3 Sheets—Sheet 1.

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WATER-METER.

No. 190,536. Patented May 8, 1877.

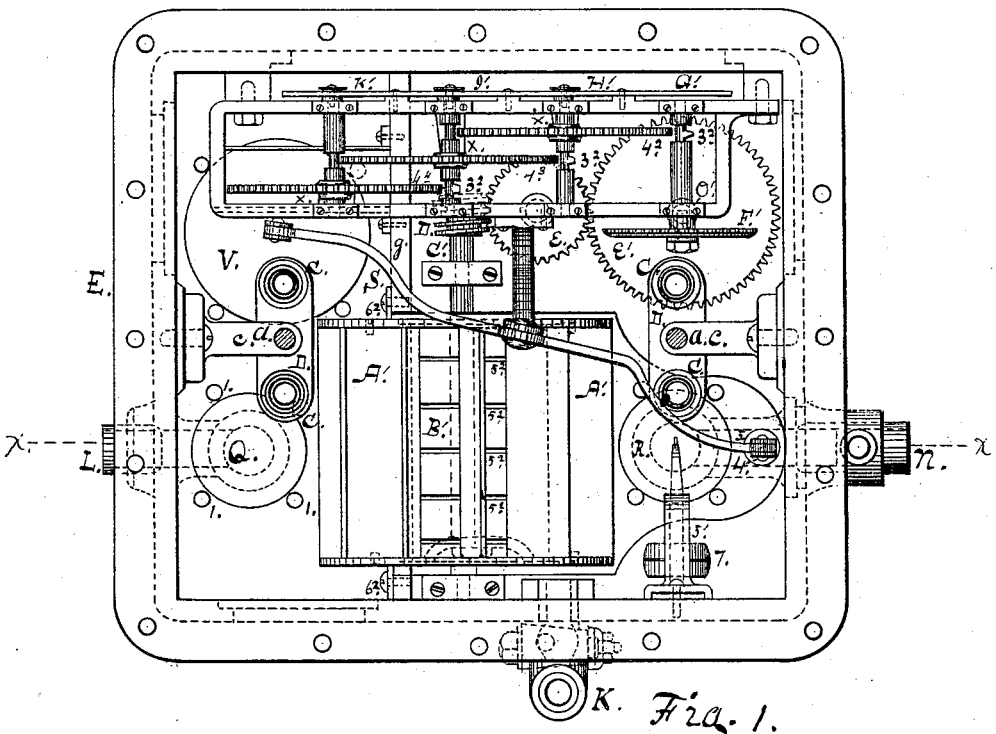

Fig. 1.

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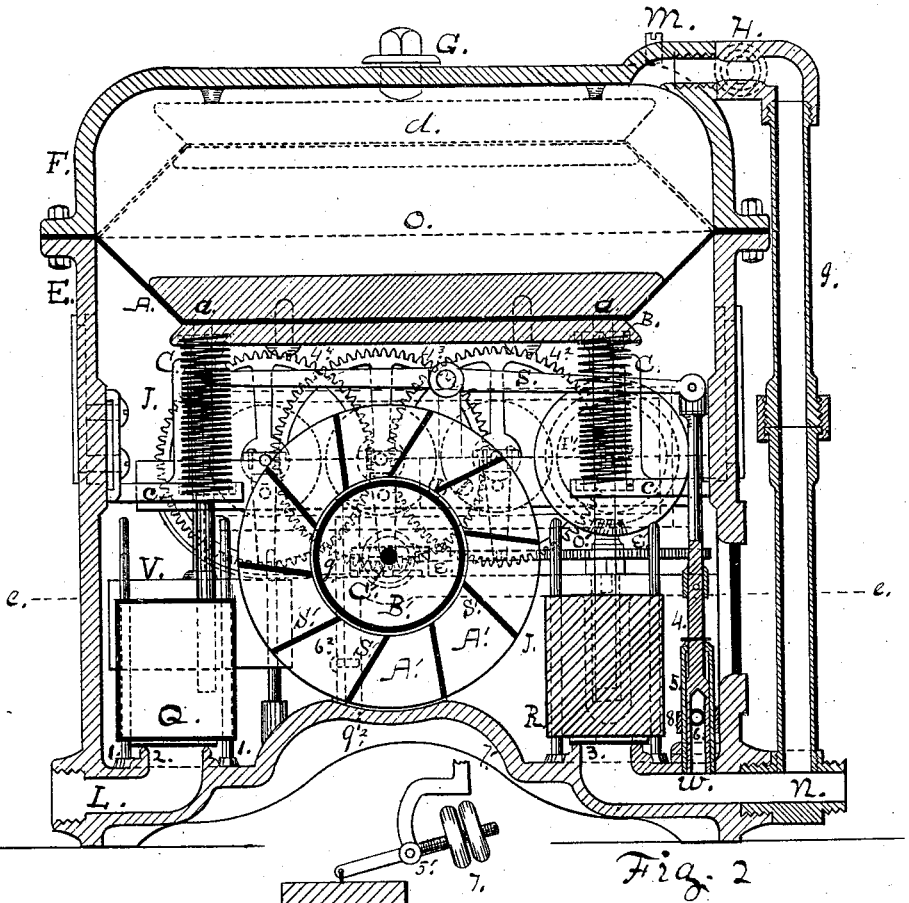

