No. 713,238. Patented Nov. 11, 1902.

C. E. PADGETT, A. M. COWHAM & W. H. ALLEN.

SMOKE CONSUMER.

(No Model.) (Application filed Oct. 14, 1901.) 2 Sheets—Sheet 1.

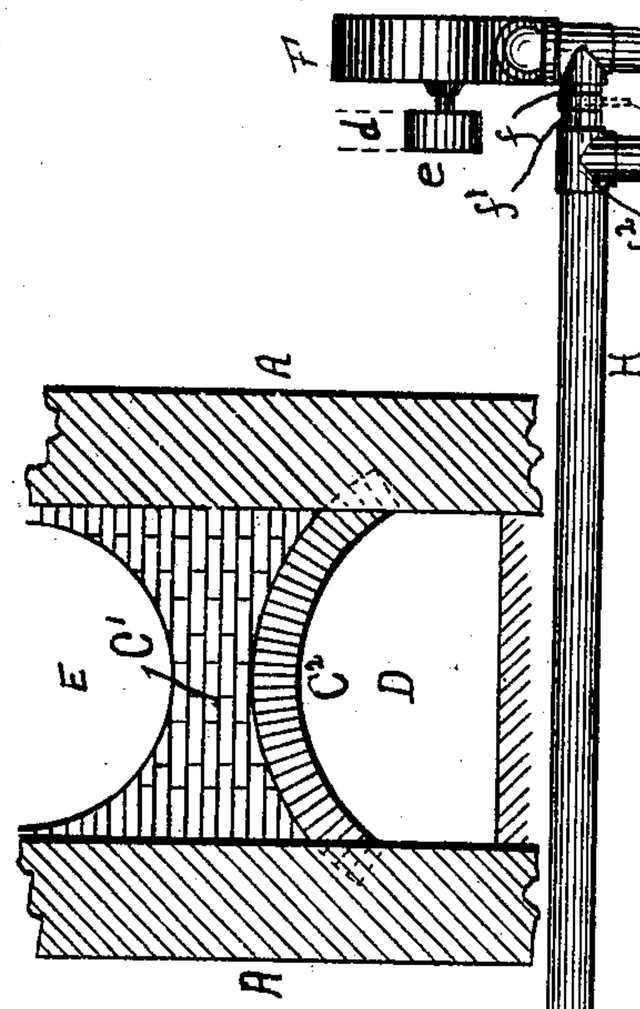

Fig. 3.

