(No Model.)

5 Sheets—Sheet 1.

J. A. BALDWIN.

SMOKE CONSUMING OR PREVENTING FURNACE.

No. 470,171. Patented Mar. 8, 1892.

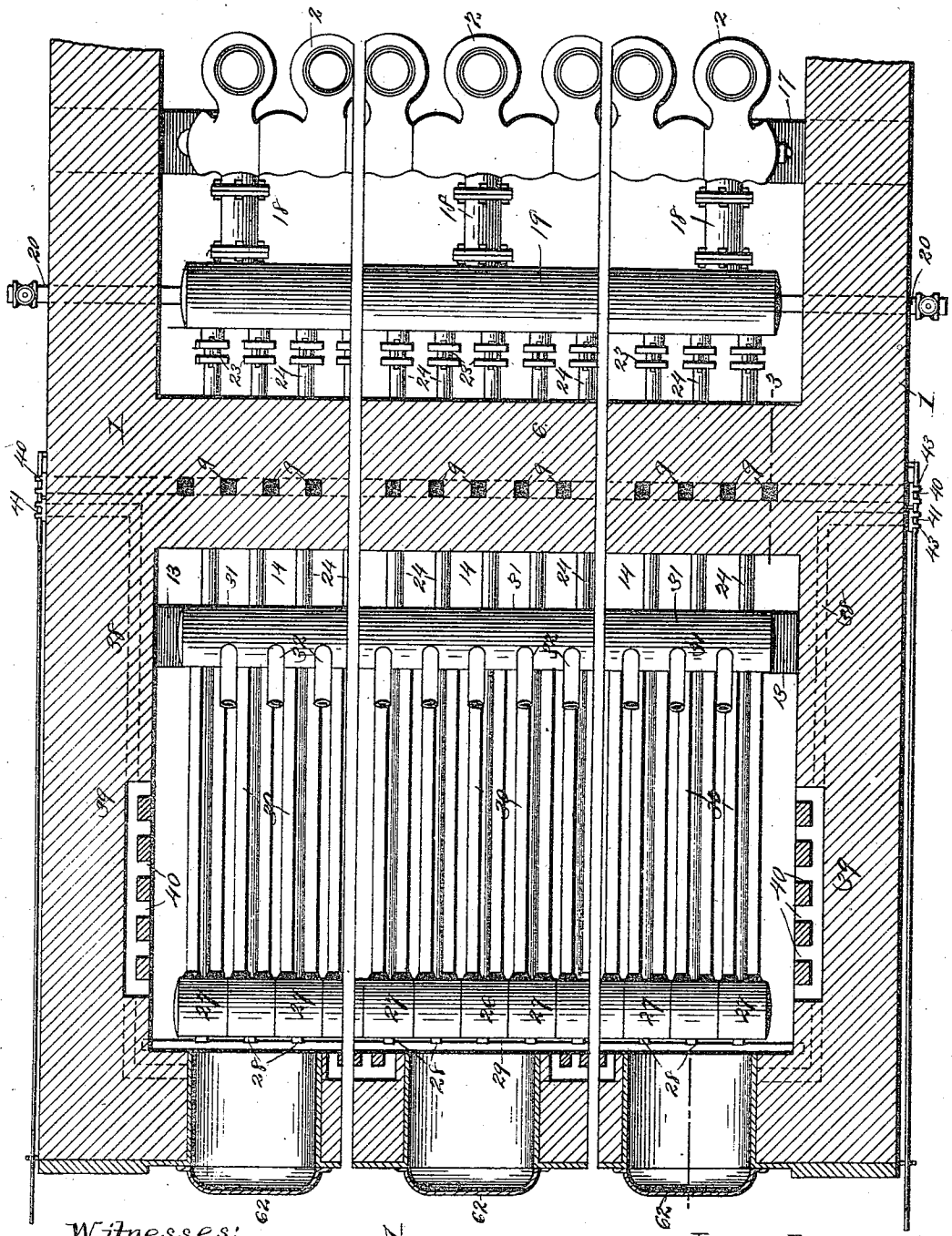

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Fig. 1.

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(No Model.) 5 Sheets—Sheet 2.

