(No Model.)

# M. HAVEY.

## WATER CIRCULATING HEATER.

No. 406,902. Patented July 16, 1889.

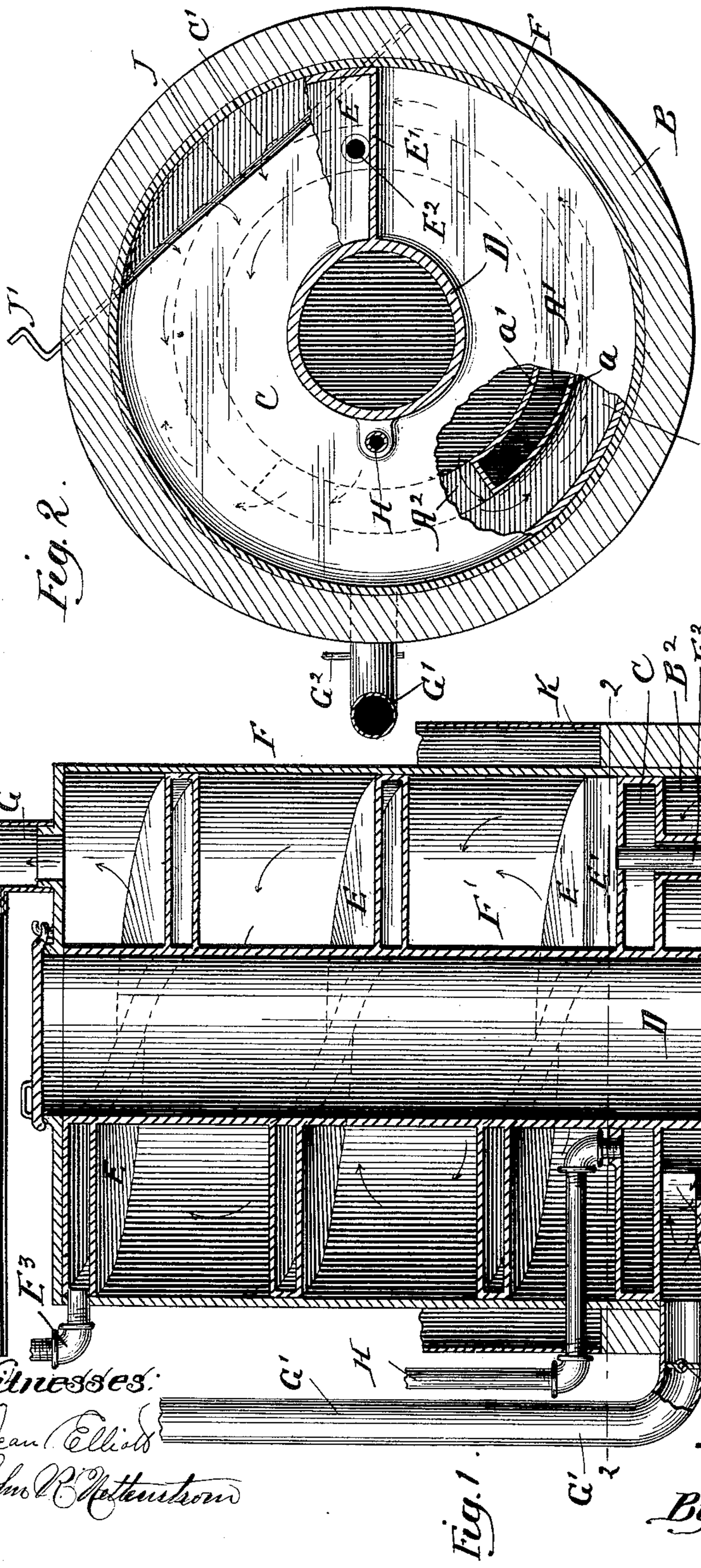


Fig. 2.

Fig. 1.

