

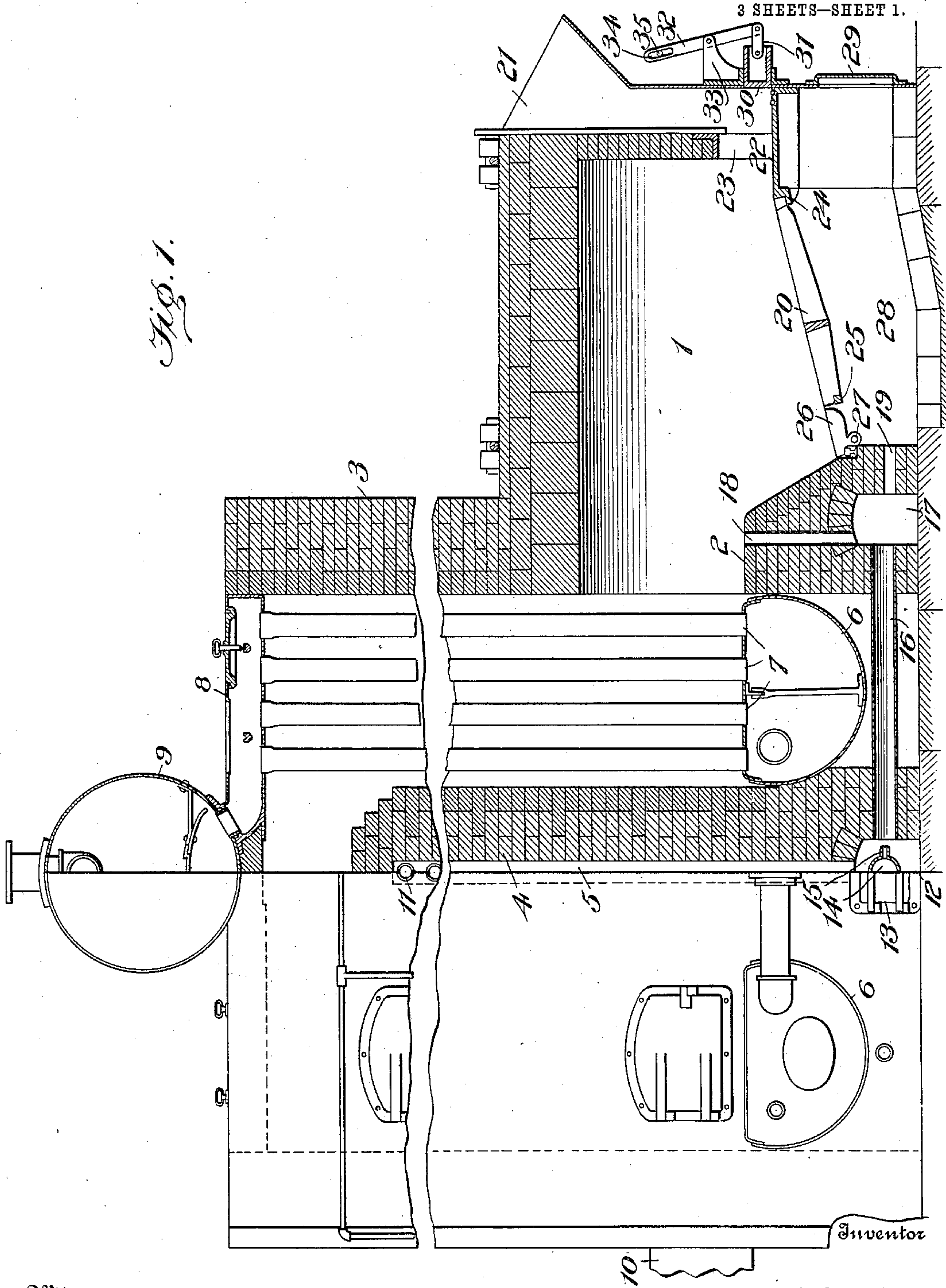
No. 824,385.

PATENTED JUNE 26, 1906.

J. F. SENTER.  
FURNACE.

APPLICATION FILED SEPT. 18, 1905.