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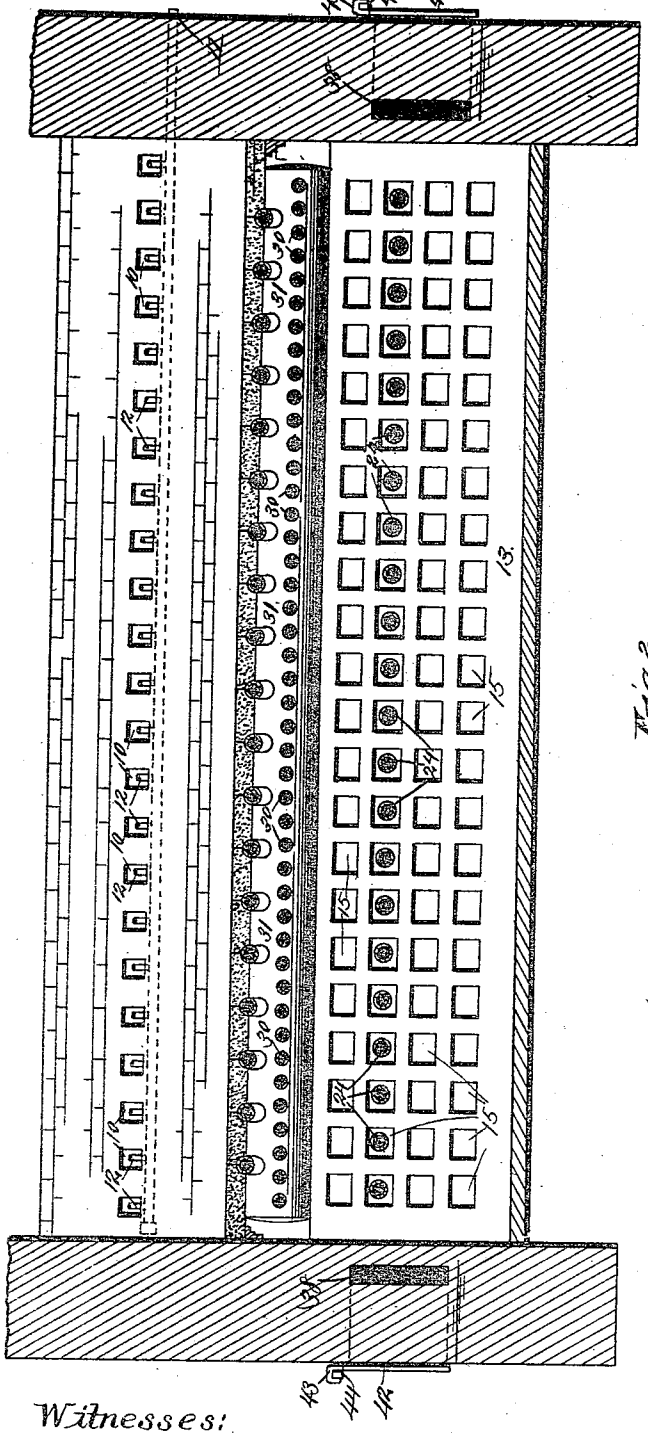


Fig. 6.

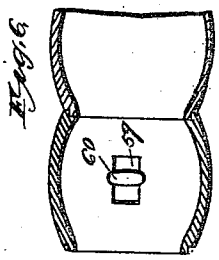


Fig. 5.

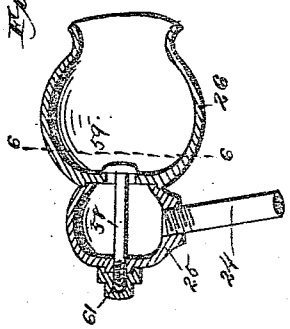
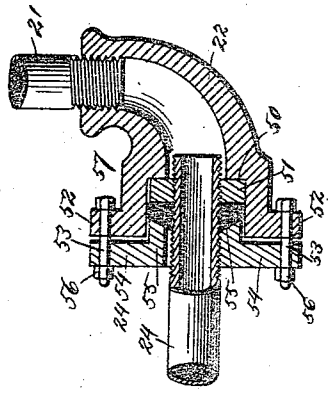


Fig. 2.

Fig. 4.



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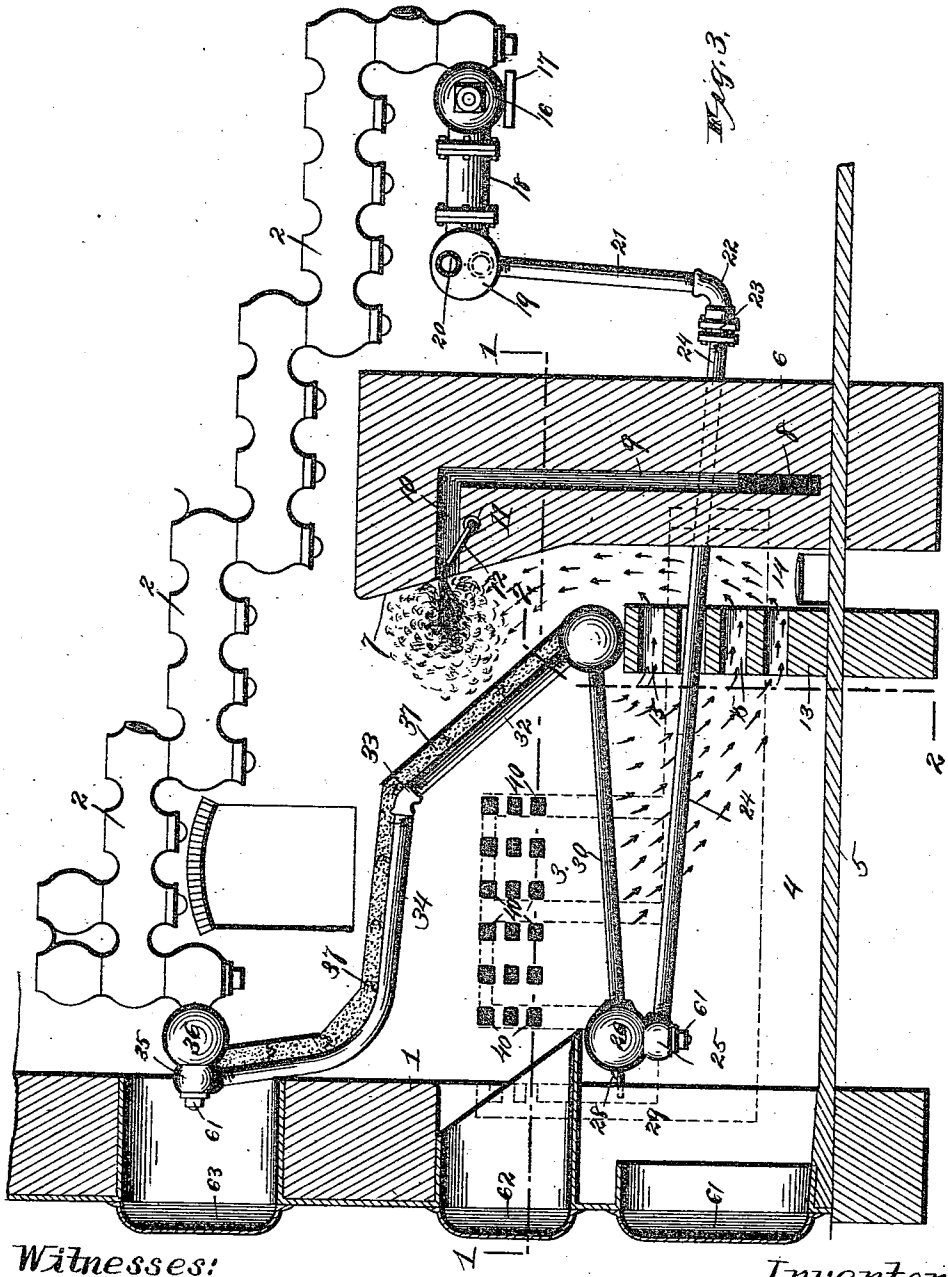
SMOKE CONSUMING OR PREVENTING FURNACE.

