(No Model.) 4 Sheets—Sheet 1.

# E. S. RENWICK.

## INCUBATOR.

No. 281,398. Patented July 17, 1883.

Fig. 2.

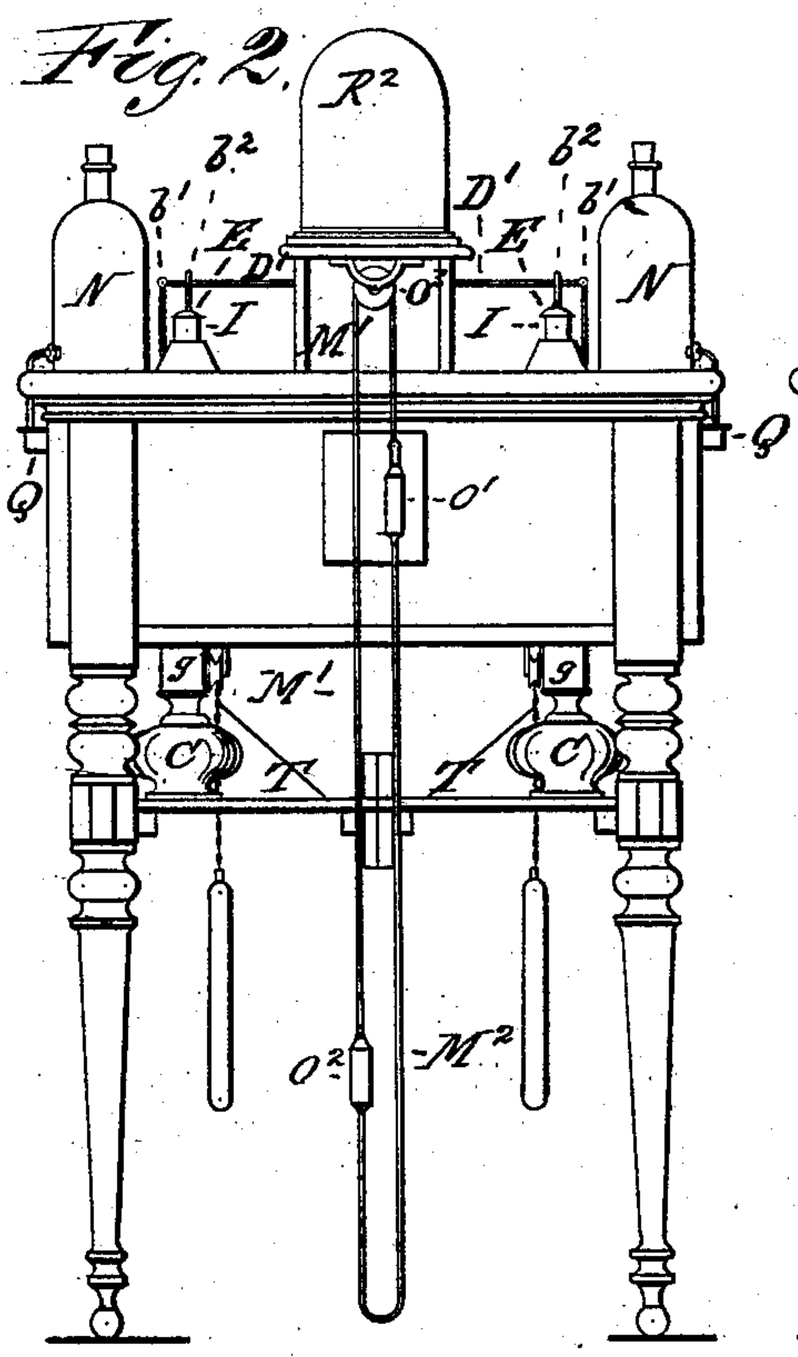



Fig. 1.

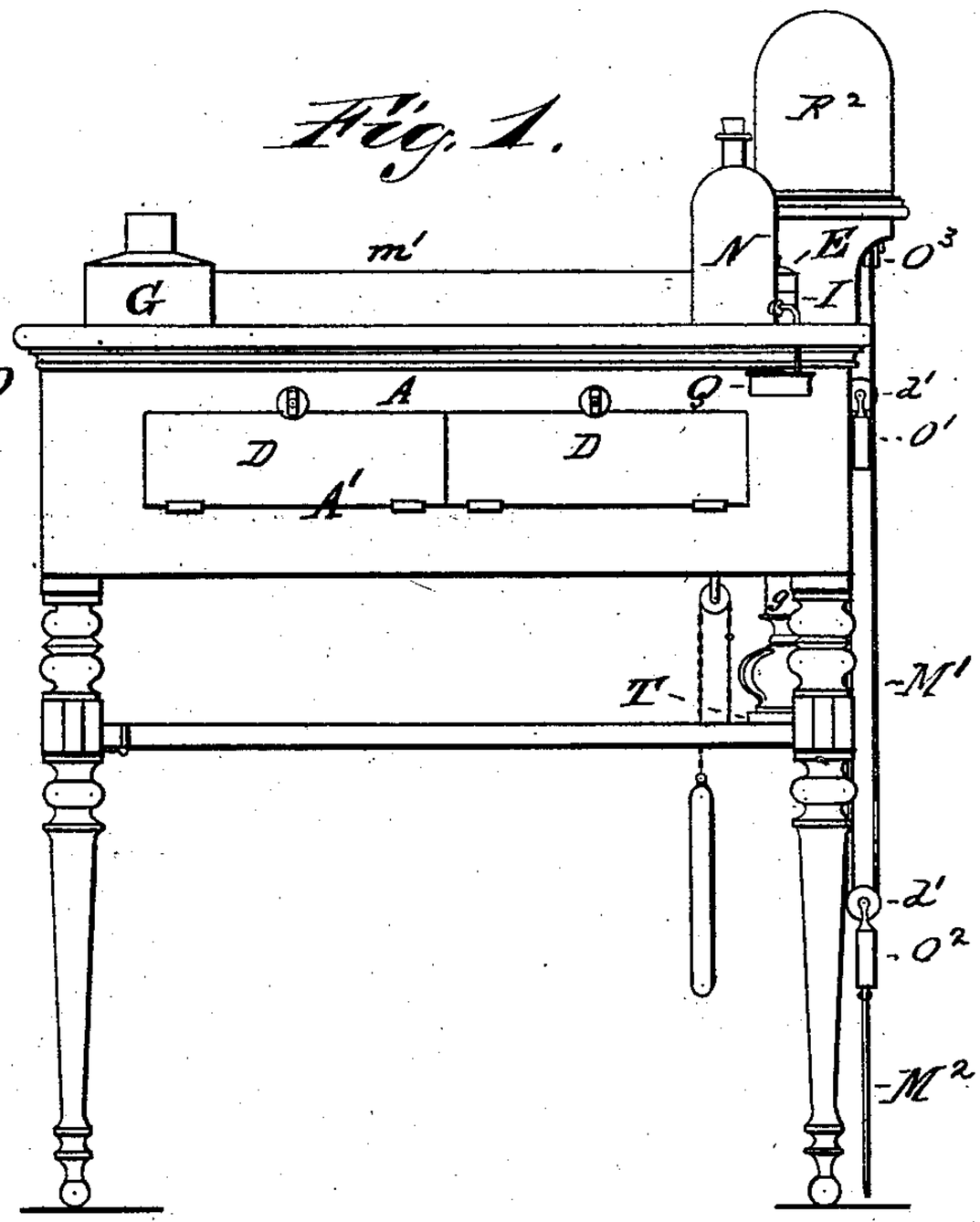



Fig. 4.