3 SHEETS—SHEET 1.



Witnesses

Edwin L. Bradford  
J. R. Nottingham

334

John F. Senter

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Attorney



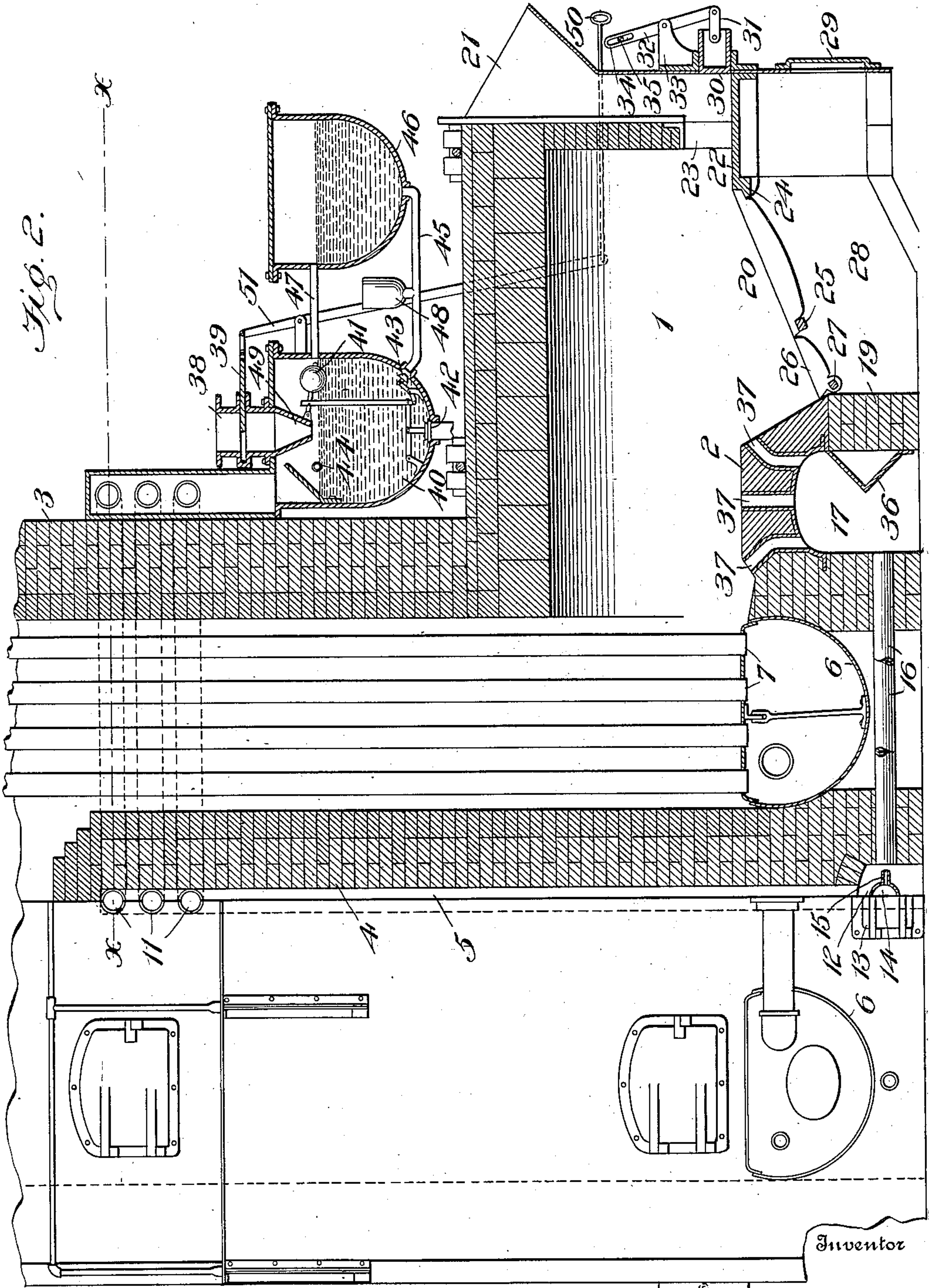
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John F. Senter  
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