No. 677,300. Patented June 25, 1901.

G. B. WILLIAMS.

SMOKE CONSUMER.

(Application filed Mar. 14, 1901.)

(No Model.)

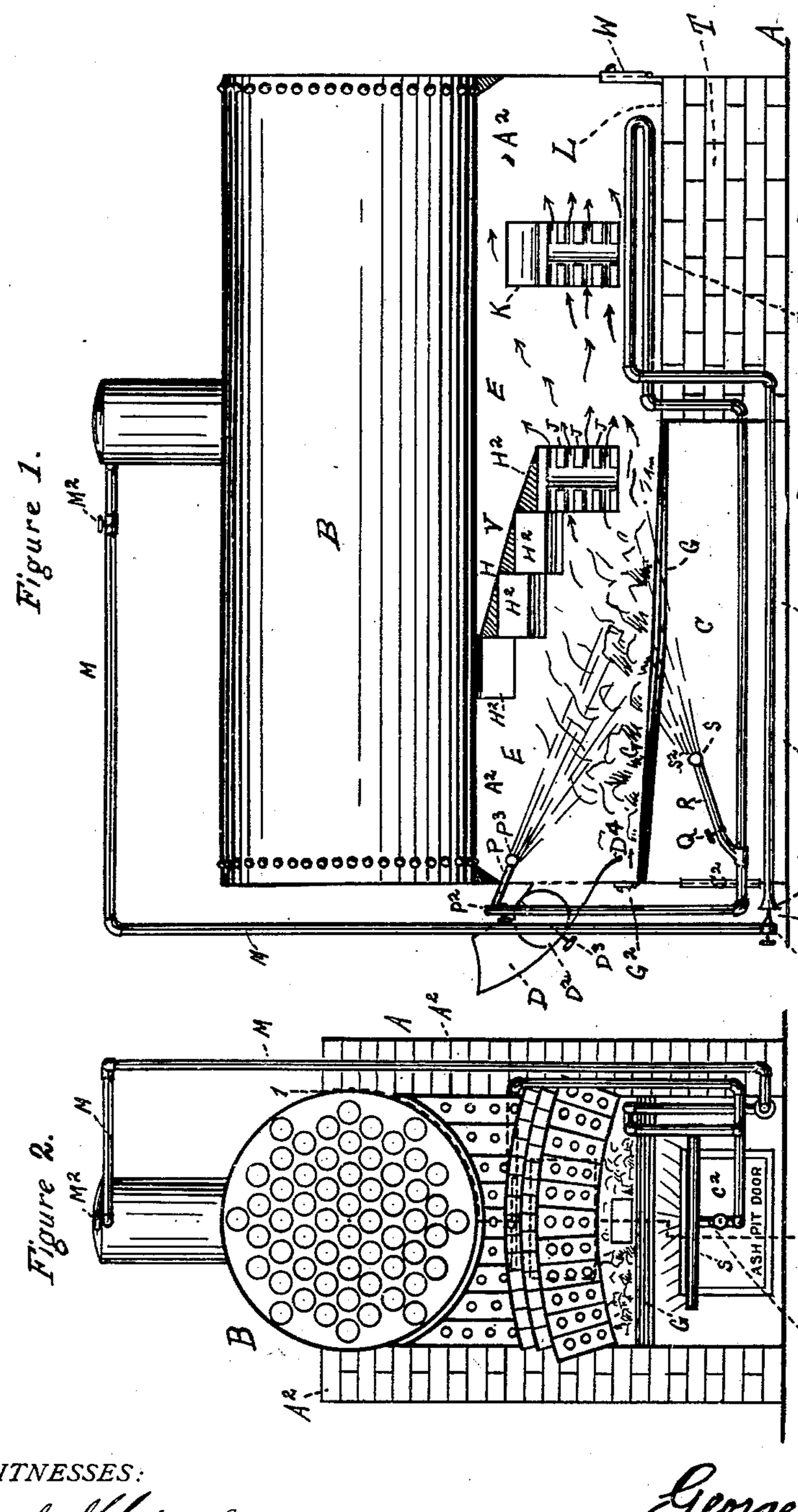

Figure 1.

Figure 4.

Figure 3.

Figure 2.

Figure 5.

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SMOKE-CONSUMER.

SPECIFICATION forming part of Letters Patent No. 677,300, dated June 25, 1901.

Application filed March 14, 1901. Serial No. 51,133. (No model.)