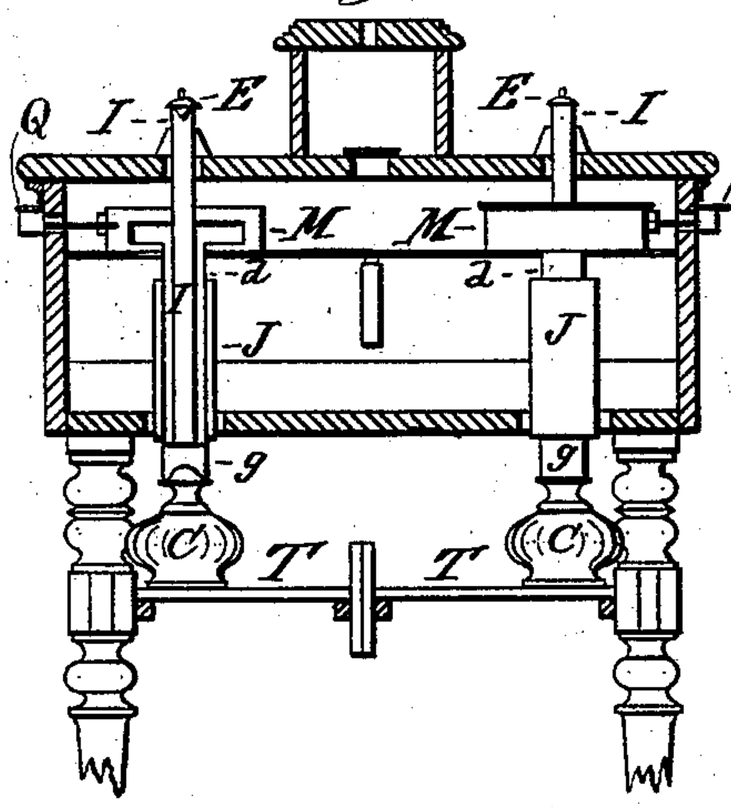
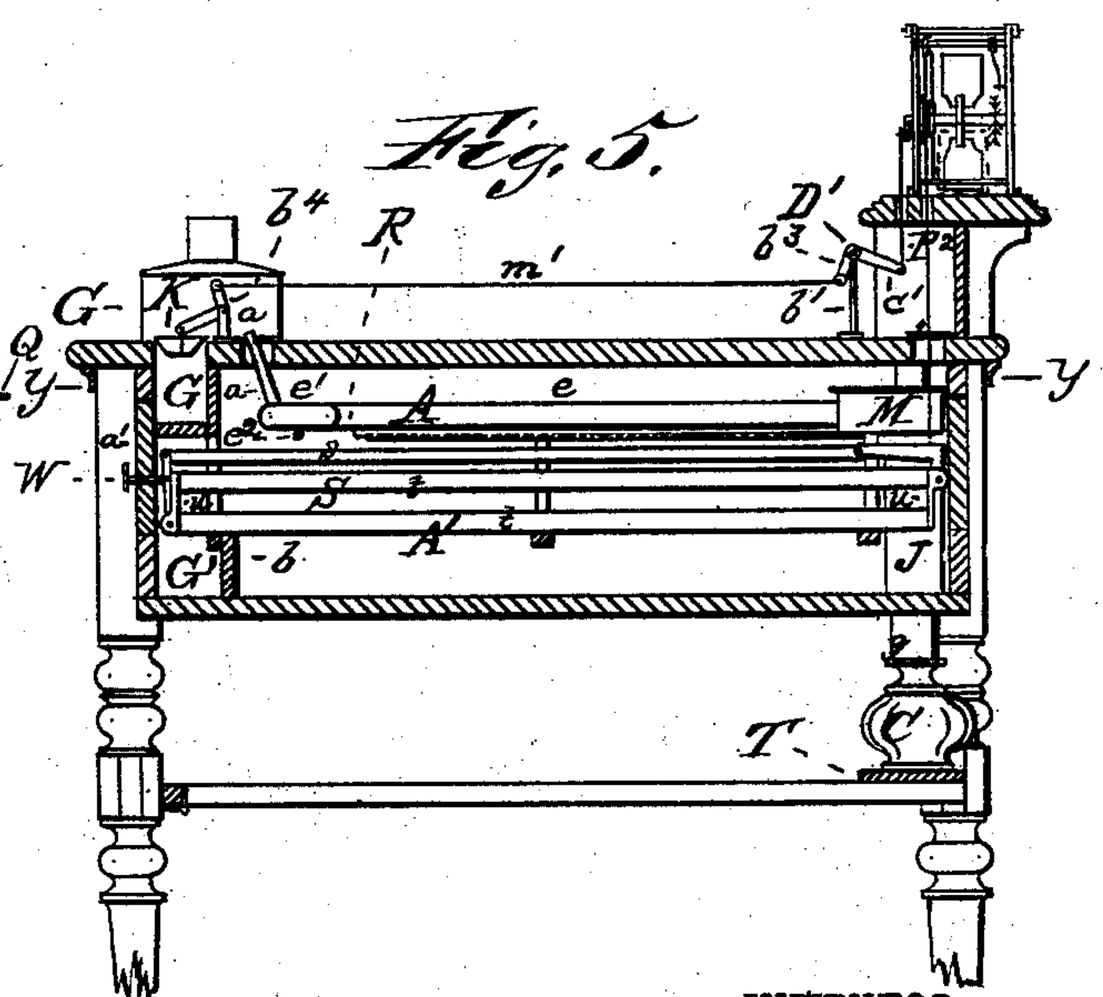



Fig. 5.




WITNESSES:

W. L. Bennett

Wm. Kellner

INVENTOR:

E. S. Renwick

(No Model.) 4 Sheets—Sheet 2.

