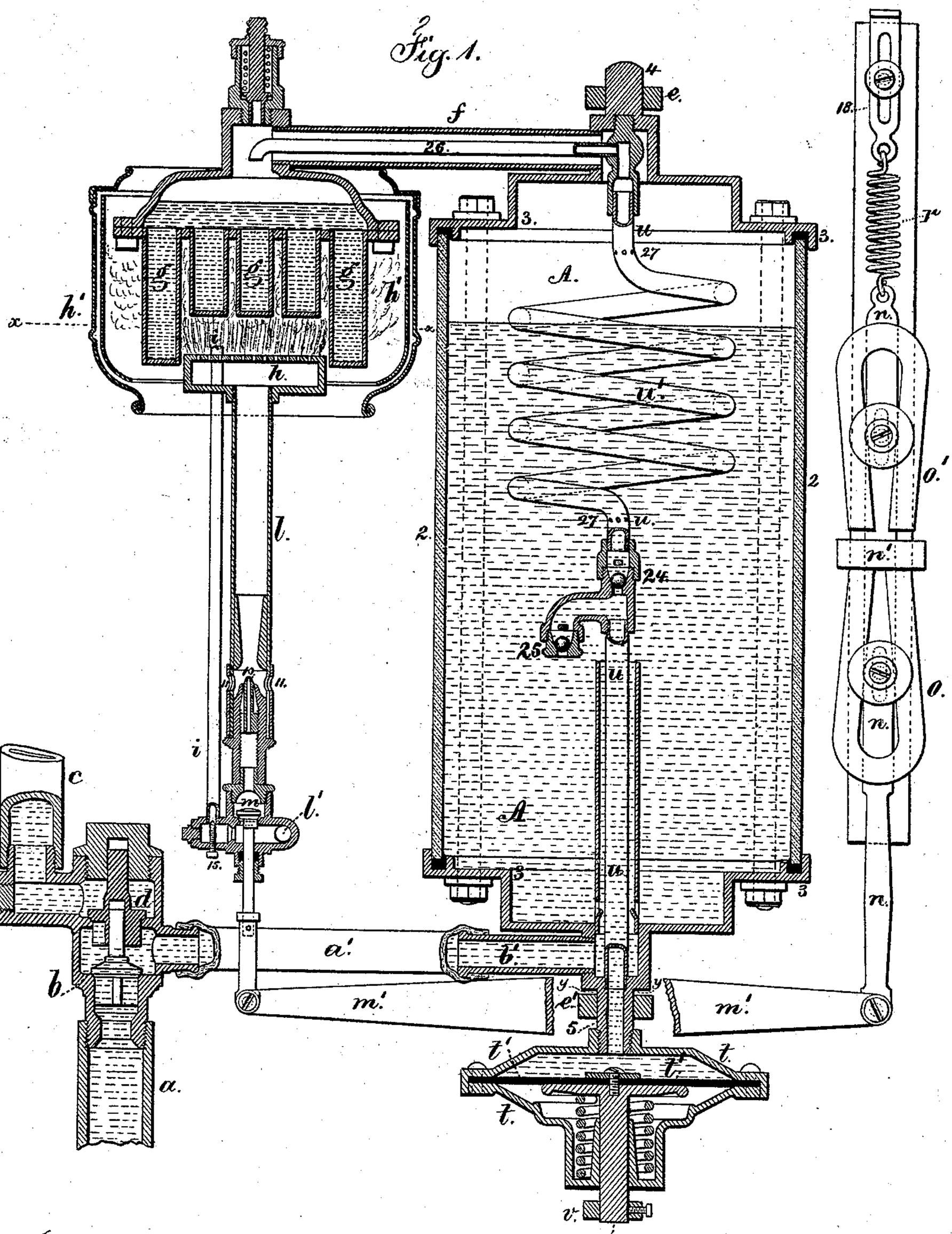
2 Sheets--Sheet 1.

H. S. MAXIM.

Steam and Vacuum Pumps.

No. 151,235. Patented May 26, 1874.

Fig. 1.



Witnesses,
Chas H Smith
Harold Serrell

Inventor,
Hiram S. Maxim.
per Lemuel W. Serrell.
atty.

2 Sheets--Sheet 2.

H. S. MAXIM.

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Fig. 3.