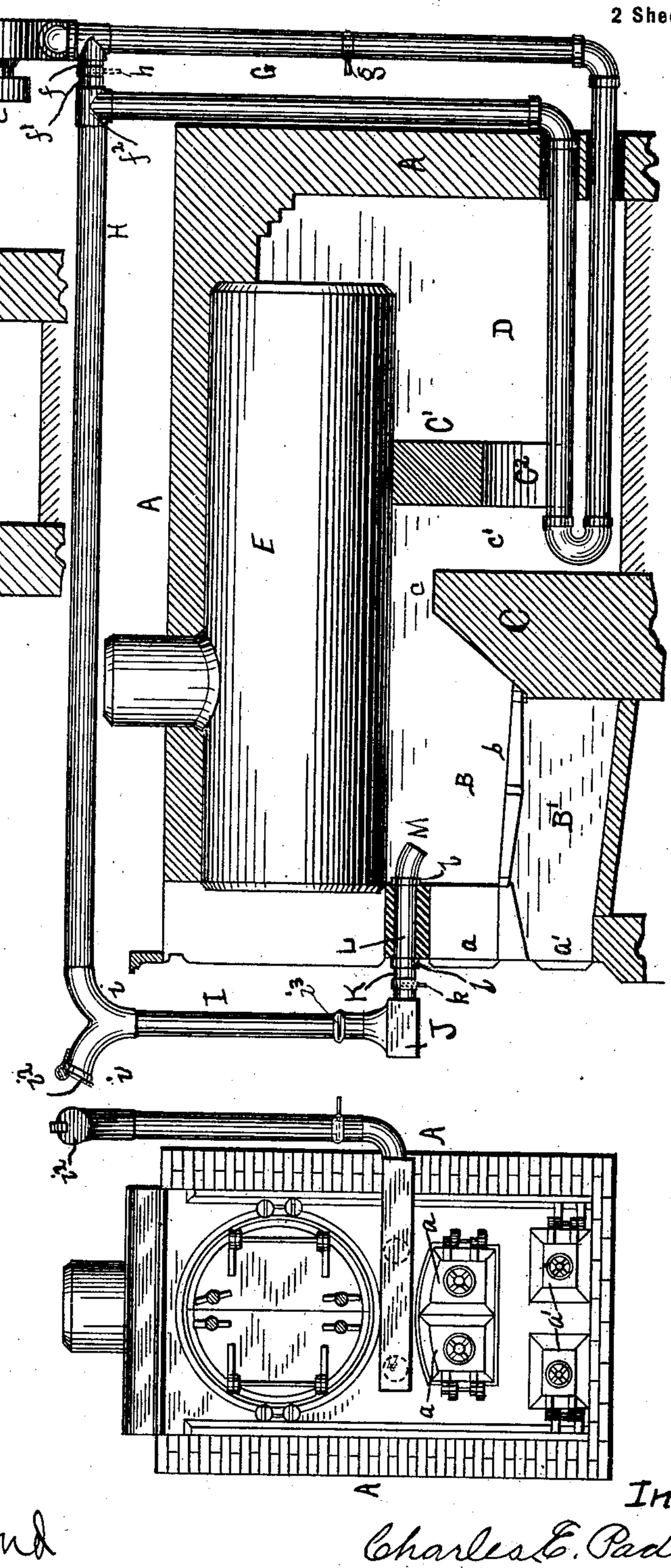

Fig. 2.

Fig. 1.

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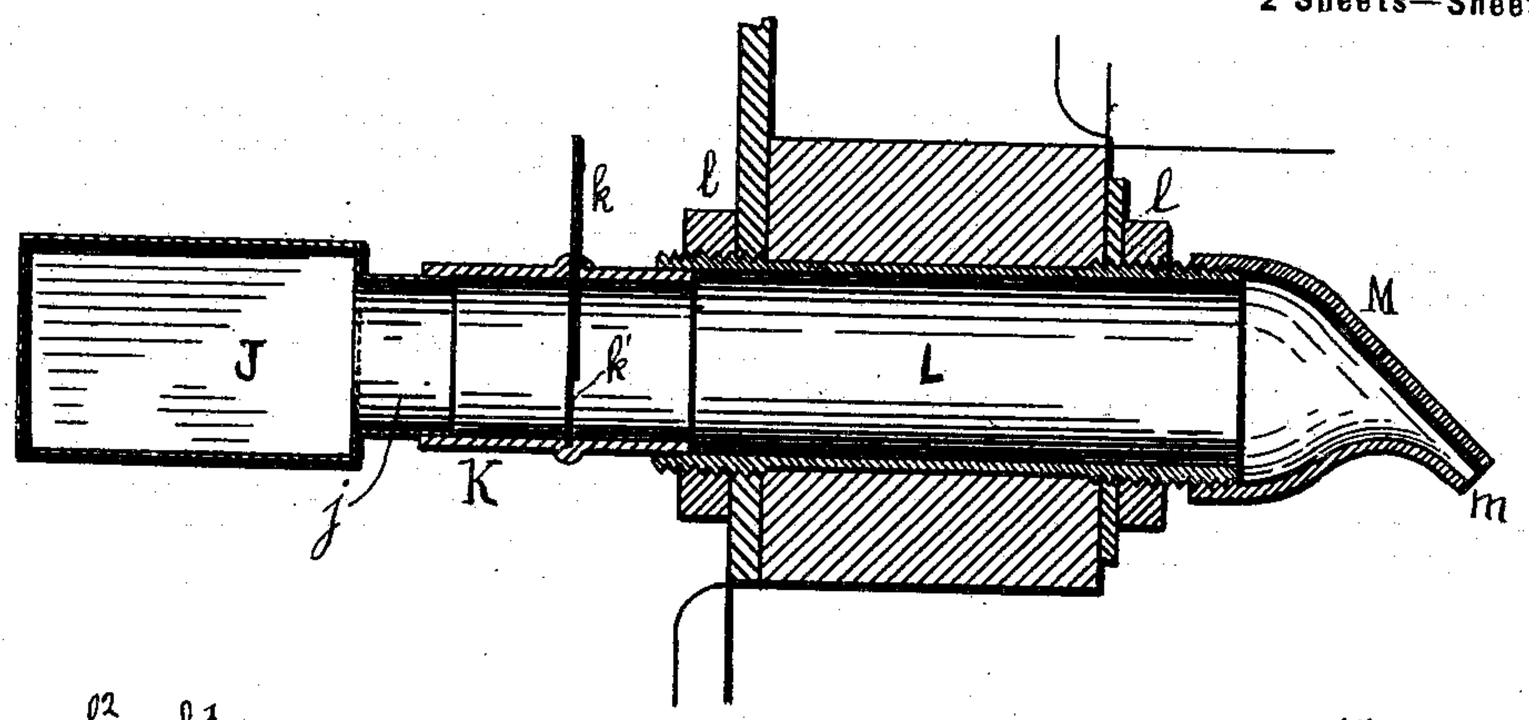