Fig. 2

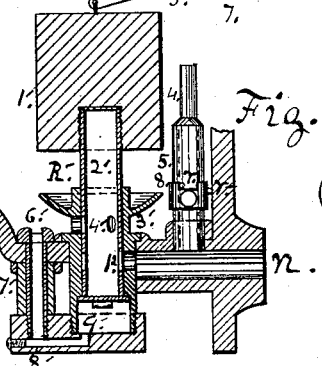

Fig. 3

Fig. 4

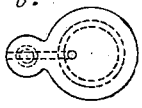

Fig. 5.

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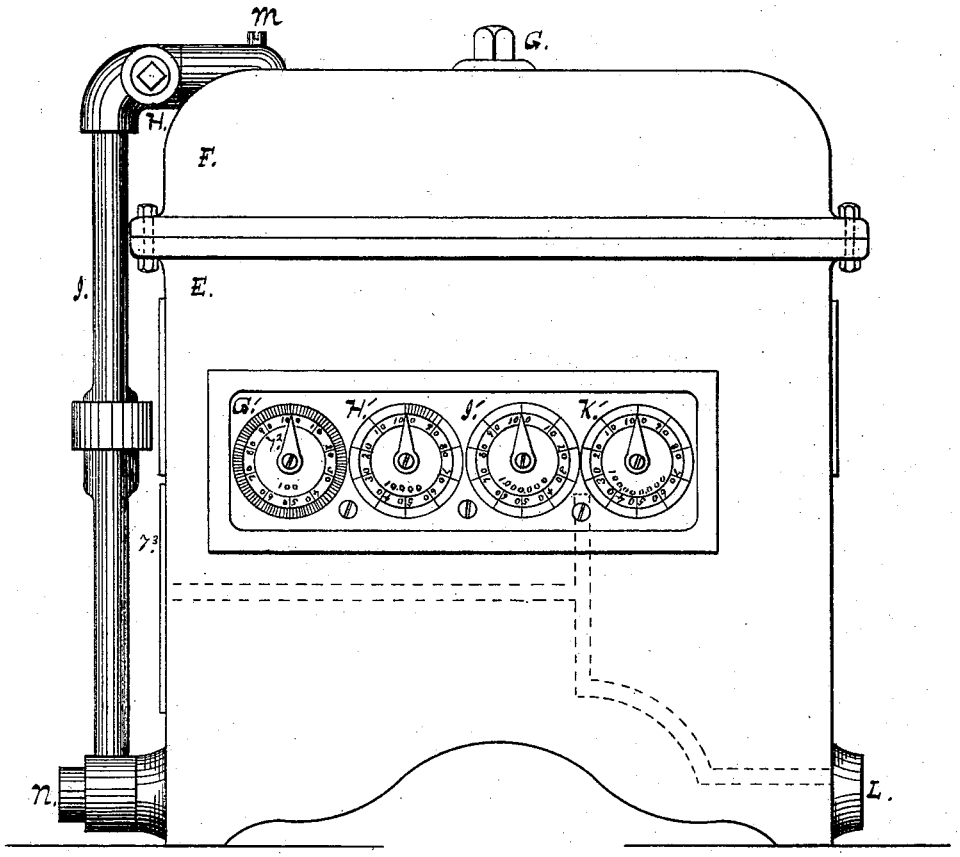