# E. S. RENWICK.

## INCUBATOR.

No. 281,398. Patented July 17, 1883

Fig. 3.

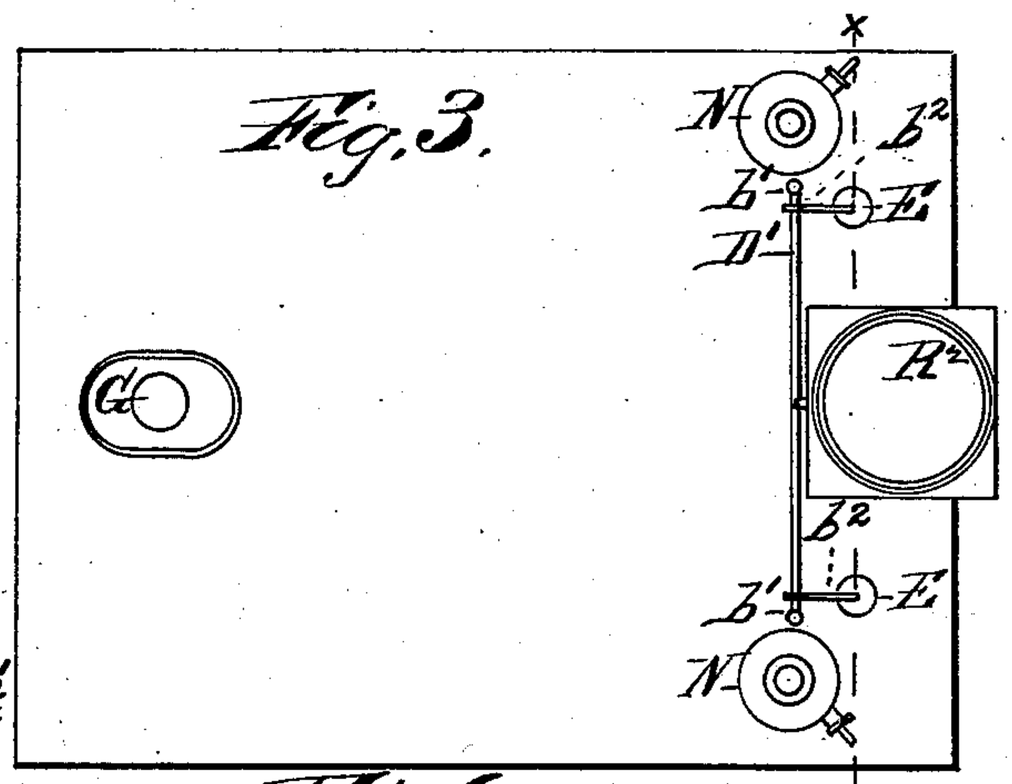



Fig. 8.

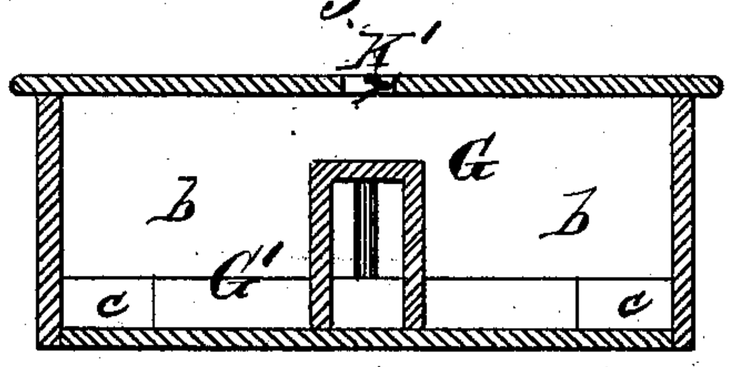



Fig. 6.

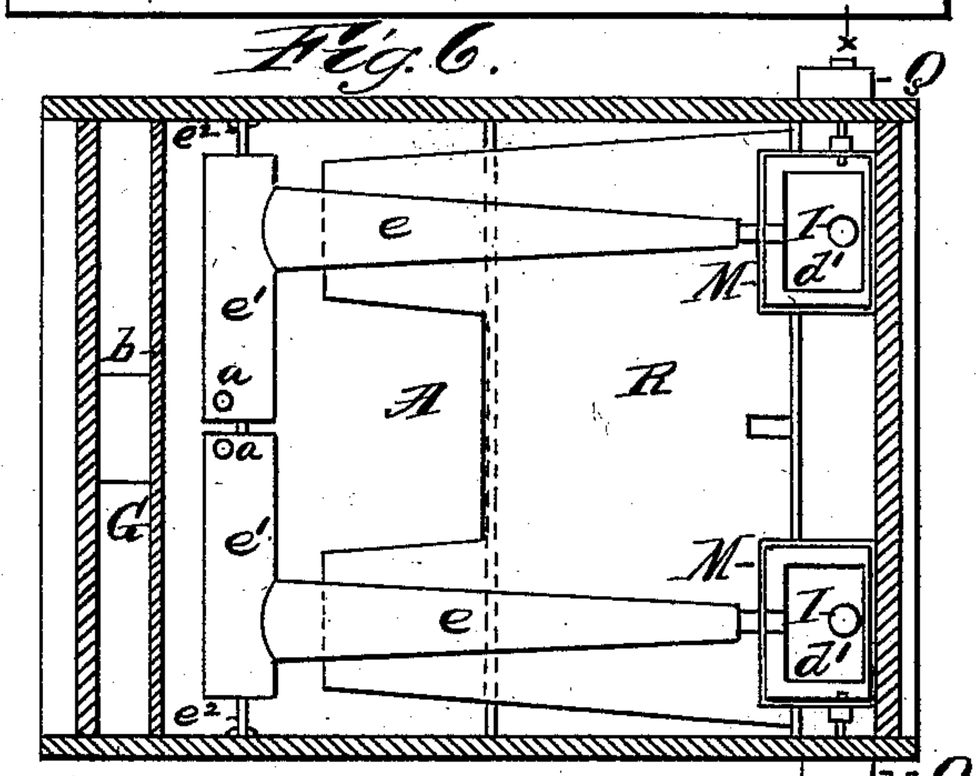



Fig. 10.