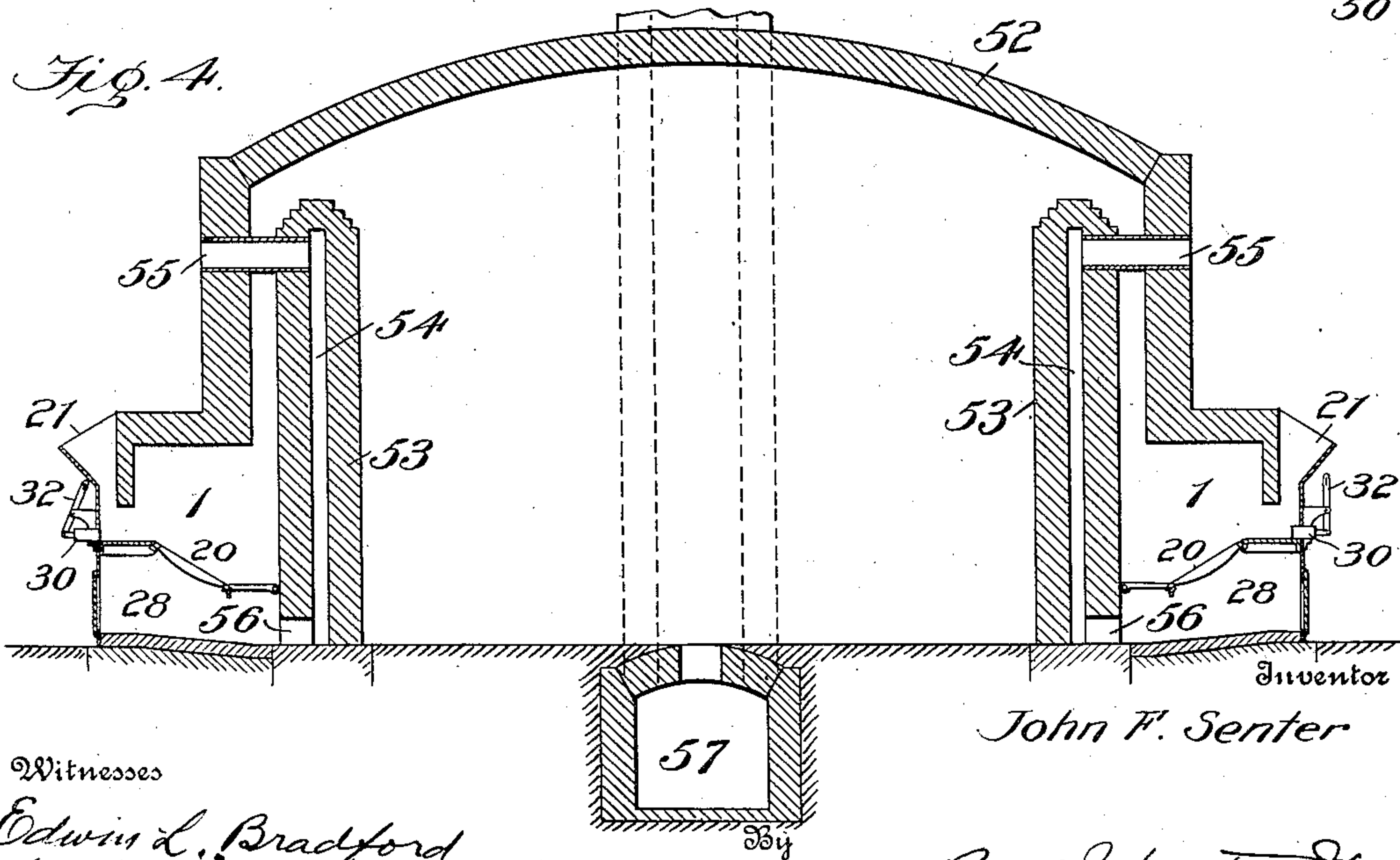
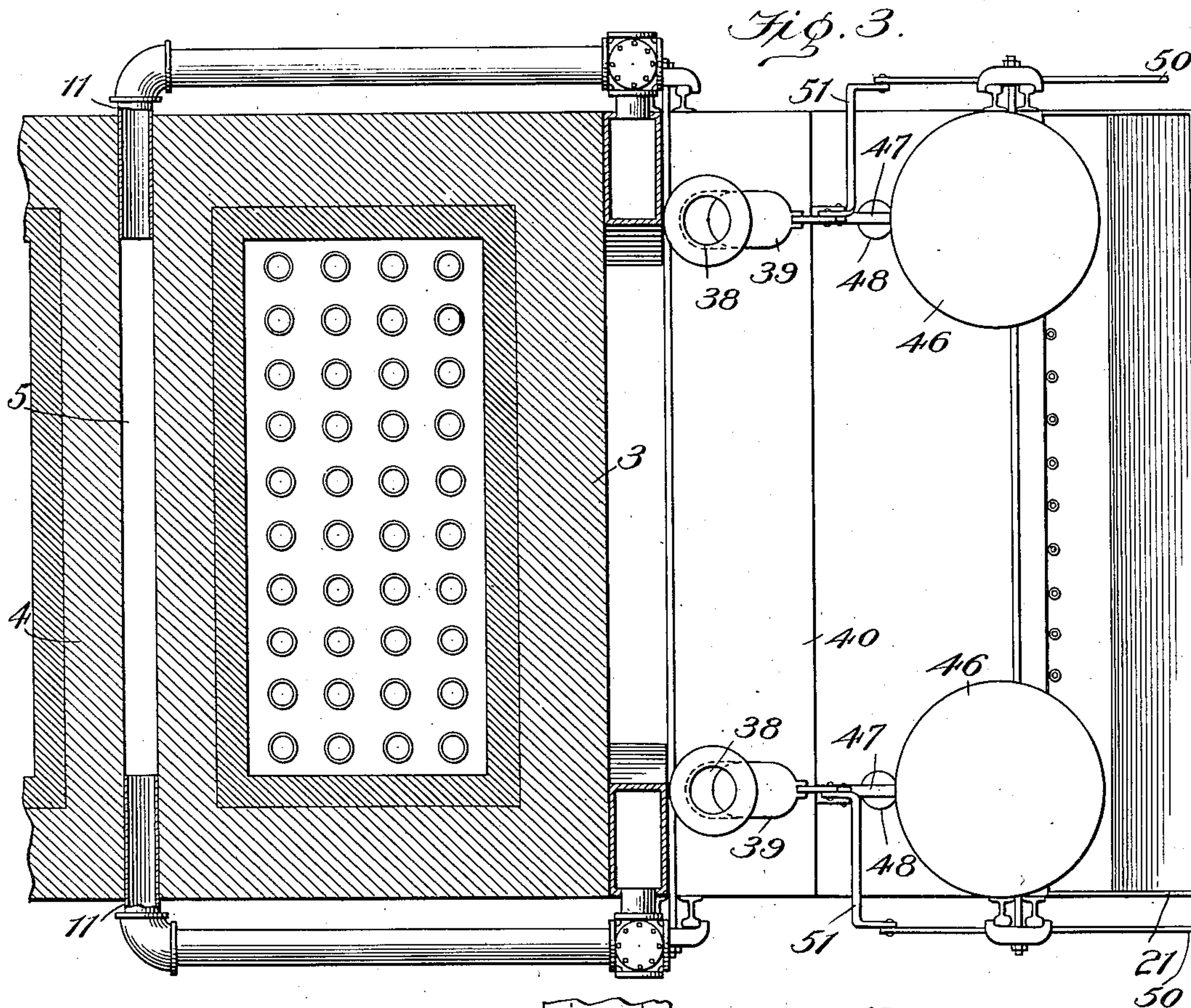
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3 SHEETS—SHEET 3.



