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J. A. BALDWIN.

SMOKE PREVENTING FURNACE.

No. 518,576. Patented Apr. 17, 1894.

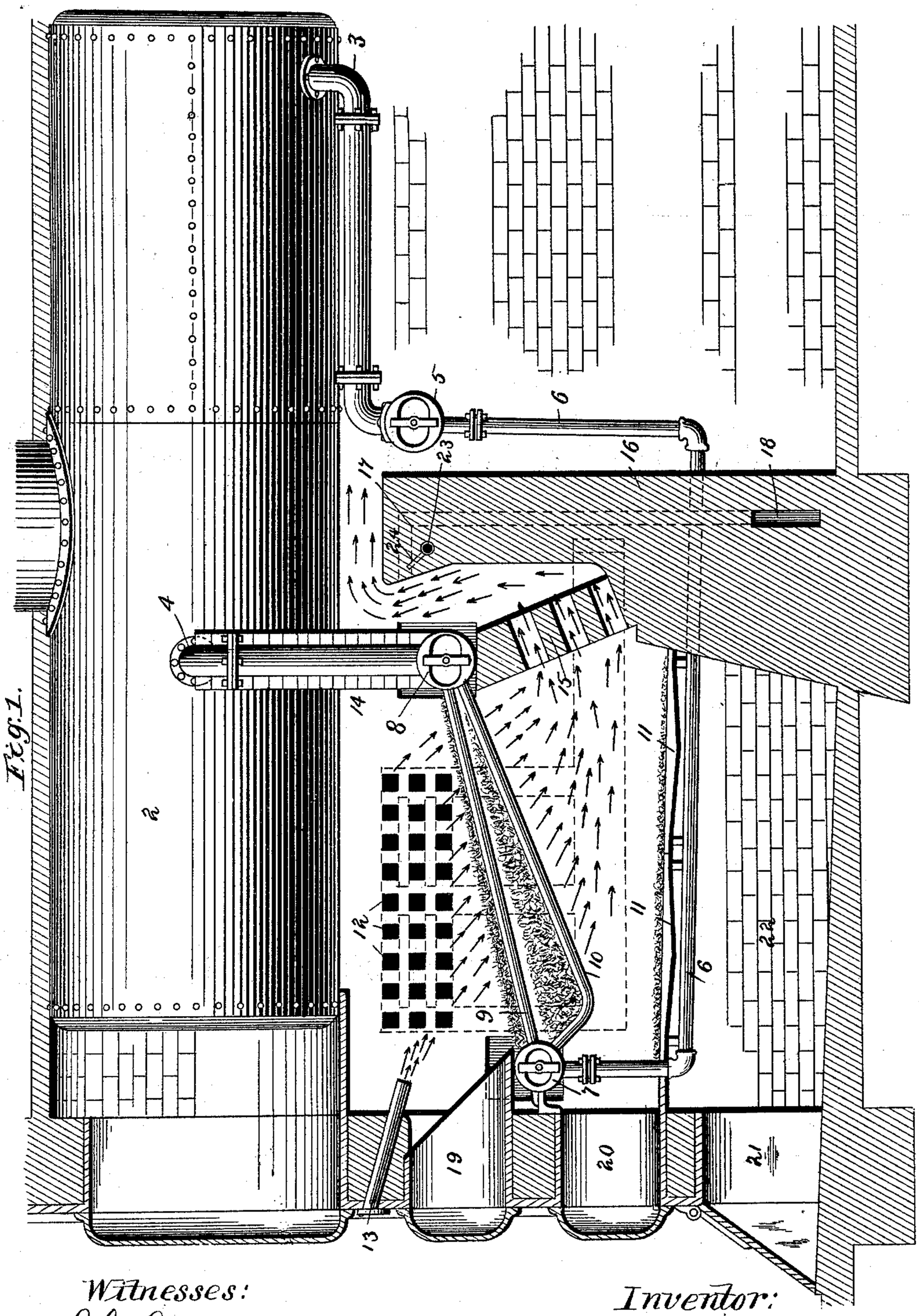

Fig. 1.

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Fig. 2.

