

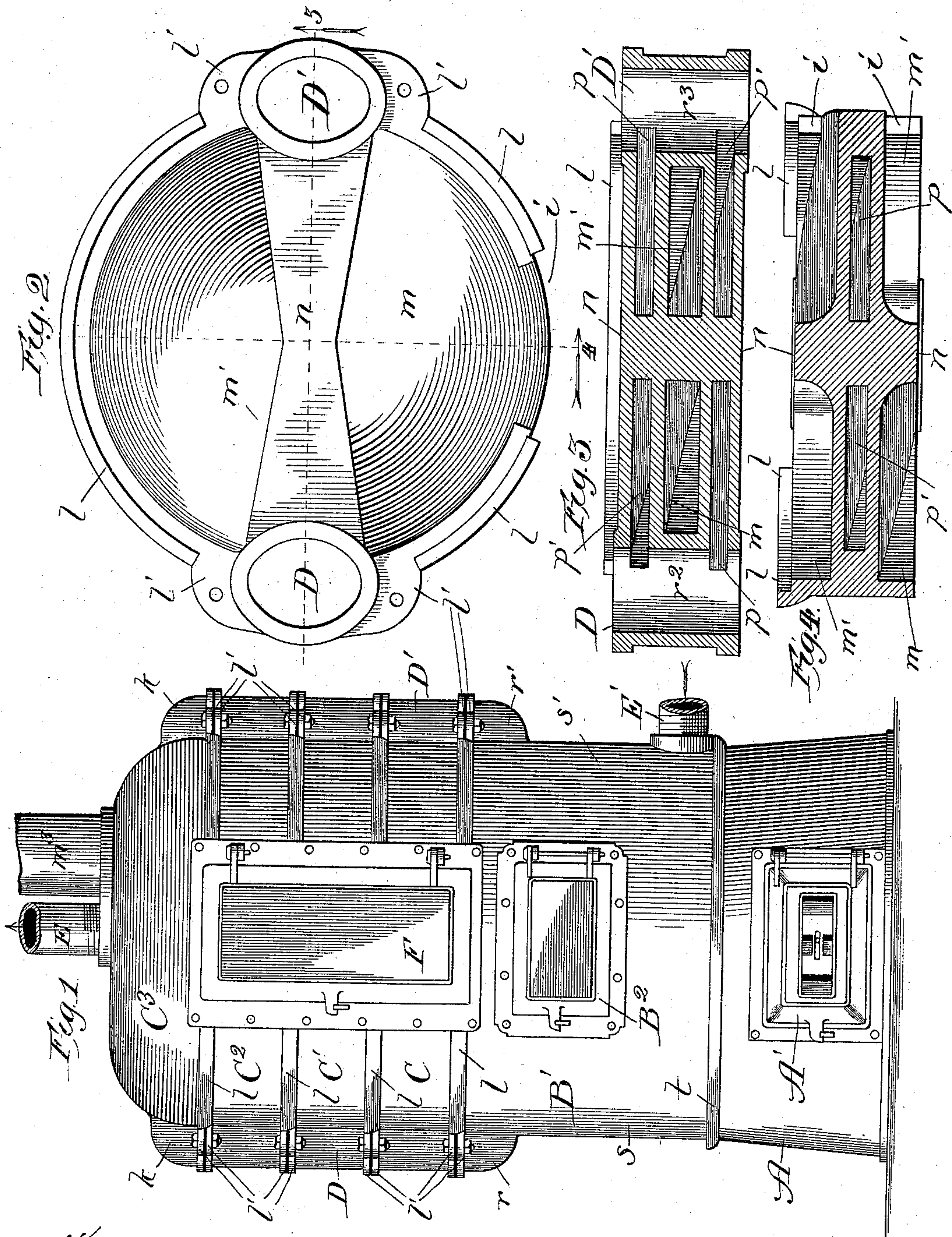
(No Model.)

2 Sheets—Sheet 1.

H. H. HUNGERFORD.  
BOILER FURNACE.

No. 544,898.

Patented Aug. 20, 1895.



Witnesses:  
E. S. Gaylord,  
Lute S. Allen

Inventor:  
Henry H. Hungerford  
By Dymunforth & Dymunforth,  
Attys.



