(No Model.) 2 Sheets—Sheet 1.

# M. HAVEY.

## WATER HEATER.

No. 395,326. Patented Jan. 1, 1889.

Fig. 3.

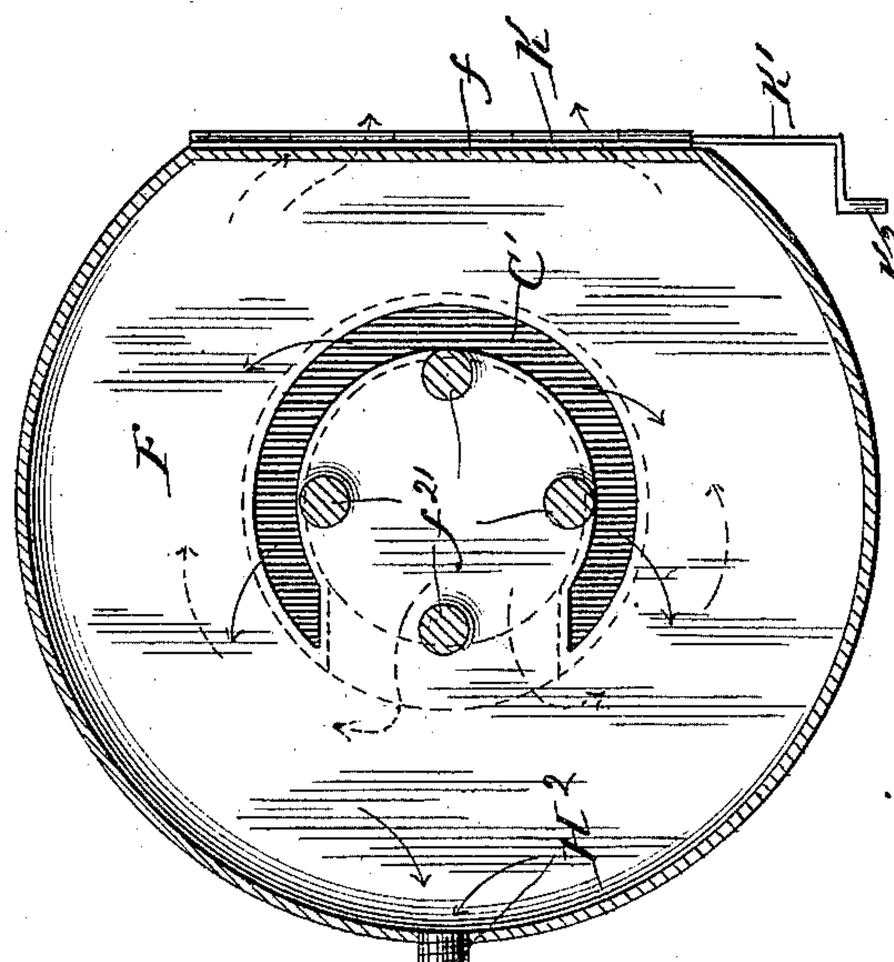


Fig. 4.

