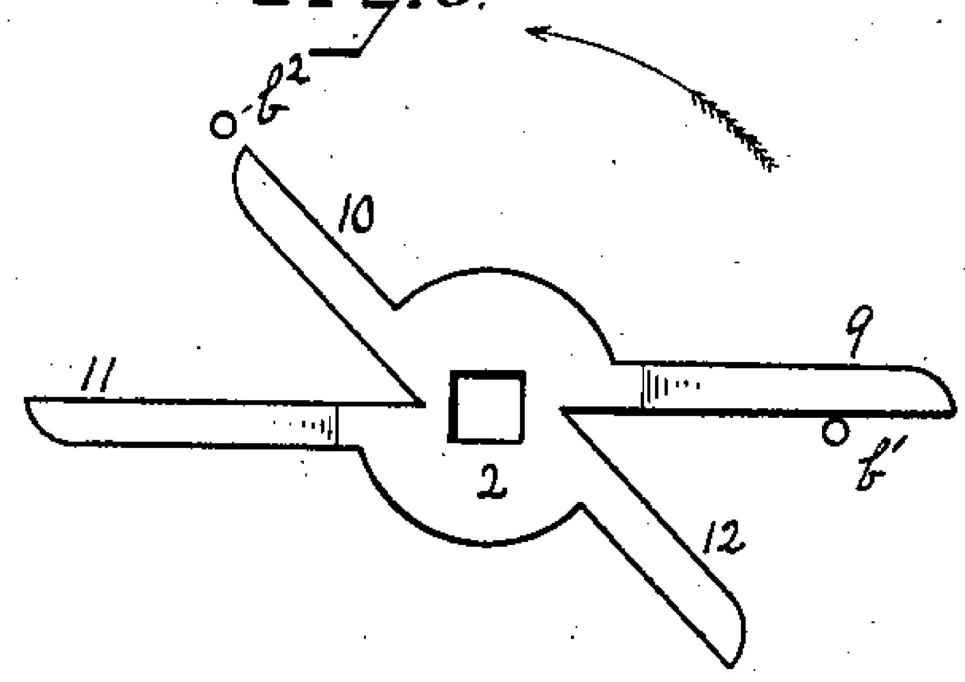


Fig. 6.

