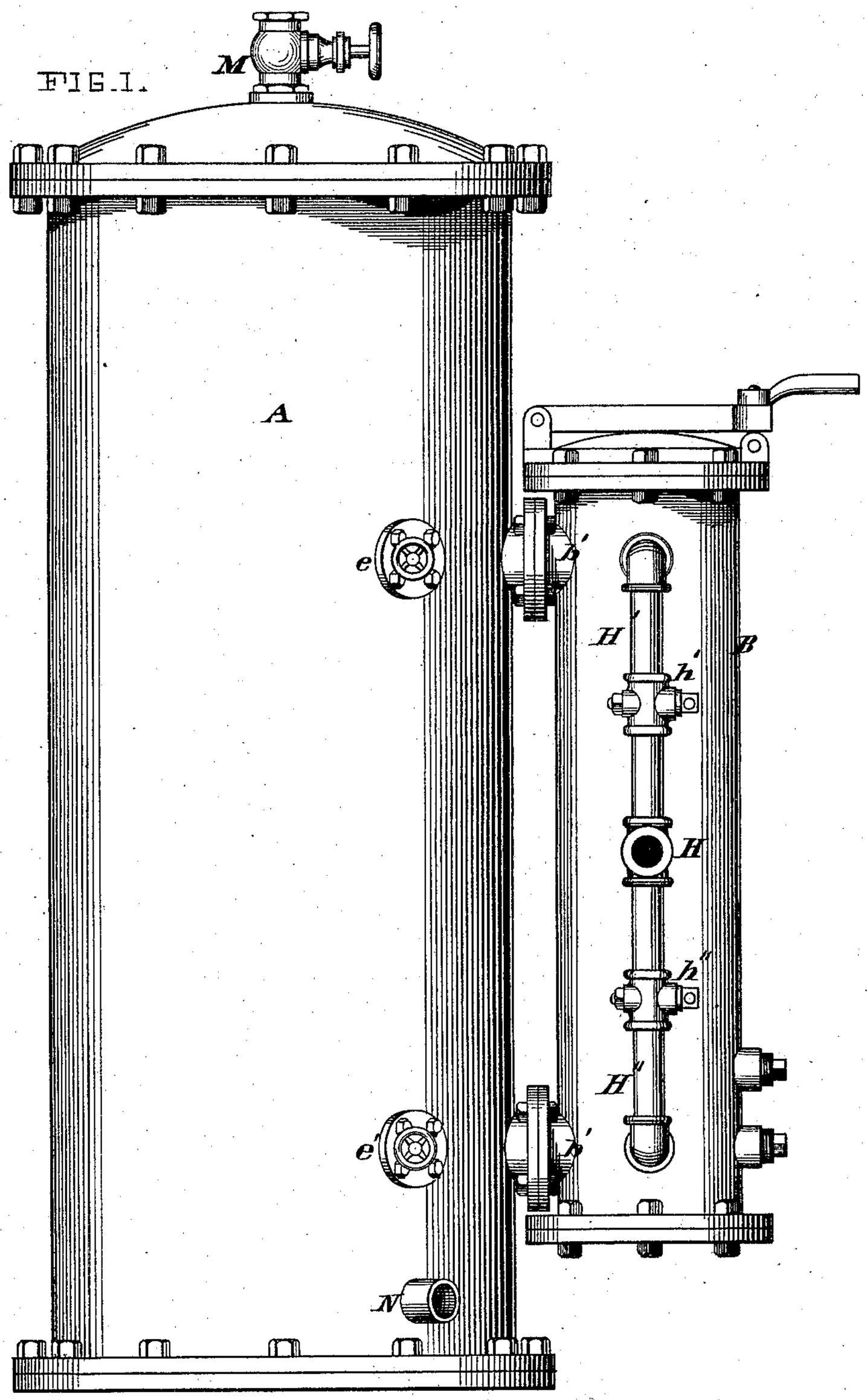
3 Sheets—Sheet 1.