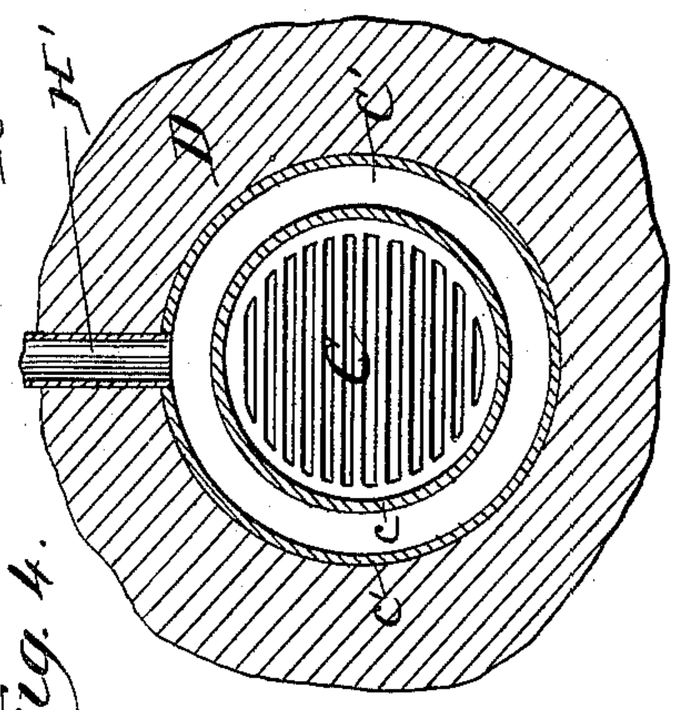
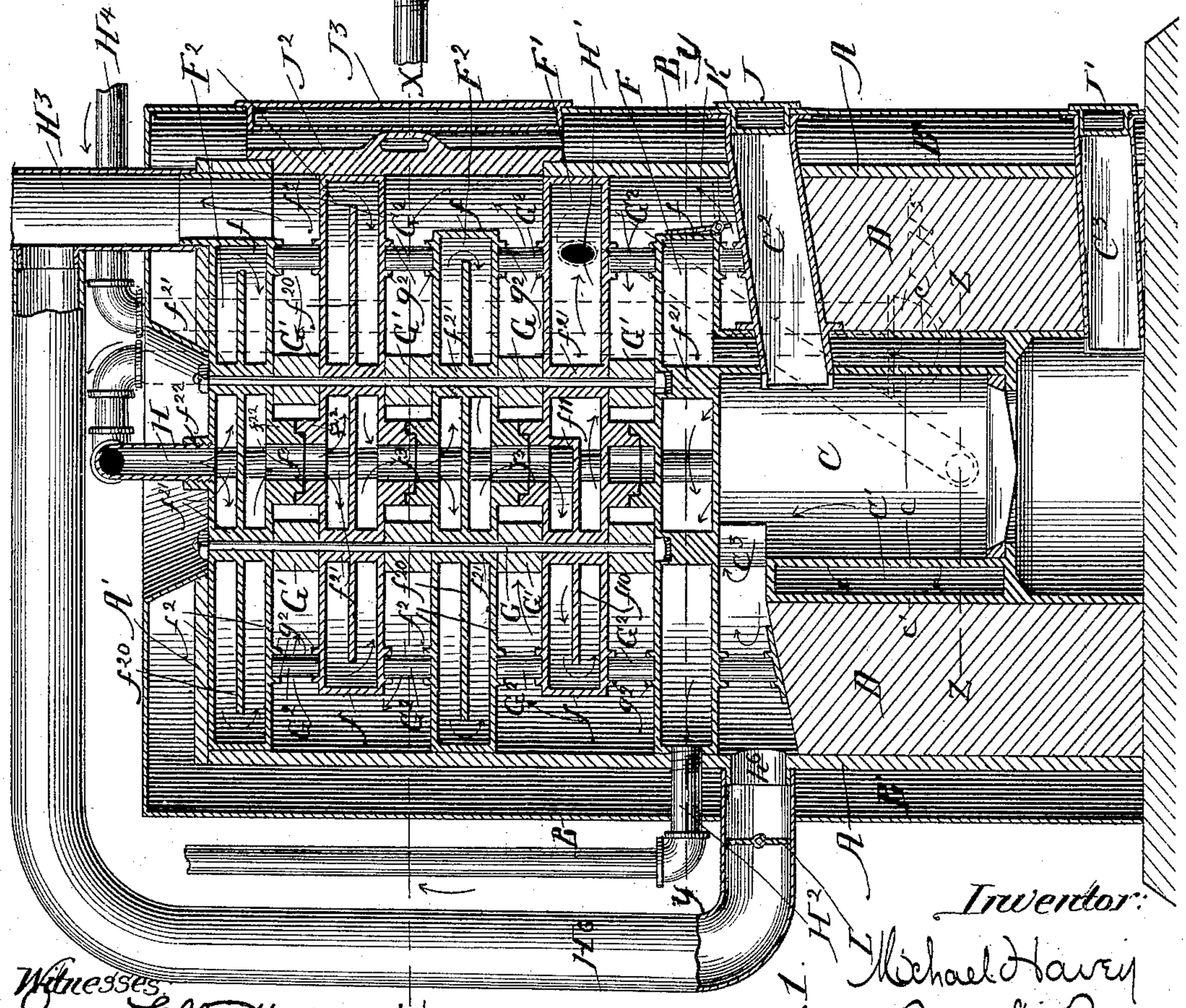


