No. 771,823. PATENTED OCT. 11, 1904.

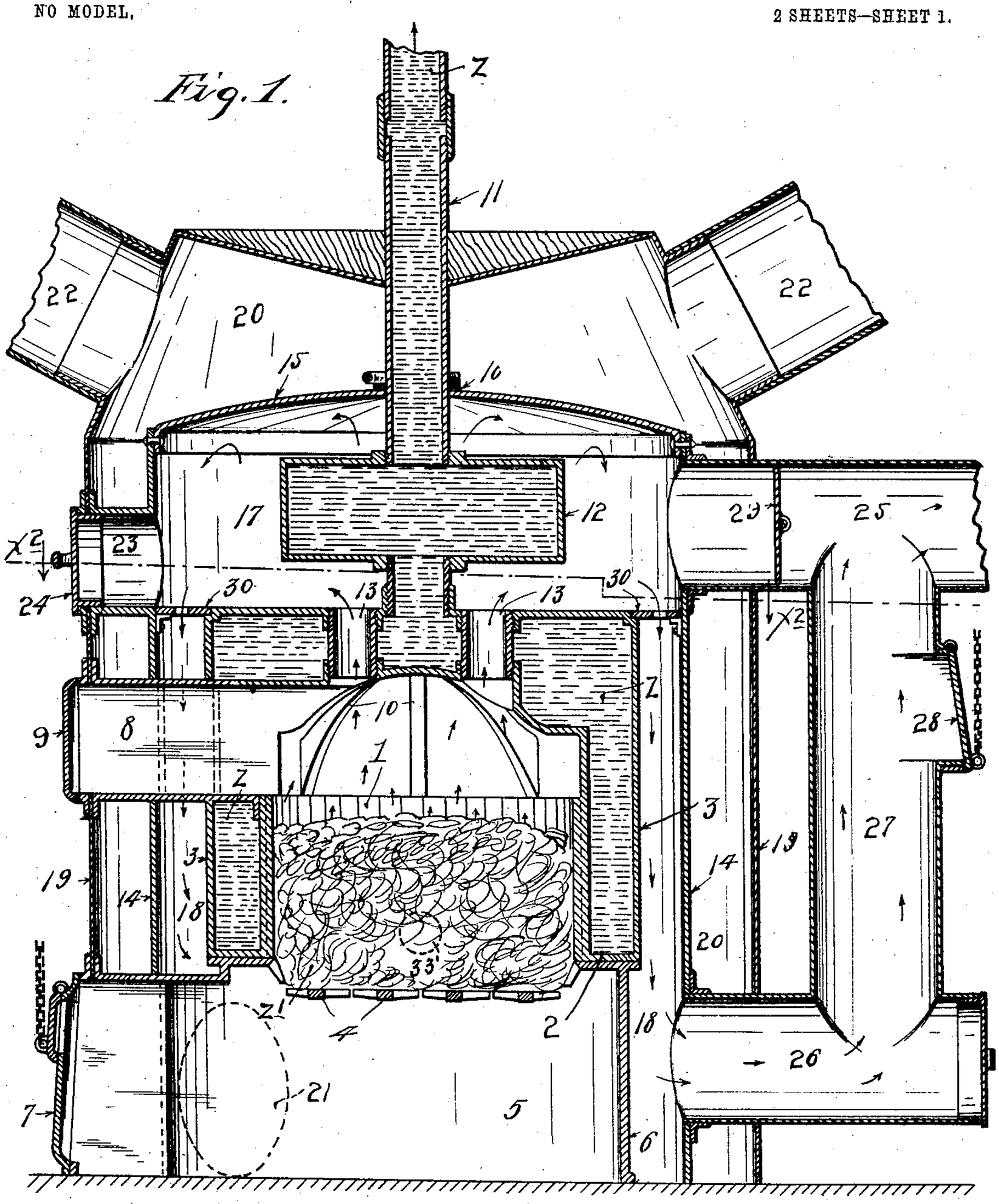
J. F. HUGHES.

COMBINATION FURNACE.