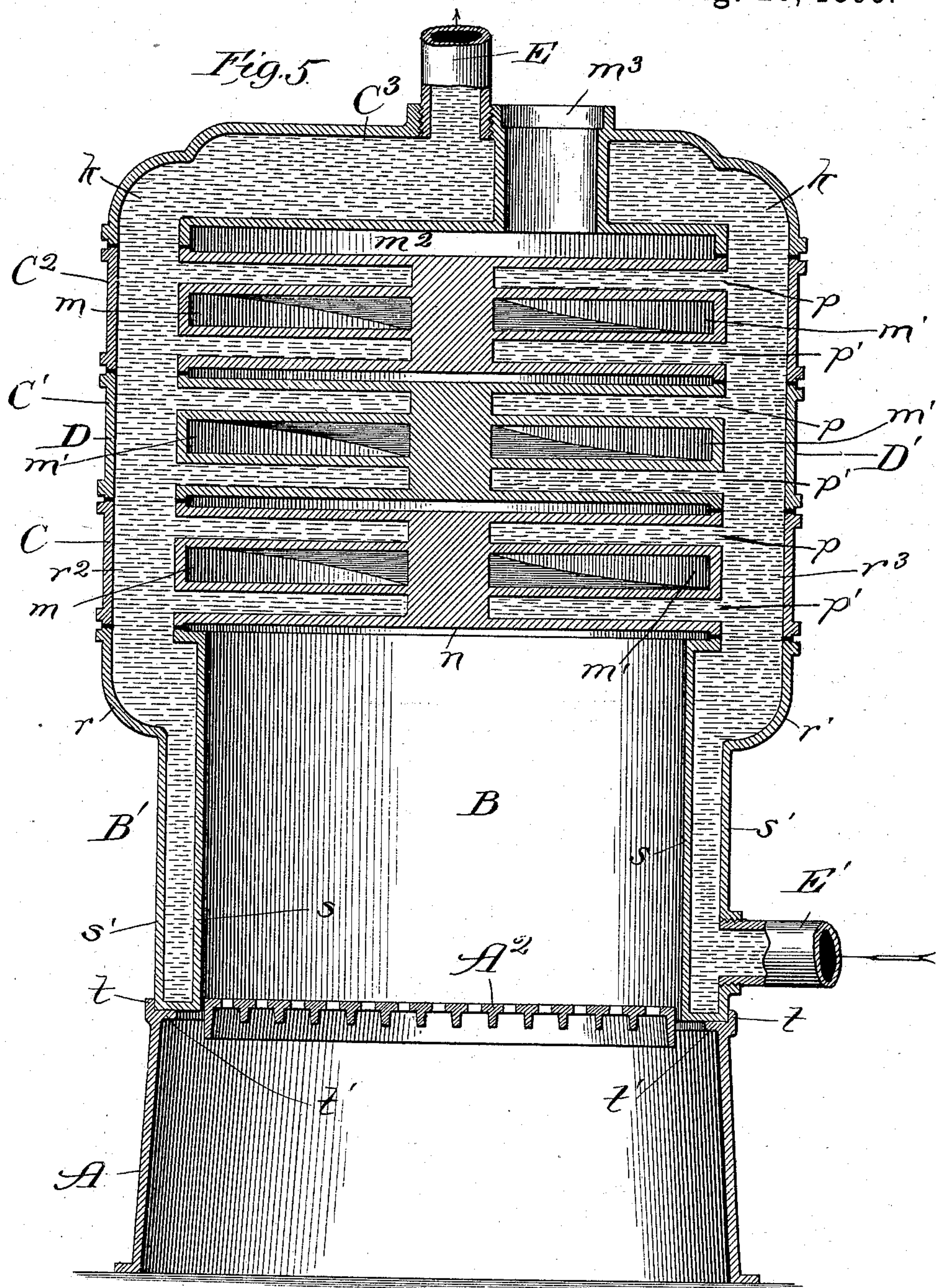
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*John J. Allen*

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*Henry H. Hungerford*  
*By Dyrenforth & Dyrenforth*  
*Attys*



# UNITED STATES PATENT OFFICE.

HENRY H. HUNGERFORD, OF CHICAGO, ILLINOIS.

## BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 544,898, dated August 20, 1895.

Application filed March 11, 1895. Serial No. 541,347. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY H. HUNGERFORD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Boiler-Furnaces, of which the following is a specification.

My invention relates to an improvement in boiler-furnaces for use more especially in hot-water-circulation heating systems for buildings, and of the class in which the hot products of combustion from the fire-chamber ascend through a spiral flue surrounded by the water to be heated, whereby their course through the body of water is prolonged and a proportionately great part of their available heat thus absorbed before they escape to the chimney.

My object is to provide a generally-improved boiler furnace or heater of the above class, with a view to economy both in the matters of construction and consumption of fuel in use.

To these ends my invention consists in providing the body portion of the structure between the fire and dome chambers of horizontal sections, which fit together and present vertical water columns extending to the dome-chamber, continuous double spiral passages for the products of combustion, and short intervening spirally-disposed passages extending between the water columns.

My invention also consists in the general construction of the heater, as well as in details of construction and combinations of parts, all as hereinafter set forth and claimed.

In the drawings, Figure 1 is a front elevation of my improved heater; Fig. 2, a plan view of one of the sections which form the body portion of the heater between the combustion and dome chambers; Figs. 3 and 4, sections taken on lines 3 and 4 of Fig. 2 and viewed as indicated by the arrows; and Fig. 5, a central vertical section of the heater enlarged, the section being upon a line corresponding with line 3 in Fig. 2.

A is the ash-pit of the furnace, to which access is had through a door A'. The ash-pit is cast or otherwise constructed with an outer annular upward projecting flange  $t$ , and adjacent thereto with an annular inwardly-pro-

jecting sill  $t'$ . In the space surrounded by the sill is a grate A<sup>2</sup> of any suitable construction.

The fire-chamber B is formed of a shell or casting having an inner wall  $s$  and outer wall  $s'$ , forming an annular chamber or water-jacket B'. Extending through the walls  $s$   $s'$  across the water-jacket is a fuel-feed passage or opening provided with a door B<sup>2</sup>. On opposite sides at the top of the chamber or water-jacket B' the walls  $s$   $s'$  are shaped with outlets forming the bases  $r$   $r'$ , respectively, of vertical water columns D D'. The fire-chamber portion of the furnace rests upon the sill  $t'$  within the flange  $t$ .

C, C', and C<sup>2</sup> are sections forming the body portion of the heater. The sections are all alike in construction, being provided on opposite sides with vertical passages  $r^2$   $r^3$ , coinciding with each other and the water-jacket outlets  $r$   $r'$  and forming sections of the water columns. Extending from the lower part of the passage  $r^2$  of each section, in a spiral upward inclined direction to the upper part of the passage  $r^3$ , is a passage  $p$ , and extending from the lower part of the passage  $r^3$  of each section, in a spiral upward-inclined direction to the upper part of the passage  $r^2$ , is a passage  $p'$ . The outer walls of the passages  $p$   $p'$  form the outer wall of the structure, which is of annular form, except where it bulges outward at the water-columns. The upper and lower walls of the passages  $p$   $p'$  are as thin as practicable and terminate at their ends at flat transverse planes  $n$  on the upper and under sides of the sections, and which form meeting surfaces between the sections. The walls of the passages  $p$   $p'$  form the walls of spiral flues  $m$   $m'$ , which at their lower ends open out of the top of the fire-chamber. Each section C, C', and C<sup>2</sup> is provided around its upper edge with a flange  $l$ , into which the next higher section fits, and at their upper and lower sides, at the water column portions and at the parts  $r$   $r'$  of the fire-chamber portion of the structure, are flat ears or flanges  $l'$ , where the parts are bolted together. Fitting upon and bolted to the top section is the dome-chamber C<sup>3</sup>, having inlets  $k$   $k$ , which register with the upper ends of the water columns. The under side of the dome-chamber is raised above the upper side of the



section  $C^2$  to afford a flue-chamber  $m^2$ , to which the spiral flues  $m m'$  lead. Extending from the flue-chamber is an outlet-flue  $m^3$ .