Fig. 6

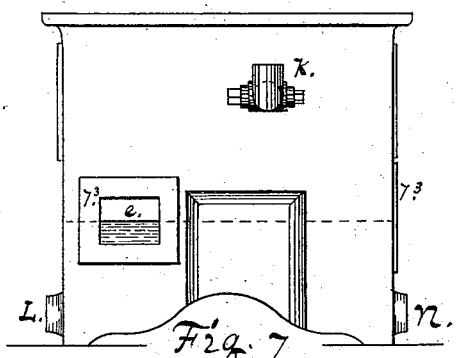

Fig. 7

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UNITED STATES PATENT OFFICE.

ANDREW R. ARNOLD, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN WATER-METERS.

Specification forming part of Letters Patent No. **190,536**, dated May 8, 1877; application filed September 30, 1876.

To all whom it may concern:

Be it known that I, ANDREW R. ARNOLD, of Newark, in the county of Essex and State of New Jersey, have invented a certain Improvement in Water-Meters, of which the following is a specification:

My invention consists in constructing a water-meter so that it shall have the same pressure in it that is found in the water in the supply-pipes, and deliver the water into the service-pipe at the same pressure, and retain an equilibrium under all changes by a combination of mechanism giving a compensating atmospheric pressure.

The machine is automatic, and records upon dials the amount of water used.

Figure 1 is a plan view. Fig. 2 is a sectional elevation on the line of *x x*. Fig. 3 is a sectional view of a modification of one of the parts. Figs. 4 and 5 are detailed views. Fig. 6 is a front view of the machine, showing the dials; and Fig. 7 is a diminished view of the rear outside of the machine.

The particular form of the machine is not a matter of invention, and a description of the parts of the machine in their working relations will enable any one skilled in manufacture to construct and use the same.

The machine is arranged for use by putting the diaphragm in place. This is made of a sheet of elastic rubber, A, and the base B composed of two metal plates screwed together, binding the rubber.

With these plates is connected a rod, *a*, at each end, which passes down through a guide-plate, *c*, and two sets of spiral springs, C, resting on, and recessed in, a cross-plate, D, connected with the plate *c*. The edges of the rubber extend out and rest on the top of the case E of the meter, and the cover F screwed down upon the case holds the rubber in position; and the diaphragm is arranged to operate between its position as shown in Fig. 2, its lowest position, and the dotted lines *d*, indicating its position under the cover.

When the diaphragm is in position, and the cover screwed down, the stopple G in the cover is removed, and the chamber above the diaphragm is filled full of water, and the stopple is restored, and the cock H in the pipe I is closed.

The chamber J below the diaphragm is then filled with air pumped in through the pipe K, and water admitted from the supply-pipe L until there is an equal pressure upon both at the water-line *e*.

The screw-vent *m* at the connection of the pipes I and cover and the cock H are slightly opened to allow the escape of the air in the pipe I driven out by the water passing up the pipe. The vent is then closed, and the cock left wholly open, and then there will be a free connection between the water above and below the diaphragm, and the pressure in all the parts, on air and water above and below, will be equal. A faucet in the service-pipe *n* may now be opened for the draft of water for use. The opening of the faucet reduces the pressure of water in the service-pipe and the pipe I, and by that means a current of water is secured in all the pipes.

To illustrate: if the pressure by the opening of the faucet be diminished ten pounds through the pipe I and its connections, it reduces ten pounds' pressure to the square inch over all the surface of the diaphragm, which destroys the equilibrium of pressures, and causes the atmosphere under the diaphragm to raise it until the equilibrium is again restored, thus relieving the pressure of the atmosphere on the water below the same amount of pounds, causing the equilibrium to be restored with the ten pounds less while the water is running through the meter. The same influence extending out into the supply-pipe causes the water to continue to flow. The rule will be found to be correct, and the results relatively the same, whether a small or large draft of water is taken from the meter.

If the faucet be closed by the movement of the water the pressure at that point is at first restored to an excessive degree; but instantaneously there returns a wave or pressure back into the "main," restrained from its too rapid backward flow by the dam *g*, and flows up the pipe I to the chamber above the diaphragm, and restores all the pressure on the water and air to its former pressure.