Fig. 1.



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By Burton & Burton
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(No Model.) 2 Sheets—Sheet 2.

# M. HAVEY.

## WATER HEATER.

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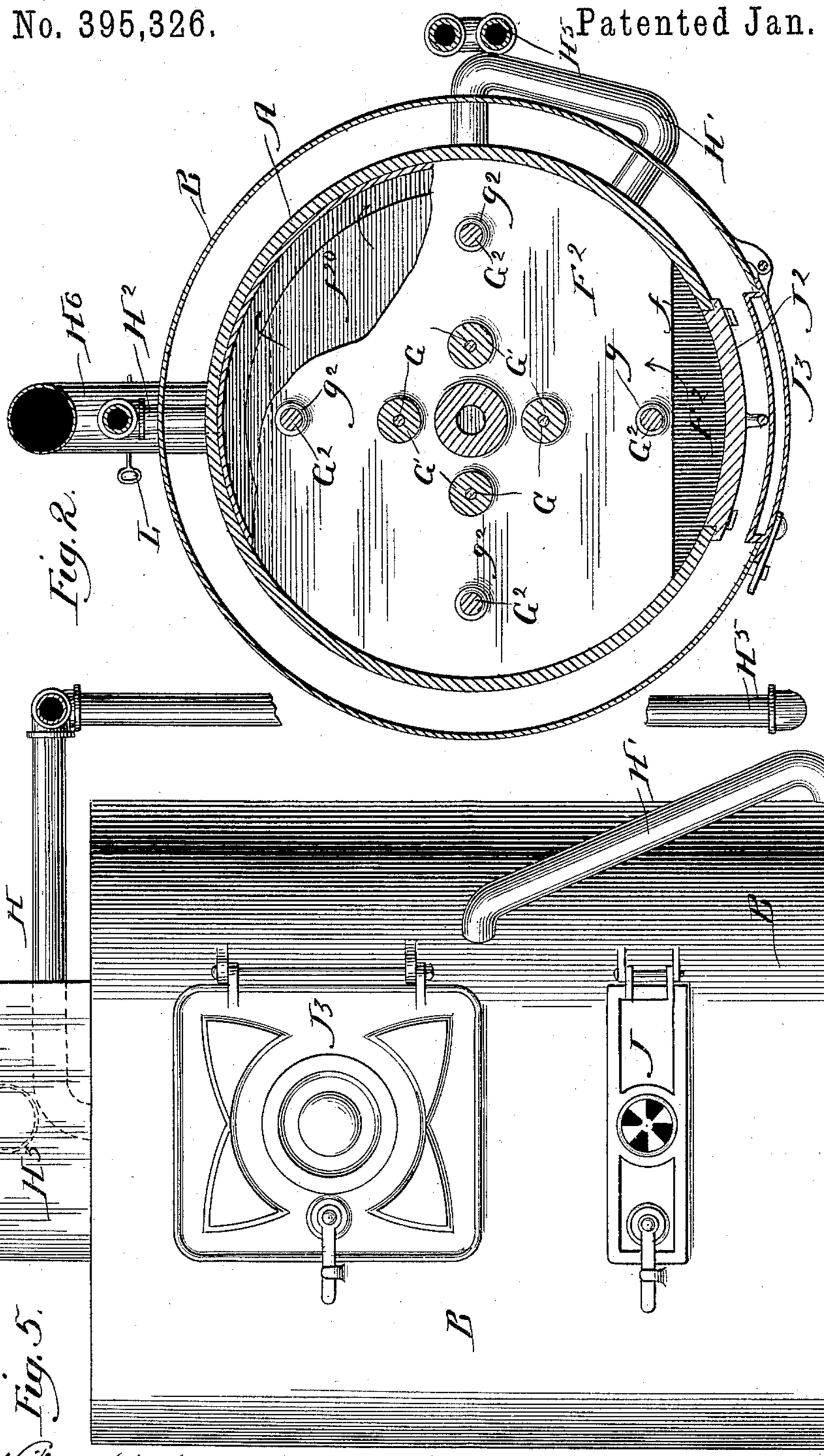