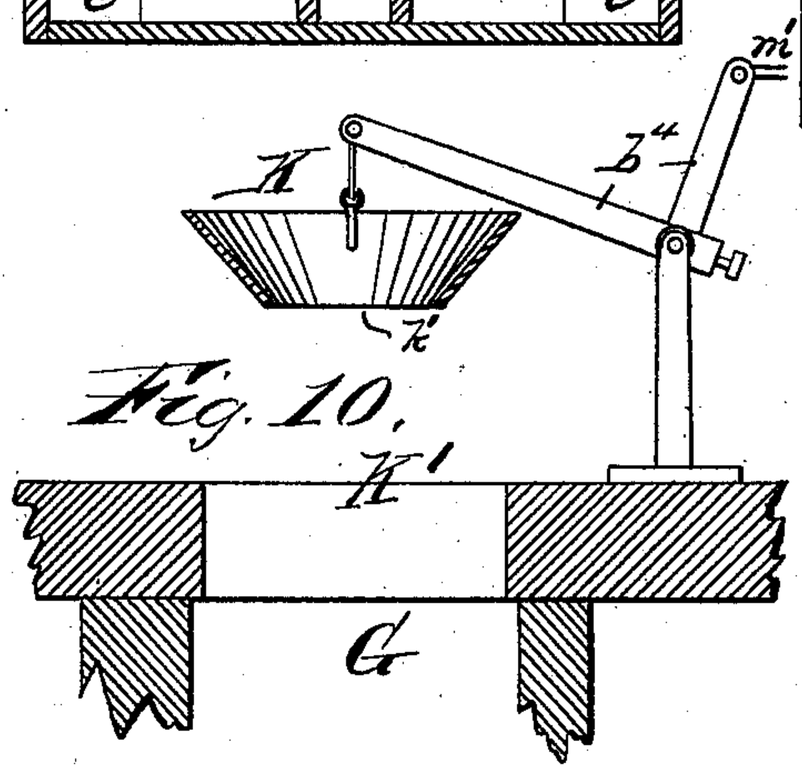



Fig. 9.

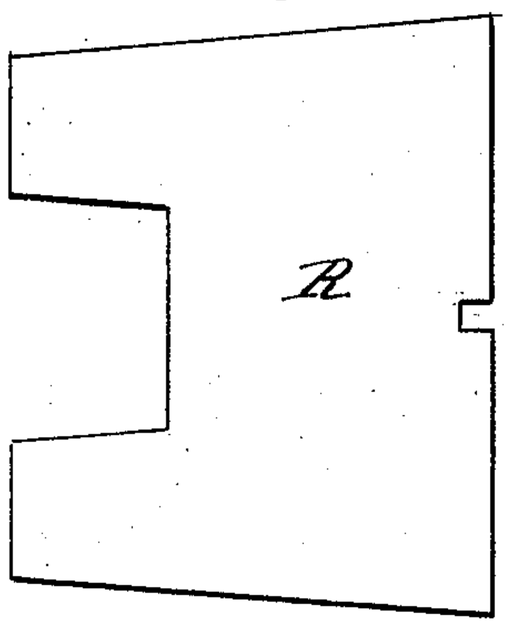
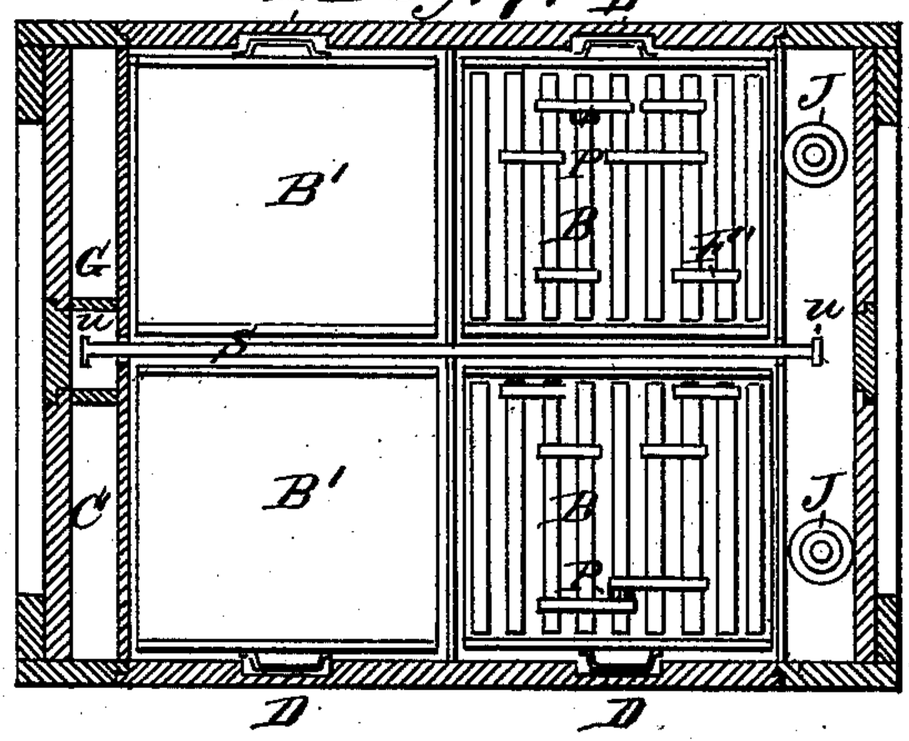



Fig. 7. D




Witnesses.
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(No Model.) 4 Sheets—Sheet 3.

# E. S. RENWICK.

## INCUBATOR.

No. 281,398. Patented July 17, 1883.

Fig. 11.