No. 470,171. Patented Mar. 8, 1892.



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(No Model.) 5 Sheets—Sheet 4.

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SMOKE CONSUMING OR PREVENTING FURNACE.

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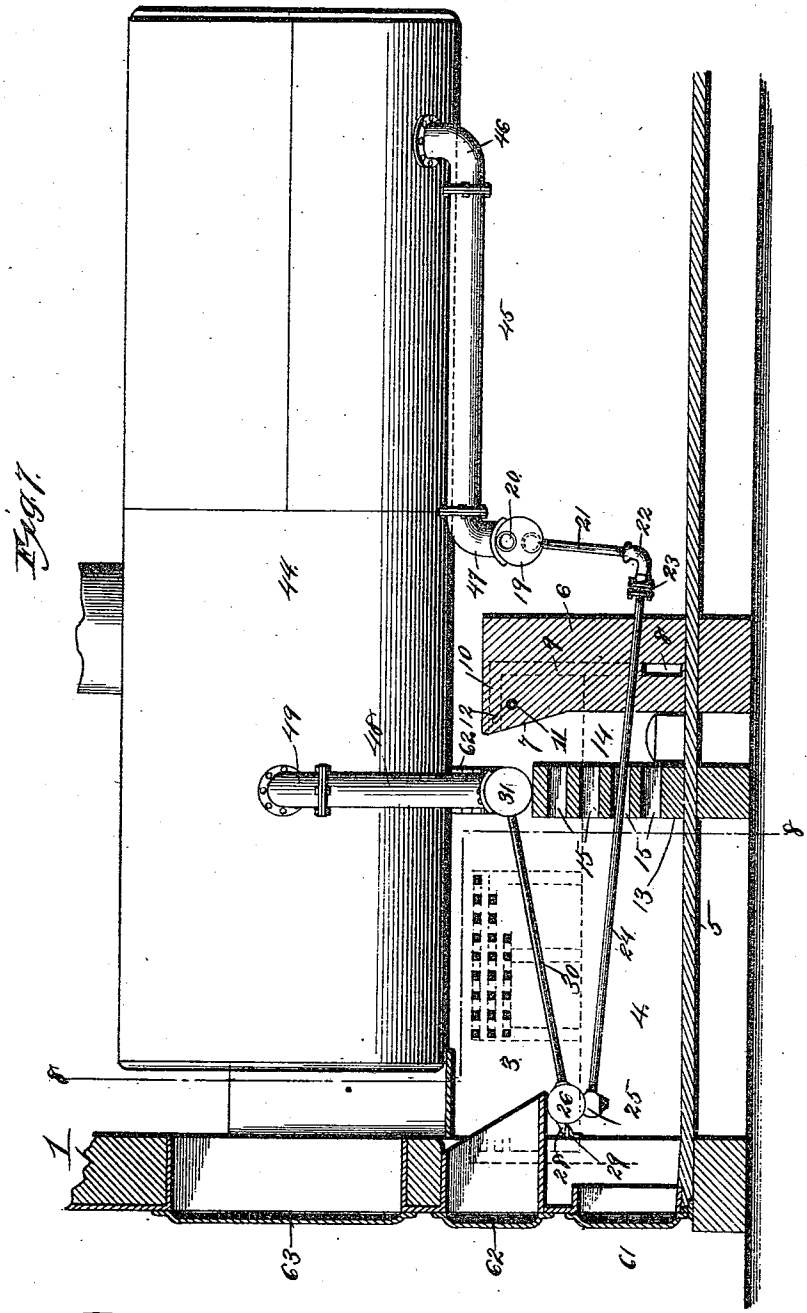

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(No Model.)