Fig. 2.



Fig. 5.

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# UNITED STATES PATENT OFFICE.

MICHAEL HAVEY, OF CHICAGO, ILLINOIS.

## WATER-HEATER.

SPECIFICATION forming part of Letters Patent No. 395,326, dated January 1, 1889.

Application filed July 23, 1888. Serial No. 280,712. (No model.)

*To all whom it may concern:*

Be it known that I, MICHAEL HAVEY, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Hot-Water-Circulating Heaters, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

In the drawings, Figure 1 is a vertical section from front to rear through my improved heater. Fig. 2 is a horizontal section at the line *x x* on Fig. 1. Fig. 3 is a horizontal section at the line *y y*. Fig. 4 is a horizontal section at the line *z z*. Fig. 5 is a front elevation.

A is the shell or principal wall of the case inclosing the circulating mechanism.

B is an exterior wall inclosing an air-space, B′, between it and the principal case A.

C is the fire-chamber, which is made with a double wall, *c c′*, having an annular chamber, C′, surrounding the fire-chamber, except where it is interrupted by the fuel-chute $C^2$ and the smoke-exit $C^3$. Both of said passages leading from the fire-chamber communicate with the fire-chamber without communicating with the annular chamber C′. The fire-box comprising the chamber C, with its double walls *c c′* and their inclosed annular chamber C′, may be built in masonry, (represented by D,) which surrounds said fire-box within the case A. Above the fire-box, and occupying the remainder of the case A, there are located water-circulating chambers F and F′ $F^2$ $F^2$ $F^2$, placed one above the other in the order named. These water-circulating chambers are made to conform to the shape of the case A, which is illustrated as circular, except that they are each cut away at one side, *f*. They thus fill the horizontal extent of the case A, except in so far as they are cut away at the side *f*. They are placed in the case A with the cut-away side alternately at the front and at the rear, the lowest chamber, F, having the side *f* cut away at the front, the next chamber, F′, being cut away at the rear, and the next chambers, $F^2$ $F^2$ $F^2$, similarly alternating from front to rear in respect to the position of the side *f*. The lowest of these chambers, F, obtains support by being blocked up upon masonry, D, and having one support resting upon the fuel-chute $C^2$. This chamber F is, however, additionally supported by the upper end of the fire-box, with which, indeed, it may be conveniently made integral, and it is so illustrated. Its interior cavity communicates with the annular chamber C′ around the fire-chamber C, that communication being interrupted only at the point where the smoke-exit $C^3$ is formed at the rear side of the fire-box. The remaining chambers, F′ $F^2$ $F^2$ $F^2$, obtain support upon the bottom chamber, F, and so ultimately upon the fire-box, as will appear from the following particular description of said chambers, respectively. The chambers $F^2$ $F^2$ $F^2$ are all alike, consisting each of an upper and lower wall, $f^2$ $f^2$, and an intermediate diaphragm, $f^{20}$, parallel with the said upper and lower walls and about midway between them, and sustained in that position by two of the more interior posts $f^{21}$. (As illustrated, there are four of these posts $f^{21}$, which join the upper and lower walls, $f^2$.) The said posts are preferably located, as illustrated, in a circle about the center of the chamber, and are vertically bored to admit bolts G, which bind together the chambers $F^2$, $F^2$, $F^2$, and F′. At the center of said chambers they are each provided with openings $f^3$ $f^3$ through both the upper and lower walls, said openings being extended through exterior bosses. These bosses are fitted together so that the lower boss of one chamber rests on the upper boss of the upper chamber, so that, suitable packing interposed, water-tight junctions may be formed between them. The upper boss of the upper chamber, in addition to being thus formed, is interiorly threaded to receive the water-supply pipe H. The chamber F′ differs from the chambers $F^2$ in that its interior diaphragm, $f^{10}$, extends only one way from the center and is connected to the upper wall of the chamber by the rib $f^{11}$, said rib extending entirely across the chamber in a direction parallel to the side *f*, and in that its lower wall has no opening at the center, but instead the pipe H′ leads from the portion of said chamber through which the diaphragm $F^{10}$ does not extend to the lower part of the annular chamber C′ about the fire-box in which the said pipe H′ opens. From the chamber F, preferably from the same side of the furnace at which the smoke-exit $C^3$ of the fire-box is

