No. 737,309. PATENTED AUG. 25, 1903.

E. J. WOOD.

STEAM BOILER FURNACE.

APPLICATION FILED AUG. 23, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

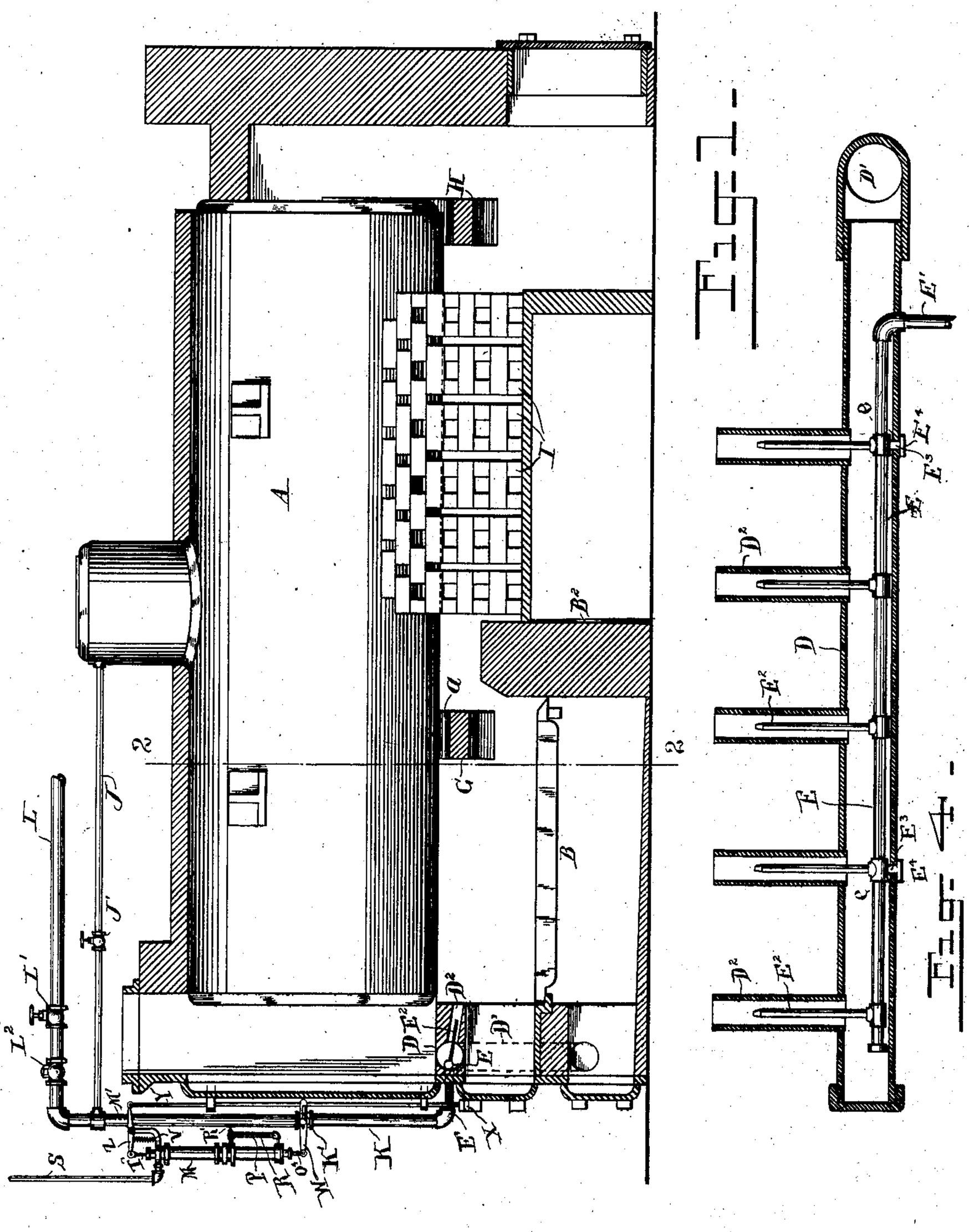

FIG. 4.