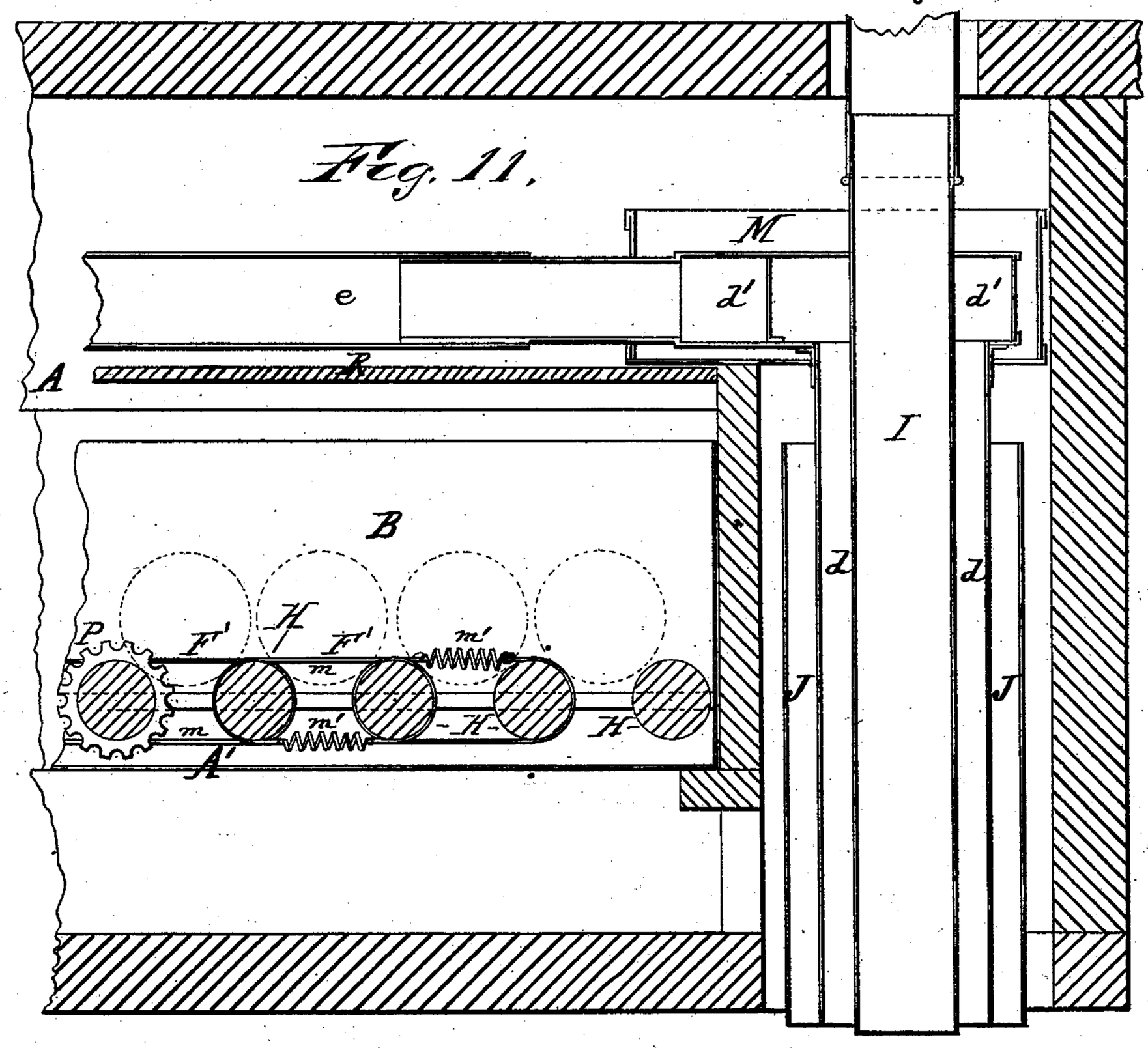
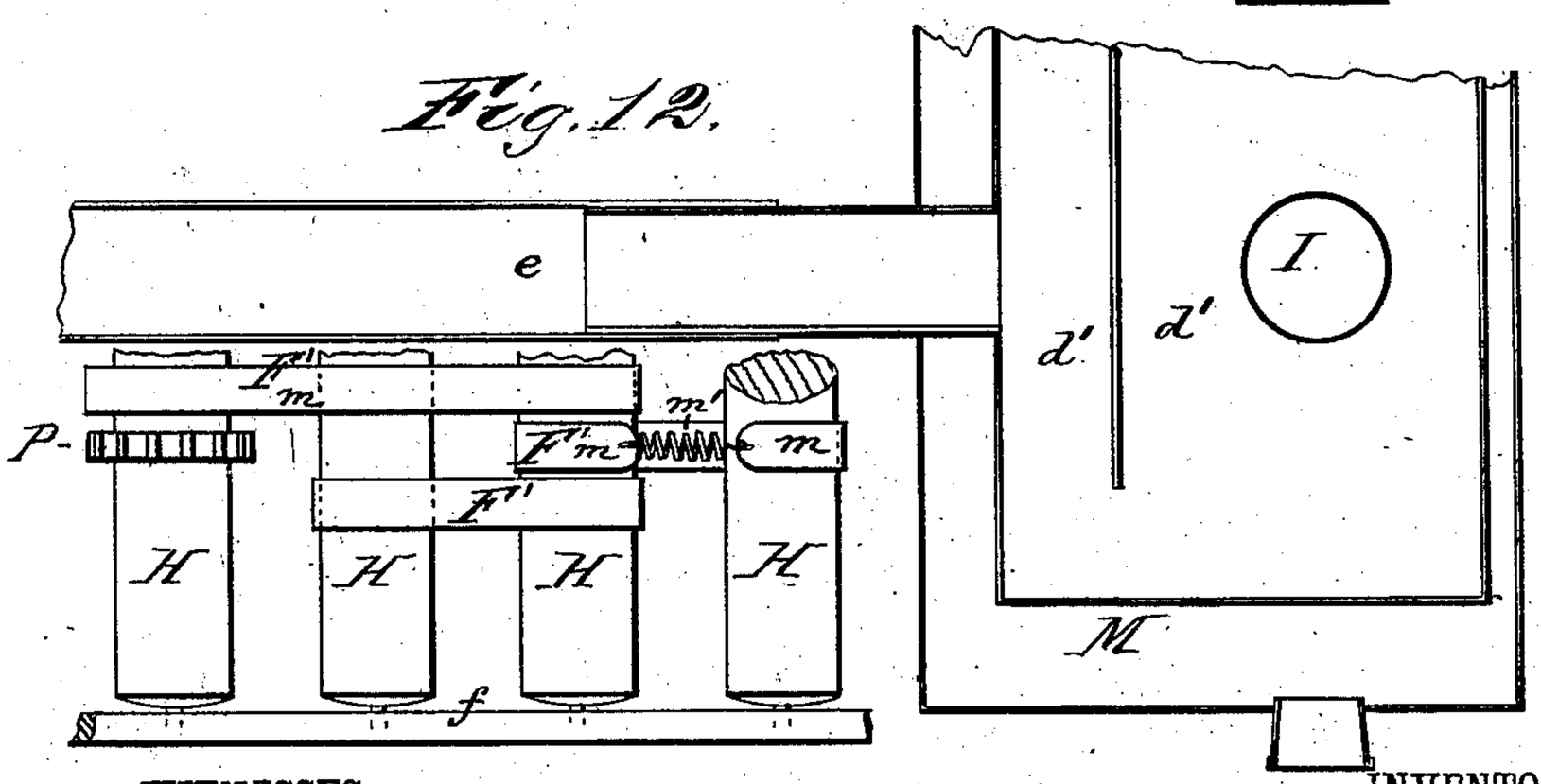



Fig. 12.




WITNESSES:

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(No Model.) 4 Sheets—Sheet 4.

# E. S. RENWICK.

## INCUBATOR.

No. 281,398. Patented July 17, 1883.

