

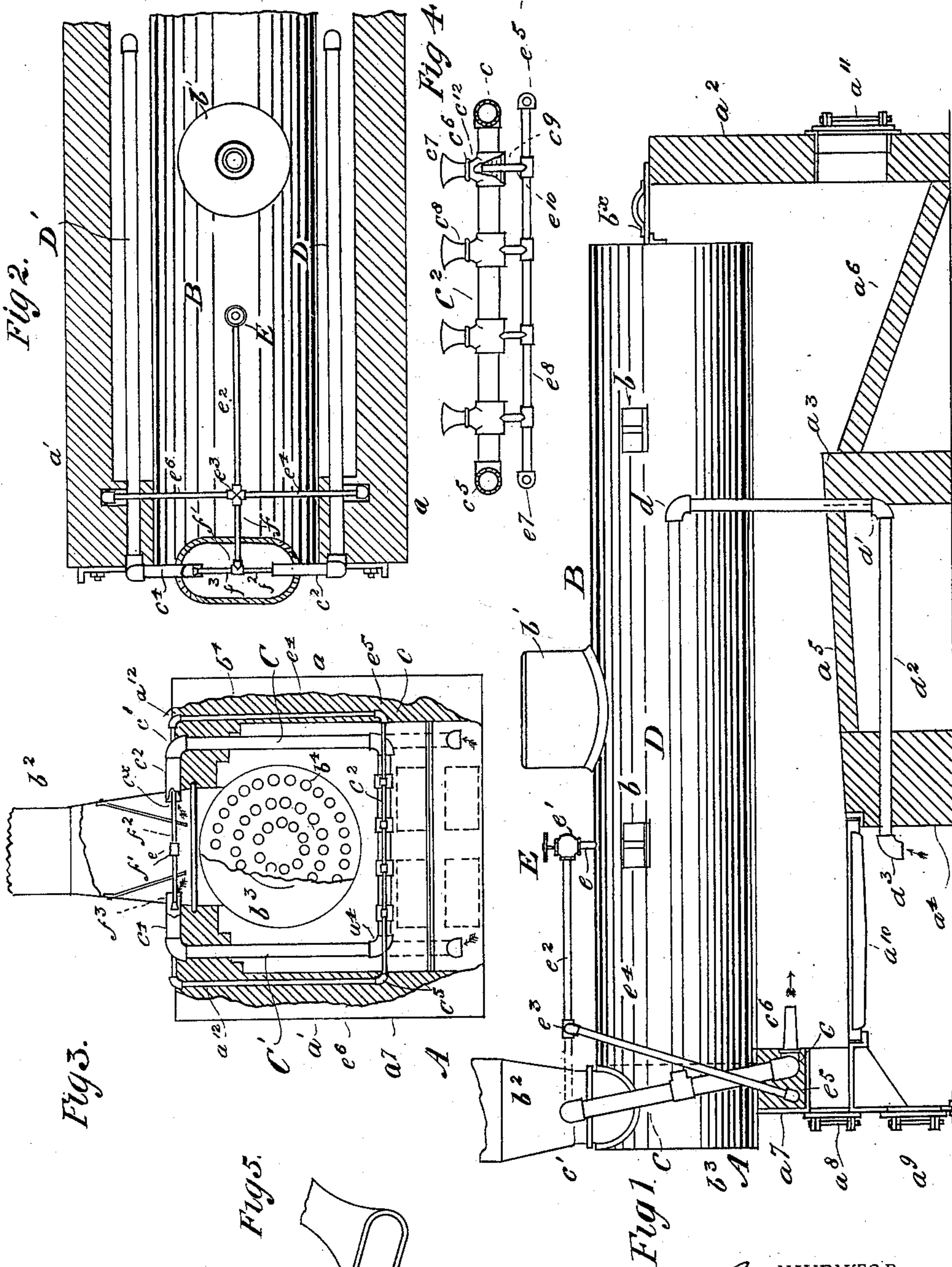
(No Model.)

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SMOKE AND GAS RETURNING APPARATUS FOR STEAM BOILERS.

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WITNESSES:

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SMOKE AND GAS RETURNING APPARATUS FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 596,638, dated January 4, 1898.

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To all whom it may concern:

Be it known that I, PETER STRAUSS, a citizen of the United States, and a resident of Leavenworth, in the county of Leavenworth and State of Kansas, have invented certain new and useful Improvements in Smoke and Gas Returning and Mixing Apparatus for Steam-Boiler Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others to make and use the same, reference being had to the accompanying drawings, forming a part of this specification.

The object of my invention is, primarily, to return the smoke and gas liberated by combustion of the fuel in the furnace, to aid combustion and thus prevent any smoke from escaping from the furnace; second, to collect the gas and smoke beneath the grate effected by a draft and aid combustion; third, to intercept the smoke and gas within the smoke-flue.