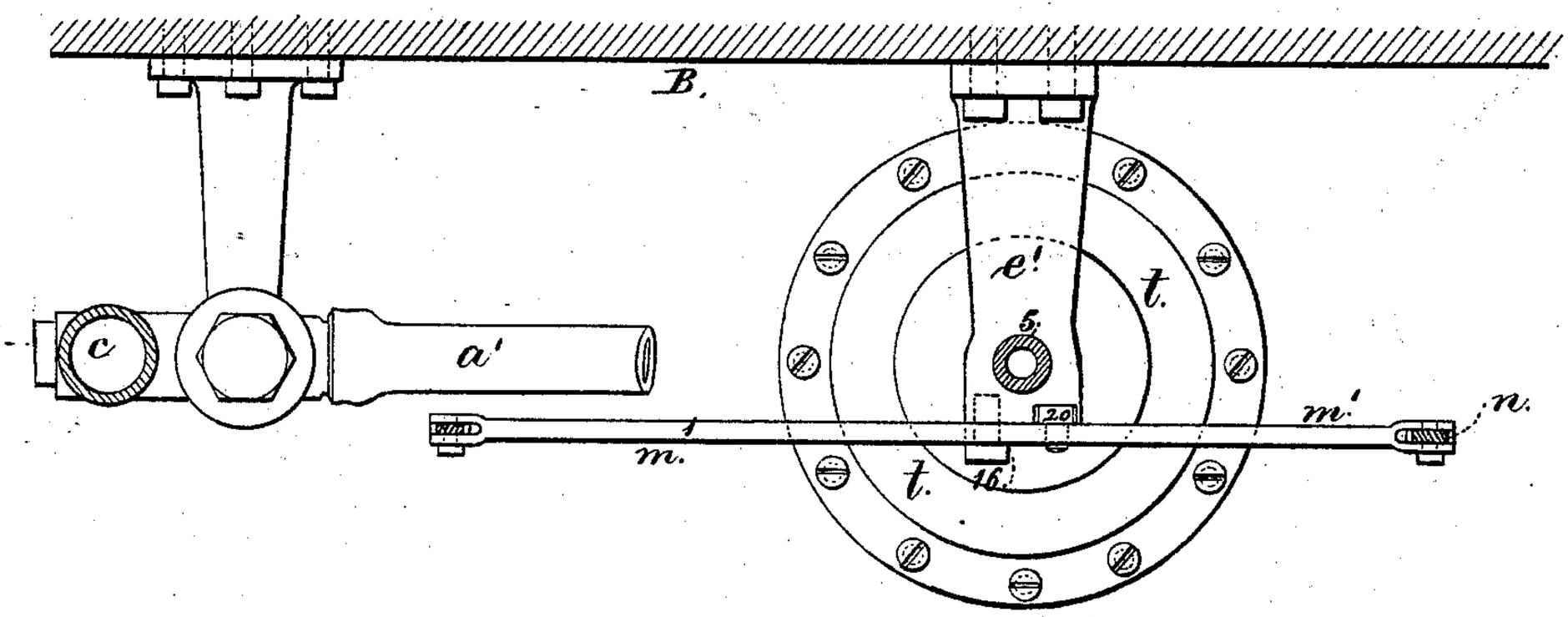
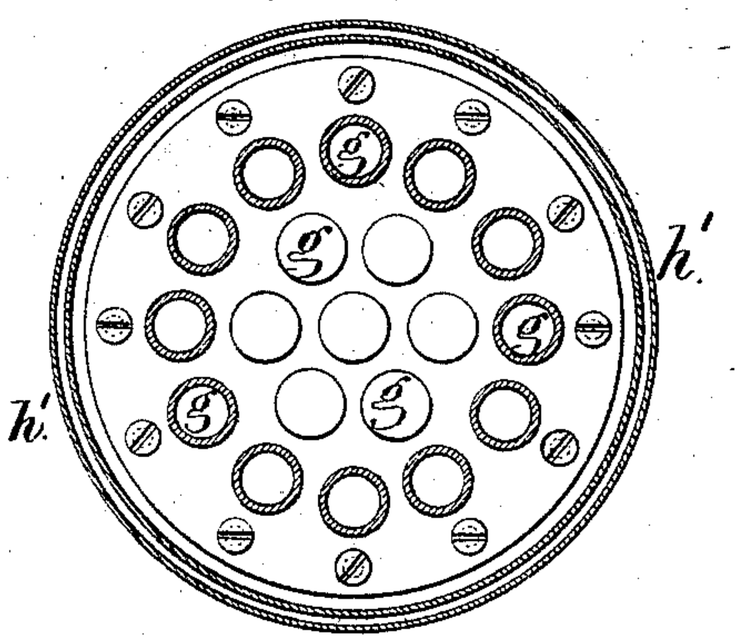


Fig. 4.