T. L. JONES.

STEAM-GENERATORS.

No. 194,440. Patented Aug. 21, 1877.

FIG. 1.



WITNESSES.

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3 Sheets—Sheet 2.

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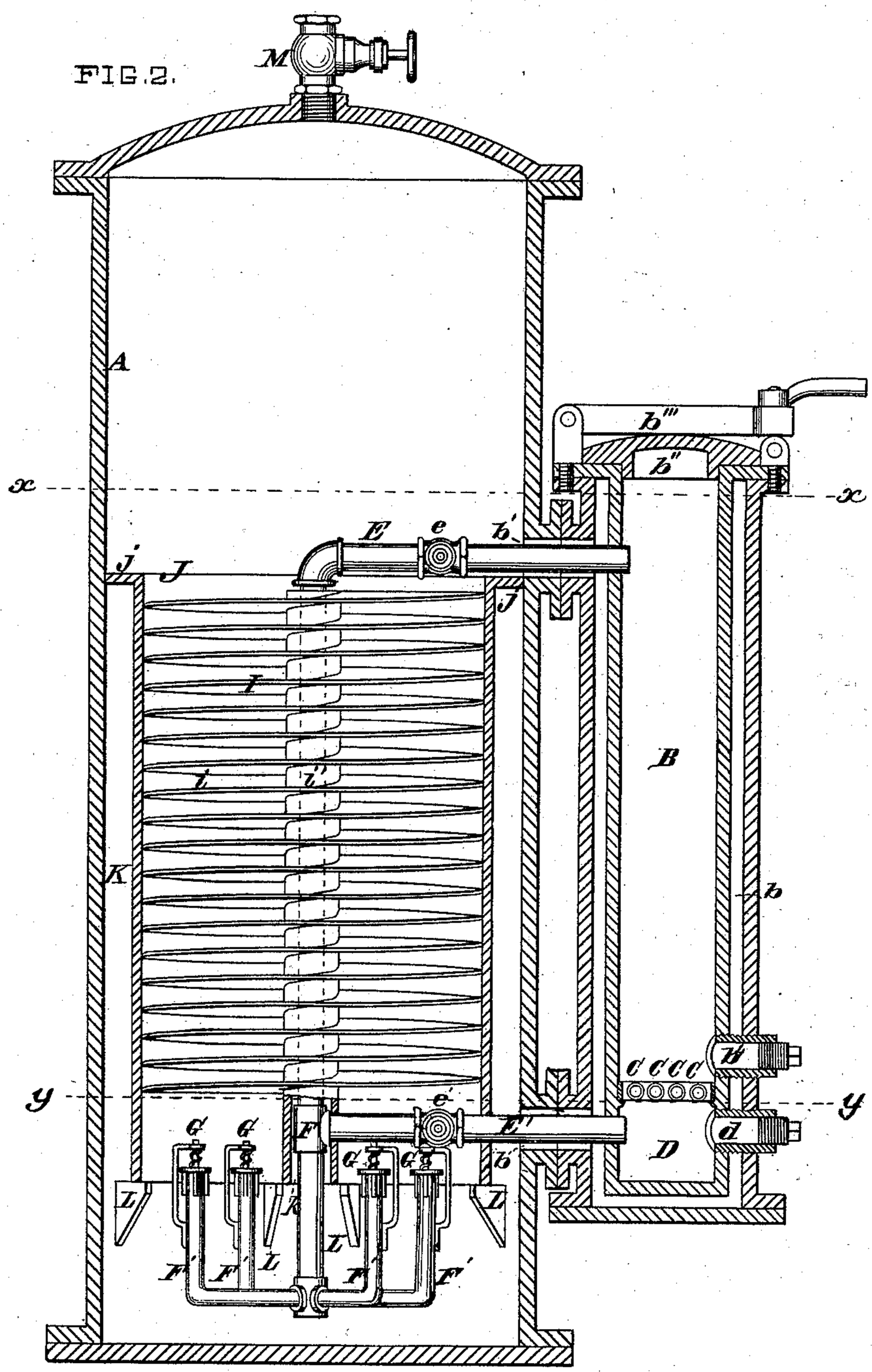
FIG. 2.