My invention consists in the novel construction and combination of parts, such as will first be fully described, and specifically pointed out in the claims.

In the drawings, Figure 1 is a longitudinal vertical sectional view of a steam-boiler furnace, showing the furnace front plate and the front of the steam-boiler broken away and my improved smoke and gas returning apparatus connected with the boiler and extending within the furnace and the smoke-flue. Fig. 2 is a plan view of the steam-boiler and furnace with the top of the furnace removed and with the rear end of the boiler and furnace broken away, also showing the smoke-flue in horizontal section and my improved smoke and gas returning apparatus in the furnace and smoke-flue. Fig. 3 is a view of the furnace and boiler, taken from a position at its forward end and with the furnace front plate broken away and the side walls in vertical section, also showing the smoke-flue broken away and the improved smoke and gas returning apparatus within the furnace and smoke-flue. Fig. 4 is a plan view in detail of the horizontal portion of the smoke and gas mixing chamber with the gas-jets and the steam pipe and jets, also showing the chamber furnace-grate broken away to show the concentric jet-openings. Fig. 5 is a detail

view of the jet-pipe connected with the gas-mixing chamber.

Similar letters of reference indicate corresponding parts in all the figures of the drawings. 55

Referring to the drawings, A represents a steam-boiler furnace, of which $a a'$ are the side walls, and a^2 the rear end wall.

a^3 is the bridge-wall. 60

a^4 is the grate-supporting wall.

a^5 is the upwardly-inclined hearth extending from the grate-supporting wall to the bridge-wall.

a^6 is the rear ash-pit. 65

a^7 is the furnace front plate.

a^8 is the upper furnace-door, opening above the grate, and a^9 the lower furnace-door.

a^{10} is the furnace-grate.

a^{11} is the door in the rear end wall for the removal of the ashes. 70

a^{12} is the top of the furnace.

B represents the horizontal steam-boiler, arranged between the side walls $a a'$ and supported at its forward end by the front plate a^7 , through which it extends, and upon its side by the bracket b , connected with the end of said boiler. 75

b^x is a wall-plate connected with the end of the boiler, resting upon the rear end wall a^2 . 80

b' is the steam-dome, and b^2 is the smoke-flue, which is connected with the upper side and forward end of the boiler B.

b^3 is the front end of the boiler, and b^4 is the smoke-flue in the boiler B, through which the smoke and gas passes from the furnace between the front plate b^3 and the flues and thence up the smoke-flue b^2 . 85

In the construction of my improved apparatus for consuming the smoke and gas a pipe C of the requisite length is extended downwardly within the furnace, through the top a^{12} upon one side of the boiler B, and of the smoke-flue b^2 , the lower end of said pipe terminating at a point a considerable distance above the upper surface of the grate a^{10} and a slight distance above a horizontal line extending through the top portion of the door a^8 . Upon the said lower end of pipe C is an elbow c . Upon the upper end of pipe C is an elbow c' . With the elbow c' is connected one end of a short length of pipe c^2 , the other end 95 100

of which pipe extends through the side of the flue b^2 at a point a short distance above the top portion of the boiler B and terminates a short distance from the inner side of said flue.

5 Upon the other side of the boiler B is a gas and smoke conducting pipe C' , which is precisely the same as pipe C and arranged in position in like manner, said pipe C' having a short length of pipe c^4 , corresponding to the
10 pipe c^2 , which extends within the flue b^2 from the other side and at a like distance from the inner side of said flue as described of pipe c^2 . Upon the lower end of the pipe C' is an elbow c^5 . With the elbow c on the lower end of the
15 pipe C is connected one end of a steam-superheating pipe or chamber c' , the other end of which pipe is connected with the elbow c^6 on the lower end of the pipe C' . On the side of pipe c^2 , toward the rear end wall a^2 and near
20 the elbow c , is a gas-jet pipe c^5 , the other end of which is extended in width, the nozzle of which is provided with an oblong orifice c^7 . A short distance from the jet-tube c^6 , in the direction of the elbow c^5 , is a jet-tube c^8 ,
25 which is precisely the same as the jet-tube c^6 , and a series of said jet-tubes are connected with said pipe c^2 in the same manner as the jet-tubes c^6 c^8 and extending in the same direction.

30 With the pipe C, at a point nearly equidistant from either end, is connected one end of a smoke and gas conducting pipe D, the other end of which pipe extends rearwardly to a position vertically in line with the inner side of
35 the bridge-wall a^3 and is bent at right angles, as at d , and extended downwardly through the hearth a^5 and a short distance below the under side portion of said hearth, and is then bent at right angles, as at d' , and a return portion d^2 extended forward through the grate-supporting wall a^4 at a point a short distance
40 below the under surface of the grate a^{10} , and an elbow d^2 , fitted upon said end, which is reversible in position, as seen in dotted lines.
45 Upon the other side of the boiler B, and connected with the pipe C' at a corresponding point as described of pipe D, is connected a smoke and gas conducting pipe D' , which is precisely the same in construction and arrangement as the pipe D and extends beneath
50 the grate a^{10} in like manner.