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Chas. A. Smith.
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atty.

UNITED STATES PATENT OFFICE.

HIRAM S. MAXIM, OF BROOKLYN, NEW YORK.

IMPROVEMENT IN STEAM AND VACUUM PUMPS.

Specification forming part of Letters Patent No. **151,235**, dated May 26, 1874; application filed April 7, 1874.

To all whom it may concern:

Be it known that I, HIRAM S. MAXIM, of Brooklyn, in the county of Kings and State of New York, have invented an Improvement in Steam and Vacuum Pumps, of which the following is a specification:

This invention is intended as a domestic water-raising apparatus, in which the motive power is derived from the combustion of gaseous or liquid hydrocarbon, and can be used conveniently in dwellings, shops, stables, and other places where a supply of water is required at a moderate expense.

I employ a boiler to generate steam and heat the same by a flame. The steam passes into a vessel in which is the water to be raised. When the pressure has accumulated sufficiently the steam forces the water up the discharge-pipe past a check-valve. When the water has been discharged from the vessel, so that its weight is lessened, a spring lifts the vessel, and in so doing closes a valve and shuts off the combustible fluid and extinguishes the flame, except a small relighting-jet that is always burning. The generation of steam being checked, the apparatus cools, and, as the pressure decreases, a jet of water is thrown into the boiler by a spring piston or diaphragm to refill the same and cool it, to prevent the water boiling in the vacuum created by the condensation of the steam in the vessel. As the vacuum is formed, which is also aided by jets of water, the vessel refills from the suction-pipe by the exhaustion, and in so doing the weight thereof is increased, and when it becomes sufficient to overcome the sustaining device it falls sufficiently to open the valve to the fluid hydrocarbon and cause the flame under the boiler to again become active and generate the steam that, passing into the vessel, expels and elevates the water as before.

In the drawing, Figure 1 is a vertical section of the apparatus. Fig. 2 is a sectional inverted plan of the boiler at the line *x x*, and Fig. 3 is a plan below the line *y y*.

The suction or inlet pipe *a*, valve *b*, discharge or elevating pipe *c*, and check-valve *d* are of ordinary character. They are stationary, and preferably attached to a suitable back plate or board, B, (see Fig. 3,) carrying the entire apparatus. The flexible tube *a'* connects to the pipe *b'* at the lower end of the vessel A. This vessel A is preferably made of a glass cylinder, 2, retained between metal heads 3, and at the top and bottom are the central guides 4 and 5, within the brackets or arms *e e'*, that extend outwardly from the vertical back plate or board B, carrying the machine, so that the vessel A, and parts connected to it, can slide up and down a small distance, sufficient to operate the valve of the burner, as hereafter detailed. The hollow arm *f* extends from the center of the head 3 to the top of the boiler *g*. This boiler is by preference made with descending water-tubes *g*, closed at their bottom ends, so that the flame from the burner *h* may circulate freely among such pendent tubes; and around the boiler *g* is an inclosing-case, *h'*, that, by preference, is made double, to prevent the radiation of heat. The burner *h* is at the upper end of the pipe *l*, and is preferably constructed as a Bunsen burner, the gas issuing from the jet 10, and the air passing in through the openings 11. The gas is supplied by the pipe *l'*, and *m* is a valve that opens or closes the supply. The pipe *i*, with a small burner at its upper end, burns constantly, and becomes a relighter to the main burner after being extinguished. The valve or screw 15 regulates the size of this relighting-burner. The valve *m* is connected to one end of the lever *m'*, that has its fulcrum 16 on the bracket *e'*, (see Fig. 3,) and at the other end of this lever *m'* is a slide, *n*, passing freely up behind the stationary magnets *o o'*, and connected to the spring *r*, that is adjustable by the slotted link-connection 18 to the back plate B. Upon this slide *n* is an armature, *n'*, between the permanent magnets *o* and *o'*. A link or small slide, 20, (see Fig. 3,) connects the lever *m'* with the lower part of the vessel A, so that the weight of the vessel A and parts connected is sustained by that lever *m'*, spring *r*, and magnet *o'*. The strength of said spring *r* is so regulated in connection with the magnet and the weight of the vessel A and attached parts that when the water is drawn into the vessel A, and has nearly filled the same, the weight will be sufficient to overcome the spring *r* and the attractive power of the armature and magnet;