APPLICATION FILED SEPT. 8, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

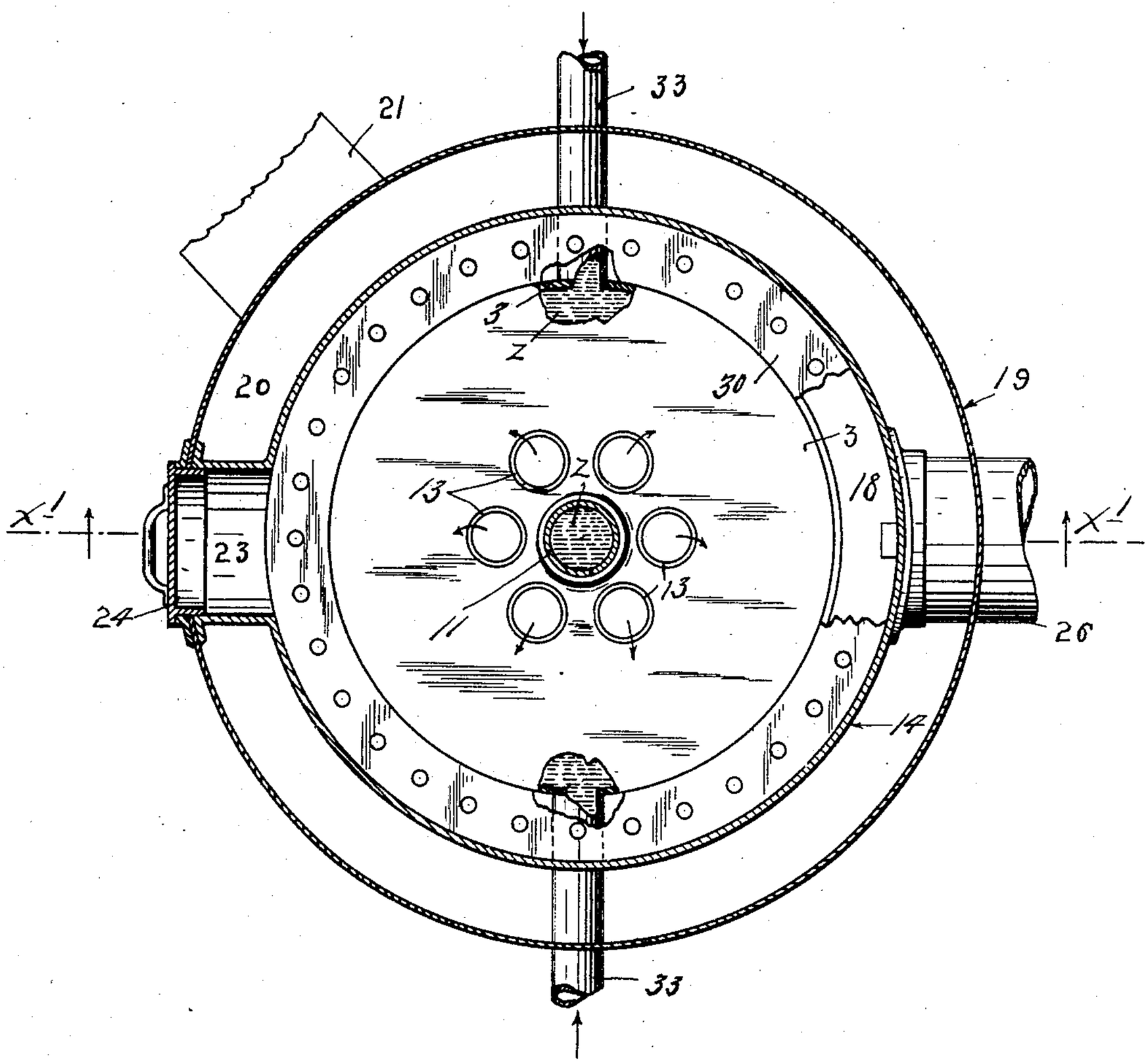
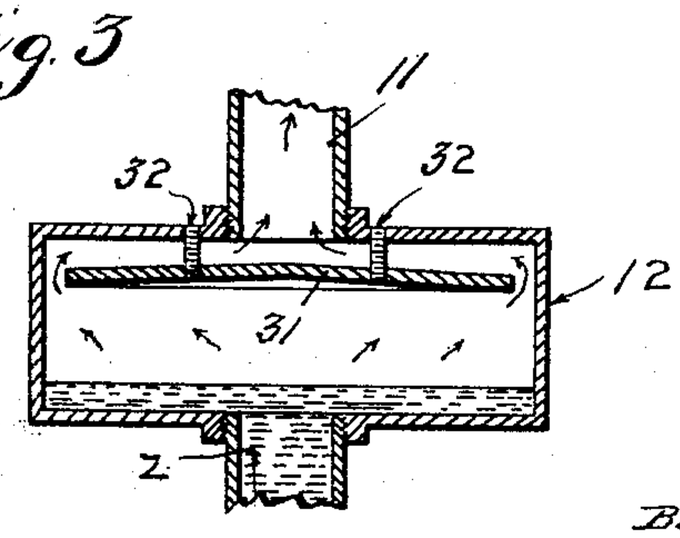