WITNESSES:

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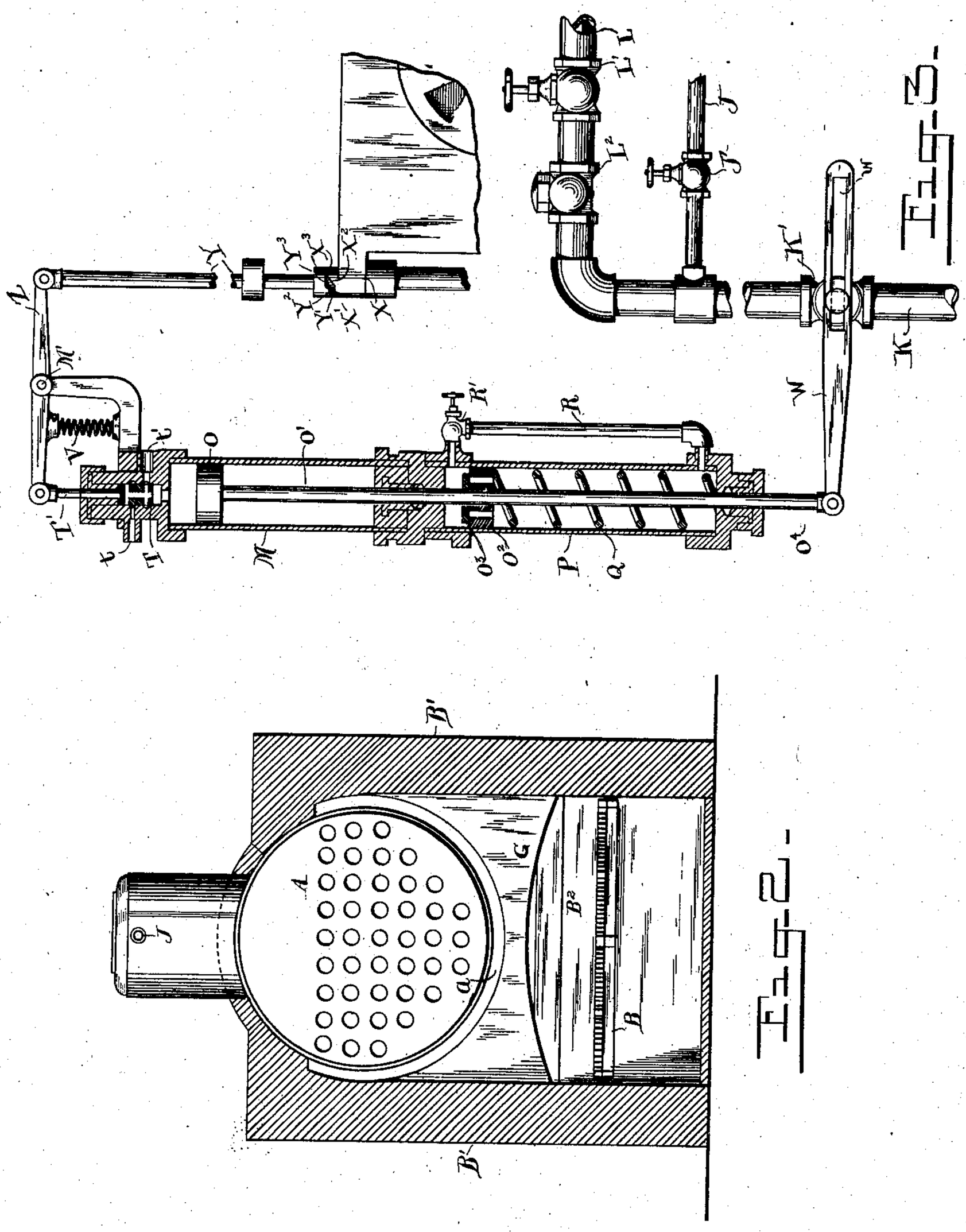

Fig. 2.

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No. 737,309. Patented August 25, 1903.

UNITED STATES PATENT OFFICE.

EDGAR J. WOOD, OF BROOKLYN, NEW YORK, ASSIGNOR TO MARGARET A. WOOD, OF BROOKLYN, NEW YORK.

STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 737,309, dated August 25, 1903.

Application filed August 23, 1902. Serial No. 120,748. (No model.)

To all whom it may concern:

Be it known that I, EDGAR J. WOOD, a citizen of the United States, residing in the borough of Brooklyn, in the city and State of New York, have invented a certain new and useful Improvement in Steam-Boiler Furnaces, of which the following is a specification.

The improvement relates to both the burning of the fuel and the transfer of the heat therefrom to the water in the boiler. It provides simple and reliable means for automatically varying the supply of fresh air and steam to the gases in the furnace, causing streams of air and steam to be injected during and for a just sufficient period after each addition of fresh fuel to the fire and automatically and gradually reducing such supply at the same rate as it is found by experiment that the liberation of combustible gases from the fuel decreases. My apparatus holds the supply of air above the solid fuel entirely suppressed after the fire has attained a certain stage until the period for firing again arrives, when the operation is repeated.