# UNITED STATES PATENT OFFICE.

MICHAEL HAVEY, OF CHICAGO, ILLINOIS.

## WATER-CIRCULATING HEATER.

SPECIFICATION forming part of Letters Patent No. 406,902, dated July 16, 1889.

Application filed January 28, 1889. Serial No. 297,845. (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 a Hot-Water-Circulating Heater, which are set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

Figure 1 is a vertical medial section through the fire-box and water-circulating chambers and smoke-flues of my improved hot-water-circulating heater. Fig. 2 is a section at the line 2 2 on Fig. 1.

The specific purposes of this invention are, first, to provide an improved self-feeding furnace for hot-water circulation, and, second, to provide an improved system and construction for the water-circulation in such heater.

A is the fire-box, which may be set in masonry B. Around the fire-chamber there is an annular water-chamber A′, formed between the two walls *a a′*, which constitute the double wall of the fire-chamber. Immediately above the fire-chamber is a horizontally-extended or flat chamber C, which is a continuation of the annular chamber A′. This chamber C is itself annular by reason of the fuel-magazine tube D, which protrudes through it at the center, as will be hereinafter more particularly explained.

The chamber C is of greater diameter than the chamber A′, being of the same diameter as the spiral chamber or water-circulating duct E, which commences at the upper end of the furnace and continues in a spiral course downward around the fuel-magazine tube D, ending at its contact with the upper wall of the chamber C, the closed end of the duct E being indicated by the letter E′. The pipe $E^2$ leads from the interior of the duct E at the lower end, closely adjacent to its end wall E′, directly downward through the chamber C, into the annular chamber A′, at the lower part of which said pipe $E^2$ opens, as seen in Fig. 1. $E^3$ is a water-pipe which enters the duct E′ at the upper end and at the outer edge. The cylindrical case F, closed at the top except where it communicates with the smoke-pipe G, completely incloses the cylindrical duct E, its walls making close junction with the edge of said duct throughout its entire spiral extent, the case F extending also down and around and inclosing in the same close-fitting manner the chamber C, and it is preferably made to extend a short distance also below that chamber, and to rest upon the ledge B′ of the masonry which incloses the fire-box. There is thus formed an annular passage $B^2$, bounded by the ledge of masonry B′ at the bottom, the under side of the chamber C at the top, the outer wall *a* of the fire-box at the inner side, and the lower portion of the case F at the outer side.

The smoke-exit from the fire-box A is made by cutting away a portion of the double wall of the fire-box at the upper edge, making the exit $A^2$, which extends through from sixty to ninety degrees of the circumference of the chamber A′, said chamber being diminished in depth by the amount of the vertical width of said exit through that proportion (sixty to ninety degrees) of its circumference. This exit, it will be seen, leads into the annular space $B^2$, and the smoke passing through it from the fire-box will divide, passing right and left around the upper end of the chamber A′ until it reaches the side of the chamber C, which is cut away, as shown in Fig. 1, forming the segmental space C′, through which space the smoke will pass by the chamber C, and so doing enter the chamber F′ between the case F and the tube D, wherein a spiral smoke-passage is formed and bounded above and below by the spiral water-duct E, which courses through said chamber. Following this spiral passage the smoke will eventually pass out through the smoke-pipe G to the chimney.

From the chamber C, opening out of the upper side thereof, and preferably immediately above the fire-box, because that is presumably the hottest place, the hot-water-circulating pipe H is conducted out through the case F and communicates with the hot-water-circulating system to be supplied, which system in its return-circuit connects with the water-supply pipe $E^3$. Through the masonry B and through the lower end of the case F, radially opposite the smoke-exit $A^2$, there is provided an opening, through which the smoke can under certain circumstances, here-

inafter explained, pass into the supplemental smoke-pipe G′, which extends thence upward and across above the furnace, leading into the smoke-pipe G. A damper $G^2$ ordinarily closes the pipe G′ and causes the smoke-exit to be, as first hereinabove described, through the spiral passage F′. A damper J is pivoted along the lower margin of the straight edge of the chamber C, where that chamber is cut away to form the segmental space C′ for a smoke-passage, and a handle J′ of said damper extends out through the inclosing-case F and the masonry B, said damper being of form suitable to close the segmental space C′. In ordinary use this damper stands open—that is, vertical—leaving the passage C′ open, but may be closed by being placed horizontal across said passage.