With the top portion of the boiler B and a short distance from the dome b' in the direction of the smoke-flue b^2 is connected one end
55 of a pipe e , with the upper end of which is connected an elbow e' , in which elbow is a valve E. With the elbow e , which is elevated above the boiler about the same height as the pipes c^2 c^4 , is connected one end of a
60 steam-conducting pipe e^2 , the other end of which pipe extends in the direction of and nearly to the smoke-flue b^2 , and upon said end is a four-way pipe-joint e^3 . With said joint e^3 is connected one end of a pipe e^4 ,
65 which is considerably less in size compared with pipe C, the other end of which pipe extends at right angles to the pipe e^2 in the di-

rection of the inner side of the wall a and within an upwardly-extended groove or recess c^x in the inner side of said wall, thence
70 extended in a downward direction within said space or recess, the lower end of which pipe extends downwardly the same distance as described of the pipe C and is inclined in position in the direction of the inner side of the
75 furnace front plate a^7 , upon which end is an elbow e^5 . With the four-way joint e^3 is connected one end of a pipe e^6 , the other end of which pipe extends in the direction of the inner side of the furnace-wall a' and also downwardly the same described distance as the
80 pipe e^4 and within a recess in the inner side of the wall a' corresponding to that in the wall a . Upon the lower end of the pipe e^6 is an elbow e^7 . With the elbow e^5 on the lower
85 end of pipe e^4 is connected one end of a steam-superheating pipe or case e^8 , the other end of which pipe is connected with the elbow e^7 on the lower end of the pipe e^6 .

In the pipe C^2 , upon the side opposite the
90 steam-pipe e^8 and directly in rear of the jet opening or orifice, is an opening c^9 , and from the side of the pipe c^6 opposite the opening c^9 is extended a small jet-pipe e^{10} , which extends
95 within the opening c^9 in the pipe C^2 and fits closely therein and also extends to and a short distance within the jet-pipe c^6 , and between said pipe c^6 and the jet-pipe c^9 is a concentric opening e^{12} .

In rear of the jet-pipe c^8 is an opening, as
100 described of the opening c^9 , in which is inserted a small pipe, connected with the pipe e^8 , as described of the pipe e^{10} , and a series of said pipes are connected with the pipe c^8
105 at suitable distances from each other in the direction of the other end of the pipe and extended within the pipe C^2 in the same manner. With the four-way joint e^3 , upon the
110 top of the boiler, is also connected one end of a pipe f , the other end of which pipe extends through the rear side of the flue b^2 to a point in line with the opposite ends of the respective pipes c^2 c^4 , and upon said end is a three-way pipe-joint f' . With the three-way pipe-joint f' is connected one end of a pipe f^2 , the
115 other end of which pipe extends in the direction of and a short distance within the pipe c^2 , between which and the inner side of the pipe c^2 is a circular space c^x for the passage of gas and smoke, the inner sides of which
120 ends are funnel-shaped. With the three-way pipe-joint f' is connected one end of a pipe f^3 , the other end of which pipe extends in the direction of and a short distance within the pipe c^4 , between the inner side of which pipe
125 and the outer side of the pipe f^3 is a circular space for the admission of smoke and gas, and funnel-shaped, as described of the end of pipe c^2 .

In the operation of my improved apparatus
130 the fuel, such as soft or bituminous coal and slack, which contains a large per cent. of carbon and is more commonly employed for furnaces, is placed upon the grate a^{10} and ig-

nited, the smoke and gas in the combustion of the fuel in the first making of the fire passing rearwardly over the hearth a^5 to the rear end of the furnace, thence through the flues of the boiler B to the forward end of the boiler, and thence up the smoke-flue b^2 . As soon as the fire has obtained sufficient headway and the water in the boiler B generates live steam the valve E in the boiler is opened, so as to admit the steam in the upper part of the boiler to the pipe c^2 , which passes through the pipes $e^4 e^6$ to the respective jets e^{10} in the steam-superheating pipe e^8 , which, from its proximity to the fire, becomes intensely hot. The gas-mixing pipe C^2 , from which extend the jet-pipes c^6 , being closer in position to the fire than the superheating-pipe e^8 , becomes also intensely hot, and the live steam admitted to the steam-superheating pipe e^8 is subjected to decomposition and passes from the oblong jet-opening c^7 in the jet-pipe c^6 with great rapidity and causing a suction within the pipes C C' and D D', which latter extend beneath the grate, and thereby drawing the gas which collects beneath the grate into the open end portion of each one of the pipes D D', which gas passes into the pipe C^2 , which forms a gas-mixing chamber, and is mixed with the decomposed steam from the superheating-pipe e^8 , thereby forming a hydrocarbon gas, which gas is forced under the pressure of the steam in a thin sheet upon the coals upon the grate, thus aiding combustion and creating an intense heat beneath the boiler.