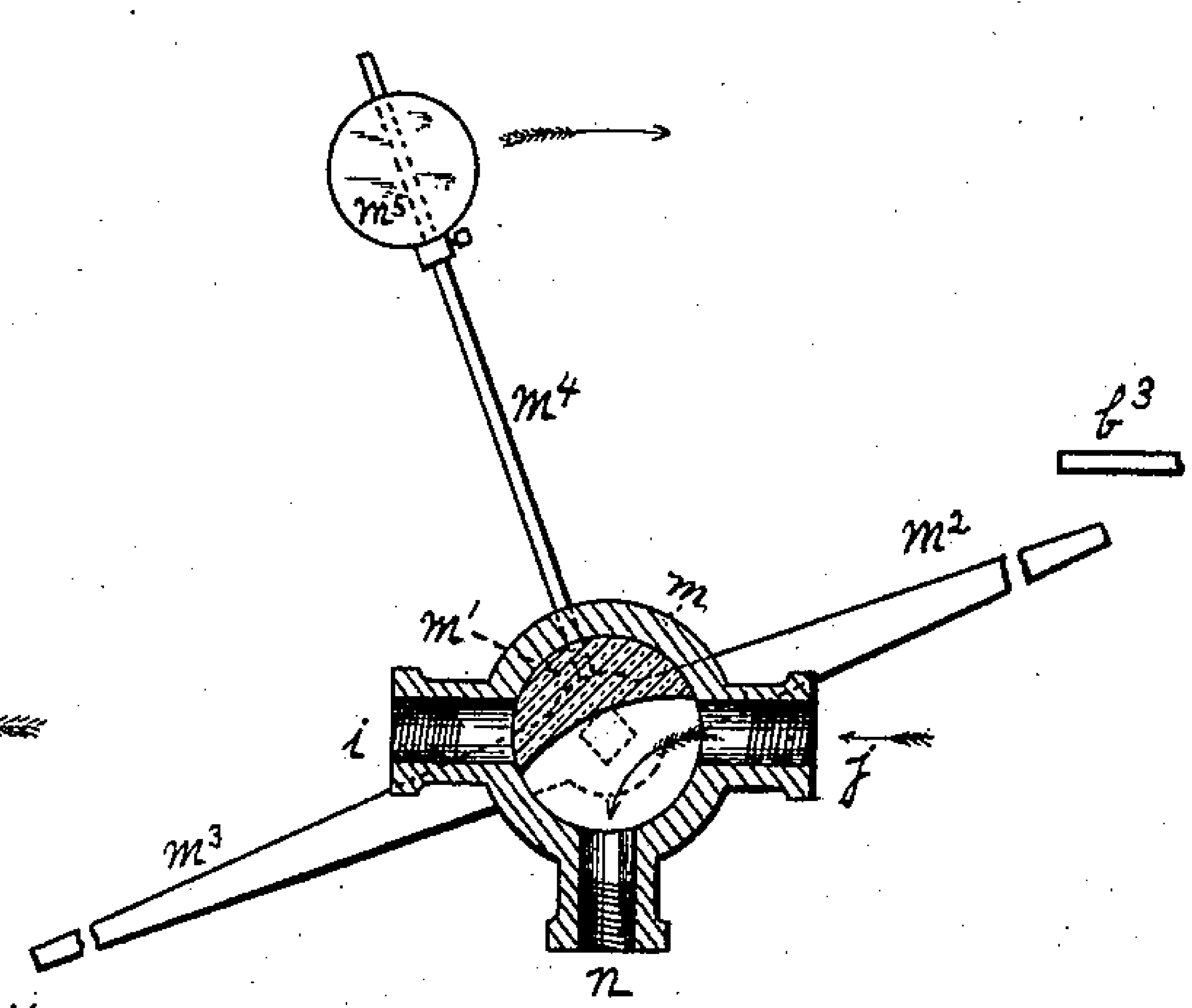


Fig. 4.