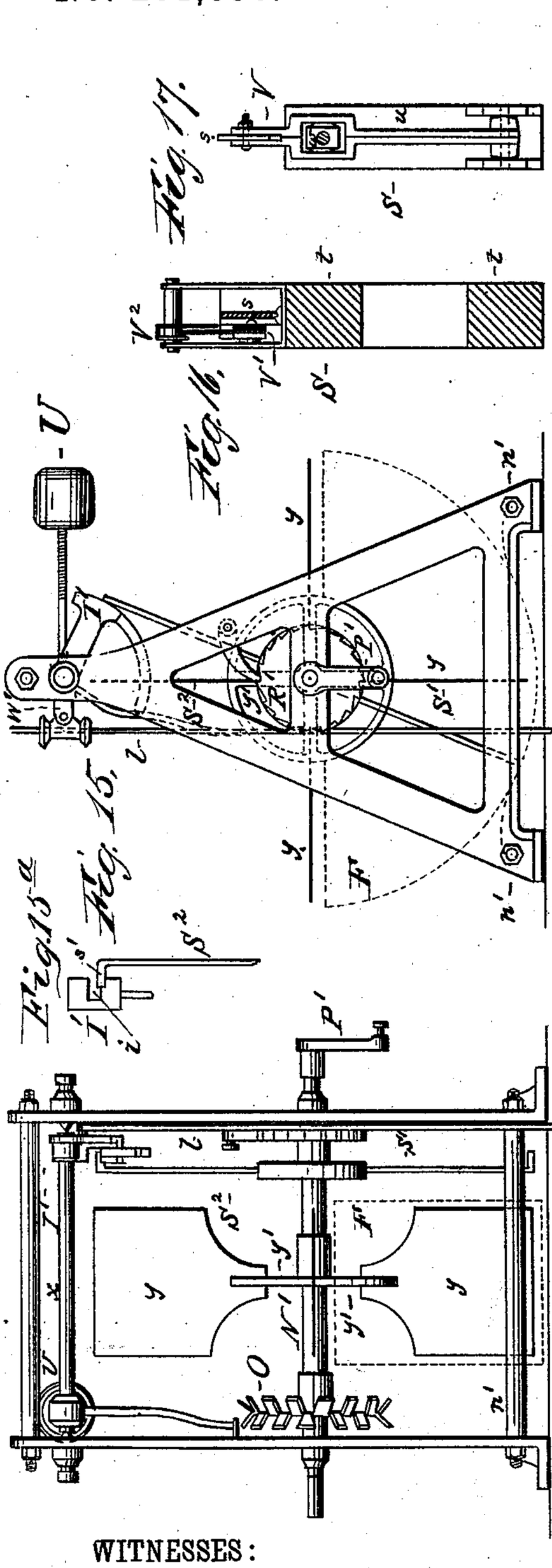

Fig. 11.



Fig. 12.



Fig. 15.

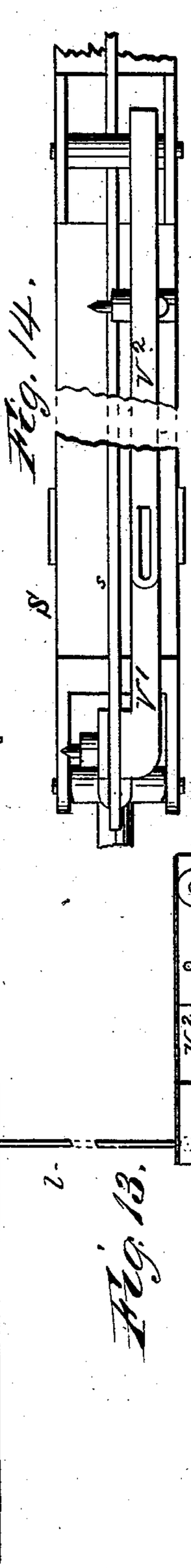

Fig. 14.

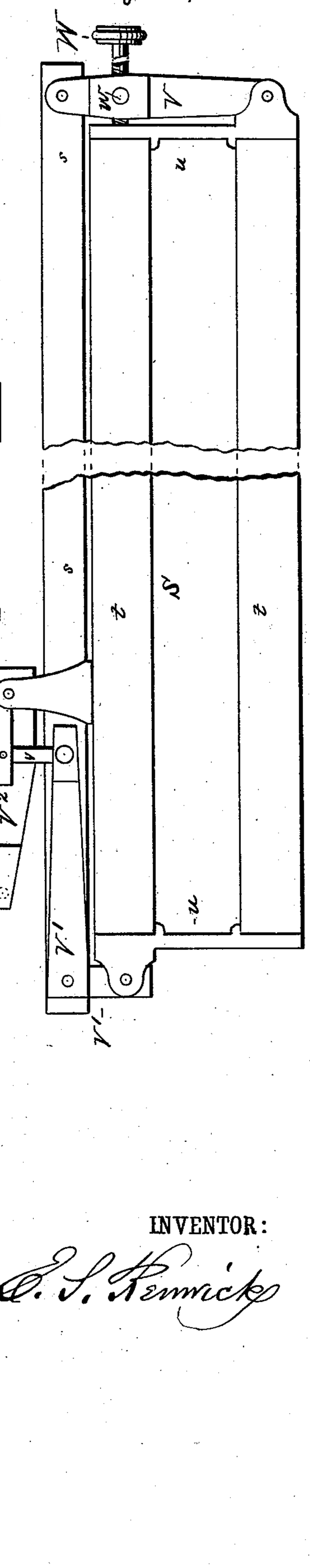

Fig. 13.

WITNESSES:

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Wm. Kellner

INVENTOR:

E. S. Renwick

# UNITED STATES PATENT OFFICE.

EDWARD S. RENWICK, OF MILLBURN, NEW JERSEY.

## INCUBATOR.

SPECIFICATION forming part of Letters Patent No. 281,398, dated July 17, 1883.

Application filed January 14, 1882. (No model.)

*To all whom it may concern:*

Be it known that I, EDWARD SABINE RENWICK, of Millburn, in the county of Essex and State of New Jersey, have made an invention of certain new and useful Improvements in Incubators; and I do hereby declare that the following, taken in connection with the accompanying drawings, is a full, clear, and exact description and specification of the same.

The object of the present improvement is to simplify the construction of incubators and improve their operation; and to these ends the invention consists of certain new and useful combinations of devices, which are recited in the claims at the close of this specification.

By a decision of the Commissioner of Patents a portion of my said improvements cannot be embraced in the same application with the residue; hence the combinations recited at the close of this specification comprise one division of my invention, the other division thereof being set forth in a specification dated August 29, A. D. 1882. In order that these combinations may be understood, I have represented in the accompanying drawings and will proceed to describe the best mode in which I have embodied the same for practical use, it being understood that the mode of embodying the improvements may be modified as circumstances or the views of different constructers may render expedient.