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3 Sheets—Sheet 3.

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FIG. 3.

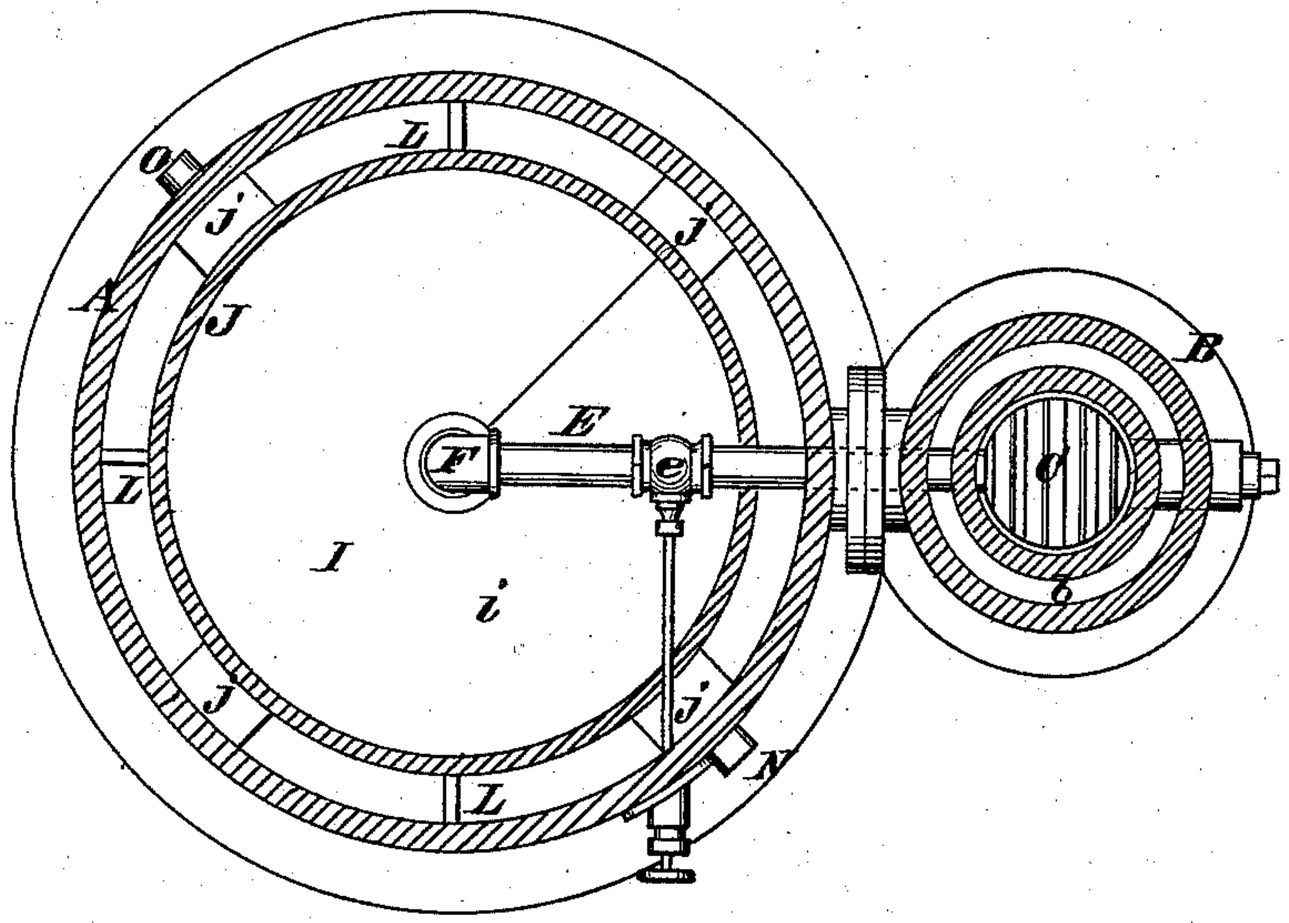
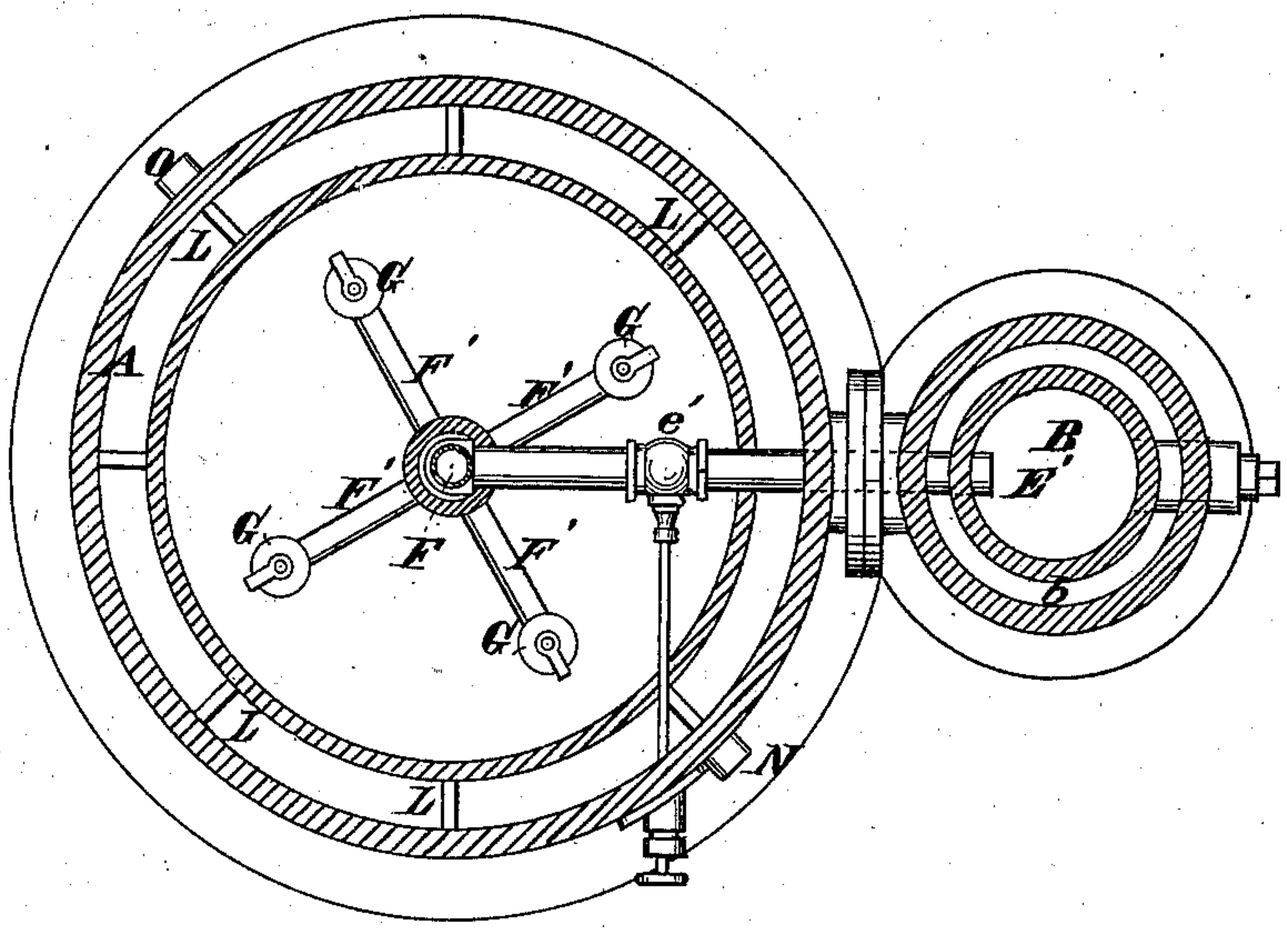


FIG. 4.