To all whom it may concern:

Be it known that I, GEORGE B. WILLIAMS, a citizen of the United States, and a resident of the city of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Smoke-Consumers, of which the following is a specification.

The several features of my invention and the various advantages resulting from their use, conjointly or otherwise, will be apparent from the following description and claims.

My invention is applicable to many kinds of furnaces and of heating apparatus.

A description of my invention as applied to a furnace for heating a steam-boiler will fully illustrate its general mode of application, its mode of operation, and its advantages. I will therefore describe my invention so applied.

In the accompanying drawings, making a part of this application, and in which similar letters of reference indicate corresponding parts, Figure 1 shows a vertical and in part central section taken from front to rear, substantially in the plane of the dotted line 1 1 of Fig. 2, that face of the sectioned parts being seen which faces toward the right in Fig. 2. In this figure the boiler and steam-dome are left in elevation. The piping for obtaining and applying superheated steam and air to the furnace is retained in view and in elevation. Fig. 2 is an elevation of the front end of the furnace and boiler, but the upper front wall of the furnace and all of the feeding-chute have been removed and so have the doors of the ash-pit, all of which removals are to disclose certain parts within the furnace and ash-pit. The piping for obtaining and applying superheated steam and air to the furnace is retained and shown in elevation. Fig. 3 is a view in perspective of the rear division or part of the front deflecting-arch. Fig. 4 is a view in perspective of the rear arch. Fig. 5 is an elevation of that terminal which throws superheated air into the front portion of the furnace. The elevation is that one which is seen when standing in the furnace in front of the front deflecting-arch and looking toward the front of the furnace.

The walls A^2 of the furnace A duly support the steam-boiler B in a well-known manner. The furnace is duly inclosed. In the front of the furnace and opposite the ash-pit C are the usual ash-pit doors, adapted to close the entrance C^2 into the ash-pit. These doors are of any well-known construction and are omitted from the front view, Fig. 2, to enable parts within the ash-box to be seen. Above in front is the hopper D. The mouth of this hopper is outside of the front of the furnace and the delivery end of it is inside of the doors and within the fire-chamber E. At the inner lower part there is a lip D^1 for guiding the coal or other fuel onward to a proper place for its deposit over the grate-bars. The hopper is adapted to deliver fuel (usually coal) into the fire-chamber at the forward portion thereof, substantially as shown. Thus no cold and unregulated drafts of air can enter the fire-chamber to disturb the proper operation of the latter. There will usually be a charger or swinging damper D^2 in the hopper, and this damper may be operated by a handle D^3.

In the fire-chamber and toward the front of the furnace, substantially as shown, is the deflecting-arch H, inclined from the top downward and rearward. In the lower portion of the curve of the arch—that is to say, the rear portion thereof, H^2—is a series of conduits or holes J, extending from the front to rear of that part of the arch. This arch also carries passage J^2, extending vertically from the bottom of the arch with the horizontal passages J above, but preferably do not extend through the roof. As the arch is preferably made of brick, it will then be usually formed in steps H^2, as indicated. The arch has no great thickness, and the space behind and above all of it except the front upper end is open, so that the bottom of the boiler is there exposed to hot air coming up from behind the arch. The front upper part of the arch encircles the lower part of the boiler and makes almost a complete closure. I will denominate that space of the fire-chamber which is below the boiler and above and behind the deflecting-arch H by the character V.

Behind the arch H (and within two feet of the grate) is sprung a suspended arch K, whose top portion K^2 follows the curve of the lower part of the boiler at a given distance

therefrom, and whose bottom K^3 is at its upper part in a curved plane, preferably slightly above the top of the holes of the deflecting-arch H. In other words, the inner curve of this suspended arch is of a radius slightly longer, than that of the curve made by the bottom of the arched portion H^2. The arch K is provided with horizontal passages K^4 through it, substantially as shown. I also provide the arch with vertical passages K^5, which begin at the bottom and connect successively with the horizontal passages above, but the vertical passages preferably do not extend through the roof of the arch.

The grate-bars G may be of any modern and well-known style. The combustion-chamber is to be filled at the sides of the grate-bars with any suitable material to the level of the grate-bars and paved with fire-brick. Back of the grate-bars G is a part L.

In the closed back of the furnace I provide a door W, through which the rear part of the furnace can be reached for repair, &c., and where the surface of the part L can be reached to be cleaned.