Fig. 3



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UNITED STATES PATENT OFFICE.

JAMES F. HUGHES, OF HUTCHINSON, MINNESOTA.

COMBINATION-FURNACE.

SPECIFICATION forming part of Letters Patent No. 771,823, dated October 11, 1904.

Application filed September 8, 1903. Serial No. 172,369. (No model.)

To all whom it may concern:

Be it known that I, JAMES F. HUGHES, a citizen of the United States, residing at Hutchinson, in the county of McLeod and State of Minnesota, have invented certain new and useful Improvements in Combination-Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to furnaces, and especially to those so-called "combination-furnaces" wherein the heat is transmitted through the medium both of hot air and hot water or hot air and steam.

The primary object of the invention is to provide a furnace of this character having increased efficiency and a corresponding economy in the use of fuel.

To the above ends the invention consists of the novel devices and combinations of devices hereinafter described, and defined in the claims.

The invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a vertical section taken through the furnace designed in accordance with my invention, on the line x' x' of Fig. 2. Fig. 2 is a horizontal section taken approximately on the line x^2 x^2 of Fig. 1; and Fig. 3 is a detail in vertical section, illustrating a modified construction of the so-called "steam-dome" or supplemental water-receptacle.

The fire-pot 1 is surrounded by a vertically-disposed annular water-chamber 2, formed within a shell 3, the upper portion of which shell extends over the top of the fire-pot, and thus, of course, correspondingly extends the said water-chamber 2. Ordinary grates 4 separate the interior of the fire-pot 1 from the ash-pit 5, which latter is formed within a shell-like base-casting 6, having the usual door 7 equipped with devices for regulating the draft. This base-shell 6 supports the shell 3 and the grates 4. The fuel is introduced into the fire-pot through a fuel-spout 8, which, as usual, is normally closed by a door 9. The shell 3 is formed on its interior with hollow arched water-legs 10, that open into the water-chamber 2 and overlie the fire-pot, so that they greatly increase the heating efficiency of the furnace. A water-feed pipe 11 leads vertically upward from the central upper portion of the water-chamber 3, and in this pipe or leg 11 is interposed an expanded section or drum 12. A plurality of short vertically-disposed flues 13 open through the upper or head portion of the shell 3 and water-chamber 2. These flues 13 are preferably evenly spaced apart and circumferentially disposed around and close to the lower end of the stack 11 directly under the drum 12. Another shell 14 surrounds the water-chamber 2 and its shell 3 and extends downward, preferably to the ground or floor. Above the drum 12 the upper end of the shell 14 is tightly closed by a head 15, through which the stack 11 passes, a tight joint being formed between the said parts 11 and 15, preferably by an asbestos packing 16. A large chamber 16 is thus formed above the water-compartment 2, and an annular chamber 18 is formed around the said water-compartment, the latter extending down below said water compartment or chamber. The large chamber 17 is for the sake of clearness herein designated as the "primary" combustion-chamber and the annular chamber 18 is for the same reason designated as the "secondary" combustion-chamber to distinguish them from the chamber in the top of the fire-pot, although as a matter of fact all three of these chambers constitute combustion-chambers in the strict and broad sense of the word. A third shell or casing 19, having a closed top, surrounds and incloses the shell 14 and affords a hot-air chamber 20, which surrounds and overlies the shell 14 and the combustion-chambers located within the latter. The cold air is delivered into the lower portion of the air-chamber 20 in the usual or any suitable way—as, for instance, by means of an air-inlet pipe 21—and the heated air is drawn off from the said chamber through the ordinary hot-air pipes 22, which latter open from the upper portion of the shell 19.