hence, when the armature is pulled away, the vessel A falls suddenly, and the armature rests upon the magnet *o*, and in so doing the lever *m'* is moved and the valve *m* to the burner *h* opened, and the flame will burn until the pressure of steam generated by the boiler is sufficient to eject the contents of the vessel A, and force it past the check-valve *d*, and up the delivery-pipe *c*, against the pressure of the head. As the vessel A lessens in weight it cannot be raised by the spring *r* until the contents are so far expelled that the spring is sufficient to both lift the said vessel by the lever *m'*, and also to detach the armature *n'*, so that the moment the armature is drawn from the magnet *o*, the spring raises the vessel A and parts, and the armature is held by the magnet *o'*, as before, and the burner *h* is extinguished by closing the valve *m*.

This construction effectually prevents the parts remaining at a neutral point, and insures a complete movement in either direction. A spring-toggle or equivalent device might be employed to insure the movement aforesaid, but I prefer the device shown.

In order to condense the steam in the vessel A, and also to supply fresh water to the boiler *g*, I make use of the device next described.

The vessel *t* hangs below the guide-tube 5 at the bottom of the vessel A, and in this vessel *t* is a sliding spring-piston, or else a diaphragm. I have shown the latter. This diaphragm *t'* is free to play up or down, the downward movement being resisted by a spring, or, preferably, two springs, one of greater strength and less range of motion than the other, and from the vessel *t* the tube *u* extends up through the vessel A, and, by preference, is made as a coil, *u'*, and provided with a check-valve, 24, and inlet-valve and bib 25, and the tube 26 extends along through the tube *f* to the boiler. As the steam-pressure in A increases, the water therein will be forced through 25 into the vessel *t*, and the diaphragm will yield. The springs being compressed as the pressure increases will increase the volume of water in *t*, and that water will be the coldest and not influenced by the heat of the apparatus. After the steam-pressure has expelled the water, and the flame of the burner been extinguished by the movement of the lever *m'* as the vessel A is raised, as aforesaid, then the pressure in A very speedily lessens, and the springs below the diaphragm *t'*, or piston, will move the same, throwing the cold water up into the coil *u'*, and that promotes condensation. The water passes on by the pipe 26 into the boiler, cools the same, fills the boiler, prevents ebullition *in vacuo*, overflows the boiler, and falls in the vessel A, condensing the steam and producing a sufficient vacuum to draw up the water by the pipe *a*, which water, being cold, completes the condensation and vacuum action, which draws the water into the vessel A until its weight causes it to descend and open the valve to the burner, and the operations are repeated. The collar *v*, that is movable on the spindle *v'*, can be clamped at any desired place, and regulates the injecting movement of the diaphragm or piston, so as to force more or less water into the boiler, and supply that which is necessary for condensing the steam. Holes at 27 in the pipe *u* will promote condensation; but ordinarily the coil *u'* will be sufficient, and the water therein will be somewhat warmed before reaching the boiler.

I claim as my invention—

1. In a water-elevating apparatus, the combination of a burner, a boiler or steam-generator, an alternate pressure and exhaustion vessel for receiving and ejecting the water, and a valve to regulate the flow of combustible material to the burner, opened or closed by the increase or decrease of weight of the water-vessel, substantially as set forth.

2. In a water-elevating apparatus, a vessel to contain water for condensing steam in the water-vessel, combined with a delivery-tube, a piston or diaphragm, and a resisting-spring, substantially as set forth, whereby the capacity of that vessel is increased as the steam-pressure increases, and the water is ejected as the pressure lessens, substantially as set forth.

3. The water-vessel connected to the induction and eduction pipes by a flexible tube, and supported in guides that allow a vertical movement, in combination with the lever *m'*, valve *m*, burner *h*, spring *r*, and magnets *o o'*, substantially as and for the purposes set forth.

4. In a water-elevating apparatus, a steam-generator and a main burner that is periodically extinguished, in combination with a small jet continuously burning for relighting the main burner, substantially as set forth.

5. A water-elevating apparatus containing an alternate pressure and exhaustion vessel and a steam-generator, in combination with a water-vessel containing a diaphragm or piston and a resisting-spring, and a tube leading to the generator to discharge water into the generator, for the purposes set forth.

Signed by me this 3d day of April, A. D. 1874.

HIRAM S. MAXIM.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.