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UNITED STATES PATENT OFFICE.

THOMAS L. JONES, OF NATCHEZ, MISSISSIPPI, ASSIGNOR OF TWO-THIRDS HIS RIGHT TO THOMAS P. LEATHERS, OF NEW ORLEANS, LOUISIANA, AND JOHN P. KEISER, OF ST. LOUIS, MISSOURI.

IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **194,440**, dated August 21, 1877; application filed February 7, 1877.

To all whom it may concern:

Be it known that I, THOMAS L. JONES, of Natchez, Mississippi, have invented new and useful Improvements in Steam-Generators, of which the following is a full, clear, and exact description, reference being had to the annexed drawings, making part of this specification, in which—

Figure 1 is an elevation of the invention; Fig. 2, a vertical section, showing the parts within the generator partly in elevation; Fig. 3, a horizontal section on the line *x x* of Fig. 2; and Fig. 4, a horizontal section on the line *y y* of Fig. 2.

The same letters denote the same parts in the various figures.

The present invention relates mainly to a mode of generating steam by passing a heated gaseous or vaporous current directly into the generator, and into contact with the water therein, and there retaining it until its heat is communicated to the water, substantially as hereinafter described.

The heated current may emanate from any suitable source, commonly an ordinary fire, in which case the products of combustion, together with any air or other agent used in supplying the fire, are delivered into the water-space of the generator. Such a heating agency is employed in the present illustration of the invention.

Referring to the annexed drawings, A represents the shell of the generator or boiler. It may be of any desirable form and proportions. As shown, it is of the upright cylindrical type.

B represents a fire-box or furnace-chamber. It is, preferably, located without the main generator, and at the side thereof, and it is surrounded, (saving at the top,) preferably, by a water-space, *b*, that is connected at *b' b'* with the main water-space of the generator.

A suitable cover, *b''*, is used to inclose the fire-chamber, when desired, and when it is needed a fastening, *b'''*, may be employed to hold the cover down in place.

C C C C represent the grate-bars of the furnace-chamber. They are, preferably, made hollow, opening at both ends into the water-space *b*.

D represents the ash-pit. The chamber B is, preferably, made very deep, being nearly or quite equal to the depth of the water in the generator. There is an opening, b^4, in the side of the fire-chamber, just above the grate, for the insertion of a poker, and, if preferred, similar openings can be inserted at various levels above the grate. There is also an opening, *d*, in the ash-pit for the removal of ashes. It may be at the side, or in the bottom, of the pit, as preferred. All of these openings may be closed by doors or removable plugs.

Tubes E E′ lead from the fire-chamber into the main generator, as follows: The tube E from the upper part of the fire-box, and from above, or at the level of, the top of the fire, and the tube E′ from the ash-pit D, or at or below the bottom of the fire, and both of them through the connections *b' b'*, respectively, and so as to have a water-space around them. At their inner ends the tubes E E′ connect with a tube, F, arranged vertically and centrally in the main generator, and extending downward nearly to the bottom of the generator, and there, preferably, branching into several branch tubes, F′ F′ F′ F′, that radiate from the main tube F toward the wall of the generator, and then, preferably, turn upward a short distance, as shown in Fig. 2.

G G G G represent valves that seat downward onto the tubes F′ F′ F′ F′, respectively, and serve to prevent the water or steam from entering the tubes when the air-blast (hereinafter described) is not in use.