The invention also provides for holding back the hottest gases until their heat is utilized and also for holding the heat of the gases stored and equalized at a high temperature, greatly contributing to continue the combustion when the temperature is momentarily low and even igniting the gases again when the flame has ceased.

The following is a description of what I consider the best means of carrying out the invention.

The accompanying drawings form a part of this specification.

Figure 1 is a side elevation of the boiler and certain checker-work under it, with a central longitudinal section of the boiler-setting. Fig. 2 is a cross-section on the line 2 2 in Fig. 1. The remaining figures are on a larger scale. Fig. 3 is a side elevation, partly in section, showing certain portions detached; and Fig. 4 is a horizontal section showing another portion detached.

Similar letters of reference indicate corresponding parts in all the figures where they appear.

A is the boiler, B the grate, and B′ the ordinary side wall, and B^2 the bridge-wall.

D is an air-pipe, of cast-iron or other suitable material, extending horizontally across the front over the fire-door, D′ a downward extension at one end, which puts it in free communication with the space in the ash-pit, and D^2 a series of branch pipes leading from the main pipe D toward the interior of the furnace.

E is a steam-pipe peculiarly mounted in the interior of the air-pipe D, having a connection E′, adapted to bring steam from outside freely into one end and provided with branches E^2, with the tips a little contracted, which extend into and nearly through the air branches D^2. This steam-pipe is secured in the front side of the interior of the air-pipe by nuts E^4, applied on threaded extensions E^3, which extend out through correspondingly-spread holes *e*. When steam at any pressure above the atmosphere is supplied through the steam connection E′, it blows through the steam-pipe E and branches E^2 into the furnace, dragging with it a supply of air which is inducted through the pipe D and delivered under the influence of the jet through the branches D^2.

G is an inverted arch, of refractory material, as fire-brick, arranged at a little distance from the boiler and extending across the back end of the furnace a little forward of the bridge-wall B^2. The upper edge is concentric to the surface of the boiler, the space *a* between being only sufficient to allow a thin sheet of flame to move rearward through it. Under ordinary conditions when the fire is actively burning and large volumes of the gaseous products of combustion arise from the fuel on the grate and the mingled air and steam received through the series of pipes D^2 completes the combustion of all the gases only a portion of the resulting flame can move through the narrow space *a* between this bridge and the boiler, and another, usually a much larger portion, is retarded and compelled to dive under the hanging bridge G, the coolest thus escaping and the hottest being retained until they have given their surplus heat to the boiler. H is another hanging bridge having a corresponding form and similarly extending across the space under the back end of the boiler. In each the upper edge

is concentric to the boiler. In each I arch the lower edge to about the extent shown, for the reason, among others, that it involves the arch principle in maintaining the integrity of the structure under the intense heats to which the parts *a*, and more especially the part G, which is in the furnace, are subjected.

I is a mass of checker-work composed of fire-bricks of proper form, cross-piled, with liberal spaces between, as indicated in my patent of December 29, 1896. These masses greatly baffle the currents and store the heat when it is in excess and give it out again when it is momentarily deficient and tend to maintain a uniform application of the heat to the entire bottom of the boiler. The bricks for this checker-work need not be strong, but must be of a very refractory quality. The principal purpose of this checker-work is to heat the gases when cooled by the opening of the fire-door or other cause and to maintain them at such a temperature that the injected air and steam may combine, producing a perfect combustion and burning all the combustible matter, including the smoke-producing gases.

I provide for automatically introducing steam through the pipe K and provide for supplying therethrough either the exhaust-steam from an engine (not shown) or live steam from the dome of the boiler A, as the conditions may render preferable.

J is a live-steam pipe bringing steam at full pressure from the dome of the boiler A past the valve J′ to the front of the boiler and thence delivers it downward through the vertical pipe K past a controlling-cock K′, which is peculiarly constructed and operated and which performs important functions. When this cock K′ is partially or completely opened, the strong steam correspondingly flows down through it through the connected pipes E′ and E, is blown into the furnace, accompanied by air, and promotes the combustion of the gases therein.

L is a branch pipe from the exhaust of steam-engine. (Not shown.) When the valve J′ is closed, the steam in the pipe L flows at a gentle pressure past a stop-valve L′ and a check-valve L^2 into the same descending pipe K and thence into the upper portion of the furnace through the branches or nozzles E^2. Under most conditions the gentle force of the exhaust-steam is sufficient to blow the required volume of fresh air through the gases and to complete the combustion of the gases therein; but when the engine is stopped, so no exhaust-steam is available, or when for any other reason it is desired to use live steam the attendant has but to open the cock J′ and the steam at full pressure or at any lower pressure becomes available. The check-valve L^2 serves in such case to close the pipe L and prevent any reverse current therein.