The spiral springs C have a twofold office: first, to modify and equalize the action of the diaphragm when it rises or falls—up to the line O the springs push, above that they pull,

and thus prevent a too sudden movement or striking above or below; second, the weight of the base-plates B, including the guide-rods *a*, is equal to the weight of the water that might be contained in the air-chamber under the diaphragm when at the line O, and above the water-line *e*, less the area of half the distance between the inside edges of the base-plates and the walls of the case on all its sides.

The springs, in the settling down of this base, lift the same amount as the weight of the water between the line O and the lowest rubber-line; and above the line O they draw down equal to the amount of water displaced by the rise of the diaphragm above the line O, and by the weight of these plates and rods, and the springs, an equilibrium of pressures is preserved.

When the water is let into the meter it lifts the float-valve Q off from its seat, and gives it a free action in the chamber between the guard-posts 1. The seat of this valve is the inner end of the supply-pipe L, where it discharges the water into the meter; and if by any means the supply of water is cut off, when the water in the meter falls to a certain predetermined depth in front of the wheel, this valve seats itself on its metallic seat 2, and arrests the escape of water and retains the compressed air within the machine, as there will be from one and one-fourth to one and one-half inch of water over the seat of the valve; and the atmospheric pressure will keep the valve resting upon the seat.

The outlet-valve R, as shown in Fig. 2, is similar in its construction and office to the one just described, and provides a guard against drawing off the water from the meter when the inlet-valve is closed, or from any cause the water at the foot of the wheel falls to a predetermined depth.

In some cases it may occur that the valve R gets stuck down on its seat and would not rise when the water was restored to the meter. To provide for that liability I place on the opposite ends of the lever S a float, V, and vacuum-valve W. When the water in the meter settles the float V will settle, and, by the lever, carry up the valve W and close the vacuum-chamber. This chamber is in the end of piston 4, which works in a case, 5. This case and piston are provided each with an inlet-aperture, 6; and when the float V is down the piston 4 is carried up, so that the apertures in the case and piston do not agree, and the flow of water is cut off, and a vacuum is produced, or will be when the faucet is opened, or the water by leakage escapes from this chamber. But when the water is restored to the meter and raises the valve Q, it also raises the float V, which, through the lever, depresses the piston 4 and opens the vacuum-chamber, and the water flowing in passes down into the outlet-chamber *n* and up under the valve R, and lifts it, if it had become stuck down, so that the ordinary rise of water in the meter would not raise it. A collar, 8, incloses the case 5. (Shown in detail in Fig. 3.) This collar has a hole through it corresponding to the hole in the case and piston, and a notch, *r*, in which it slides on a pin, in a lateral motion, as it is turned by the pin *r'*. The use of this collar is to graduate the flow of water through this piston by closing the hole in it more or less. The flow of water ordinarily through this piston is to assist in supplying water to the pipe *n* and I, to keep up the flow and equilibrium above the diaphragm.

Fig. 3 shows a modification of the valve R, and is a balance-pressure float-valve, R', and in the machine will occupy the place of the valve R above described. This valve is made with the upper part 1^1 of cork, with a hollow piston, 2^1, closed at the upper end, screwed into it. This piston, closed at the bottom, operates in a case, 3^1, and has three holes, 4^1, in the sides, corresponding to holes in the case, which are shown in a cross-section, (see Fig. 4,) through which the water from the meter flows out into the interior of the hollow piston 2^1, and out the hole 1^2 into the service-pipe *n*.

The jam-nuts 7 on the lever 5' are to balance the piston part of this valve R', and make it really a float-valve.

A screw, 6^1, sets down into the case 7^1, or bottom of the meter, having a cylindrical hole through its entire length, making connection with the passage 8^1, which connects with the chamber 9^1 below the piston 2^1; and when the water is supplied to the meter it passes down through the hole in the screw 6^1, and up under the piston 2^1, and assists the cork, as a counterbalancing pressure, to raise it up until the three holes in the piston and case agree, and the water will flow into the piston through these holes; and as a matter of course, if the water falls in the meter, as before shown, and the valve Q is seated, the valve R' will also settle down until the lower end of the piston finds a seat at the bottom of its chamber, and the holes 4^1 will be closed by disconnection, and the outflow of the water will be prevented. In this view (Fig. 3) the screw 6^1 is shown at the left of the valve R', that it may be displayed. It is not material on which side it is placed.