5 Sheets—Sheet 5.

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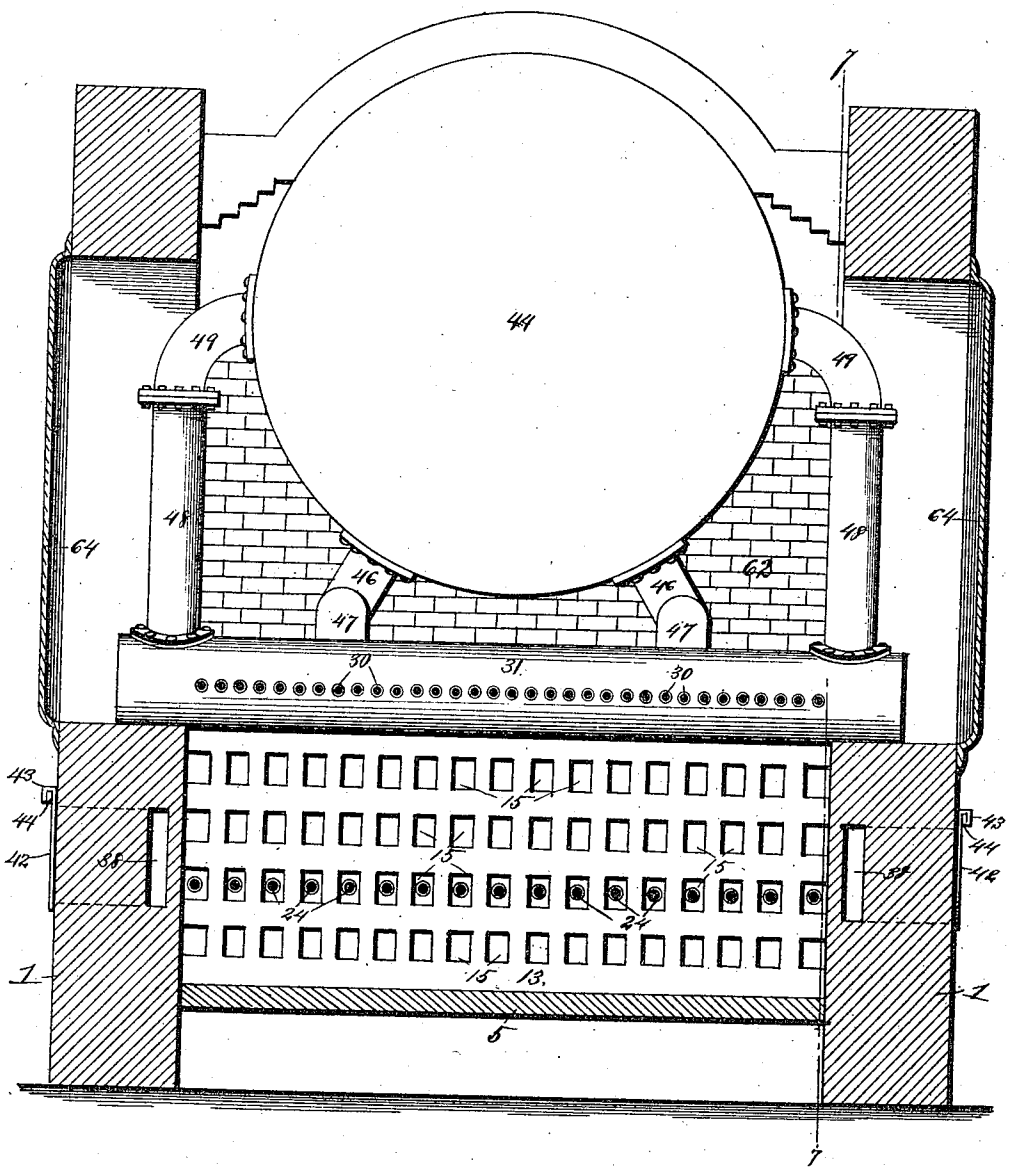
SMOKE CONSUMING OR PREVENTING FURNACE.

No. 470,171. Patented Mar. 8, 1892.

Fig. 8.



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UNITED STATES PATENT OFFICE.

JUDSON A. BALDWIN, OF BENTON HARBOR, MICHIGAN.

SMOKE CONSUMING OR PREVENTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 470,171, dated March 8, 1892.

Application filed September 7, 1891. Serial No. 405,027. (No model.)

To all whom it may concern:

Be it known that I, JUDSON A. BALDWIN, of Benton Harbor, Berrien county, Michigan, have invented certain new and useful Improvements in Smoke Consuming or Preventing Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to furnaces which are designed for use in connection with steam-generators for power or for steam-heating systems or for other purposes to which steam-generators are or may be applied.

The objects of my invention are, first, to produce a furnace which shall completely and thoroughly consume all of the inflammable or combustible products of combustion which have heretofore escaped and been lost in the form of smoke, thus materially economizing fuel, and at the same time materially increasing the effective capacity of the generator; secondly, to produce a furnace which, in addition to the advantages above stated, shall be simple, durable, and comparatively inexpensive in construction, and capable of application to all of the various types of steam-generators heretofore devised, and the circulating attachments of which can be readily and quickly built up and disconnected.

A still further object of my invention is to produce a furnace which shall operate as a feed-water heater, and by means of which a constant circulation of water shall be maintained in the generator, the colder water being constantly passed through the furnace and heated, and as constantly supplied to the generator in such heated condition, and the effective capacity of the boiler being thus further increased.

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

In order that my invention may be fully understood, I will proceed to describe it with reference to the accompanying drawings, in which—

Figure 1 is a horizontal cross-section of my improved furnace on the line 1 1 of Fig. 3, the furnace being applied to a generator of the safety type. Fig. 2 is a transverse vertical section of the same on the line 2 2 of Fig. 3. Fig. 3 is a vertical longitudinal section of the same on the line 3 3 of Fig. 1. Figs. 4, 5, and 6 are detached sectional views of certain features of construction, hereinafter described. Fig. 7 is a view, partly in side elevation and partly in vertical longitudinal section, on the line 7 7 of Fig. 8 of my improved boiler-furnace applied to a cylinder boiler. Fig. 8 is a transverse vertical section of the same on the line 8 8 of Fig. 7.

In the said drawings, 1 designates the setting of a steam-generator, the said setting being either of brick-work, masonry, or of any other suitable or preferred material, and of such form and dimensions as circumstances may require. In Figs. 1, 2, and 3 I have shown the setting 1 as inclosing a generator of the safety type, and more particularly of what is known as the "Wharton-Harrison" type of safety-boilers, this type of generator consisting of a number of balls or spheres 2, united together by peculiarly-arranged bolts, so as to form "units," and these units being grouped to form "slabs." It is to be understood, however, that while in the said figures of the drawings I have shown my improved furnace as applied to this particular type of safety-boilers and shall describe it as so applied, the said furnace is equally as well adapted to other types of safety-boilers.