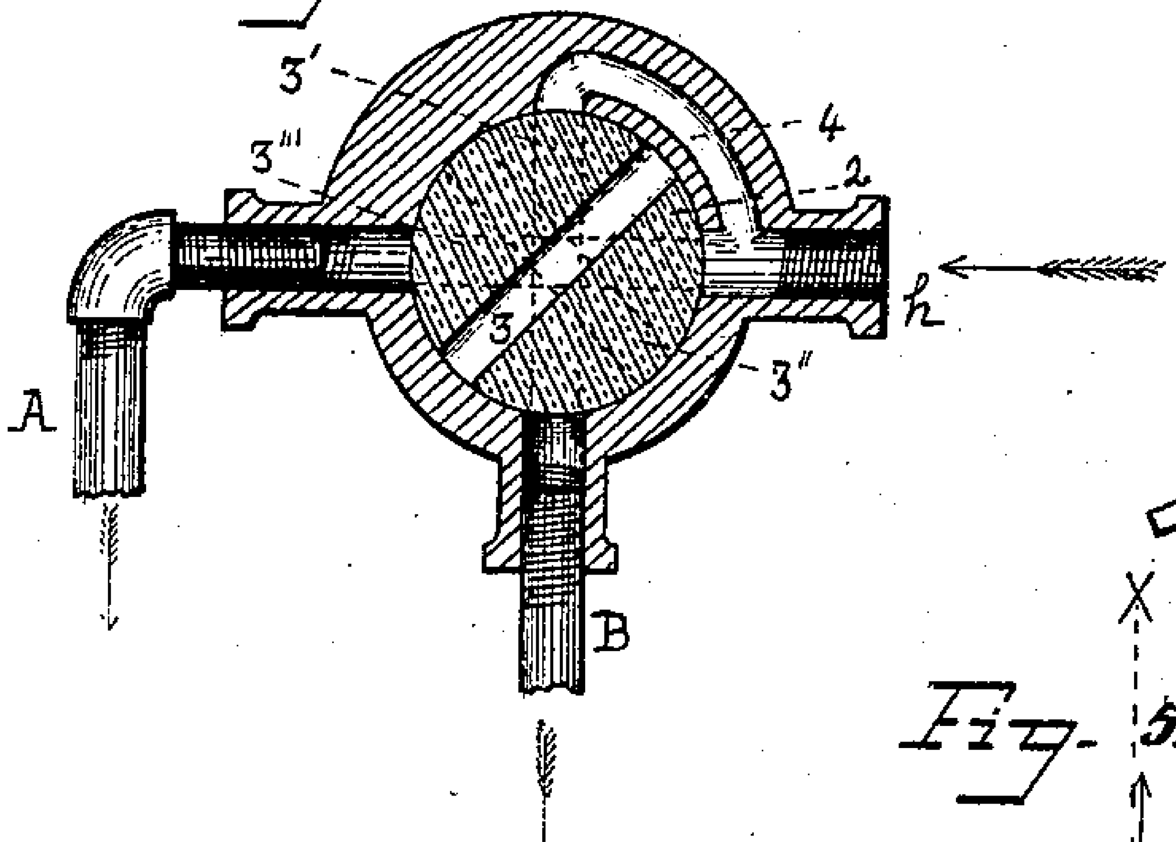
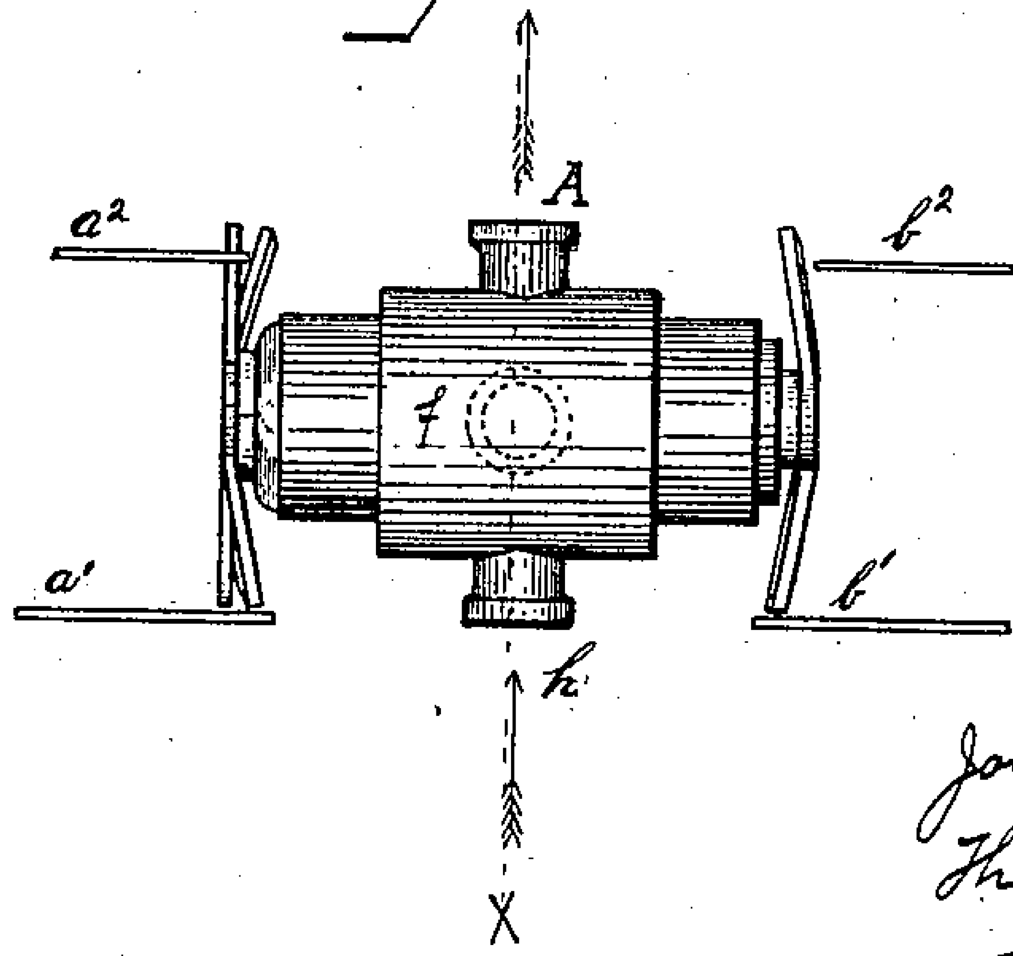


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOSEPH N. PEW, OF PITTSBURG, AND THOMAS L. SHIELDS, OF SEWICKLEY, PENNSYLVANIA.

GAS REGULATOR AND METER.

SPECIFICATION forming part of Letters Patent No. 321,136, dated June 30, 1885.