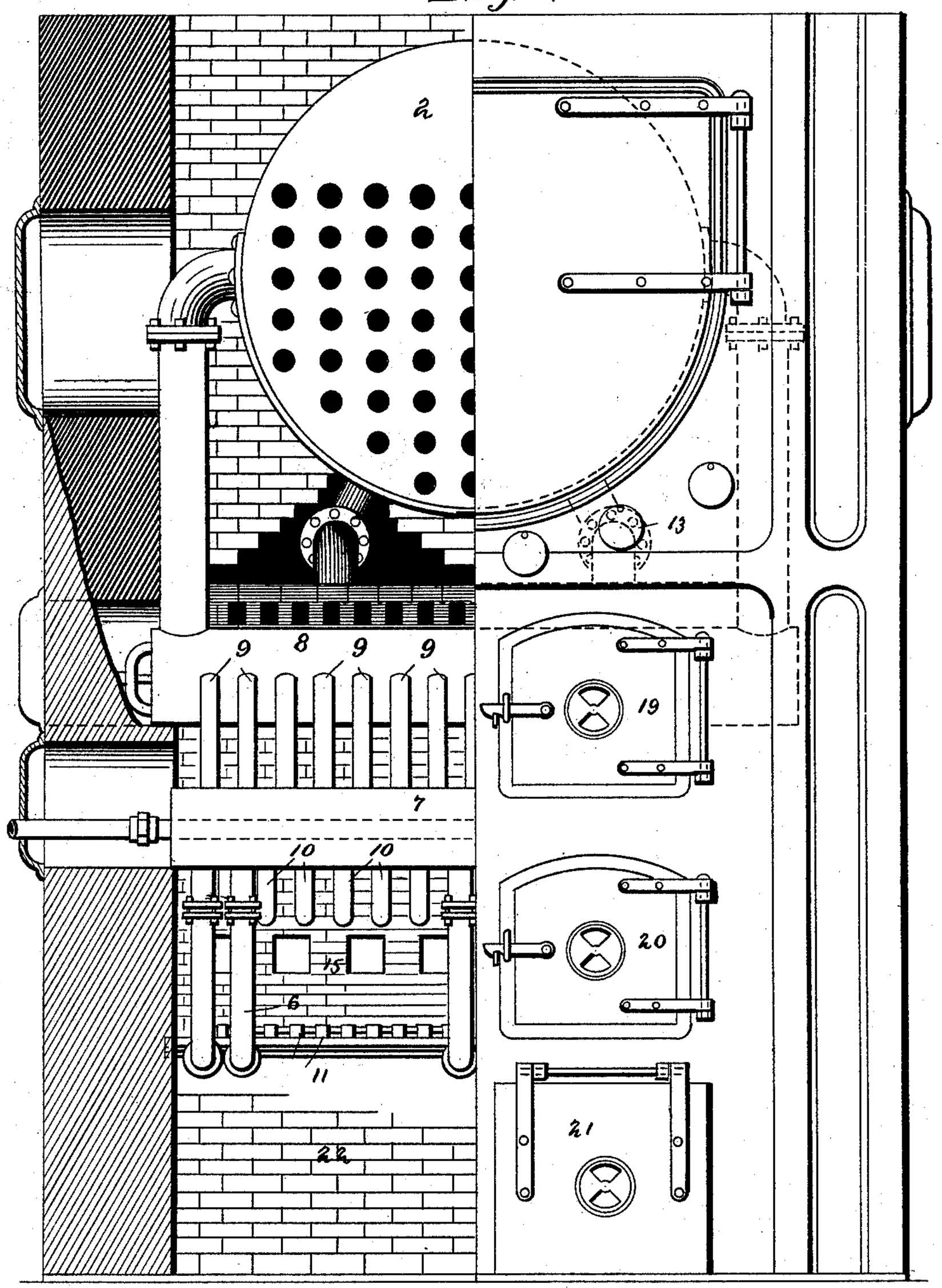

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