Let 3 designate the fire-chamber, and 4 the ash-pit, of my improved furnace, the bottom of said ash-pit being formed by a horizontal plate or bottom piece 5, which is of any suitable or preferred non-combustible material, and which extends from front to rear of the boiler-setting. 6 designates the bridge-wall of the furnace, the said wall being also of brick-work, masonry, or other suitable non-combustible material and extending vertically and also from side to side of the setting 1. The upper front portion 7 of this bridge-wall is preferably inclined forwardly and upwardly, as is best shown in Fig. 3. In the lower part of this bridge-wall is formed a horizontal air-supply channel 8, which extends from end to end of the bridge-wall and which opens out through the corresponding sides of the setting 1. From this main air-supply channel 8 extend a number of vertical branch channels 9, which are also formed in the bridge-wall and

which at their upper ends communicate with the inner or rear ends of a corresponding number of horizontal branch channels 10. These branch channels 10 are formed in the upper part of the bridge-wall 6 and open at their front ends out of the upper front portion 7 of the bridge-wall. Through the upper part of the bridge-wall 6 extends a steam-supply pipe 11, which extends horizontally from end to end of the bridge-wall and which is suitably connected at one end to the steam-space of the generator. This pipe 11 extends immediately beneath the upper channels 10 before described, and is provided at intervals with jet-nozzles 12, each of which extends obliquely upward and forward from the supply-pipe 11, and the upper end of each of which opens outwardly and forwardly into the front part of each channel 10. Immediately in front of the bridge-wall 6 is a second or auxiliary bridge-wall 13, which is of less height than the main bridge-wall and which extends from one side of the setting 1 to the other or opposite side of the same. This wall occupies such a distance from the said bridge-wall 6 as to leave a transverse space or chamber 14 between the front side of the main bridge-wall 6 and the rear side of the auxiliary bridge-wall 13. This auxiliary bridge-wall 13 is of fire-brick or any other suitable refractory material, so as to be indestructible by heat, and said auxiliary wall is also of considerable thickness for a purpose to be presently explained. In the drawings the bridge-wall 13 is shown as of somewhat less thickness than the main bridge-wall 6, and said auxiliary wall is formed with a number of openings or channels 15, the front ends of which communicate with the interior of the ash-pit 4, while their rear ends communicate with the space 14. Owing to the thickness of the auxiliary bridge-wall 13, its openings or channels 15 are elongated horizontally, and are of such length as to operate as retorts for the products of combustion, as hereinafter explained.

16 designates a drum, which is supported upon a suitable shelf or ledge 17 back of the bridge-wall 6, and which extends horizontally across the setting 1 from side to side of the same. This drum 16 is suitably connected with the adjacent units or balls 2, and is also provided with a number of outlet-pipes 18, which extend forwardly from said drum. Three of these outlet-pipes 18 are shown; but it is obvious that a greater or less number of said pipes may be employed, if desired. The front ends of these outlet-pipes 18 are connected to a second drum 19, which also extends horizontally across the interior of the setting 1 back of the bridge-wall 6, and which is provided at each end with an inlet-pipe 20 for the admission of cold water from a pump or other feeding appliance. To the under side of this drum 19 are connected the upper ends of a number of pipes 21, which extend vertically back of the bridge-wall 6 and the lower ends of which are connected by bends 22 and coupling 23 to the rear ends of a number of pipes 24. The peculiar construction of the couplings 23 will be hereinafter described; but at present it will suffice to say that the pipes 24 extend obliquely forward and upward through the bridge-wall 6 and the dividing-wall 13, and at their front ends are connected to extensions 25 at the lower part or under side of a third drum 26. This drum 26 is composed of a number of separate and independent short cylindrical sections 27, each of which is formed on its under side with one of the extensions 25, to which the front ends of the pipes 24 are connected. Each of the sections 27 is provided on its front side with a lug 28, the said lugs resting on the upper side of a ledge 29, which extends horizontally along the inner side of the front wall of the casing 1 from side to side thereof. To the inner or rear side of each of the sections 27 is connected the front end of a pipe 30, there being thus any number of said pipes corresponding with the number of the sections 27. These pipes 30 constitute the water-bars of the furnace-grate and extend obliquely rearward and upward above the ash-pit 4 and pipes 24. At their rear ends these water-bars are connected to the front side of a drum 31, which rests upon the top of the dividing-wall 13 and which extends thus horizontally across the interior of the casing 1 from side to side of the same. This drum 31 is of elongated integral cylindrical form, (as also are the drums 16 and 19 before described,) and to its upper side are connected the lower ends of any desired number of pipes 32. These pipes 32 extend obliquely upward and forward, as is best shown in Fig. 3, and to their upper ends are connected a corresponding number of bends or elbows 33, to which latter are also connected the lower ends of a corresponding number of pipes 34. These pipes 34 are of approximately J form, their lower portions extending obliquely upward and forward at a slight angle from the horizontal and their upper portions extending also obliquely upward and forward at a slight forward angle from the perpendicular. The said pipes 32 and 34 thus form the top of the fire-chamber 3, and the upper ends of the pipes 34 are connected to extensions 35, which project from the front side of a drum 36. This drum 36 is of continuous cylindrical form, like the drums 16, 19, and 31, and said drum 36 extends horizontally within the interior of the casing 1 from side to side thereof, said drum being also connected to the front units or balls of the generator at a point considerably above the point of connection of the drum 16 with the generator. Upon the upper parts of the pipes 32 and 34 is laid a course or lining 37 of fire-bricks or other suitable refractory material, which thus completely closes the top of the fire-chamber 3. As will be seen by reference to the arrows in Fig. 3, this furnace is what is known as a "downdraft" furnace—that is to say, the fresh air for supporting combus-

tion of the fuel is fed inward upon the upper surface of the fuel upon the water-bars 30 and passes downward through the fuel, as hereinafter more fully explained.