Fig. 4.

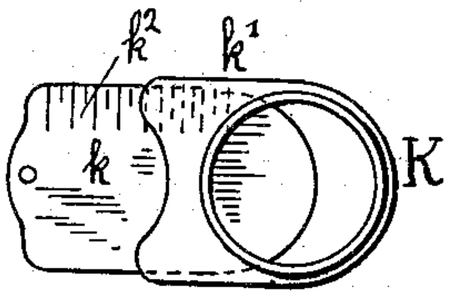

Fig. 7.

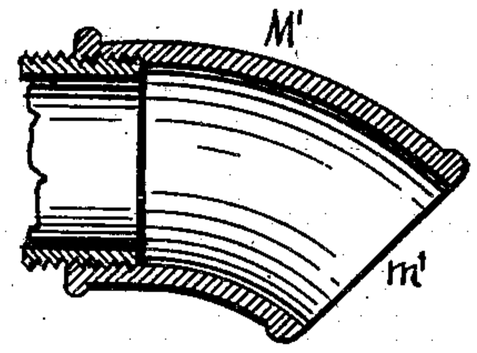

Fig. 6.

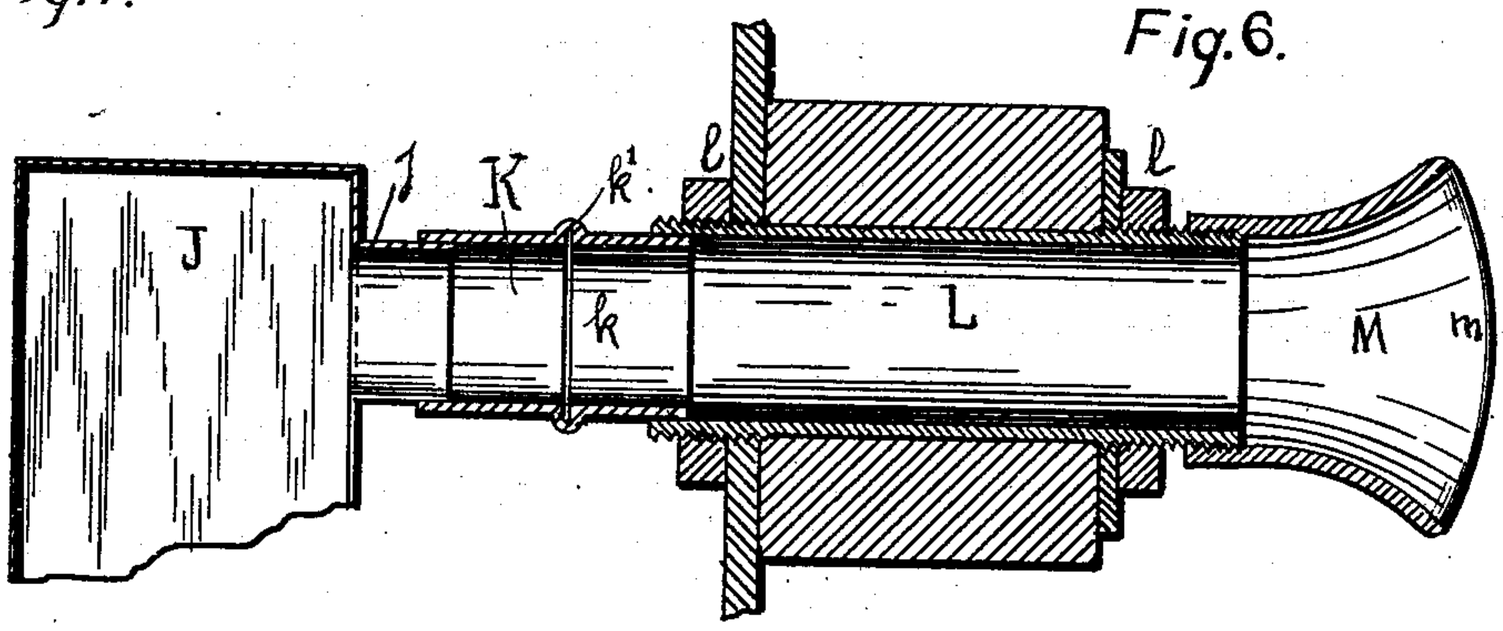

Fig. 5.

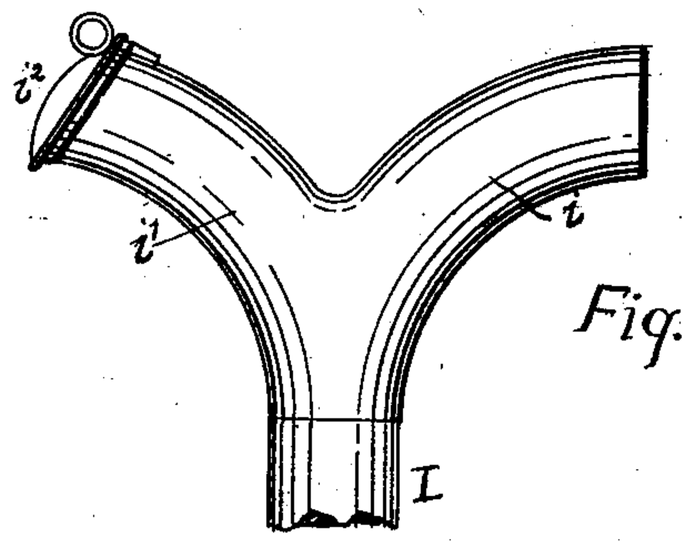

Fig. 8.

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SMOKE-CONSUMER.

SPECIFICATION forming part of Letters Patent No. 713,238, dated November 11, 1902.

Application filed October 14, 1901. Serial No. 78,562. (No model.)

To all whom it may concern:

Be it known that we, CHARLES E. PADGETT, ARTHUR M. COWHAM, and WILLIAM H. ALLEN, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Smoke-Consumers, of which the following is a specification.

It is well known that with perfect combustion there is practically no smoke, and perfect combustion can be secured where the supply of oxygen or air is sufficient to suit the requirements of the fuel being burned.

The primary object of our invention is to supply air in regulated quantities and under proper conditions to the fire-pot of a furnace, boiler, or other heating appliance, so that perfect and complete combustion, so far as it is practicable to obtain the same, will be obtained; to have the blast of supply air projected into the furnace in such manner as to pass over the body of the fuel in the fire-pot and intermingle with the escaping products of combustion, so as to insure a combustion that will to all intents and purposes eliminate smoke; to control and regulate the blast of projected air thrown into the fire-pot, so as to furnish the amount required for insuring perfect combustion and an incandescent heat; to construct and arrange the air-supply means in such manner as to project either a blast of cold air or a blast of hot air or a commingled blast of hot and cold air and have the blast, no matter of what character, regulated and controlled as to the amount forced into the fire-pot and over the bed of fuel therein; to direct and deflect the blast of air projected into the fire, so as to produce the most advantageous and best results in commingling the supply of projected air with the escaped products of combustion for preventing the smoke, and to improve generally the construction, arrangement, and operation of the several parts or elements which enter into the apparatus as a whole; and the invention consists in the features of construction and the combination of parts hereinafter described and pointed out as new.