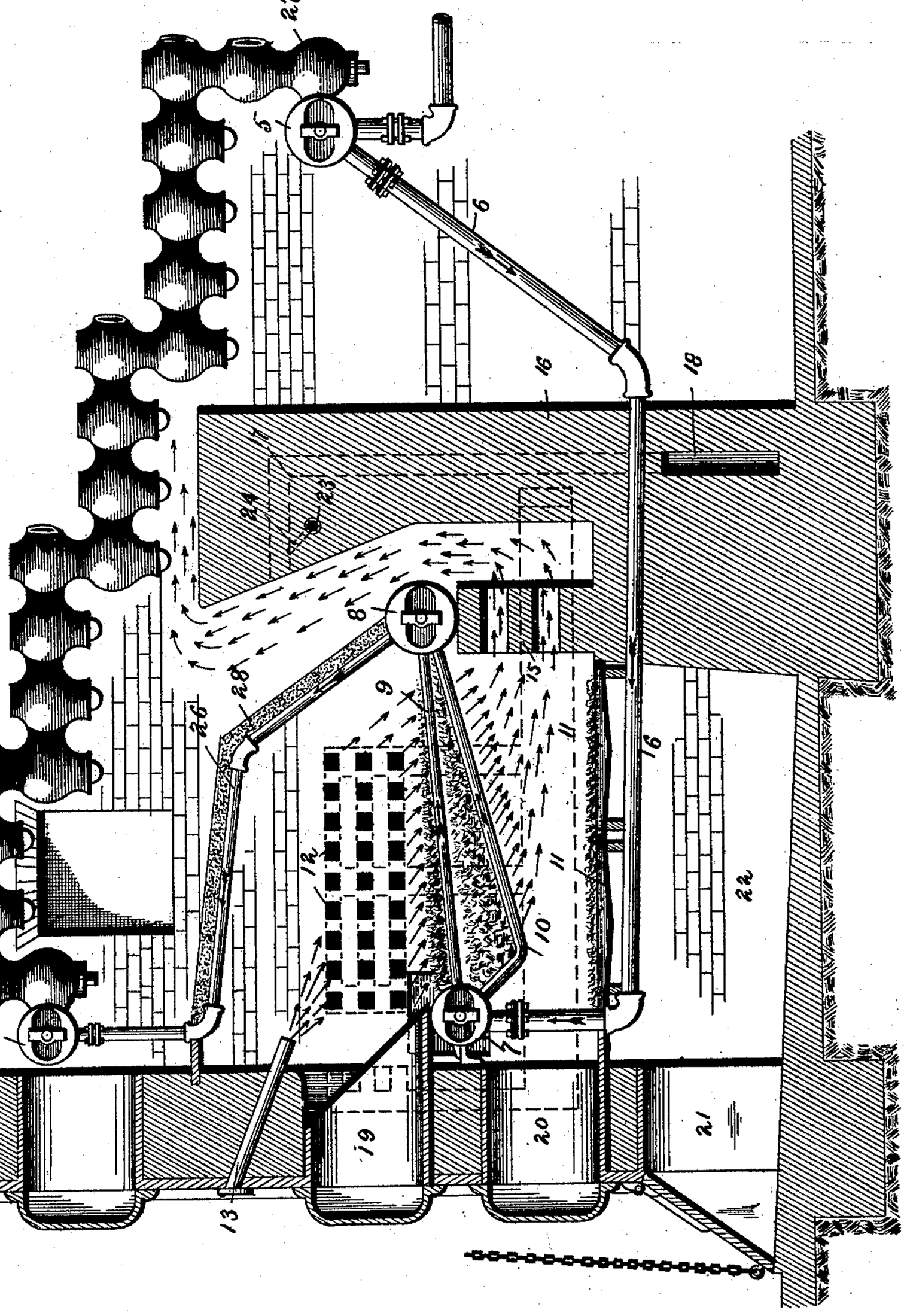
Fig. 3.