I automatically vary the supply of steam and air as often as the fire-door is opened and fresh fuel is supplied. In the use of all coals, and more especially those which are bituminous or partly bituminous, there is a more or less liberal giving off of combustible gases when a layer of fresh fuel is applied over the fire-grate. For a considerable period after such layer has been applied and the fire-door is closed a large quantity of combustible gases thus rise, and unless air is supplied above the grate such gases are unconsumed. As the heating and combustion of the fresh fuel proceed the quantity of such valuable gases given off decreases, and for a considerable period before it is time to apply fresh fuel there is little or no such gas given off. I provide for automatically accommodating the supply of air to these conditions, admitting steam most liberally, whether from the exhaust-steam pipe L or from the live-steam pipe J, during the first portion of each interval between the firings, thus allowing the steam to blow in at those periods with its fullest force. Later the steam to effect such blowing is gradually shut off and at or near the middle of the period the steam is entirely shut off, the quantity of air thrown into the furnace therewith being always closely proportional. I operate through the controlling-cock K′. When the fire-door is opened, this cock is opened and the mingled steam and air is blown in a number of parallel streams inclined downward in the upper portion of the furnace. This condition continues while the fresh fuel is being shoveled in and distributed, and it continues for a considerable period after the fire-door is shut; but it gradually lessens. The apparatus may be adjusted so that the period can be longer or shorter.

M is an upright steam-cylinder; O, a piston moving therein and having a piston-rod O′ extending down through a stuffing-box in the bottom and continued through a water-cylinder P below and out through the bottom of the latter. The lower end O^4 of the rod is knuckled to a piece W, which serves both as a lever and as a slide. It engages by a long slot *w* with a squared or T-shaped head on the plug of the cock K′. On the rod O′ within the cylinder P is fixed a piston O^2, which receives an upward force from a helical spring Q.

O^3 is a valve of the piston O^2. It opens freely upward, but resists the movement of any fluid downward, except through the by-pass, to be presently described.

R is a by-pass pipe leading from the top to the bottom of the cylinder P and is controlled by a valve R′, which may be nicely adjusted by the attendant to make the movement of the water down through R more or less obstructed, as required. In preparing the apparatus for use the cylinder P and by-pass pipe R are filled with water or, preferably, dilute glycerin, which avoids difficulty from freezing.

A pipe S, only a portion of which is shown, brings fresh steam from the boiler to a balanced and easily-movable valve T in the top of the cylinder M. In its elevated position

this valve makes connection between the upper end of the cylinder M and the atmosphere. When this valve T is raised, any steam which had been previously above the piston O is allowed to escape through the passage t'. When, on the contrary, this valve T is depressed, it closes the discharge t' and opens the connection t from the boiler to the interior of the upper portion of the cylinder M. This depresses the piston O and through the rod O′ compresses the spring Q, and no matter how soon after this nor how completely the balanced valve T is raised again the knuckle O^4 will not rise again except by the slow passage of the glycerin from the top of the cylinder P down through the by-pass R into the bottom of such cylinder. The rate at which this movement is permitted can be controlled within wide limits by adjusting the controlling-valve R′. Each time that the steam is let onto the upper surface of the piston O the depression of the rod O′ carries down the knuckled end of the lever W, inducing the proper turning motion of the controlling-cock K′ to widely open it. This movement increases the distance of the knuckle O^4 from the cock K′. The slot w allows this piece W to slide in its connection to the cock in effecting this movement. Next on raising the valve T the steam escapes from above the piston O, and the spring Q, asserting itself, slowly lifts the valved piston O^2, with its connections, forcing the glycerin down through the by-pass R. By this movement the knuckled end of the lever W will be raised again and the cock K′ again closed. It follows that the mixture of steam and air is blown into the upper portion of the furnace during the period of firing and is gradually closed during a period afterward which may be more or less prolonged, according as the cock R′ is adjusted.

I have devised simple mechanism for making the required automatic movement by which the valve T is opened when the fire-doors are opened. The upper portion of the upper hinge X of the fire-door is finished in two planes at different levels X′ X^3, joined by an inclined plane X^2. Immediately above this hinge and in line therewith is a rod Y, which is guided so that it can rise and sink, but cannot turn. The lower end of this rod is correspondingly finished with two planes at different levels Y′ Y^3 and an intermediate incline Y^2. The upper end of this rod is knuckled to a lever Z, which turns on a fixed center M′, with its opposite end knuckled to a stem T, operating the valve T. A spiral spring V, introduced under this lever Z, exerts a constant force tending to lift the valve T, and consequently to depress the rod Y. When the door is swung open, it causes the incline X^2 on the upper face of the door-hinge to slide under the corresponding incline Y^2 on the lower face of the rod Y and raises such rod, thus rocking the lever Z and depressing the valve T in opposition to the force of the spring V. This position is maintained during the short period while the door is open and for a little time after. The closing of the fire-door removes the incline X^2 from under the incline Y^2 of the rod and allows the valve T to again rise. The movement of the valve T and its connections is prompt both downward and upward. The movement of the piston O^2 and its connections, on the contrary, is slowed to any required degree in its rising, according as the valve R′ is set more or less open.