I provide a system for heating air and introducing the same under pressure in a novel and advantageous manner. My construction for this purpose is as follows: A conduit M receives steam from any appropriate source. In the present instance it receives steam from the boiler B. The passage of steam through this conduit is regulated by a suitable valve M^2. This steam it forcibly delivers at its exit M^3 into the funnel-mouth N^2 of an induction-pipe N, passing under the grate-bars and rearwardly. An injection-valve M^4 at the exit of the conduit M regulates the delivery of steam into the pipe N. The latter conduit in passing rearward preferably passes through the brickwork T and then up into the furnace, then back under the arch K, and to one side, (see Fig. 2,) thence rearwardly nearly to the rear end of the furnace, thence forward under the arch H, and thence forward to a point substantially as shown, thence down into and through the ash-pit, toward the front of the furnace, thence upwardly at the front of the furnace to a point a little beneath the bottom of the boiler. At this point it has a delivery-tube P, carrying a cross-tube P^3, having jet-openings, through which the mixed superheated steam and air are forcibly discharged into the front portion of the space near the boiler in a rearward direction. A cock P^2 is present for regulating the volume of commingled steam and air which shall enter there and also for graduating the speed at which such gases enter this furnace-space. On that part of the return division of the conduit N in the ash-pit is located a branch conduit R, inclined forward and upward and leading into the cross-pipe S, having jet openings or tubes S^2 for delivering the superheated air upward and rearward, so that this air will enter the spaces between the rear portion of the grate-bars and at an angle thereto, substantially as shown. The branch conduit R is inclined forward, so that it may deliver the superheated air and steam in the direction in which it is to enter the jet-opening S^2 and to issue therefrom. A cock Q in the conduit N primarily regulates the volume and delivery speed of the commingled air and steam superheated, which is to be delivered from the cross-pipe S and from the delivery-pipe P.

The object of the arrangement of the presence of the conduit N in the rear portion of the furnace-space is to bring it into contact with the heat of the furnace, and thus conveniently and effectively superheat the steam and air passing through the said conduit in preparation for their employment for the purposes hereinafter mentioned. The location of this conduit in the hot-air space of furnace for receiving heat may be varied quite a little without departing from the essence of that feature of my invention, of which such an arrangement forms a part.

The mode in which my invention operates is as follows: Fuel is introduced through the hopper D onto the grate-bars and in sufficient quantity to well cover the latter. The hopper is then closed by operating its damper D^2. This fuel is duly ignited. It may be here remarked that I usually provide one or more small hinged doors G^2 in the front of the furnace under the hopper; the bottom of the door G^2 being about on a level with the grate-bars for the insertion of the poker to keep the fires level and raise the fuel or clean the bars of ashes when necessary.

When the furnace is in operation, the only additional work to be performed is to open the steam-valve M^3 to the extent required to induct the requisite steam into the induction-conduit N to deliver the necessary amounts of superheated air and steam by the delivery-orifice mentioned, and to regulate the issue of superheated air and steam from the delivery-point S^2 by the cock Q, and the issue from exit P by cock P^2. When the furnace is properly working, the check-damper—viz., a door of the chimney, (not shown, but well understood in the art)—is operated. The unconsumed gases arising from the fuel strike the front portions of the heated arch H, and are thereby deflected down and pass through the checkers J J^2. Thus by their deflection toward the bed of the fire and their contact with the lower portion of the arch H they receive additional heat. A portion of the gases from the fuel passes through the openings J J^2. After passing this arch K they are deflected upward into sudden contact with the boiler. Thus these gases are heated to a very high temperature. I introduce into these gases atmospheric air and steam in such a superheated condition and in such quantities and at such a degree of diffusion as will produce a perfect chemical combination and combustion. I also obtain by this method an even distribution of heat to the heating-surface of the boiler. I increase by these means

the evaporation and generation of steam and the saving of fuel.