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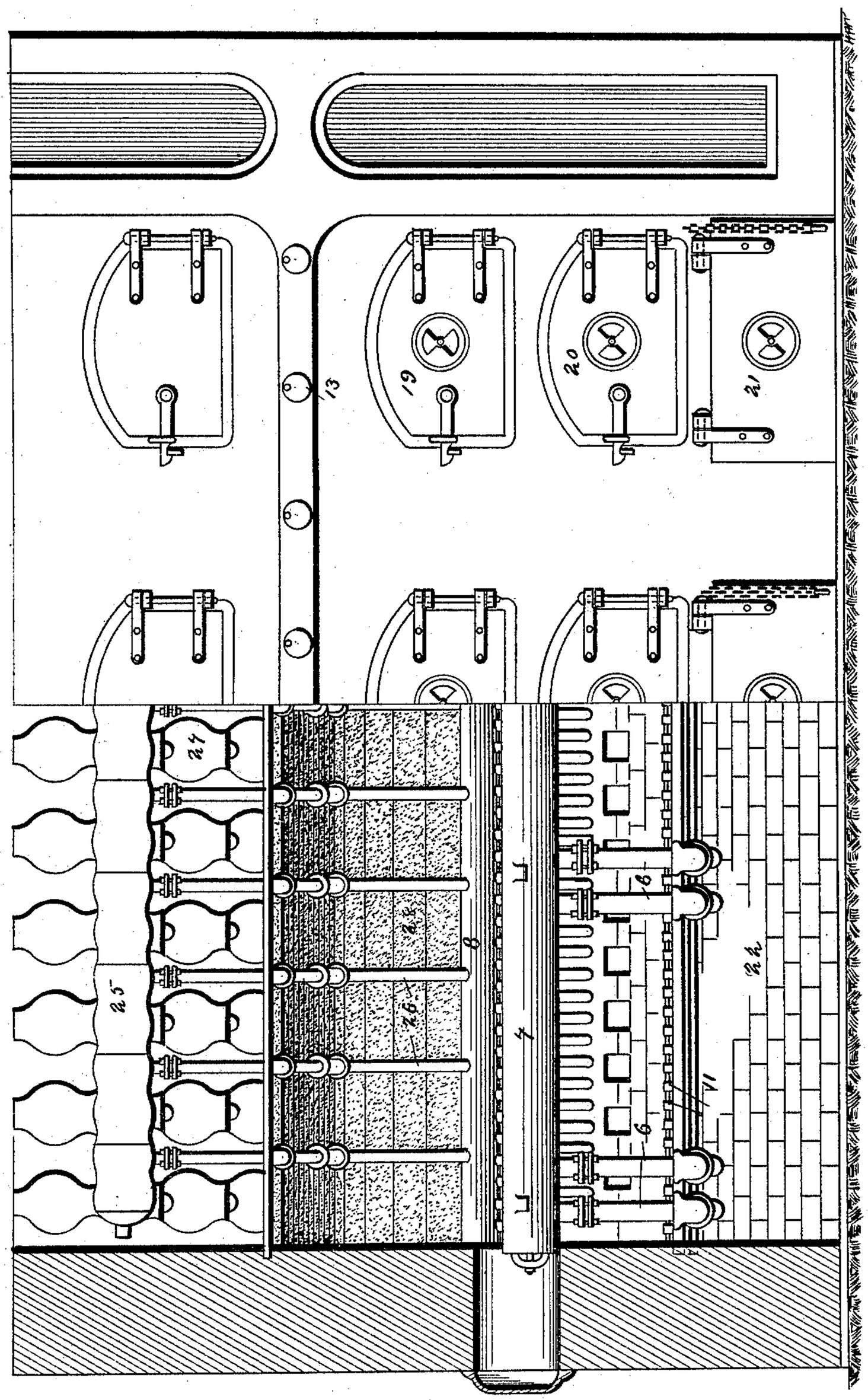

Fig. 4.

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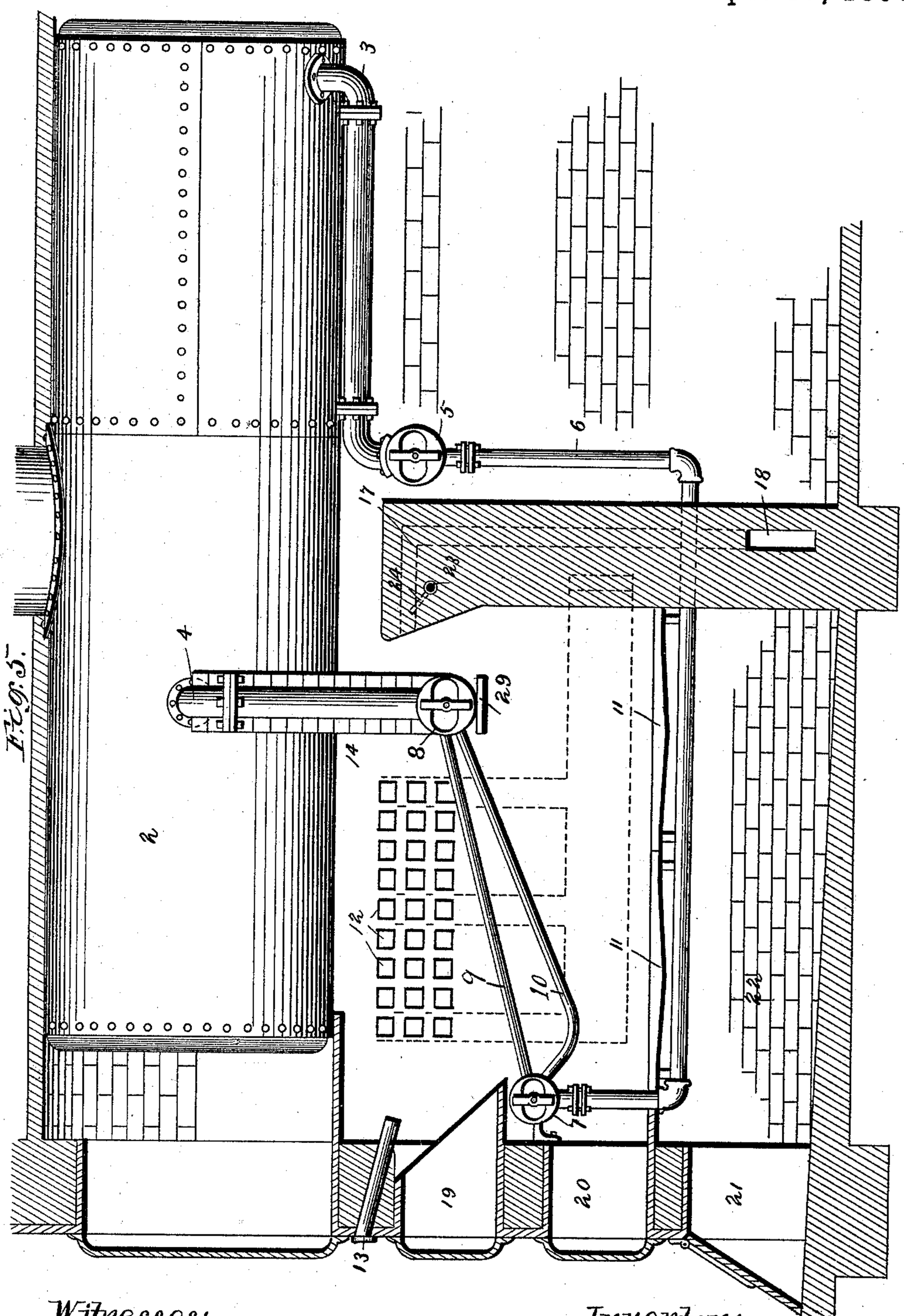