Application filed October 20, 1884. (No model.)

To all whom it may concern:

Be it known that we, JOSEPH N. PEW and THOMAS L. SHIELDS, the former a resident of Pittsburg, and the latter a resident of Sewickley, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Gas Regulators and Meters; and we do hereby declare the following to be a full, clear, and exact description thereof.

Our invention has for its object the supplying of gas from a place of storage in such manner as to produce a constant and even flow without fluctuation, induced by change in the pressure at which it may be fed from the well or other source. As an incident to the peculiar arrangement of the apparatus embodying our invention, it has the quality of giving an exact measurement of the amount of gas which may pass therethrough. We will now describe it with reference to the accompanying drawings, in which—

Figure 1 represents a side elevation of a gasometer illustrating our improvement. Fig. 2 is a side elevation of one of the valves. Fig. 3 is an end view of one of the parts of said valve. Fig. 4 is a vertical cross-section on the line *x x* of Fig. 5. Fig. 5 is a plan view of the valve shown in Fig. 2. Fig. 6 is a vertical sectional view of a valve used in regulating the flow of the gas from the gasometer and reservoirs to the gas-mains. It is shown at *m* in Fig. 1. Figs. 2, 3, 4, 5, and 6 are shown on a larger scale than is Fig. 1.

Like letters of reference indicate like parts wherever they occur.

In the drawings, *a* and *b* represent gas-reservoirs, commonly known as "gasometers," which consist of the usual metal cylinders, the bottoms being open and the tanks adapted to rise and fall within water-filled tanks *c* by means of the pressure or outflow of the gas. For this purpose they may be placed within upright frames and made vertically movable therein, having chains or ropes attached to the tank and running over pulleys situate on the top of the uprights of the frame. For convenience' sake, however, and because of the simplicity of construction and ease of arrangement, we prefer to place within each tank a single vertical fixed rod, *d*, which extends through a central tubular casing, *e*. This casing passes through the top of the tank and reaches to its lowest level, thus preventing escape of gas therefrom, and holding the tank securely in its proper position. The tanks *a* and *b* are situate side by side and at but a short distance apart, for a purpose which we shall explain hereinafter.

Gas is fed into the reservoir-tanks *a* and *b* through supply-pipes A and B, each of which extends from the inside of its proper cylinder upward to a cock, *f*, by the working of which gas is alternately discharged into one or other of the reservoirs.

A gas-supply pipe, *h*, leads from the source of supply of the gas to the valve *f* and communicates therewith through its shell at two points distant about ninety degrees apart, while the tank-supply pipes A and B communicate with the valve—one pipe opposite each mouth of the pipe *h*. As shown in the drawings, we prefer to have one branch of the pipe *h* lead directly into the valve, and the other branch, 4, to lead from *h* in a circumferential passage through the shell of the valve to the point where it enters the interior thereof.

The interior of the valve-shell *f* is circular in cross-section, and has a revoluble key or plug, 2, through which is a transverse diametrical slot, 3. When this slot is in a horizontal position, it communicates with the supply-pipe *h* and with A, one of the reservoir supply-pipes, thereby establishing a continuous passage for the gas between them, and when in a vertical position it causes communication between the branch 4 of the pipe *h* and the gas-supply pipe B. It will thus be clear that when the slot 3 is horizontal gas will be discharged from the pipe *h* into the supply-pipe A, and thence into the gas-reservoir *a*, and that when it is turned into a vertical position by a quarter-revolution it will discharge into the reservoir *b* through the pipe B. When the slot is in intermediate positions, the supply *h* will be shut off, and no gas discharged into either of the reservoirs. The plug 2 is preferably operated and revolved by means of radial arms 5 to 12, which extend at right angles to the axis of the plug, four of the arms being at one end and four on the other end of the same. Fig. 2 represents the arms keyed to one end of the plug. Two of these four arms, 5 and 7, are diametrically opposite to each other, and are longer than the other two arms, 6 and 8, which also extend in diametrically-opposite directions at an angle of forty-five degrees from the arms 5 and 7. The arms on the other end of the plug are similarly situated with relation to each other and with relation to the arms 5, 6, 7, and 8, that all the arms may be substantially equidistant from each other on the circumference of a cross-section of the plug. Projected on the plane of this circumference the long arms 5 7 and 9 11 are at right angles to each other, and the short arms occupy the same relative positions. Together they divide the circumference into eight equal parts of forty-five degrees each.