Witnesses

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# UNITED STATES PATENT OFFICE.

JOHN F. SENTER, OF BIRMINGHAM, ALABAMA, ASSIGNOR OF ONE-HALF  
TO THE WALSH AND WEIDNER BOILER COMPANY, OF CHATTANOOGA,  
TENNESSEE, A CORPORATION OF TENNESSEE.

## FURNACE.

No. 824,385.

Specification of Letters Patent.

Patented June 26, 1906.

Application filed September 18, 1905. Serial No. 279,007.

*To all whom it may concern:*

Be it known that I, JOHN FLETCHER SENTER, a citizen of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented new and useful Improvements in Furnaces, of which the following is a specification.

My invention relates to improvements in the construction and arrangement of furnaces wherein I propose to increase their efficiency and economy of operation by providing means to introduce air or gas into the fire-box in a highly-preheated condition by passing it through a heating-passage formed in a division-wall in the furnace-casing.

My invention is particularly applicable in connection with the improvements in boiler construction briefly shown and described herein and constituting the subject-matter of a separate application, Serial No. 279,006, filed of even date herewith. As utilized for this purpose the boiler-tubes are preferably divided by a vertical partition in the main casing, which is hollow and is supplied with air or gas at its upper end and at its lower end communicates with conduits by means of which the air or gas may be discharged into the fire-box. I prefer to use a steam or air jet to positively force the fluid preheated by the partition into the fire-box, and I preferably discharge it into the fire-box through a plurality of openings in the bridge-wall thereof, these openings being arranged in the manner most suitable for the particular character of the combustible with which the furnace is fired.

When using my invention in connection with the burning of solid fuel, the furnace is normally maintained closed and the fuel introduced by a mechanical stoker to avoid the disadvantages of a surplus supply of air upon the opening of furnace-doors. The necessary amount of air for insuring a complete and substantially smokeless combustion of the fuel is then introduced through the hollow division-wall in the boiler-casing and at any desired points below the grate or above the bridge-wall, where it commingles with the gases from the fuel and produces a complete consumption of combustible elements therein. To produce the best results with solid fuel, it is desirable that the same should be fed into the furnace regularly and evenly

and in a manner to cause a complete volatilization of its combustible matter. I obtain this important result by feeding the fuel through a chute to a platform of considerable width which terminates within the fire-box substantially flush with the grate, which slopes downwardly and is preferably provided at its lower end with a dumping-grate portion. The width of the platform is provided for the purpose of effecting a substantial coking of the fuel before it passes onto the grate, the movement of the fuel toward the grate being effected by one or any desired number of mechanically-operated plungers. This even distribution and feed of the fuel in combination with the controllable supply of preheated oxygen delivered in a controllable quantity at the points where it will produce the best results enable me to obtain with my furnace a complete and smokeless consumption of the fuel.

My furnace is convertible for the burning of furnace or other kinds of gas, it being only necessary to connect the gas-supply conduit with the supply-ports for the hollow division-wall and utilizing an air-jet for the purpose of forcing the preheated gas into the fire-box. To further perfect this adaptation of my invention, I provide means to purify the furnace-gas by washing it in water treated with a purifying agent, such as trisodium phosphate.

My invention is also applicable for use as a furnace for ovens or kilns, the air or gas being preheated in a high partition-wall disposed within the oven or kiln and so arranged that the flames from the furnace are caused to pass upwardly over this partition before entering the oven. As applied to this use a plurality of furnaces may be used for each oven or kiln, which is then provided with a central outlet-flue in its bottom.

In addition to the above particular uses my invention possesses advantages in the details of construction and arrangement of parts which are hereinafter described, and illustrated in the accompanying drawings, in which—

Figure 1 is a vertical sectional view of my furnace as applied to my improved steam-boiler, which is shown partly in side elevation. Fig. 2 is a similar view of my furnace as converted for the burning of gas. Fig. 3 is a view along the line *xx*, Fig. 2. Fig. 4 is



a vertical sectional view through an oven or kiln, showing it provided with my improved furnace.

Similar reference-numerals refer to similar parts throughout the drawings.

In describing my invention as applied to my improved boiler I have illustrated it as comprising a fire-box 1, provided with a bridge-wall 2, over which the flames pass and enter the main casing 3 of the boiler. A hollow vertical division-wall 4, forming a pre-heating-chamber 5, divides the interior of the boiler-casing into two compartments, in each of which is seated a lower drum 6, connected by water-tubes 7 with headers 8, which are in turn connected to and support a steam-drum 9. The flames pass over the division-wall 4 and down to the stack-opening 10. One or more ports or passages 11 lead through the ends of the division-wall and casing, as in Fig. 3, and introduce air or gas, as the case may be, to the upper end of the chamber 5. These pipes preferably enter the division-wall on both sides, so as to distribute the air or gas more evenly therein. At its lower end this chamber 5 opens into a compartment 12, having doors 13 at its ends to enable it to be cleaned out. A pipe 14 is disposed within the compartment 12 and provided with one or a series of jet-nozzles 15, which are adapted to discharge a fluid, such as air or steam, under pressure into one or more pipes or passages 16, which lead through the division-wall and beneath the front drum 6 and enter a chamber 17 in the hollow bridge-wall 2. The compartment 12 may be dispensed with, in which case the pipe 14 will be disposed in the lower end of the chamber 5. Preferably a number of pipes 16 are used and a jet-nozzle 15 disposed so as to discharge into each of these pipes, thus acting with an ejector effect to draw the air or gas through the chamber 5 and force it into the chamber 17. From this point air or gas flows through passages, such as 18 and 19, which discharge, respectively, above the bridge-wall and below the grate 20 of the fire-box. In the case of gas, as hereinafter described, I prefer to cover the passage leading below the grate, so that the gas flows through the top of the bridge-wall.