In operation, the water entering through the pipe $E^3$ descends by gravity through the spiral duct E′, and from the lower end of said duct, through the pipe $E^2$, into the lower part of the chamber A′ around the fire-box, which it will fill, rising therein until it fills also the chamber C, which is simply a continuation of the annular chamber A′. These combined chambers A′ and C are exposed to the greatest heat of the fire, and the water therein, and especially in the upper part thereof—*i. e.*, in the chamber C—will become very highly heated, and, assuming the circulatory system between the pipes H and $E^3$ to be first filled, the tendency of the hottest water in the chamber A′ C will be to rise, entering the pipe H, passing into the circulatory system, from which the cooler water will return through the pipe $E^3$, completing the circuit through the spiral duct E. The products of combustion passing from the fire-box, and being compelled to pass entirely around the same underneath the chamber C, cause that chamber to become very highly heated, not only at the portion which is immediately exposed above the fire in the fire-box, but also in the annular portion, which is above the space $B^2$. The smoke escaping from the space $B^2$ through the segmental opening C′, and being compelled to follow the circuitous course defined by the spiral duct E, parts with its heat, communicating the same to the said spiral duct and the water therein, and becomes cooled to as low a point as is consistent with proper draft before it is able to escape from contact with the duct through which the water is passing. Thus a very large proportion of the heat which the fire can afford is utilized in heating the water.

A special advantage of the mode of circulation illustrated is that the coldest water—viz., that which enters through the pipe $E^3$—meets only a moderately-heated—in fact, the coolest—portion of the water circulatory system of the heater, and as it becomes heated while passing downward through the spiral duct E it is constantly coming in contact with more highly-heated surfaces until, when it reaches the hottest chamber—viz., the chamber A′ C—it has itself become considerably heated. Thus there is avoided the disadvantage which sometimes amounts to danger caused by cold water meeting an exceedingly heated surface—that is to say, by bringing the extremes of temperature of the water on one hand and the furnace on the other hand into contact. The difficulty in accomplishing this ordinarily is that the water as it becomes heated has a tendency to rise, and the products of combustion rising departing from the orignal source—the fire—are becoming cooled, so that the coolest part of the furnace is the upper part, where naturally the hottest part of the water would be, so that it becomes necessary to cause the water to descend as it becomes heated, instead of permitting it to rise, as it would normally in a completely-connected and freely-circulating system or body; but the circulation of the water through the circulatory system must be eventually by convection—*i. e.*, by the tendency of the water to rise when heated on account of its diminished specific gravity. At some point, therefore, there must occur a reversal of the mode of circulation, so that the water which has been descending as it gained heat shall rise by reason of its heat. This is effected by causing the spiral duct E to discharge through the pipe $E^2$ into the lower part of the hottest chamber A′ C, this chamber and the pipe $E^2$ constituting a trap past which the water cannot circulate backward, and from which it will pass out through the pipe H by virtue of the diminished specific gravity of the hottest water.

The arrangement of the water-course E in a spiral enables me to utilize the central portion for a fuel-magazine D, as illustrated, thereby making the furnace self-feeding in a manner well understood, and making it also very compact and easy of construction and erection.