We will explain the operation of this valve more fully hereinafter.

i and *j* represent the pipes which lead the gas from the reservoir-tanks to the gas-mains or to the point of utilization. They both connect with a valve, *m*, where they unite and communicate with the gas-main *n*. Within the valve *m* is a cylindrical plug, *m'*, which is so cut away or slotted as to be capable of being turned so as to open communication with either pipe *i* or *j* and the gas-main *n*, and at the same time to shut off the other pipe *i* or *j* from its proper reservoir. The plug of the valve *m* is preferably provided with radial arms m^2 m^3, which are keyed thereto so as to extend in diametrically-opposite directions. This valve is shown in Fig. 1, and on a larger scale in Fig. 6, in which it is shown as affording communication between the pipes *j* and *n*, thus allowing gas to escape from the reservoir *b* into the gas-main. The connection with the reservoir *a* is then cut off. If, now, the arm m^2 be depressed and the plug *m'* thereby turned until the edge of its unslotted portion reaches the lowest part of the mouth of the pipe *j*, it is clear that the pipe *j* will be shut off and the pipe *i* opened into communication with the main *n*.

The side of each of the tanks *a* and *b* is provided with three arms, *a'* a^2 a^3 and *b'* b^2 b^3, which are placed in such position that in the ascent and descent of the tanks they may respectively engage the radial valve-arms of the two valves *m* and *f*. Thus, for example, the largest tank-arms *b'* and *a'* will strike the valve-arms 7, 5, 9, and 11, the shorter arms a^2 and b^2 will operate the valve-arms 6, 8, 10, and 12, while the short tank-arms a^3 and b^3 will engage the arms m^2 and m^3 of the valve *m*. In order that the tank-arms *a'* a^2 *b'* b^2 may operate freely and without striking the wrong valve-arms, they should be placed in different vertical planes on each side of the plane of the axis of the valve-plug 2. The longer arms of the valve *f* are bent inward out of the path of the arms a^2 b^2. Thus constructed the arms a^2 b^2 will operate only the short arms of the valve-plug 2, and only during the descent of the tanks *a* and *b*, while the long arms *a'* and *b'* will operate the long arms of the plug during the ascent of the reservoirs.

We will now explain the operation of these parts in detail. Supposing the different parts to be in positions shown in all the figures of the drawings, except Fig. 3, the tank *a* will be full of gas and lifted to its highest position by the upward pressure thereof. The valve *f* will also be closed and discharging into neither of the reservoirs, while the reservoir *b* is nearly empty and is discharging into the gas-main through the open valve *m*. As shown, the tank-arm b^3 is just above the arm m^2 of the valve *m*, and a little further descent of the arm b^3 will depress the arm m^2 and will turn its valve-plug, as before described, so as to cut off connection of the tank *b* with the gas-main and to open that of the tank *a* therewith. In order to facilitate the turning of this valve and to secure speedy action, its plug is provided with a long arm, m^4, which, when the valve is in the position shown in the drawings, extends upward at a small inclination from the perpendicular. At the top of this rod m^4 is a weight, m^5, and in depressing the arm m^2 the arm m^4 will rise, and when it passes the perpendicular will suddenly turn over and reverse the valve *m*, thus establishing communication between the tank *a* and the gas-main *n*. The tank *b* will then have descended to its lowest point, and, by reason of gas escaping from the tank *a* into the gas-main, the latter tank will immediately begin to descend on the rod *d*. In its descent the short tank-arm a^2 (see Fig. 5) will engage the short arm 6, and will carry it downwards. It is so placed as to strike the arm at a short distance from its extremity, this distance being so adjusted that the plug may be turned for one-eighth part of a revolution by the descent of the tank, and that when this part of a revolution has been completed the tank-arm may release the valve-arm and allow the valve to remain stationary. The slot 3 of the plug 2 is then in apposition with the orifice of the branch pipe 4 and of the tank-supply pipe B, so that the gas immediately begins to flow therethrough into the tank *b*. The end of each of the arms of the valve *f* is beveled, so that the longer tank-arms may miss the long valve-arms during the descent of the tanks, and that the short tank-arms may not strike the short valve-arms during their ascent. This will be apparent by reference to the drawings. The rush of gas into the tank *b* immediately causes it to ascend, generally with considerable rapidity. When it rises almost to its full height, the long tank-arm *b'* will meet and engage the long valve-arm 9, which is then in the horizontal position shown in Fig. 3, and will raise it for a distance of forty-five degrees, thereby bringing the slot 3 into the position shown at 3″. (See Fig. 4.) The gas will then be prevented from flowing into either reservoir, because of the cessation of pressure, and the tank will remain stationary. Meanwhile the tank *a* has been descending and forcing gas through the valve *m* into the mains. When, however, the tank-arm a^3 reaches the now elevated arm m^3, it will depress it in the manner before explained, thereby throwing the weighted rod m^4 over and reversing the valve *m*, so as to cut off connection between the gas-mains and the tank *a* and to open connection of the tank *b* therewith. The tank *b* then descends, and in descending the short arm b^2 strikes the valve-arm 10, thereby turning the slot in the plug 3 into the position 3''' and opening connection between the gas-supply pipe *h* and the tank *a*. This causes the latter tank to rise, and the operation is continuously repeated, as before described.