Access is had to the interior of the primary combustion-chamber 17 through a sleeve 23, the outer end of which is normally closed by a cap or closure 24.

A direct smoke-stack 25 leads outward from

the primary combustion-chamber 17, and an indirect smoke-stack 26 opens outward from the lower portion of the annular secondary combustion-chamber 18. Both of said stacks 25 and 26 pass outward through the case or shell 19, and outward thereof they are in communication through a vertical stack-section 27, which, as shown, is equipped with a check draft-damper 28. In the stack 25, inward of the point of junction therewith of the vertical stack-section 27, is a damper 29, by means of which the said stack 25 may be opened and closed at will.

The primary combustion-chamber 17 is of course in communication with the annular secondary chamber 18; but to restrict this communication to some extent and distribute the burning blasts or gases quite evenly around the entire cross-section of the latter a perforated annular distributing-flange or choke-ring 30 is interposed between the said two chambers, the same preferably being supported by the shells 3 and 14 in line with the upper plate or choke-ring of the former. This distributing-plate is preferably capable of being lifted from working position to afford communication with the annular secondary combustion-chamber 18.

It will be noted that the annular so-called "secondary" combustion-chamber 18 at a point below the bottom of the fire-pot and below the bottom of the water-chamber 2 is expanded or increased in cross-section. This is shown as being accomplished by projecting said chamber 18 under the said chamber 2. This feature of construction is important, because it increases the conducting capacity of the lower portion of the said chamber 18. The perforated choke-plate or flange 30 tends to hold back the burning products of the combustion within the primary combustion-chamber 17, and thereby to give a somewhat increased pressure within said primary combustion-chamber. Otherwise stated, the said perforated choke-plate or flange prevents the burning gases from taking a direct short cut on the line of least resistance from the primary combustion-chamber into the secondary combustion-chamber and from thence out at the lower smoke-stack opening and accomplishes this by holding back, as it were, the burning gases within the primary combustion-chamber 17 until they have thoroughly filled the same and have found escape-passages through the circumferentially-disposed perforations of the choke-ring or flange 30. The gases will thus be introduced into the secondary combustion-chamber evenly around the water-chamber 2 and will be drawn nearly straight downward into the expanded lower portion of the said secondary combustion-chamber and from thence will pass to the lower smoke-stack opening after they have passed below the said water-chamber. In practice I have demonstrated that substantially the above-described action will take place.

When hot water is used as the medium for conducting heat, the drum 12, if then used, acts as a supplemental water-chamber and increases the efficiency of the furnace; but it may be dispensed with, and even then the furnace will be of extremely high efficiency. It is, however, when the furnace is to be used to generate steam for heating purposes that the said drum 12 becomes of the greatest importance, for in this case it serves as a steam-dome. When the said drum is thus used as a steam-dome, it is important to provide the same, as shown in Fig. 3, with a horizontally-disposed deflecting-plate 31, located just below the central outlet at the top of the said drum. This deflecting-plate 31 may be conveniently supported, as shown in Fig. 3, by means of stay-bolts 32, screwed into the same and into the upper plate of the said drum. This deflecting-plate causes the steam to take a winding course around the same and will catch and precipitate more or less of the heavy moisture which may be drawn by the steam upward from the surface of the water. Approximately the proper level of the water for generating steam is indicated in said Fig. 3. In the drawings water is indicated by the character Z and the fuel is indicated by the character Z'. The relatively cold water is delivered into the lower portions of the water-chamber 2, as shown, at diametrically opposite points through a pair of return-pipes 33. (Shown in full in Fig. 2 and by dotted lines only in Fig. 1.) Hence with this construction, as well as with water-heating furnaces as usually constructed, the coldest water will be at the bottom of the water compartment or chamber, and the water will constantly increase in temperature toward the uppermost portions of said chamber.