The air-supply for the furnace is conducted through two horizontal air ducts or channels 38, one of which is formed within each side wall of the setting 1 and each of which opens at its rear end out of the side of the setting at a point back of the furnace. The front end of each of these air-channels opens into one of two chambers 39, each of which is formed in one side of the setting 1 and which communicates with the interior of the fire-chamber 3 through a suitable number of openings 40. The quantity of air entering through the channel 8 in the bridge-wall 6 and into the channels 38 in the sides of the setting 1 is regulated, as desired, by means of two slides or dampers 40 and 41, which cover the outer ends of the channels 8 and 38, respectively. There are, as shown, two of these slides or dampers at each side of the setting and each pair of said slides or dampers is carried by the rear end of an operating-bar 42, which extends horizontally along the side of the setting and the front ends of which project at the front of the setting. These dampers are supported in position by hooked lugs 43, which rest upon supporting-brackets 44 at the sides of the setting and allow the required movements of the slides or dampers.

I have thus described the construction and arrangement of my improved furnace as applied to a safety-boiler, and before describing certain details of construction which are applicable to all forms of the furnace I will describe the said furnace as applied to a cylindrical boiler, this description relating to the structure shown in Figs. 7 and 8. In these figures 1 designates the setting; 3 and 4, the fire-chamber and the ash-pit, respectively; 5, the bottom of the ash-pit; 6, the bridge-wall having the forwardly and upwardly inclined upper portion 7; 8, the air-inlet channel in the bridge-wall, and 9 and 10 the branch inlet-channels of the bridge-wall. 11 designates the steam-supply pipe, and 12 the steam-jet nozzle. 13 designates the dividing-wall, which is separated from the bridge-wall 6 by the space 14 and which is provided with the openings 15, and 40 designate the air-inlet openings from the channels 38. 42 designates the operating-bar for the slides or dampers, 43 the supporting-lugs of the same, and 44 the supporting-brackets for said lugs. These parts are designated by the same numerals as those which designate corresponding parts in the preceding figures, and said parts are in all respects like said corresponding parts in respect to form, material, and location. In this instance, however, a cylindrical generator 44, of the usual or any preferred type, is shown as located within the setting 1, the front end of said generator projecting over the upper part of the fire-chamber 3. In this instance the drum 16 is dispensed with and a connection is made with the lower part of the generator 44 by a pipe 45, a bend 46 being connected to the rear end of said pipe and establishing communication between the rear end of the pipe and the water-space of the generator. This pipe 45 is shown as extending horizontally forward behind the bridge-wall 6, and to its front end is connected a second bend 47, which communicates with the upper part of a drum 19. This drum corresponds in construction and location with the drum 19, before described, and is provided at its ends with water-inlet pipes 20, as before. From the under side of this drum 19 lead outlet-pipes 21, corresponding to the pipes 21, previously described, and which, as before, extend vertically downward behind the bridge-wall. The lower ends of these pipes are connected by bends 22 and couplings 23 (which are to be hereinafter more fully described) to the rear ends of the pipes 24, as before, and these pipes also extend obliquely forward and upward through the bridge-wall and dividing-wall and also through the ash-pit 4 in like manner as has already been described. The front ends of these pipes 24 are connected to extensions 25 at the under sides of the sections of the drum 26, and said drum-sections are supported by lugs 28, which rest upon the ledge 29, as previously explained. To the rear sides of the sections of drum 26 are connected the front ends of the water-bars 30, which extend obliquely upward and rearward in the fire-chamber 3, and the rear ends of which are connected to the drum 31, said drum resting, as before, on the top of the dividing-wall 13. These parts 19, 20, 21, 22, 23, 24, 25, 26, and 30 are similar in all respects in both forms of the furnace; but in this instance the drum 31 is connected by a pair of pipes 48, having each a bend 49 at its upper end with the generator 44 at points above the point of connection of the pipe 45 with said generator. In this instance the drum 36, before described, is dispensed with and the top of the fire-chamber is formed by the front end of the generator. In order to insure the required downdraft through the grate, a wall 62, of fire-brick, masonry, or other refractory material, is interposed between the pipes 48 and the top of the drum 31 and the under side of the generator 44, said wall serving the same purpose as the course or lining 37 before described.

In Fig. 4 I have shown the construction of the couplings 23, which connect the lower ends of the pipes 21 with the rear ends of the pipes 24, and I will now proceed to describe the construction of said couplings. In this figure 22 designates one of the bends which are screwed upon the lower ends of the pipes 21. Each of these bends is formed at its lower part with an internal annular shoulder 50. The rear end of each pipe 24 is externally screw-threaded to receive an internally-screw-threaded ring 51, which, when the connection is properly made, rests snugly against the said internal shoulder. The front end of