The operation of the invention as thus far set forth is as follows: The generator is filled (and, by suitable means, kept filled) with water, say, to the level of the line *x x* of Fig. 2, and a fire is made in the fire-chamber, and, preferably, extending from the grate upward to the top of the chamber, and the cover B″ is closed and fastened. An air-blast is then, and, preferably, by means of a suitable pumping apparatus (not shown) forced into and through the fire, and thence, together with the products of combustion, into the generator, and there discharged into the water therein.

H represents the tube through which the air is introduced into the fire-chamber. It can be made to enter the latter at any desired

level, but I prefer to divide the tube into two branches, H′ and H″, that respectively enter the fire-chamber near the top and near the bottom thereof. Valves *h′* and *h″* are arranged, respectively, in the branch tubes H′ and H″, to close either of them, as desired. Similar valves *e* and *e′*, for a similar purpose, are arranged, respectively, in the tubes E and E′. By operating the valves referred to suitably the air-blast can be sent either upward or downward through the fire, as desired. In starting, it is preferable to send the blast upward. Accordingly the valves *h′* and *e′* are closed, and the valves *h″* and *e* opened. The air then, carrying the products of combustion along with it, passes upward through the fire and thence through the tube E, tube F, and branch tubes F′ F′ F′ F′.

I have found, however, that more of the consumable portion of the fuel is borne away from the fire-chamber into the generator in an unconsumed condition than when the course of the air-blast is downward through the fire. Therefore, when the fire is well started, I preferably close the valves *h″* and *e*, and open the valves *h′* and *e′*, and direct the air-blast downward through the fire and through the tubes E′, F, and F′. In either case the force of the blast is sufficient to open the valves G G G G against the pressure of the water and steam, and allow the air and products of combustion to pass directly into the water. By this means almost the entire amount of heat arising from the combustion of the fuel in the fire-chamber is utilized.

The fire-chamber and tubes are contained in the water-space of the generator, and the entire heat-current is finally received into the water from which the steam is formed. The steam is therefore generated very rapidly and economically even when the heat-currents are allowed to escape from the tubes F′ F′ F′ F′ directly upward through the water.

I have observed, however, that the air and gas currents pass up through the water much too rapidly to allow more than a portion of their heat to be communicated to the water, and, in consequence, only that portion is utilized in generating the steam.

It is obvious that this difficulty cannot be overcome unless the air and gas are kept for a very much longer time in contact with the water before emerging therefrom.

If the column of water in the generator were, say, one hundred feet in height, a much larger portion of the heat might be absorbed. But a generator of such size is impracticable. Moreover, a hydrostatic pressure proportionate to the height of the column must be overcome, increasing the difficulty in passing the currents through the water, and necessitating a boiler-pressure greater than is frequently desirable to use.

To overcome these difficulties, and to provide means for retaining and absorbing all, or nearly all, the heat of the air and gas currents after they shall have been discharged into the generator. and without having to use a body of water that is uncontainable in a steam-generator of ordinary size, the following mode and means are employed:

Instead of allowing the air and gas currents to pass directly upward through the water, I cause it to traverse a circuitous route through the same, and I accomplish this, preferably, by the following means: A screw, I, is arranged in the water-space of the generator, and in such a position as to intercept the air and gas currents as they escape upward from the tube F or tubes F′ F′ F′ F′, and cause them to wind round and round through the water in their ascent.

In forming this screw the tube F may, if desired, serve as a stem for the thread *i*, and the latter may extend laterally to the side of the generator. I have found, however, that the air and gas currents are apt to urge the water upward along with them into the upper part of the generator, and that provision must be made for the return of such water to the lower part of the generator. To this end the screw, in diameter preferably, does not quite reach to the sides of the generator, and is inclosed and held in a casing, J, and leaving a space, K, between the casing and the generator. It is desirable, also, to make the stem *i′* of the screw independent of, and larger than, the tube F, so as to have a space, *k*, between them.