With prior furnaces the greatest heat is applied to the lower portion of the water-chamber, and the heat is directed continuously upward until it leaves contact with the said water-chamber. Of course the rapidity of heat radiation from the burning products or from the combustion will depend on the difference in temperature between the same at the point of application and the temperature of the water, and it is evident that with the usual arrangement just named the temperatures of the two continuously more closely approach each other, since the temperature of the water constantly increases and the temperature of the combustion constantly decreases throughout the entire heating action. This, however, is not the case with a furnace constructed on the plan of my furnace, the preferred form of which is illustrated in the drawings. With my said improved furnace, designed as herein illustrated, the greatest heat—to wit, the heat of the fire-pot—is directly radiated into the water within the surrounding water-cham-

ber, and then the very hot products of combustion pass upward into the so-called "primary" combustion-chamber 17 and are then again drawn downward around the water-chamber—to wit, through the annular secondary combustion-chamber 18—and in passing through the latter the said burning products pass by and act upon water, which is of constantly-diminishing or lower temperature toward the bottom of the said water-chamber.

From what has been said it will be understood that the apparatus described is capable of a large range of modification within the scope of my invention as herein set forth and claimed.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. In a furnace, the combination with the fire-pot, of a water-chamber surrounding and overlying said fire-pot, a primary combustion-chamber overlying said water-chamber and communicating with said fire-pot, a secondary combustion-chamber leading downward from said primary combustion-chamber, surrounding said water-chamber and extending below the bottom of the fire-pot, and a smoke-stack outlet leading from said secondary combustion-chamber, and located entirely below the bottom of said fire-pot, substantially as described.

2. The combination with a fire-pot, of a water-chamber surrounding and overlying said fire-pot, a primary combustion-chamber overlying said water-chamber and communicating with said fire-pot through a plurality of flues, a secondary combustion-chamber surrounding said water-chamber and communicating with said primary combustion-chamber through a plurality of circumferentially-spaced, restricted draft-passages, the said secondary combustion-chamber extending below said fire-pot and said water-chamber, and being expanded in cross-section below the same, and a smoke-stack outlet opening from the expanded lower portion of said secondary combustion-chamber, substantially as described.

3. In a furnace, the combination with a fire-pot, of a water-chamber surrounding and overlying said fire-pot, a primary combustion chamber or dome overlying said water-chamber and communicating with said fire-pot through a plurality of centrally-grouped flues, an outlet-pipe for the hot water or steam, leading upward from said water-compartment and having a drum or expanded section directly overlying all the said flues, and a secondary combustion-chamber surrounding said water-chamber, extending below the bottom of the fire-pot, and communicating with said primary combustion-chamber through a plurality of restricted circumferentially-spaced passages, substantially as described.

4. In a furnace, the combination with a fire-pot, of a water-compartment surrounding and overlying the said fire-pot, a primary combustion-chamber overlying said water-chamber, a secondary combustion-chamber surrounding said water-chamber, extending below said fire-pot, communicating with said primary combustion-chamber through a plurality of circumferentially-spaced restricted draft-passages, and provided with a smoke-stack outlet located below the fire-pot, substantially as described.

5. In a furnace, the combination with a fire-pot, of a water-chamber surrounding and overlying said fire-pot, a primary combustion-chamber overlying said water-chamber and communicating with said fire-pot through a plurality of centrally-grouped flues, an outlet-pipe for the water or steam, leading upward from said water-compartment and having a drum or expanded section directly overlying all of said flues, a secondary combustion-chamber surrounding said water-chamber and extending below said fire-pot, a removable choke-ring interposed between said primary and secondary combustion-chambers, and having a plurality of circumferentially-spaced draft-passages, a smoke-pipe having one branch opening from said primary combustion-chamber, and another opening from said lower portion of said secondary combustion-chamber, and a damper for opening and closing the upper direct smoke-stack passage, substantially as described.

6. The combination with a fire-pot, of a water-chamber surrounding and overlying said fire-pot, a combustion-chamber overlying said water-chamber and communicating with said fire-pot, an outlet-pipe for the hot water or steam, leading upward from said water-chamber, and having a drum or expanded section located within said combustion-chamber, and an approximately horizontal deflecting-plate secured within the said drum of expanded water-pipe section, between the inlet and outlet passages thereof, the periphery of which deflecting-plate closely follows, but is spaced apart from, the side walls of the said drum, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES F. HUGHES.

Witnesses:

ELIZABETH H. KELIHER,

F. D. MERCHANT.