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UNITED STATES PATENT OFFICE.

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SMOKE-PREVENTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 518,576, dated April 17, 1894.

Application filed March 18, 1892. Serial No. 425,377. (No model.)

To all whom it may concern:

Be it known that I, JUDSON A. BALDWIN, a citizen of the United States, residing at Benton Harbor, in the county of Berrien and State of Michigan, have invented certain new and useful Improvements in Smoke-Consuming Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to furnaces for steam-generators, either such as are used for supplying steam to engines, or to heating-systems or for any of the purposes to which steam-generators are or may be applied, and my invention relates also to furnaces for steam generators and for various other similar and analogous heating purposes.

Among the primary objects of my invention is included that of producing a furnace which shall completely, thoroughly and rapidly consume absolutely all of the inflammable products of combustion, both solid and gaseous, such as usually escape from furnaces in the form of smoke, and which shall possess a free draft and be under perfect control at all times. Furthermore, to produce a furnace in which the products of combustion shall be first directed downward through an upper grate and then over a lower grate, so as to effect not only an absolute consumption of all of the inflammable products of combustion, but also a most thorough and economical consumption of the fuel itself.

A still further primary object of my invention is to produce a furnace in which the fuel shall be disposed at greater depth at points where the draft or combustion is the more vigorous, and at less depth at points where the draft or combustion is less vigorous, and thus insure a perfectly uniform rate of combustion throughout the furnace, and a most thorough and complete consumption of the fuel.

The primary objects of my invention also include that of producing a furnace, of the kind in which water-grates are used, which shall possess a free water-circulation and also a maximum rate of effective heat-application to the water, so as to insure both a perfect and general heating action upon the water at an economical rate of fuel-consumption.

Furthermore, another primary object of my invention is to produce a furnace in which both the upper and lower grates shall be subjected only to the action of a downward draft, and in which the air supplied to the grates shall be composed partly of air heated previous to its entrance into the furnace, and also partly of cold air taken directly from the external atmosphere, whereby a most vigorous combustion shall be insured, and whereby also the furnace-room shall be maintained at a comparatively low temperature.

To the above purposes, my invention consists in certain peculiar and novel features of construction and arrangement, as hereinafter described and claimed.

The more precise nature of my invention will be better understood when described with reference to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of a smoke-consuming furnace embodying my invention; the furnace being shown as applied to a cylindrical boiler. Fig. 2 is a view of the same, partly in front elevation and partly in transverse vertical section. Fig. 3 is a vertical longitudinal section of a furnace embodying my invention applied to a safety-boiler. Fig. 4 is a view of the structure shown in Fig. 3; this view being partly in front end elevation and partly in transverse vertical section. Fig. 5 is a vertical longitudinal section of a furnace embodying my invention and applied to a cylindrical boiler; the furnace having but a single bridge-wall.