We have described the tank-arms *a'* and *b'* as causing the valve-plug 2 to turn forty-five degrees during each ascent of the tank; but in practice this will rarely occur, for as soon as the arm has been moved far enough to break the connection of the slot 3 with the supply-pipe *h* or its branch 4, the tank will cease to rise and the plug 2 to turn. This, however, does not cause any change in the operation of the gasometer, since the descent of the tank will cause the plug 2 to turn far enough to complete the ninety degrees properly belonging to the two motions of the plug and to bring the slot into apposition with the proper tank-supply pipe.

If it should happen that the supply of gas from the pipe *h* be checked, so that not sufficient gas flows into the still reservoir *a* to raise it to its full height before the discharging-reservoir *b* has descended and turned the valve *m*, this will not stop the working of our improved apparatus. In such case the gas would both flow into and out of the tank *a* until sufficient gas has been supplied to exceed the outflow and to cause the tank to rise and shut off the inflow-valve *f*. The only result of such intermission would be that the gas would flow to the mains directly from the source of supply, and subject to any irregularity which might occur in the pressure of gas at its source. This can obviously be remedied by turning the valve *f* to the proper position by hand.

If desired, the supply-valve *f* may be substituted by a valve similar in construction and operation to the valve *m*, though this would obviously possess many disadvantages; or the valve *m* may be dispensed with and a hand-operated reversing-valve employed; or both the valves *f* and *m* may be worked by hand, or by mechanism independent of the gas-reservoir tanks. We prefer, however, to use the apparatus herein described, since it secures a continuous automatic working of the reservoir and does not require tending.

Various other changes may be made in the construction of the valves *f* and *m* in the relation of the different parts thereof and in the number of the operating arms or handles. These will readily suggest themselves to the mind of any one skilled in the art.

The advantages of our improved apparatus are many. The chief one is that it cuts off the supply of gas to the service-pipes from any connection with the source of gas, and therefore effects a flow of unvarying pressure. This quality makes it especially applicable for use in the distribution of natural hydrocarbon gas, for this substance flows from the well at such a pressure as to be almost ungovernable, and often in intermittent gushes, which cause a flickering and uncertainty in the flame produced. It has been attempted to neutralize the evil effects of this varying pressure by various devices, many of which consist of diaphragms which act upon shut-off valves when the pressure of gas begins to vary. These and similar contrivances are liable to several serious disadvantages in their application to the regulation of natural gas, which may not arise in their use with manufactured coal-gas. Thus the gas comes from the well at a low temperature, (about 40° Fahrenheit,) and is therefore apt to contract the parts of a delicately-organized governor and to render it almost inoperative, while the grit and sand with which the issuing gas is charged seriously cut and injure the valves and diaphragms. The simple action of our governor avoids the above-mentioned objections entirely.

The action of the tanks *a* and *b* is continuous and may be repeated indefinitely without at any time allowing the gas from the well to come into direct communication with the service-pipes.

An important feature of our invention is that the tanks rise to a known height and at that time contain a certain amount of gas, which can be easily calculated. It is clear, therefore, that if the number of times of descent and ascent of each of the tanks be registered, there will be an accurate measure of the amount of gas used. The registering of these motions may be performed automatically by means of any suitable gage having an index-finger, which is caused to move one point over a dial-face by action of the tanks upon an armature or lever as they pass the gage in their upward or downward motion.