I propose as a preferred means of introducing fuel in the fire-box 1 to feed it through a chute 21, connected to the front end of the fire-box and disposed above a platform 22, which forms a bottom for the feed-doors 23, through which the fuel enters the fire-box. The platform 22 projects well into the fire-box and is provided with a flanged shoulder 24, which supports the front end of the grate 20, preferably on a level with the platform. A cross-bar 25 supports the rear end of this grate adjacent to the dumping-grate 26, which is swivelly mounted on an axis 27 and

adapted to drop cinders and ashes into the pit 28, from which they may be withdrawn through the door 29.

To control the feed of fuel, I provide any desired number of plungers 30, which rest upon the outer edge of the platform and pass through suitable openings at the bottom of the chute. Links 31 swivelly connect these plungers to operating-rods 32, journaled upon standards 33, connected to the chutes. These rods are provided with elongated slots 34 at their upper ends, through which a common actuating-rod 35 passes, so that the plungers at the front of the fire-box can be moved simultaneously. This effects an even and regular supply of fuel to the grate, which is of considerable advantage. The platform 22 is of such a width that the fuel as it drops thereupon from the chute is coked before the plungers shove it across and onto the grate. The continued operation of the plungers forces the fuel as it burns down the inclined grate 30 until it reaches the dump-grate 26, when it will have been completely burned. The dump-grate is operated, preferably, at the same time with the plungers, so that equal quantities of fuel are introduced upon and discharged from the grate at the same time. This maintains a regular distribution of the fuel in a comparatively thin body over the grate, thus giving the preheated air a ready access to all the fuel and enabling the combustible matter of the latter to be readily and completely volatilized. The best results are obtained from the furnace by regulating the supply of air thereto proportionately to the supply of fuel, this regulation being effected either by valving the ports 11 or varying the injector-pressure of the steam-jets.

In adapting the furnace hereinbefore described for burning gas the latter is introduced through the ports 11 and is forced by a jet of compressed air into the hollow bridge-wall 2. The chamber 17 in the bridge-wall is preferably provided with a director-plate 36, opposite the pipe 16, which causes the air and gas to thoroughly commingle before passing up through the ports 37 in the top of the bridge-wall. This plate 36 may be used to close the port or ports 19, leading under the grate, as it is desirable to burn the gas at the top of the bridge-wall.

In adapting my invention for burning blast-furnace gas it is desirable to separate from the gas all particles of carbon, lime, mineral particles, and other hardenable crust-forming materials with which the gas is usually heavily charged and which, if permitted to enter the furnace, will incrust the boiler with a thick scale and greatly reduce its steaming efficiency, as well as cost of maintenance and cleaning. To avoid this, I propose to wash the gas by introducing it through pipes 38, under the control of valves



39, into a long tank 40. The tank is provided with a float 41, which controls the flush-valve 42. Water is supplied to the tank 40 through a pipe 44, under the control of a globe-valve or other suitable means, to supply it as it is needed. The valve 43 controls the return of water through a pipe 45, from a tank 46, which is connected with the tank 40 through a pipe 47. A water-purifier, such as trisodium phosphate, is introduced into the circulation through a receptacle 48, connected to the return 45. This purifier is preferable, as it is readily soluble in the water, will not vaporize and pass off in the steam, and is non-corrosive in its action. It will immediately act upon the boiler-injuring carbonates and sulfates of lime, magnesia, and other incrusting materials, changing them into unhardenable phosphates and neutralizing the carbonic and sulfuric acids which the water takes up from the gas. By maintaining the water in this condition, the gas is thoroughly washed and all injurious impurities are deposited in the tank 40 and flushed out through outlet 42, so that the gas may be burned without necessitating the constant cleaning out of the boiler and the blowing off of the tubes. When gas is used, the top of the fuel-chute is closed or the fire-box opening 23 is closed to prevent the entrance of cold air.