the bend is also formed with an external flange 52, through which are inserted any desired number of bolts 53, the said bolts extending also through the external flange 54 of a gland 55, which enters the front end of the bend, and nuts 56 being also screwed upon the front ends of the bolts 53 to retain the parts in position. A gasket 57, of any suitable material, is interposed between the front or outer side of the ring 51 and the rear or inner end of the gland 55, and the compression of this gasket, when the parts are properly connected, insures a perfectly-tight joint for the coupling. The opposite ends of the pipes 24 are also externally screw-threaded, the pitch of these front screw-threads being opposite from that of the screw-threads at the rear ends of the said pipes, and the said front ends of the pipes are screwed into the extensions 25, before referred to. Thus it will be seen that the front ends of the pipes are first screwed into the extensions 25, and the rings 51 are then screwed upon the rear ends of the pipes to such an extent as to bring the inner or rear sides of the rings snugly against the shoulders 50, when the parts are assembled. Before the rings are screwed upon the pipes 24 the glands and gaskets are placed upon said pipes in the order named, and after the rings have been properly adjusted upon the pipes the glands are forced against the gaskets by the nuts 56 of the bolts 53, and perfectly-tight joints are formed, as before stated. The extensions 25 are separate from the sections 27 of the drum 26, and are secured thereto by bolts 58, which extend longitudinally through the said extensions. An elongated opening or slot 59 is formed in the base of each section 27, and each bolt 58 is first inserted through said slot or opening, so that its head 60 (see Fig. 6) shall overlie the margins of the slot. Upon the opposite end of the bolt is screwed a rounded or capped nut 61, which presses upon the under side of the extension 25, and thus strongly connects the extension to the drum-section. By virtue of this arrangement expansion and contraction between the extensions 25 and the drum-sections are allowed, and at the same time all possibility of the bolts being burned out is prevented by the water which surrounds the bolts and by the capped nuts which protect the ends of said bolts. As before stated, these forms of couplings and connections of the pipes 24 with the pipes 21 and drums 26 are employed in both forms of the furnaces, and the described connection of the extension 25 with the sections 27 of the drum 26 is also employed in connecting the extensions 35 with the drum 36. In both forms of the furnace the front wall of setting 1 is provided with an ash pit door 61, and a fire-door 62, located immediately above the ash-pit door. In both instances, also, access to the interior of the setting is afforded by means of a door 63, which is located immediately above the fire-door, and in the structure shown in Figs. 7 and 8 access to the interior of the setting is also afforded by a pair of doors 64, which are located at the front part of the sides of the setting.

I will now proceed to describe the general operation of the furnaces above described. Referring first to the furnace shown in Figs. 1, 2, and 3, the fuel is fed upon the water-bars 30, the fire-door being normally in closed position, and the air for supplying combustion flows through and is highly heated in the channels 38 and passes through the openings 40 into the fire-chamber 3 and flows thence downward through the fuel and thence downward and also rearward through the ash-pit 4. The currents in passing downward and rearward through the ash-pit carry off from the fuel all of the gases resulting from combustion and also the finely-divided solid particles or smoke, which also result from the combustion of the fuel and which have heretofore been discharged through the stack and wasted. These products of combustion now flow through the openings of the dividing-wall 13, and owing to the fact that this wall is of considerable thickness, as above stated, the products of combustion become highly heated by the furnace. The products of combustion in passing through the elongated channels or perforations in this wall are also raised to a very high temperature in passing through the openings, said openings or channels thus serving as retorts for the products of combustion, and the latter are so divided up by the said openings as to be raised to the highest possible degree of temperature. The products of combustion in this highly-heated condition now flow upward in the space 14 between the bridge-wall and the dividing-wall, and the bridge-wall being also highly heated prevents any lowering of temperature of the products of combustion. Meanwhile fresh air is flowing through the channels 8, 9, and 10 in the bridge-wall and escapes into the upper part of the space 14 and becomes intimately intermingled with the products of combustion. At the same time this incoming air is charged with steam from the jets 12, and, owing to the highly-heated condition of the incoming air, products of combustion, and steam, the instant such elements meet they burst into flame and the smoke and combustible gases are immediately and totally consumed. Thus no smoke whatever escapes from the stack and the entire combustible substances of the fuel are consumed within the apparatus. Furthermore, the water passing through the pipes 24 is heated by the downdraft in the ash-pit from the furnace and also by the updraft in the space 14, and the water is also further heated in the drum 26 by direct contact of said drum with the fuel. The water is still further heated in the water-bars 30 by direct contact of the latter with the fuel, and is furthermore additionally heated in the drum 31 by contact of said drum on its

front side with the fuel and on its rear side with the burning products of combustion in the space 14. In flowing upward through the pipes 32 and 34 the water is further heated by the heat in the fire-chamber 3 above the grate or water bars 30, while the drum 36 is maintained at a high temperature by the burning products of combustion flowing from the space 14. These burning products of combustion likewise impinge upon the slabs or units of the generator proper and thus augment the generation of steam in said generator. It will thus be seen that not only is all of the combustible substance of the fuel completely consumed in the apparatus, but that the water flowing out of and back into the generator is subjected to repeated heatings, so that the maximum heating capacity of the fuel is both fully developed and effectively applied. The arrangement of the water-conducting devices is such that a constant and rapid circulation of water is automatically maintained, the water being taken from the lower and colder portion of the generator and returned to an upper and hotter part of the same. The operation of the furnace shown in Figs. 7 and 8 is precisely that just described in all essential particulars and need not, therefore, be described in detail. The air-supply is easily and quickly regulated, as desired, by the dampers 40 and 41 in the manner heretofore explained.

From the above description it will be seen that I have provided a furnace which is applicable to all types of steam-generators, and which is simple, durable, and inexpensive in construction, and the operation of which is entirely automatic and under perfect control. It will be furthermore seen that every particle of combustible matter in the fuel is entirely consumed, so that the full heating capacity of the fuel is developed and fully applied, and all escape of smoke is prevented. Thus the amount of fuel-consumption is greatly economized and the generating capacity of the apparatus is materially increased.

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

1. An improved downdraft smoke consuming or preventing furnace comprising a water-grate, a main bridge-wall located at the rear of said grate, and a perforated wall located in front of the bridge-wall and separated from said wall by a suitable vertical interval or space for the passage of the products of combustion, substantially as set forth.