The furnace embodying my invention is adapted for use in connection with boilers or generators of a great variety of structural types, and for this reason I have shown it in Figs. 1, 2, and 5 as applied to a cylindrical boiler or generator 2, of the usual or any preferred kind; this boiler 2 being shown as placed horizontally in a suitable setting of brick or masonry work, and the furnace shown in Fig. 5 differing from that shown in Figs. 1 and 2 principally in having a single bridge-wall 16 in lieu of such wall and an auxiliary bridge-wall 15, as shown in Figs. 1 and 2.

In Figs. 3 and 4, I have shown the furnace as applied to a safety boiler or generator, of

what is known as the "Harrison-Wharton" type of construction, and which consists typically of sections or "slabs" each composed of a plurality of globular chambers or "units" having internal communication with each other. I wish it to be distinctly understood that I do not propose to confine myself exclusively either to these precise applications of the furnace, or to the application of the furnace to steam-generators, as it is capable of various other uses within the spirit of my invention.

The furnaces shown are of the type known as water-grate furnaces and the arrangement of circulating and grate pipes and of the drums is shown as similar to those shown and described in Letters Patent No. 470,171, granted to myself March 8, 1892, and I also desire it to be understood that I do not propose to confine myself exclusively to this precise arrangement of water-circulating connections. Indeed, certain features of my invention are equally applicable to furnaces having other than water-grates; such being true as to the inclined relation of the sections of the upper grate, in association with a lower grate which is also solely a downdraft grate, as will be evident from the ensuing description.

Referring first to the structure shown in Figs. 1 and 2, 3 designates two pipes which are connected at their upper or rear ends to the under side of the shell 2, at opposite points from the median line of said shell, and 4 designates two pipes the upper ends of which are connected to the shell 2 at opposite sides thereof, and at a considerably higher level than that of the points of connection of the pipes 3; the intention being to take the water from the boiler at lower or cooler points, by means of the pipes 3, and after passing it through the furnace so as to heat it, to return it to the boiler, by the pipes 4, at higher or warmer points. The pipes 3 are shown as extending forward beneath the shell 2 and as connected at their lower or forward ends to a drum 5 which extends horizontally beneath and transversely of the shell, and also just back of the top of the main bridge-wall 16. From this drum 5 lead pipes 6 which extend vertically downward behind the main bridge-wall 16 and then forwardly through the lower part of said bridge-wall and also horizontally through the lower part of the furnace-chamber, to the front thereof; these horizontal portions of the pipes 6 serving as supports for the blind-grate 11, to be hereinafter more fully described, and the front ends of said pipes 6 extending upward and being connected to a drum 7 at the front of the furnace-chamber. The drum 7 extends horizontally adjacent to the front wall of the furnace-chamber, and transversely of said chamber, and to said drum are connected the front ends of the upper pipes 9 and lower pipes 10 of the upper grate. The peculiar relative positions of these pipes 9 and 10 will be hereinafter fully described, but for the present it will suffice to state that the rear ends of said pipes are connected to a third drum 8 which rests upon the top of an auxiliary bridge-wall 15, and that the lower ends of the pipes 4 are connected to said drum 8, so as to take the water therefrom. The main bridge-wall 16 terminates at its top below the under side of the shell 2, so as to leave a space for the escape of the non-combustible products, and across the lower part of the main bridge-wall extends a horizontal air-channel 18 the ends of which open out of the side walls of the setting or furnace-chamber. An air-passage 17, or if desired a plurality of such air-passages, leads upward from the channel 18 and opens at the front of the top of the main bridge-wall, and a steam-supply pipe 23 leads across the upper part of the main bridge-wall, below the upper end of the channel or channels 17, and is provided with a number of discharge-nozzles 24 which deliver steam forwardly and upwardly to and through the upper ends of the channels 17. This arrangement of air-channels is such that the air is drawn into the passage 18, through the ends thereof, and flows upward through the passages 17, and is discharged at the upper ends of said passages; the steam-jets issuing from the discharge-nozzles 24 serving to insure a free flow of air through the air-channels, and such air being heated by the hot bridge-wall 16. A second transverse air-passage 18^a is shown as formed in the bridge-wall 16, at a point above and in front of the channel 18; this channel 18^a opening at its ends through the sides of the furnace-chamber, and communicating with air-channels 18^b leading horizontally forward in the side walls of the furnace-chamber, and communicating at their front ends with air-inlet openings 12 which are also formed in the side-walls of the furnace-chamber. The air also enters the channel 18^a through the ends thereof, and flows through said channel and the channels 18^b, and enters the furnace-chamber through the openings 12; the air being heated by the hot bridge-wall 16 and by the hot side-walls of the furnace-chamber. The auxiliary bridge-wall 15 rests upon the front of the main bridge-wall 16 and is inclined upwardly and forwardly therefrom so as to leave a space between itself and the main bridge-wall for the passage of the unconsumed products of combustion. This auxiliary bridge-wall is formed with numerous openings extending from its front surface to its rear surface; the unconsumed products of combustion being compelled to pass through such openings, and being consequently thoroughly broken up and highly heated, and the openings or channels in the auxiliary bridge-wall being of sufficient length to insure an effective retorting action upon the products of combustion passing therethrough. The space between the two pipes 4 is closed by a wall 14 of fire-brick, or other refractory material, which also extends from the top of the aux-