The gas-pipes 38 preferably terminate in spread nozzles 49. The valves 39 may be operated by handles 50, through the rigging 51, the handles being disposed conveniently to the front of the fire-box.

In adapting my invention for firing ovens or kilns I provide a main oven 52 with a high partition-wall 53, which is hollowed out to form the chamber 54, as in Fig. 1. Pipes 55 admit air or gas to the upper end of this chamber, from which it flows through port 56, into the fire-box 2, which is provided with the fuel feeding and burning appliances hereinbefore described. In this case the division-wall takes the place of the bridge-wall, being arranged so that it becomes highly heated by the flames as they pass upwardly between the wall and casing before entering the top part of the oven. A suitable outlet-flue 56 is provided for the flames near the center of the bottom of the oven or kiln. As shown, two or more of these furnaces may be used to fire the same kiln, which may thus be heated by solid fuel or gas, as may be most convenient.

I have in detail described several applications of my invention and have illustrated it in its preferred forms. It will be understood, however, that it may be modified without departing from the principles which control its operation, and I desire to protect all such modifications.

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

1. In combination with a vertical boiler-

casing divided into compartments by a hollow partition-wall, a transverse chamber at the bottom of said partition, a steam-pipe therein, a plurality of pipes leading therefrom, a plurality of jet-nozzles for discharging steam into said pipes, ports to admit air or gas near the top of said hollow partition, a fire-box, a hollow ported bridge-wall therefor to which said pipes lead, and means to protect said pipes from the direct action of the flames.

2. The combination with a furnace-casing and a separate fire-box communicating therewith, of a vertical hollow partition-wall having an enlarged chamber at the bottom thereof, ports for the admission of air or gas at the top of said wall, a hollow bridge-wall parallel to said partition-wall, a set of pipes to carry the preheated air or gas from said enlarged chamber to said bridge-wall, and a multiported steam-pipe in said chamber to force the circulation through said pipes.

3. The combination with a vertical boiler-casing, having a hollow partition-wall therein, of a Dutch oven opening into said casing, a hollow bridge-wall over which the products of combustion flow from said oven, a drum seated behind said bridge-wall, air-pipes connecting said hollow partition and bridge-walls and disposed below said drum, and ports to admit air or gas to said hollow partition-wall and discharge it through said bridge-wall into said Dutch oven.

4. The combination with a furnace-casing divided into two compartments by a vertical partition over which the products of combustion flow, a Dutch oven opening near the bottom of one compartment, a hollow bridge-wall at the inner end of said oven, a drum mounted between said wall and partition, pipes to connect the hollow chambers in said wall and partition which are protected by said drum, ports to admit air or gas to the chamber in said partition, a multiported steam-pipe to force said air or gas into said pipes, and ports to discharge said air or gas into said oven, substantially as described.

5. In a furnace for burning solid or gaseous fuel, the combination with a vertical boiler-casing, a fire-box opening into said casing and provided with a grate and fuel-charging doors, a hollow wall between said fire-box and casing, a hollow deflector-wall in said casing, a normally open port or ports leading from the interior of said deflector-wall without said boiler-casing, a gas-supply pipe or pipes, means to connect said pipes and ports, a chamber at the bottom of said deflector-wall, a steam-jet pipe therein, a plurality of pipes disposed out of contact with the flames, which lead from said chamber to said hollow wall between the fire-box and casing, and ports in said latter wall which discharge the gases into said fire-box.

6. The combination with a boiler-furnace



having a vertical hollow partition-wall therein, of gas-pipes entering the upper end of said wall, a steam-pipe entering the lower part of said wall, a fire-box without the boiler-casing  
5 provided with grate-bars and fuel-charging doors, a bridge-wall for said fire-box disposed parallel to said partition-wall and provided with a chamber, pipes leading from the partition-wall to said chamber in the bridge-wall,  
10 steam-jets to force the gas admitted to said partition-wall into said chamber in the bridge-

wall, an angular plate in said chamber against which the gases are discharged, and a plurality of ports leading from said chamber, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JOHN F. SENTER.

Witnesses:

W. H. MOORE,  
NOMIE WELSH.