located, the hot-water or service pipe $H^2$ takes its exit and leads to the coils or boiler to be supplied by this heater.

The course of the water through this system of chambers and pipes, it will be understood, is as follows: Entering through the pipe H into the upper chamber $F^2$, it strikes the diaphragm $f^{20}$, and, spreading out over it, falls around it on all sides, striking the lower wall of the chamber and flowing over it from all sides toward the center, and finding its exit from the opening in said lower wall, and passing thence through the joined bosses $f^{22}$ of the first and second chambers $F^2$, it enters the second chamber and circulates through it, and thence through all subsequent chambers $F^2$ in the same manner. From the lowermost of the chambers $F^2$ it enters the chamber F′ and strikes its half-diaphragm $f^{10}$, and, spreading out over it, falls around it on all sides to the lower wall of the chamber F′, and thence flows to and enters the pipe H′, by which it is conducted into the annular chamber C′, in which it rises until it fills the same and passes up into the chamber F, from which it passes into the service-pipe $H^2$. The water circulates through all these chambers in such manner as to pass over, as nearly as possible, their entire interior surface before it passes out into the service-pipe. It will be noticed that the chamber F at its central part is exposed directly to the heat of the fire in the fire-chamber C. From this fire-chamber the smoke and heated-air currents and all the products of combustion pass out through the smoke-exit $C^3$ underneath the chamber F, and, dividing, pass in two currents forward around the fire-chamber, still underneath the chamber F, to the forward part of the furnace, where they pass above the fuel-chute $C^2$ and pass by the side *f* of the chamber F, where said chamber is cut away for that purpose, passing between the side *f* and the forward wall of the case A. They are then returned back over the chamber F, between it and the chamber F′, and find another upward passage between the side *f* of the chamber F′ and the rear wall of the case A, and then return in like manner forward between the chamber F′ and the chamber $F^2$, and, passing up in front of the chamber $F^2$, where it is cut away, return to the rear, and thus pass back and forth between the successive chambers $F^2$, as compelled by the fact that they allow escape past them only at the side where they are cut away, leaving an aperture between them and the case A, and that such apertures are alternately at the front and at the rear part of the case. The top plate, A′, of the case A rests upon the top chamber $F^2$, and covers the aperture between the side *f* of that top chamber and the side wall of the case, and at this point is provided with suitable connection for the smoke-pipe $H^3$. As illustrated and as conveniently made, this top plate has a central opening large enough to expose the upper ends of the bolts G, which pass down through the vertical bore made in all the posts $f^{21}$, and by means of which the said chambers F′ $F^2$, &c., are bound together and the packed joints between their central bosses kept water-tight. In order that these bolts may be clamped tight without any danger of springing the chambers, I interpose between said chambers the blocks G′, whose height is equal to that of the two bosses which constitute the joint between the successive chambers. These blocks G′ are vertically bored to admit the bolts in the same manner as the posts $f^{21}$. In order that the chambers may not warp or spring and that they may be ultimately supported upon the lower chamber, F, I interpose between them about midway between the blocks G′ and the outer circumference of said chambers the blocks $G^2$, using, preferably, four such blocks, placed in a circle between each of the chambers. In order to keep the blocks in place, I form upon the upper and lower walls of the chambers the boss $g^2$, having sockets to receive the ends of the said blocks $G^2$. Similar bosses similarly provided with sockets are formed upon the upper surface of the chamber F, and similar blocks, $G^2$, being interposed between the chamber F′ and the chamber F, the ultimate support of the chambers above F is obtained. The blocks which support the chamber F upon the masonry, D, and upon the fuel-chute $C^2$ may be held in place by similar socketed bosses, in which the ends of said blocks are retained, and a similar socketed boss is formed for the lower end of the block, which ends upon the fuel-chute $C^2$, and plates *d*, having similar socketed bosses on their upper surface, are secured upon the masonry, D, to receive the lower ends of the blocks which rest upon said masonry.