The gage may be arranged so as to be actuated by the motion of either or both of the reservoir-tanks, as may be desirable.

One of the important features of our invention is that the tanks in performing the function of a regulator, being actuated by the high pressure of the gas as it flows into the tanks, also perform the function of a meter in measuring the amount of gas used. This pressure, as we have already stated, being quite great, serves to raise the tanks without the aid of counter-weights or other devices, and although the gas is delivered to the tanks under this high pressure it passes therefrom under low pressure, determined by the wieght of the tank.

The pressure of the gas in the tanks may be regulated by weighting the tops of the tanks to any desired amount.

Our improved apparatus may be made of any size desirable for the nature of the use to which the gas consumed is to be put. It may be made very large, or of more tanks than two acting in concert, or in several pairs where a large number of service-pipes are to be supplied; or the tanks may be made so small as to be easily portable for supplying small manufactories or dwelling-houses.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The combination, in a gas regulator and reservoir, of several reservoir-tanks capable of rising with the inflow of gas-pressure and of falling with the outflow of the same, with a reversing inflow-valve by which the gas may be caused to flow into one of said tanks and to be shut off from the other, and an outflow-valve capable of being operated so as to cause the gas to discharge from the tank from which the gas-supply has been cut off, and to shut off said discharge from the other of the tanks, substantially as and for the purposes described.

2. The combination, in a gas regulator and reservoir, of several reservoir-tanks capable of rising with the inflow of gas-pressure and of falling with the outflow of the same, with a reversing inflow-valve by which the gas may be caused to flow into one of said tanks and to be shut off from the other, or to be shut off from both thereof, and an outflow-valve capable of being operated so as to cause the gas to discharge from the tank from which the gas-supply has been shut off, and to shut off said discharge from the other of said tanks, said valves being operated by means of the action of the reservoir-tanks thereon as said tanks rise and fall, for the purpose of measuring the gas and regulating the pressure thereof, substantially as described.

3. The combination, in a gas regulator and reservoir, of several reservoir-tanks capable of rising with the inflow of gas-pressure and of falling with outflow of the same, with a reversing inflow-valve by which the gas may be caused to flow into one of said tanks and to be shut off from the other, or be shut off from both thereof, substantially as and for the purposes described.

4. The combination, in a gas regulator and reservoir, of several reservoir-tanks capable of rising with the inflow of gas-pressure and of falling with the outflow of the same, with a reversing inflow-valve by which the gas may be caused to flow into one of said tanks and to be shut off from the other, or may be shut off from both, said valve being so operated by means of action of the reservoir-tanks thereon as said tanks rise and fall, substantially as and for the purposes described.

5. The combination, in a gas regulator and reservoir having several reservoir-tanks capable of rising with the inflow of gas-pressure and of falling with the outflow of the same, of an inflow-valve having suitable projecting arms or handles whereby the valve may be turned so as to discharge gas into either of said reservoirs and to shut it off from both, with projections or arms fixed to the tanks and capable of engaging and operating the arms of said valves during motion of one of the tanks, whereby gas may be turned off from the rising tank when it shall have reached the desired height and caused to flow into the other tank during the downward motion of the full tank, substantially as and for the purposes described.

6. The combination, in a reversing-valve the shell of which communicates with gas-supply pipes and outlet-pipes situate at right angles to each other, substantially as herein shown and described, of a revoluble plug situate within said valve-shell and having a transverse passage extending through the same, with a suitable arm affixed to said plug, and capable of revolving the same, whereby the gas may be alternately shut off from both of said outlet-pipes and caused to flow into one of the same by successive one-eighth revolutions of said handle in the same direction, and a moving gas-tank arranged to engage with the arm so as to operate the valve, substantially as and for the purposes described.

7. The valve *m*, having extending arms for reversing the same by action of a moving gas-tank thereon, in combination with a rising weighted arm, m^5, for completing the motion of said valve after the said arm m^5 has passed a vertical position, and a moving gas-tank, substantially as described.

In testimony whereof we have hereunto set our hands this 16th day of October, A. D. 1884.

JOSEPH N. PEW.
THOMAS L. SHIELDS.

Witnesses:
W. B. CORWIN,
THOMAS W. BAKEWELL.