Figure 1 of said drawings represents a front view of the incubator. Fig. 2 represents an end view of the same. Fig. 3 represents a plan of the same. Fig. 4 represents a transverse section of the incubator at the line *x x* of Fig. 3. Fig. 5 represents a central longitudinal section of the same. Fig. 6 represents a horizontal section of the incubator at the line *y y* of Fig. 5. Fig. 7 represents a similar section above the tops of the egg-holders or trays for eggs, and Fig. 9 is a plan of the heat-distributer. Fig. 8 and Figs. 10 to 17, inclusive, represent views of various portions of the incubator, Figs. 10 to 13 and 15 to 17 being of half the working dimensions, and Fig. 14 being of full size.

The incubator represented in the said drawings embodies improvements recited in previous patents granted to me as well as those recited in the claims at the close of this specification, A A′ being the incubating-chamber; B B′, the egg-holders in the form of drawers, fitted either with rollers or with perforated bottoms; *d*, the heat-flues; I, the waste-heat chimneys; E E, the chimney-valves; G, the ventilating-chimney; K, the ventilating-valve; J J, the air-supply pipes; M M, the water-trays, open at their tops; N N, the water-founts; Q Q, the water-basins, connected with the water-trays by tubes, and *e e′* the horizontal portions of the flues.

In the present case the heat is supplied by means of two lamps, C C, with burners B, of the ordinary construction, for burning kerosene, and both of these lamps are arranged at the same end of the incubating-chamber; but they are spread apart laterally, so as to distribute the heat to the front and rear of said chamber. If the heat is to be produced by gas, the lamps are to be replaced by gas-burners. Each lamp is supported by a counterpoised gallery, T, which permits it to be readily removed and replaced, and the short chimney *g* of each lamp slips over the lower end of the corresponding heat-flues, *d*. The head of the upright portion *d* of each heat-flue is enlarged in the form of a rectangular box, *d′*, and is contained within a water-tray, M, from which moisture is supplied by evaporation. The horizontal portions *e e′* of these heat-flues are preferably made broader as they extend from the water-trays, and their delivery portions *e′* are supported upon a cross-bar, $e^2$, Figs. 5 and 6, and are brought together as represented in Fig. 6, their adjacent ends being perforated for the vent-pipes *a*, Figs. 5 and 6. The upright part *d* of each heat-flue is surrounded by an air-supply or ventilating pipe, J, through which the air enters for ventilation, the air being discharged from the said pipe into the upper part of the incubating-chamber. The incoming supply of heated air forces that in the incubator downward through the egg-holders to the lower part of the incubating-chamber, whence it escapes by lateral openings *c c*, Fig. 8, in the lower part of the partition *b*, Figs. 8 and 5, into the base G′ of the ventilating-chimney. The rate of ventilation is controlled by the ventilating-valve K, which is fitted to a hole, K′, in the top of the incubator, which at this part constitutes a diaphragm in the ven-

tilating-chimney. The ventilating-valve is conical, it having the form of a hollow truncated cone, so that it tends to center itself when dropped in the hole to which it is fitted, and it closes the hole only partially, the central opening, *k'*, Fig. 10, of the valve always permitting some ventilation to take place.

In order that the draft of the ventilating-chimney may be increased without increasing its height, the vent-pipes *a a* of the heat-flues *d e e'* are arranged to deliver into the part of the ventilating-chimney above the ventilating-valve K, thus heating the air in said chimney and quickening its upward movement.

The egg-holders of the incubator consist of four drawers or trays, B B B' B', of galvanized iron, fitted to slide upon ways into and out of the incubating-chamber, the openings in the front and rear walls of said chamber, through which the trays are inserted, being closed by shutters D. Two of the said egg-holders are represented in Fig. 7 as fitted with a series of rollers for turning all the eggs simultaneously, as described in a previous patent granted to me. The other two drawers are represented as without rollers. Each roller has pivots in its ends, which are fitted to turn in holes formed in horizontal bars *f*, Fig. 12, one arranged at the front of the egg-holder and one at its rear. The rollers are combined together by elastic driving belts or bands F', which are by preference of composite construction, each being composed of a strip of worsted braid, *m*, Figs. 11 and 12, or other flexible material, (which need not be elastic,) and of an elastic metallic spring, *m'*, by which the ends of the strip of flexible material are connected. In this combination the metallic spring furnishes the requisite tension required of the band, while the flexible material supplies a broad frictional surface to act upon the surface of the roller. In practice I find it expedient to make the flexible strip long enough to be doubled around the two rollers, in which case one thickness of the said material intervenes between the metallic spring and the surfaces of the rollers. The last roller at each side of the drawer is not combined by a band with the other rollers, it being found by experience that the frictional contact of the eggs with it is sufficient to cause it to turn simultaneously with the other rollers.

In order that the rollers may be turned by hand without the cost and inconvenience of extending one of their pivots through the wall of the egg-holder and applying a turning device at the outside of the egg-holder, one of the rollers is fitted with a turning device, P, secured directly upon its body, the most convenient position for this turning device being with its middle at about the average length of an egg from the front of the drawer or tray. In this position the turning device is inside of the egg-holder, but can be readily turned from beneath the egg-holder by hand, the egg-holder being previously partly withdrawn from the incubating-chamber. The turning device which I prefer to use is a fluted ring, as represented in the drawings; but it may be formed in other ways—as, for example, by the heads of a ring of tacks driven into the roller.

The heat is supplied to the eggs in the egg-holders from above partly by radiation from the heat-flues *e e'* and partly by the hot air forced downward by the entering supply. As the lamps, or their equivalents, are applied at one end only of the incubator, and no circulation of water is employed to transmit the heat, the natural tendency is for the parts of the incubating-chamber nearest the heat-supply to become hotter than the parts farther therefrom. In order to counteract this tendency and to equalize the average temperature in the egg-holders, the heat-distributer R is interposed between the egg-holders B B' and the heat-flues above them. This heat-distributer is made by preference of a poor conductor of heat—such, for example, as thick pasteboard—and it is cut to a form to suit the circumstances of the incubator to which it is applied. When the incubator has the arrangement of incubating-chamber and heat-flues shown in the drawings, the form of heat-distributer represented at Figs. 6 and 9 gives satisfactory results, the open spaces left over the two egg-holders which are nearest the heat-supply permitting the descent of air for ventilation. When the heat-distributer is made of pasteboard, it is expedient to coat it with shellac varnish to protect it from the action of the moisture within the incubator.

The egg-holders B B' are arranged in pairs back to back, with their backs separated by a space which is wide enough to receive the thermostat S, which is placed between the egg-holders, so that it is at the level of the egg-holders, or thereabout, and is affected by substantially the same changes of heat that affect the eggs in the egg-holders, thus causing the thermostat to be a more reliable indicator of such changes than it is when placed in the top of the incubating-chamber, or in a separate compartment connected with that chamber.