If, by any means, the draft is too rapid for the supply, caused by the opening of faucets or by leakage, the fall of water at the foot of the wheel around the valve R' will cause the valve to settle down, so that the openings 4^1 and 1^2 will close, or partially so, to prevent any derangement of the meter. In the flow of the water through the meter it catches into buckets A' of the wheel B', filling them full, and turns it for registering.

The blades S' may be set at any desired angle from the center.

On the end of the shaft C' of the wheel is a worm-gear, D', which communicates motion to the gear E, and that, in turn, to the gear

E′, in the hub of which is a pinion, O′, working into the face-gear F′, on the shaft of which is an index-hand, 7^2, to register on dial G′, (see Fig. 6,) registering from one to one hundred gallons. On this shaft is a one-tooth gear, 3^2, which, when the shaft turns once around, catches into the gear 4^2 and moves it one point, which makes a register on dial H′ of 100, which, continued, registers 10,000. The same order of connection, by the one-tooth gear 3^2 catching into the gears 4^3 and 4^4, makes a register on dial I′ up to 1,000,000, and on dial K′ up to 100,000,000.

There are friction-springs X attached to the dial-shaft frame of the meter, which press against the wheels 4^2, 4^3, and 4^4, to prevent them from moving only as they are acted upon by the one-tooth gears 3^2.

The bottom of the buckets, under the blades or partitions, is provided with grooves 5^2, through which any air may escape as the water rushes in and fills the buckets; also, to vent the buckets as the water escapes from them.

Metal plates 6^2 are secured, through slotted holes, to the case at either end of the wheel B′, to provide that if, in any event, there may be wear in the wheel that would allow the water to flow past the ends of it, these plates may be set up and close the space.

The apron under the wheel, to prevent the escape of water under its periphery, is composed of a lining of soft non-oxidizing metal, 9^2, and in case of wear by continuous operation of the machine, the under faces of the boxes can be reduced, so as to allow the wheel to settle down to compensate for the wear.

The glasses 7^3 in the case let light into the meter to show the level of the water in relation to the water-line *e*, dials, &c.

I claim—

1. The combination, in a water-meter, of a series of superimposed chambers of water and air, producing an automatic equalizing pressure, whereby the loss of pressure by the flow of water, under any head or draft, shall be fully compensated for by the atmospheric pressure, and a constant uniformity of action shall be produced, substantially as and for the purposes set forth.

2. The case E, having the removable cover F, the supply-opening L, service-opening *n*, air-opening K, and water-line gage *e*, substantially as and for the purposes specified.

3. The cover F, having the hole with its stopple G, and connection with the pipe I, and fitted to be screwed down on the top of the case, binding the rubber edges A of the diaphragm, thus forming above the diaphragm a close water-chamber, substantially as specified.

4. The diaphragm composed of rubber A and plates B, suspended by its edges between the cover and the top of the case, and steadied and graduated in its action by the rods *a* and spiral springs C, substantially as and for the purposes specified.

5. The chamber J, formed by the sides and bottom of the case, and by the diaphragm containing the operating mechanism, and provided with the water-supply pipe L and the air-supply pipe K, by which it is filled with an equalizing pressure of water and air, in combination with the water-chamber above the diaphragm, substantially as and for the purposes set forth.

6. The pipe I, forming a connection, by the service-pipe *n*, with the lower part of the chamber J—that part containing water—and, through the cover F, with the chamber below it, thus establishing a free communication between the said chambers, to assist in equalizing the pressures upon the meter, and having the cock H and vent-screw *m*, substantially as and for the purposes set forth.

7. The inlet float-valve Q, the outlet float-valve R, or its equivalent, and the balance-pressure float-valve R′, in combination with the supply-pipe L and service-pipe *n*, substantially as and for the purposes specified.

8. In combination with the valve R, the vacuum-valve *w*, operated by the float *v* through the lever S, substantially as set forth, and for the purposes specified.

9. The wheel B′, having the buckets A′ with the air-grooves 5^2, and provided with the adjustable plates 6^2, and having, in connection with its shafts C′, an operating mechanism for registering the amount of water drawn, substantially as specified.

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Witnesses:

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