E is an outlet-pipe from the dome-chamber, and which supplies the hot-water-circulating system, and  $E'$  is the return-pipe, which enters at the lower part of the chamber or water-jacket  $B'$ . When put together, the sections of the structure fit closely upon each other and may be provided with gaskets  $h$  at the water column joints to prevent leakage.

F is a door covering openings  $i$ , which give access to the spiral flues  $m m'$  and flue-chamber  $m^2$ .

In operation the hot products of combustion from the fire-chamber  $B$  rise through the spiral flues  $m m'$  to the flue-chamber, thus following an extended course through the body of water which fills the water columns and spirally-disposed passages  $p p'$ . Water entering at  $E'$  is brought in the chamber  $B'$  in close contact with the fire-chamber. From the chamber  $B'$  it rises through the passages  $r r'$  to the water columns, whence it passes back and forth through the spirally-disposed passages  $p p'$ , a constant circulation being kept up until it rises to the dome-chamber and passes out at the pipe  $E$ . Thus, owing to the prolonged course which the hot products of combustion have to pursue in close contact with the body of water before escaping to the chimney, practically all the available heat may be absorbed from the products of combustion by the water, thereby reducing the fuel consumption to a minimum. The structure may be enlarged to any desired extent by adding sections. The door  $F$  gives access to every part of the spiral flues and flue-chambers for cleaning the latter.

While during very cold weather it may be necessary to keep fire going in the fire-chamber which will heat the water to a high temperature and effect a rapid circulation through the pipes and radiators of the heating system, in more moderate weather so much heat is neither comfortable nor economical. It is desirable, however, even when the water is heated only to a moderate temperature in the heater, that the circulation shall be sufficiently free and rapid to heat the radiators of the system equally. The friction which the water encounters in its passage through the heater has a very material bearing upon the rapidity of the circulation through the system, and if the friction is great in the heater the circulation is apt to be unduly sluggish, especially when the fire is low. For this reason in many furnaces, even in moderate weather, heat must be kept up in the fire-chamber to a comparatively high degree to maintain a sufficiently rapid circulation through the system to be serviceable.

In constructing my improved heater my object has been to present as little friction as possible to the passage of the water and at the same time heat it rapidly with a minimum amount of fuel. The entire body of water

does not pursue an extended and continuous spiral course from the inlet to the outlet pipe through a contracted passage, but, instead, a portion only of the body of water passes in a spiral direction across the path of the products of combustion, and as fast as heated it rises directly upward in the water columns. Thus, while obtaining all the advantages of heat-absorption by passing the water across the path of the products of combustion, the main circulation is straight upward through the water columns from the water-jacket to the dome-chamber, the frictional resistance being comparatively little.

The construction, involving the vertical water columns and comparatively short contracted spirally-extending cross-passages, is a very material improvement in hot-water heaters, and effects a freer and more rapid circulation of water through the system, and a greater economy in fuel consumption than any other heater of this class of which I am aware.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a water-heating furnace, the combination with the fire and dome chambers, of an intervening body-portion formed with vertically disposed water-columns extending to the dome chamber, and comparatively short inclined spirally disposed passages extending between the water columns and forming the walls of spiral flues, which carry off the products of combustion from the fire-chamber, substantially as described.

2. In a water-heating furnace, the combination with the fire and dome chambers, of an intervening body-portion comprising horizontal sections having vertical passages  $r^2 r^3$  through them forming continuous vertical water columns which extend to the dome chamber, and inclined spirally disposed passages extending between the water columns and forming the walls of spiral flues which carry off the products of combustion from the fire-chamber, substantially as described.

3. In a water-heating furnace, the combination of the ash-pit, fire-chamber, water-jacket about the fire-chamber, horizontal sections above the fire-chamber having vertical passages forming water columns which communicate with the said water-jacket, inclined spirally disposed passages extending between the water columns and forming the walls of spiral flues which communicate with the fire-chamber, dome chamber above the sections communicating with the said water columns, flue space communicating with the said flues and having an outlet, discharge pipe extending from the dome chamber and return pipe extending to the said water-jacket, all constructed and arranged to operate substantially as and for the purpose set forth.

HENRY H. HUNGERFORD.

In presence of—

M. J. FROST,  
J. H. LEE.