Both of the spaces K and *k* are open, above and below, to the water-space of the generator. The casing fits closely around the screw, to prevent the passage of the air or gas between the periphery of the screw and the casing. The latter is, preferably, supported on brackets L L L L, and is steadied laterally above by the lugs *j′ j′*. The casing extends downward below the level of the point where the air and gas are delivered into the water to prevent the air and gas from turning to the outside of the casing into the space K.

As it requires much more power to force a gas downward into water than upward, the bottom of the casing need not be more than a few—say, seven or eight—inches below the mouths of the tubes F′ F′ F′ F′. The stem *i′* is extended downward similarly and for a similar purpose.

The proportions and form of the screw may be varied to suit the shape of the generator. It is desirable to make it, in diameter, as large (making allowance for the space K) as the size of the generator will permit, and the pitch of the screw should be very fine—say, three or four inches in a screw three feet in diameter.

While a screw is the most natural form of construction to employ to effect the result in question, it is obvious that other constructions will measurably suffice. For instance, a vertical series of inclined planes may be used, or even a vertical series of horizontal shelves, open, alternately, at opposite ends, will answer to give a winding course to the gaseous

currents. Also, one or more screws may be used in the same generator, and the screw or screws may be in the form of a coil or coils of pipe.

The effect of this circuitous route is to keep these currents very much longer in contact with the water, and afford opportunity for their heat to be communicated to the surrounding water, which is all around and in the screw.

An important advantage accrues from thus being able to retain the heat—viz., the air and products of combustion can be heated to a temperature greatly exceeding that corresponding to even the highest pressure at which steam is ordinarily used. This high temperature is desirable, for the ratio of incondensible air and gas finally escaping from the generator to the volume of steam generated will be inversely to the temperature employed, the hotter the fire the smaller the volume of air and gas required. Hence the proportion of the latter can be reduced to such a degree as to enable a condensing-engine to be used in connection with the present generator.

Independent of the benefit derived from the circuitous route the water takes in its ascent within the casing J, a further advantage is obtained from dividing, by means of the casing J or other equivalent vertical partition or partitions, the generator into different compartments, and introducing the heated gaseous current or currents into the lower end or ends of one or of a portion only of the compartments, and leaving the other, or remaining compartment or compartments, for the return to the lower end of the generator of the water—that is, by the heated gaseous current or currents forced to the upper part of the generator, viz., the water is kept thoroughly and rapidly in circulation, and thereby brought more effectually in contact with the heated gaseous current or currents.

M represents the usual steam-exit pipe, N the water supply-pipe, and O a blow-off cock pipe, each of which may be arranged at the most desirable part of the construction.

What I claim is—

1. In a steam-generator, the screw I, substantially as and for the purpose of causing the current or currents of heated air or gas to follow a circuitous route through the water.

2. The combination of the generator A, screw I, and casing J, substantially as described.

3. The combination of the generator A, fire-chamber B, tubes E and E′, or either of said tubes, tube F, screw I, and casing J, substantially as described.

4. The combination of the screw I, casing J, and tube F, substantially as described.

5. The combination, in a steam-generator, of the screw I, casing J, tube F, and branch tubes F′ F′ F′ F′, substantially as described.

6. The generator A, fire-chamber B, tubes E and E′, tubes H H′ H″, and cocks *h′ h″ e e′*, combined and operating substantially as described.

7. The combination of the casing J and the tubes F′ F′ F′ F′, the former extending below the level of the mouths of the latter to prevent the escape of the gaseous current from the tubes directly into the channels K and *k*, substantially as described.

8. In an aero steam-generator, the combination of a heat-retaining screw, by which the heated gaseous or vaporous currents are caused to traverse a circuitous route in their passage upward through the water, and an independent channel or channels through which the water that is urged by said currents to the upper part of the generator can return to the lower part of the generator.

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Witnesses:

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