During the mixing of the gases in the gas-mixing chamber or pipe C^2 the said pipe is raised to a cherry-red heat, effecting the rapid production of the gas. At the time the suction is caused upon the respective pipes C C', by the live steam passing through the pipes $e^4 e^6$, the steam also passes rapidly within the open ends of each one of the pipes $c^2 c^4$ and thence down the pipes C C', causing a suction within the said pipes $c^2 c^4$ and drawing the vapors or gases which pass through the flues in the boiler into the pipes C C' and from thence carried to the gas-mixing pipe or chamber C^2 and mixed with decomposed steam. In this manner a circulatory action upon the products of combustion is effected, from the updraft beneath the grate and the downdraft in the smoke-flue, preventing the smoke from ascending and the hydrocarbon gas replenishing the fuel upon the grate, so that the saving in fuel is effected and the poor grades of bituminous coal may be used without the loss of its steam-making products. The total abolition of smoke from the furnace is thus attained. The flame which passes over the hearth a^5 carries a large quantity of fire-ash, which falls to the pit a^6 , and is removed through the door a^{11} in the rear end wall a^2 .

In my invention the suction upon the smoke and gas in the smoke-flue and also beneath the furnace-grate is accomplished without the necessity of valves to regulate the

flow of the gases or the admixture of the gases with the live steam.

The apparatus may also be applied to a battery of boilers with equal facility as in the single-boiler furnace, and the flow of the live steam regulated in any manner preferred or taken from any other source without departing from my invention.

The smoke and gas conducting pipes D D' are designed to offer ready passage for the products of combustion, and are therefore of suitable size, the elbows at the ends of the pipe beneath the grate being changed, when desired, so as to be directed toward the grate. The steam-conducting pipes $e^4 e^6$, which are within the furnace, are kept therein preferably to prevent chilling of said pipes and the condensation of the steam. When desired, the lower furnace-door a^9 in the front plate a^7 is opened to admit the air which passes through the pipes D D' and mixing with the decomposed steam in chamber C^2 forms an oxyhydrogen gas, which is more inflammable and decarbonizes the products of combustion and is emitted from the gas-jet, so as to cover a wide space above the fuel upon the grate, as described in burning the hydrocarbon gas.

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

1. In a steam-boiler furnace the combination with said furnace and the smoke-flue of a gas-mixing chamber having gas-jet pipes arranged above the furnace-grate and within the heating agent, and a steam-superheating case in rear of said gas-mixing chamber and also in the heating agent, and a pipe connected with said superheating-case and extending within said gas-mixing chamber in rear of said gas-jet pipe and a short distance within said jet-pipe and having a concentric opening for the passage of the mixed gases, a smoke-conducting pipe connected with said gas-mixing chamber at one end and the other end extended upwardly within the smoke-flue, a pipe for the live steam connected at one end with the steam-boiler and with the steam-superheating case at the other end, a branch pipe connected with the said steam-conveying pipe at one end, and having the other end extending within the upper end of the said smoke-conducting pipe in the smoke-flue, said pipe having a concentric opening for the passage of the smoke, and a smoke and gas returning pipe connected at one end with the upright smoke-conducting pipe at a suitable point between the opposite ends of said pipe and the other end extended beneath the furnace-grate, as and for the purpose described.

2. In a steam-boiler furnace the combination with said furnace and the smoke-flue in the forward part of said furnace, of a gas-mixing chamber having gas-jet pipes arranged above the furnace-grate, and within the heating agent, and a steam-superheating case in rear of said gas-mixing chamber and

also in the heating agent, and a pipe connected with said superheating-case and extending within said gas-mixing chamber in rear of said jet-pipe and a short distance
5 within said jet-pipe and having a concentric opening for the passage of the mixed gases, a smoke-conducting pipe connected with said gas-mixing chamber at one end and the other end extended upwardly within the smoke-flue,
10 a pipe for the live steam connected at one end with the steam-boiler and the other end extended within the upper end of the smoke-conducting pipe, and having a concentric opening for the passage of the smoke, a branch
15 pipe connected at one end with the steam-

conducting pipe and the other end with the steam-superheating case in said furnace, and a smoke and gas returning pipe connected at one end with the upright smoke-conducting pipe from the smoke-flue, at an intermediate
20 point from the ends of said pipe and the other end of said smoke and gas returning pipe extended rearwardly in the furnace and a return portion of said pipe extending beneath the furnace-grate as and for the purpose de- 25 scribed.

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Witnesses:

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