As is well known, the difficulty with many furnaces has been that the products of combustion have been carried away to the chimney with great rapidity, and consequently a waste of heat, partly in an active condition and partly in a latent form. To avoid this, I provide my invention, and thereby carry on the combustion of the fuel at a high temperature. I hold the resulting unconsumed gases in check and mix them with the amount of air necessary for their ignition by intercepting them, deflecting them, and dividing them by the arches, the checkers, and by the forced drafts. They thereby become thoroughly mixed with the superheated oxygen gas and are adapted to be consumed. The unconsumed products of combustion, in the form of gases and minute particles of carbon, rising at the front of the furnace toward the boiler are met by the rapid forceful current of superheated air and steam and are carried downward into the flame and simultaneously divided and mixed with superheated air and steam. Thus they are largely consumed before passing beneath the arch. Unconsumed products of combustion more or less mixed with superheated steam and air and divided by passing through the holes J J^2 of the arch are greatly heated, being deflected and retarded by the arch K. Some of the unconsumed gases and carbon passes above the arch K and next to the boiler and some through the passages K^4 K^5, while other portions pass below the arch, and thus while in the hottest part of the furnace are consumed. Between rear portions of the grate-bars rapid streams of superheated air and steam pass upwardly toward the arch K and rearwardly and divide and intimately intermingle with the unconsumed products of combustion produced at the rear portion of the fire-bed and in connection with the great heat in the furnace at this point effectively accomplish the consumption of these products.

The results of my invention are a substantially perfect combustion and a smokeless furnace.

Where the term "air" is employed in the claims, it is to be understood as standing for steam or air or for the two intermingled.

What I claim as new and of my invention, and desire to secure by Letters Patent, is—

1. In a furnace, the combination of the deflecting-arch located so that the gases from combustion cannot at the upper front of it pass above it, and provided with the passages in its inner radial portion, and the supplemental suspended arch, a little to the rear thereof, and slightly above or beyond the line of the bottom of the first-named arch, and means for introducing heated steam to the incandescent fuel at and in the vicinity of the grate-bars, substantially as and for the purposes specified.

2. In a furnace, the deflecting-arch, dropped from the top of the furnace and extending downward and rearward, and provided near its bottom with the horizontal passages J, substantially as and for the purposes specified.

3. In a furnace, the deflecting-arch, dropped from the top of the furnace and extending downward and rearward, and provided near its bottom with horizontal passages J, and vertical interconnecting passages J^2, substantially as and for the purposes specified.

4. In a furnace, the deflecting-arch H, extended from the top of the furnace downward and rearward, and a rear arch as K, having a space above, and a space below, substantially as and for the purposes specified.

5. In a furnace, the deflecting-arch H, extending from the top of the furnace, and the rear arch K, having a space above it and below it, and provided with transverse passages K^4, substantially as and for the purposes specified.

6. In a furnace, the deflecting-arch H, extending from the top of the furnace, and the rear arch K, having a space above it and below it, and provided with transverse passages K^4, and with vertical passages K^5, substantially as and for the purposes specified.

7. In a furnace, the deflecting-arch H, extended from the top of the furnace, and extending downward and rearward, and having its bottom part provided with horizontal passages J, and the suspended arch K, having a space above it and below it, and provided with transverse horizontal passages K^4, substantially as and for the purposes specified.

8. In a furnace, the deflecting-arch H extended from the top of the furnace and dropping downward and rearward, and having its bottom part provided with horizontal passages J, vertical passages J^2, and the arch K at rear and having a space above and a space below, and horizontal passages K^4 through it, and vertical connecting-passages K^5, substantially as and for the purposes specified.

9. In a boiler-furnace, a front deflecting-arch dropped from the roof, and a rear arch K having a passage-space above its top, the latter being concave and corresponding to the curve of the bottom portion of the boiler (in transverse section,) and it (the arch K) also having a passage-space under its upwardly-curved bottom part, substantially as and for the purposes specified.

10. In a furnace, a deflecting-arch H dropped from the upper part of the furnace, and a rear arch K, adapted to deflect the unconsumed products of combustion, over it and under it, and means adapted to supply superheated air by sending it up rearwardly, between the grate-bars, and also to supply it at the upper front portion of the furnace, in front of the deflecting-arch H, substantially as and for the purposes specified.

11. In a furnace, a front deflecting-arch H, a rear arch K, provision of passages for di-

viding and heating, and consuming the unconsumed products of combustion, a conduit for superheated air, means for forcing the air through it, the conduit having an ash-pit branch R, carrying a cross-terminal S having jets for directing the oxygen substantially as specified, the conduit for superheated air also having a furnace branch in the front of the furnace, and in front of the arch H, and carrying a cross branch P^3 having jets, for throwing down the air, into the combustion, substantially as and for the purposes specified.

In witness whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GEORGE B. WILLIAMS.

Attest:
SAMUEL A. WEST,
K. SMITH.