Modifications may be made without departing from the principle or sacrificing the advantages of the invention.

Some parts of the apparatus can be used without others. The spring V may be dispensed with and the rod Y made to operate by gravity. The controlling-cock R′ may be omitted, and the pipe R may effect the proper retardation of the liquid flowing downward without ever requiring adjustment. The live-steam pipe J or the exhaust-steam pipe L may be used without the other.

The ash-pit is always sure to furnish a supply of air, and in case there is artificial blowing into the ash-pit it is of advantage that the blowing through my apparatus shall be correspondingly increased in strength. The extension D′ is important for this reason and also for the reason that it reduces the noise in the fire-room when live steam is blown. Instead of being absolutely horizontal the pipe D may be arched a little, as the corresponding part I is arched in my patent of 1896 referred to.

I claim as my invention—

1. In a steam-boiler furnace the air-pipe D extending horizontally, adjacent to the upper portion, and branches D^2 extending toward such portion, in combination with the pipe E connected with a source of steam and inclosed within the former and having corresponding branches E^2 and with the cock K′, the spring Q for operating such cock in one direction, and the fire-door having on its upper face an inclined surface X^2, the rod Y capable of rising and sinking but held against being revolved, having on its lower face the incline Y^2 arranged to be raised by the opening of the door, the connected easily-worked valve T controlling the flow of the steam, the cylinder M and piston O operated therein to operate said cock in the reverse direction, all substantially as herein specified.

2. In a steam-boiler furnace, the air-pipe D extending horizonally adjacent to the upper portion, and branches D^2 extending toward such portion, the pipe E connected with a source of steam and inclosed within the former and having corresponding branches E^2 and the cock K′ and connections for operating it by the act of opening and closing the fire-door, and provisions for holding such valve open a variable period and then closing the same automatically after each firing, in combination with the live-steam pipe J

connected to the boiler and the exhaust-steam pipe L connected to any convenient exhaust-pipe, and the check-valve L^2 adapted to allow live steam to be substituted and the apparatus again restored to the first condition at will by turning the single cock J', all substantially as herein specified.

3. In a steam-boiler furnace the air-pipe D extending horizontally adjacent to the upper portion, with branches D^2 extending toward such portion, and the pipe E connected with a source of steam and inclosed within the former and having corresponding branches E^2, and with the cock K' and connections for operating it by the act of opening and closing the fire-door, in combination with the piston O and its connections and lever W having the slot *w* engaged with freedom to slide laterally on the steam-cock K', all arranged for joint operation substantially as herein specified.

4. In a steam-boiler furnace the air-pipe D extending horizontally adjacent to the upper portion, and branches D^2 extending toward such portion, in combination with the pipe E connected with a source of steam and inclosed within the former, and having corresponding branches E^2 and with the passage D' connecting one end of D with the ash-pit, the hanging bridge G arranged in front of the bridge-wall B^2 with the thin space *a* between it and the boiler too limited to allow the flow of the whole of the gases, all arranged for joint operation substantially as herein specified.

5. In a steam-boiler furnace the air-pipe D extending horizontally, adjacent to the upper portion, and branches D^2 extending toward such portion, in combination with the pipe E connected with a source of steam and inclosed within the former, and having corresponding branches E^2, and with the passage D' connecting one end of D with the ash-pit, the hanging bridge G arranged in front of the bridge-wall B^2 with a thin space *a* between it and the boiler less than sufficient to discharge the gases, and with the checker-work I and the second hanging bridge H arranged near the back of the boiler, all adapted for joint service substantially as herein specified.

6. In combination with a steam-boiler furnace having provisions for blowing fresh air and steam therein, the valve T with connections for admitting steam therethrough, the tight piston O arranged to operate by such steam in the cylinder M and the connected perforated piston O^2 the valve O^3 and the spring Q in the cylinder P, and with the by-pass K and with the connection to a steam-cock K' controlling the blowing, all arranged to serve substantially as herein specified.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

EDGAR J. WOOD.

Witnesses:
THOMAS DREW STETSON,
M. F. BOYLE.