J is the fuel-door. J′ is the ash-door; $J^2$, the door closing the man-hole or the cleaning-out door. The doors J and J′ are made in the outer case, B, and the fuel and ash chutes $C^2$ and $C^3$ are made to extend across the air-space B′ and are secured to the said outer case; but the door closing the man-hole $J^2$ is made to fit the inner case, A, as is necessary in order that it may abut against the end of such of the chambers $F^2$ as necessarily reach the wall of the case at that side. An additional door, $J^3$, is therefore provided in the outer case at the locality of the man-hole. The opening for this door is made large enough so that the man-hole plate can be removed through it. All of these doors may be hinged or made removable, as preferred. In Fig. 5 they are illustrated as hinged.

In order to provide ample trappage for the feed-water, the pipe H, instead of receiving that water directly, receives it through the pipe $H^4$, which passes down alongside the furnace from the top to near the bottom, and then makes a bend upon itself, passing up again to the top, where it connects with the

pipe H. The top, $H^5$, thus formed serves the usual purpose of such a trap in water-circulating systems.

I do not limit myself to any particular form in the construction of this heater, nor is it necessary to locate the fire-box underneath the center; but it may be located underneath either side without departing in any respect from the principle employed. The number of chambers $F^2$ may be varied to meet the necessities of each particular case.

It will be noticed that the water in entering the heater strikes first surfaces which are farthest from the fire-chamber, and therefore least heated, and circulates downward over surfaces successively hotter and hotter until it leaves the chamber F′, when it passes to the annular chamber C′, immediately surrounding the fire-box, which is the most highly heated of all, and that from this chamber it passes into the chamber F, which is only slightly, if any, less heated, being the chamber which is exposed to the direct heat of the fire and of the flame, and the products of combustion immediately after that leave the fire.

In order to facilitate the cleaning of the apparatus through the man-hole while the fire is still burning, I provide for carrying the products of combustion directly from the fire-chamber to the smoke-pipe without passing them through remainder of the case around the chambers F′ $F^2$, &c., and for that purpose I connect the pipe $H^6$ to the case A through the opening $h^6$, located below the chamber F, and lead said pipe $H^6$ to the smoke-pipe $H^3$ above the case. A damper, K, is pivoted to the lower exterior corner of the side *f* of the chamber F, said damper being in the shape of the segmental opening between the side *f* of the chamber and the forward side of the case A. This damper I provide with a stem, K′, passing out through the cases A and B, and operated by a suitable handle, $K^2$, at its exterior end. A damper, L, is also provided at any convenient point in the pipe $H^6$. When it is desired to clean out the spaces between the chambers F′ and $F^2$, if there is fire in the fire-box, the damper L being opened and the damper K being closed, the products of combustion pass through the pipe $H^6$ without circulating among the chambers F′ $F^2$, so that the man-hole may be opened without causing the escape of gas or smoke.