The thermostat is constructed to operate by its tensive force. It is composed of a tensile strip of vulcanite (hard rubber) sustained by a frame. The expansive tensile strip of vulcanite, *s*, in the incubator represented in the drawings is about thirty-nine inches long. Its frame (see more particularly Figs. 13, 14, 16, and 17) is made by preference of two bars, *t t*, of dry wood, connected together by metallic mountings *u u*. Each end of the frame carries a lever. The lever V, at one end of the frame, is forked at its upper end to receive one end of the vulcanite strip *s*, and is pivoted at its lower end to the metal mounting *u*. At an intermediate part of this lever there is a swiveling nut, *w*, to which the adjusting-screw W is fitted, so that the lever V becomes an adjusting-lever by which the expansive tensile strip may be adjusted longitudinally for use. The stem of said screw W is long enough to pass through a hole in the adjacent end wall, *a'*, Fig. 5, of the incubator, so that the head of the adjust-

ing-screw is at the exterior, where it may be conveniently turned without the necessity of opening the incubator. The lever V′, at the opposite end of the incubator and frame, is used to transmit the motion caused by the expansion and contraction of the expansile strip to the device to be controlled by it. This motion-transmitting lever V′ is of elbow form, and is pivoted to the adjacent metal mounting, and is connected at its vibrating end with a second lever, $V^2$, by means of a link, *v*. The end of the second lever, $V^2$, is connected by a rod, *l*, with the detent-lever *w′* of the valve-engine above, and the rock-shaft *x* of this detent-lever is fitted with a weighted arm, U, (which, if deemed best, may be replaced by a spring.) The strip of vulcanite is connected with the levers V V′ of the thermostat by pivots, and the levers, links, and rods are also connected by pivots. The levers are arranged as represented in the drawings (or in some other equivalent mode,) so that the expansile strip of vulcanite is subjected to the tensile strain of the weight U, whose force is multiplied by the action of the levers. Consequently the expansile strip of vulcanite, *s*, is constantly under a strong tensile strain far greater than the force it is required to exert to move the detent I′. Moreover, as the weight U is at one end of the system of connections with the detent I′ of the valve-engine, while the expansile strip *s* is at the other end of the same system, and the two operate antagonistically, all the play of the connections is taken up, and the thermostat operates with great certainty and force.

The dynamic or valve engine has preferably but one revolving shaft, N′, which is fitted with a chain-wheel, O, and two detent-arms, S′ $S^2$. These arms operate in connection with the detent I′, each arm having a cross-end, *s′*, fitted to pass through the slot of the detent I′ when the slot is moved to the proper position by the action of the thermostat S. One of the detent-arms is longer than the other, so that their ends are at different radial distances from the axis of the main shaft N′. Consequently when the detent is moved to a position to permit one arm, $S^2$, to escape through the detent-slot *i*, Fig. $15^a$, the face of the detent is in position to stop the other arm, S′, when the engine-shaft N′ has made half of a revolution. The chain-wheel O receives the weight of the chain O′, Figs. 1 and 2, by which the requisite power to move the valves is supplied, and it is expedient to apply a ratchet-wheel R′ to the engine-shaft N′, with a pawl upon the engine-frame to prevent the accidental backward movement of the engine-shaft. The engine-shaft N′ is fitted with a crank, P′, whose crank-pin is connected by a rod, $P^2$, Fig. 5, with the arm *c′* of the valve rock-shaft D′, whose ends are fitted to rock in bearings in the heads of the standards *b′ b′*. The rock-shaft D′ carries the arms $b^2$ $b^2$, Figs. 2 and 3, from the ends of which the valves E, which control the waste-heat chimneys I I, are suspended, the valves being raised to open these chimneys and permit the heat from the lamps to escape when the heat of the incubating-chamber rises, and being dropped to close the waste-heat chimneys I when the heat of the incubating-chamber falls below the mean temperature. The same valve rock-shaft is connected by an arm, $b^3$, a rod, *m′*, (passing through a hole in the wall of the ventilating-chimney,) and an elbow-lever, $b^4$, with the ventilating-valve K, so that the valve is raised or opened and is dropped or closed simultaneously with the opening and closing of the chimney-valves E E.

A liquid speed-controller is employed to prevent the engine-shaft N′ from moving with too great speed. In a previous patent I have described such a controller as made separately from the engine, but combined with it. In the present case the paddle-arms *y′* of the paddles *y* of the speed-controller are connected directly with the engine-shaft at about the center of the engine-frame, and the trough F (shown in dotted lines in Figs. 13 and 15) of the controller is secured to the cross-bars *n′ n′* of the said frame, so that the members of the liquid speed-controller are held in their proper relationship by the engine-frame. The weight-chain M′ and weights O′ $O^2$ are arranged by preference according to the "Huyghens" system, the chaim M′ being continuous, and being applied to the pulleys *d′ d′* of two weights, O′ $O^2$, of which one, $O^2$, is lighter than the other, O′, by being made hollow, and the shaft of the counter chain-wheel $O^3$, Figs. 1 and 2, being fitted with a ratchet-wheel controlled by a pawl, (or a pawl being fitted to operate directly upon the chain-wheel,) so that the power-weight O′ may be wound up (by turning the counter chain-wheel $O^3$) without affecting the engine. It is also expedient to connect the two weights by a chain, $M^2$, of double the lineal weight of the main chain M′, so that the strain upon the engine is not varied by changes in the position of the weights. It is also expedient to cover the valve-engine with a glass shade, $R^2$, to protect it from dust.

As those portions of my above described and represented mechanism which embrace the thermostat and associated devices have been claimed in an application for a patent for another division of my invention, according to a decision of the Commissioner of Patents, requiring a division, they are not claimed under this division.

I claim as my invention—

1. The combination, substantially as before set forth, of the incubating-chamber with two lamps, both arranged at the same end of said chamber and separated laterally, for the purpose described.

2. The combination, substantially as before set forth, of the incubating-chamber, the heat-flue, the ventilating-chimney, and the vent-pipe for the heat-flue, arranged to deliver into the ventilating-chimney.

3. The combination, substantially as before set forth, of the egg-holder, the series of roll-

ers thereof, and the turning device, arranged within the walls of the egg-holder, which inclose said rollers.

4. The combination, substantially as before set forth, of the incubating-chamber, the egg-holder thereof, the heat-flue arranged in the upper part of the incubating-chamber, above the egg-holder, and the heat-distributer arranged below the heat-flue, between it and the egg-holder.

5. The combination, substantially as before set forth, of the egg-holders arranged back to back, with a space between them, and the thermostat arranged between said egg-holders.

Witness my hand this 11th day of January, A. D. 1882.

E. S. RENWICK.

Witnesses:
W. L. BENNEM,
WM. KELLMER.