iliary bridge-wall 15 to the under side of the boiler-shell 2. The outer ends of the air-channels 18 and 18[a] are preferably covered by damper-plates 18[c], and two fire-doors 19 and 20 are provided in the front wall of the furnace-chamber; an ash-pit door 21 being also provided below the lower fire-door 20.

The furnace shown in Fig. 5 differs from the furnace shown in Figs. 1 and 2 principally in having no auxiliary bridge-wall 15; the drum 8 being, in this instance, supported upon a girder 29 which extends from one side-wall of the furnace-chamber to the other. In all other respects, the construction and arrangement are similar to that previously described, and like parts are designated by like numerals of reference in said Figs. 1, 2 and 5.

In Figs. 3 and 5, 27 designates a portion of a safety boiler, of what is known as the "Harrison-Wharton" type, and the principal differences in construction between this structure and those shown in Figs. 1, 2, and 5, relate to the drum 5, the bridge-wall 15, and to the connections between the drum 8 and the front part of the generator. In this instance the rear or upper ends of the pipes 6 are connected to a drum 5 which is directly connected to a lower part of the generator, at the rear thereof, and a second drum 25 is directly connected to the front part of the generator, at a point above the level of the point of connection of the drum 5. Pipes 26 connect the drum 25 with the drum 8, said pipes extending obliquely upward and forward at the top of the furnace-chamber, and a wall 28 of fire-brick, or other refractory material fills the space between the top of the furnace-chamber and the under side of the generator 27. The auxiliary bridge-wall extends vertically upward, in this instance, from the lower part of the main bridge-wall 16, and the space for the passage of the products of combustion is inclosed between the front surface of the main bridge-wall 16 and the rear surface of the auxiliary bridge-wall 15 and of the lining or partition 28. In all other respects, this structure is similar to that shown in Figs. 1 and 2, and also to that shown in Fig. 5, and like parts are designated by like numerals of reference in all of said figures.

In all of the three forms of the furnace above described the two drums 7 and 8 are connected together by the upper bars 9 and the lower bars 10 of an upper furnace-grate, and the upper and lower bars of this upper furnace-grate are inclined relatively to each other in such manner that the space between said upper and lower bars is deeper at points nearer the draft-entrance and shallower at points more remote from said draft entrance. As shown, this result is accomplished by imparting a greater forward and downward inclination to the lower grate-bars 10 than to the upper grate-bars 9; the front ends of the lower grate-bars being bent upward so as to properly connect with the drum 7. However it is to be distinctly understood that the diminution in the depth of the space between the upper and lower grate-bars may be accomplished either by imparting the excess of inclination to the lower grate-bars as shown, or to the upper grate-bars; the higher ends of the upper grate-bars being, in this latter instance, a greater distance above the lower grate-bars than would be the lower ends of said upper grate-bars. Nor need the inclination, in either event, be from rear to front as shown, nor, furthermore, need the grate-bars necessarily be water-bars since this feature of my invention is equally applicable to other than water-grates. The front end of the upper grate is shown as below the fire-door opening 19, and the upper grate-bars 9 are also shown as below the inlet-openings 12 for hot air at the sides of the furnace. Cold air inlets 13, in the form of inwardly and downwardly extending pipes, are also shown as placed in the front wall of the furnace-chamber above the upper grate, so that the draft to said upper grate is wholly and constantly a downward draft; the fire-door 19 being always kept closed excepting at the actual moments of introducing fuel to the grate. The bars of the upper grate 9 are preferably arranged in line with the spaces between the bars of the lower grate 10, and if desired, the spaces between the lower grate-bars may be narrower than the spaces between the upper grate-bars.