I claim—

1. In a water-heater, in combination, substantially as set forth, a vertical series of horizontally-extended water-chambers communicating with each other successively through their horizontal walls, each of said chambers having a horizontal diaphragm intermediate its upper and lower walls and obstructing the line of communication between its induction and eduction openings, the water-supply pipe entering the uppermost of said chambers through its upper wall, and an eduction-pipe from the lowermost of said chambers, whereby the water descends by gravity from one chamber to the next, and is compelled to spread out over the horizontal diaphragm and return underneath it to pass to the next chamber.

2. In a water-heater, in combination with a case to which the products of combustion have access at the lower part and from which they escape at the upper part, a series of communicating water-chambers located within such case between the access and escape of the products of combustion, such chambers contacting the interior wall of said case throughout their entire periphery except a portion at one side, consecutive chambers having that portion at opposite sides of the case, such water-chambers communicating with each other successively, each of said chambers having a diaphragm intermediate its upper and lower walls wholly or in part dissevered from the lateral walls of the chamber and obstructing the line of communication between its induction and eduction openings, the water-supply pipe entering the uppermost of said chambers above the diaphragm, and an eduction-pipe from the lowermost of said chambers, whereby the water descends by gravity from one chamber to the next, and is caused to flow back and forth in contact successively with the upper and lower interior surfaces of such water-chambers, while the products of combustion pass back and forth in contact successively with the lower and upper exterior surfaces of the same walls, substantially as set forth.

3. In a water-heater, in combination with the fire-chamber having double walls inclosing an annular chamber around the fire-chamber, a series of horizontal communicating chambers, F′ $F^2$, located above the fire-chamber, the lowermost of said chambers communicating with the lower part of the annular chamber, and the chamber (as F) communicating with the upper part of the annular chamber, a water-supply pipe entering the topmost of the horizontal chambers, and the service-pipe leading from the chamber F, substantially as set forth.

4. In combination, substantially as set forth, the fire-box and the water-chamber located above the same and supported thereby, said chambers having their upper and lower walls connected by posts, (as $f^{21}$,) and the blocks G′ interposed between said chambers in vertical line with said posts, whereby the weight of the chambers is transmitted to and sustained by the walls of the fire-box.

5. In combination, substantially as set forth, the chambers $F^2$ and F′, located one above another in vertical series and communicating through their bosses $f^{22}$, seating one upon another successively, each of said chambers having its upper and lower walls connected by the interior posts, $f^{21}$, the blocks G′, interposed between said chambers in vertical line with said posts, said posts and blocks being vertically bored to admit the bolts G, inserted

through them, whereby said chambers are bound together and the junctions at their bosses $f^{22}$ kept tight.

6. In combination, substantially as set forth, the fire-chamber C, having the annular water-chamber C′ surrounding it, and the horizontally-extended water-chamber F, located above it, communicating with the chamber C′ and with the service-pipe, the communicating chambers F′ and F², located one above another and above the chamber F, the lowest of said chambers communicating with the annular chamber C′ and the uppermost communicating with the induction-pipe H, whereby the water circulates downward by mere gravity until it reaches the annular chamber C′ about the fire, and thence circulates upward to enter the service-pipe.

7. In combination with the case A, the fire-chamber, and the water-chambers located above it, the damper K, pivoted to the lowest of the water-chambers and adapted to close the communication past said chamber within the case, and the supplemental smoke-pipe $H^6$, communicating with the case below the lowest water-chamber and with the main smoke-pipe above the highest water-chamber, substantially as and for the purpose set forth.

In testimony whereof I have set my hand this 16th day of July, 1888.

MICHAEL HAVEY.

Witnesses:
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