2. An improved downdraft smoke consuming or preventing furnace comprising a water-grate, a main bridge-wall located at the rear of said grate and provided with air-supply passages, and a perforated wall located in front of the bridge-wall and separated from the latter by a suitable vertical space for the passage of products of combustion, substantially as set forth.

3. An improved downdraft smoke consuming or preventing furnace comprising a water-grate, a main bridge-wall located back of said grate and provided with air-inlet channels and with a steam-supply pipe having discharge-jets located in the front ends of said channels, and a perforated wall located in front of the bridge-wall and separated from the latter by a vertical space for the passage of products of combustion, substantially as set forth.

4. An improved downdraft smoke consuming or preventing furnace comprising a suitable setting, air-inlet channels at the sides of the setting and opening into the fire-chamber above the water-grate, a water-grate located in said setting below the openings of said air-inlets, a main bridge-wall located back of said grate and provided with air-inlet channels and a steam-supply pipe having discharge-jets opening at the front ends of said air-channels, and a perforated wall located in front of the bridge-wall and separated from the latter by a vertical space for the passing of products of combustion, substantially as set forth.

5. An improved downdraft smoke consuming or preventing furnace comprising a suitable grate, a main bridge-wall located back of said grate, and a perforated wall of considerable thickness located in front of said main bridge-wall and separated from the latter by a vertical space for the passage of products of combustion, the perforations or channels of said wall being also of a length corresponding with the thickness of the wall, substantially as set forth.

6. An improved downdraft smoke consuming or preventing furnace comprising a suitable generator, a water-grate, a main bridge wall located back of the water-grate, a perforated wall located in front of the bridge-wall and separated therefrom by a vertical space for the passage of products of combustion, a drum located back of the bridge-wall and connected to a lower part of the generator, and a second drum, also located back of the bridge-wall and connected to the first-named drum, tubular connections leading from the second-named drum and passing forwardly through the bridge-wall and the dividing-wall and also forwardly through the ash-pit, a third drum connected to the front of the water-grate and to the front ends of the said tubular connections and located at the front of the fire-chamber, a fourth drum mounted upon the top of the perforated wall and connected to the rear of the water-grate, a fifth drum connected to an upper front part of the generator, and tubular connections forming the top of the fire-chamber and connecting the last-named drum with the drum upon the perforated wall of the furnace, substantially as set forth.

7. An improved downdraft smoke consuming or preventing furnace comprising a suitable generator, a water-grate, a main bridge-wall located back of the water-grate, a per-

forated wall located in front of the bridge-wall and separated therefrom by a vertical space for the passage of products of combustion, a drum located back of the bridge-wall and connected to a lower part of the generator, a second drum, also located back of the bridge-wall and connected to the first-named drum, tubular connections leading from the second-named drum and passing forwardly through the bridge-wall and ash-pit and also forwardly through the ash-pit, a third drum connected to the front of the water-grate and to the front ends of said tubular connections and located at the front of the fire-chamber, a fourth drum mounted upon the top of the perforated wall and connected to the rear of the water-grate, a fifth drum connected to an upper front part of the generator, tubular connections forming the top of the fire-chamber and connecting the last-named drum with the drum upon the perforated wall, and a course or lining of refractory material supported upon said tubular connections and closing the top of the fire-chamber, substantially as set forth.

8. An improved downdraft smoke consuming or preventing furnace comprising a suitable generator, a water-grate, a main bridge-wall located back of the water-grate, a perforated wall located in front of the bridge-wall and separated therefrom by a vertical space for the passage of products of combustion, a drum located at the front of the fire-chamber and connected to the front of the water-grate, a second drum mounted upon the perforated wall and connected to the back of the water-grate and also communicating with an upper front part of the generator, a drum located back of the bridge-wall and communicating with a lower rear part of the generator, and tubular connections between the latter drum and the drum at the front of the fire-chamber, substantially as set forth.

9. An improved downdraft smoke consuming or preventing furnace comprising a water-grate composed of a number of tubular sections, a water-supply drum composed of a corresponding number of separate hollow sections, each connected to one of the water-grate sections, and a number of water-supply tubes leading from the generator and connected each to one of said supply-drum sections, substantially as set forth.

10. An improved downdraft smoke consuming or preventing furnace comprising a tubular water-grate, a sectional water-supply drum connected to said grate, a number of water-supply tubes connected each to one of the supply-sections, a number of supply-tubes connected to the generator, a corresponding number of couplings each connecting the corresponding supply-tubes, said couplings consisting each of a bend having an internal shoulder, a ring surrounding the tube and abutting against the shoulder, a gland also surrounding the tube and connected to the bend, and a gasket interposed between the inner end of the gland and the outer side of the ring, substantially as set forth.

11. An improved downdraft smoke consuming or preventing furnace comprising a casing or setting having air-inlet openings located above the grate, a drum having a separate extension, a bolt extending through a slot or opening in the drum and through the extension, a closed or capped nut screwed upon the threaded end of the bolt, a number of tubular water-grate bars connected to the drum and located below the air-inlet openings, and a number of water-inlet pipes located below the tubular grate-bars and connected to the drum-extensions, substantially as set forth.

12. An improved downdraft smoke consuming or preventing furnace comprising a water-grate, a main bridge-wall located back of said grate, a number of supply-tubes connected to said grate and passing through the bridge-wall, and a supply-drum located back of the bridge-wall and connected to the generator and to the supply-tubes and also provided with inlet-pipes for water, substantially as set forth.

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

JUDSON A. BALDWIN.

Witnesses:
H. E. PRICE,
JNO. L. CONDRON.