The intention is to feed the fuel directly upon the upper grate-bars 9, and as the fuel burns it will fall upon the lower grate-bars 10, either partly or wholly filling the space between the upper and lower grate-bars. The products of combustion are forced downward through the mass of fuel upon the upper grate-bars and also through the mass of fuel upon the lower grate-bars, and a very thorough combustion of such products is thus attained. This result is further insured by the admixture of hot and cold air afforded by the air-inlets 12 and 13, and the latter also keep the boiler-room comparatively cool inasmuch as they rapidly draw air directly from such room. From the lower grate-bars 10, the products of combustion flow backward through the space between the lower grate 10 and the blind grate 11. This blind-grate 11 consists simply of a number of plates set closely together, side by side, upon the water-pipes 6, and said plates serve to catch and hold the hot ashes and small incandescent coals which drop from the lower grate 10, as the result of ordinary combustion, or of raking said lower grate 10. There is no updraft whatever through the blind grate 11, the ash-pit door 21 being always kept closed excepting at actual moments of removing ashes from the pit. The mass of hot ashes and coal upon the blind grate 11 serves to heat the escaping gaseous products of combustion, which then are consumed within the openings in the auxiliary bridge-wall 15, or which in any event when mingled with the steam and hot air from the channels

17 instantly burst into a mass of flame and are totally consumed as they flow over the top of the main bridge-wall 16. The plates composing the blind grate will, of course, be formed with openings or holes large enough to permit the ashes to be raked down through them into the ash-pit of the furnace. The water flows from the generator through the pipes 3 (or drums 5) and into the pipes 6, and thence into the drum 7, through the grate-bars 9 and 10, and also from said drum 8, through the pipes 4 (or the pipes 26 and drum 25), back into the generator. The water is thus repeatedly and continuously heated, in its passage through the pipes and drums, and is consequently returned to the generator in the most advantageous condition for conversion into steam; the plates of the blind-grate 11 also radiating their heat downward upon the supporting pipes 6, so as to heat the water flowing through the latter.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. A downdraft-furnace, comprising an upper downdraft grate composed of upper grate-bars and a lower set of grate-bars so disposed relatively to the upper bars as to produce an intervening space of greater depth adjacent to a draft-inlet and of less depth remote from such draft-inlet, and a blind down-draft grate located below the upper grate and receiving its draft wholly downward from such upper grate, substantially as set forth.

2. A downdraft-furnace, comprising an upper downdraft-grate composed of a plurality of sets of upper and lower water-grate bars so disposed relatively to each other as to produce an intervening space of greater depth adjacent to a draft-inlet and of less depth remote from such draft-inlet, and a blind-grate located below the upper grate and supported upon water-heating pipes, and also receiving its draft wholly downward from the upper grate, substantially as set forth.

3. A downdraft-furnace, comprising an upper and also a lower grate each composed of a plurality of sets of grate-bars so disposed relatively to each other as to produce an intervening space of greater and less depth, hot-air inlets located above said upper grate and in the sides of the furnace-chamber, and other air-inlets located in the front of the furnace-chamber and also above said upper grate, substantially as set forth.

4. A downdraft furnace, comprising a fire-chamber containing a bridge-wall provided with air-heating inlet-passages, a plurality of water-heating drums located at the front and rear of said chamber, an upper downdraft grate composed of a set of upper tubular grate-bars connected to said drums, and a lower set of tubular grate-bars also connected to said drums and so disposed relatively to the upper grate-bars as to produce an intervening space of greater depth adjacent to a draft-inlet and of less depth remote from such draft-inlet, and a blind downdraft grate located below the upper grate and receiving its draft wholly downward from said upper grate, substantially as set forth.

5. A downdraft furnace, comprising a fire-chamber containing a bridge-wall having air-heating inlet-passages, a pair of drums one of which is located in the front and the other in the rear of the chamber, a plurality of pipes connecting the rear drum to a boiler and supporting a closed wall or lining, an upper downdraft grate composed of an upper set of tubular bars connected to said drums, and a lower set of tubular bars also connected to the drums, and a blind downdraft grate located below the upper grate and receiving its draft wholly downward from said upper grate, substantially as set forth.

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