I preferably cast the magazine D and the duct E in one. Obviously it may be made in sections not inconsistently with this method—that is, a section of the magazine and the encircling section of the spiral duct being a single piece, and any number of such pieces being built one upon another and their junctions united; but in this case great care is necessary to make the junctions of the adjacent sections of the duct E water-tight. In any case the fire-box, with its double walls, constituting the chamber A′, and the chamber C, which forms the top of the fire-box, I prefer to cast integral, and the entire structure may be cast integral, as illustrated, the fire-box with its double walls making the chamber A′ and its top wall constituting the chamber C, the central magazine D, and the encircling spiral water-duct E, all in one piece; but these details of construction are matters of preference only, and will be varied according to the situation and size of the furnace.

It is desirable in some situations to inclose the entire structure to prevent loss of heat

by radiation, as in the jacket K, which may rest upon the upper edge of the masonry B and surround the case F through the whole or any part of its height, leaving an air-chamber between said case and the jacket for the usual purpose and with the usual effect of preventing undue radiation from the case.

The usual accessory details of construction of a furnace may pertain to this one. The grate L, the ash-pit M, the ash and draft door N, and any other desirable accesses to the fire may be provided.

In order to secure the circulation starting promptly in the direction and manner indicated—*i. e.*, downward through the duct E—when the system is cold and the fire is to be first started, I close the damper J and open the damper $G^2$, thereby cutting off all heat from the duct E and causing only the chamber A′ C to be heated. This will insure the upward flow of the water through the pipe H and its descent through the duct E. Such movement having been inaugurated, I then reverse the arrangement of the dampers, closing $G^2$ and opening J, and allow the heat access to the duct E′.

This entire apparatus may be used for heating the feed-water for steam-boilers, in which case the pipe H will connect with the boiler and the pipe $E^3$ will take the water-supply.

I claim—

1. In a water-heating furnace, in combination with a fire-box, a water-chamber constructed in the form of a spiral about an upwardly-extending axis, the successive turns of such spiral being non-communicating except in the direction of their continuous spiral course, whereby the water is compelled to follow that course, and the smoke-passage leading from the fire-box having as its upper and lower walls the coils of said spiral water-chamber, substantially as set forth.

2. In a water-heating furnace, in combination with the fire-box, a water-chamber adjacent thereto and directly exposed to the heat thereof, a water-chamber constructed in the form of a spiral about an upwardly-extending axis, the successive turns of such spiral being non-communicating except in the direction of their continuous spiral course, whereby the water is compelled to follow that course, said spiral chamber communicating at its lower end with the lower part of the water-chamber which is adjacent to the fire-box, a water-supply pipe communicating with the spiral chamber at the upper end, the water-discharge pipe leading from the upper part of the chamber which is adjacent to the fire-box, and a case inclosing the spiral chamber, the smoke-passage from the fire-box leading into said case, whereby the spiral interval between the successive coils of the spiral water-chamber forms part of the smoke-passage to the chimney, substantially as set forth.

3. In a water-heating furnace, in combination with a fire-box, a water-chamber constructed in the form of a spiral duct about an upwardly-extending axis, such duct being quite broad with respect to its thickness, the successive turns of such spiral being non-communicating except in the direction of their continuous spiral course, whereby the water is compelled to follow that course, a case inclosing the entire spiral duct, and the smoke-passage from the fire-box leading into the case, whereby the interval between the turns of the spiral duct forms a continuation of the smoke-passage, whereby such duct exposes to the smoke upper and lower surfaces which are large relatively to the quantity of water in the duct, substantially as set forth.

4. In a water-heating furnace, in combination with the fire-box, a chamber communicating with the same bounded by an outer case F and an interior tube D, a water-chamber in the form of a spiral duct located in the space between the tube D and the case F, the successive turns of such spiral being non-communicating except in the direction of their continuous spiral course, whereby the water is compelled to follow that course, and making close junctions with the walls of said tube and case, respectively, whereby it defines and forms the upper and lower boundaries of a spiral smoke-passage from the fire-box through the chamber constituted by the tube D and the case F, and the smoke-pipe leading from the upper end of said chamber, substantially as set forth.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois.

MICHAEL HAVEY.

Witnesses:
CHAS. S. BURTON,
JEAN ELLIOTT.