In the drawings which illustrate an application of the invention to the furnace of a tubular boiler, Figure 1 is an end elevation of a furnace and boiler with the invention or improvement applied thereto; Fig. 2, a side sectional elevation of the same, showing one of the pipes from the pressure-blower entered into the combustion-chamber of the furnace; Fig. 3, a cross-section of the furnace in front of the depending or rear bridge-wall; Fig. 4, a sectional elevation of a discharge-nozzle for projecting a blast of air under pressure into the fire-box; Fig. 5, a top or plan view of the nozzle shown in Fig. 4; Fig. 6, a detail in section showing a modification of the discharge end of the nozzle; Fig. 7, a detail showing a gate or valve for regulating the blast, and Fig. 8 a detail showing a relief for overpressure in the blast-pipe.

The furnace represented in the drawings has walls A of brick or otherwise and of the ordinary construction for the furnaces of horizontal tubular boilers. The furnace has a fire-pot B, with an ash-pit B′ beneath the grate-bars of the fire-pot, and the front of the furnace has feeding-doors *a* for access to the fire-pot and doors *a′* for access to the ash-pit. At the rear of the grate is a bridge-wall C, as usual, with an opening or space *c* between its top and the boiler, and at the rear of the front or ordinary bridge-wall C is a secondary bridge-wall C′, depending from the under side of the boiler and having an arch C^2 on its under side, and between the primary or front bridge-wall and the secondary or rear bridge-wall is a passage *c′* for the escaping heat and vapors from the fire-pot into the combustion-chamber. The combustion-chamber D extends from the primary or front bridge-wall beneath the secondary or rear bridge-wall to the rear end of the boiler, and the heat and vapors from the fire-pot pass over the primary or front bridge-wall and under the inverted secondary or rear bridge-wall, giving a course of travel for the heat by which the action thereof on the boiler will give increased results, and at the same time the two bridge-walls serve to carry the flame and products of combustion upward and downward, so as to be subjected more efficiently to the action of the blasts of air for commingling of the air and the products of combustion, so that in

the passage through the combustion-chamber the smoke products will be consumed and eliminated. The parts so far described, with the exception of the secondary or inverted rear bridge-wall, can be of any ordinary and well-known forms of construction and arrangement for furnaces having horizontal or tubular boilers E of the usual construction.

The air for insuring combustion of the products escaping from the fuel is to be supplied to the fire-pot under pressure, and for this purpose any usual and well-known means for creating pressure can be employed. As shown, a centrifugal or blower fan F is used for supplying the air under pressure, such fan being of any well-known type and driven by a belt *d*, running over a pulley or driving-wheel *e*, or in any other suitable manner from a source of power. The discharge or eduction *f* of the fan has connected therewith a pipe or tube G, which, as shown, extends down and forwardly into the combustion-chamber of the furnace and returns and extends up and is connected to a pipe H; but it could be otherwise arranged so as to enter the furnace and be subjected to the heat for producing hot air to be carried and projected into the fire-pot through the pipe H and the blast-pipe, which communicates with the fire-pot. The discharge or eduction *f* of the fan has two outlets, one of which is connected to the pipe G and the other of which has connected thereto a short pipe *f'*, leading to a coupling f^2, by which the pipe G is connected with the pipe H, giving the pipe H a direct communication with the eduction or discharge of the fan through the short pipe *f'* and also a direct connection for hot air, by which arrangement either hot air or cold air or a mixture of hot and cold air can pass through the pipe H to the blast-pipe for the fire-pot. The pipe G has therein a gate or other valve *g*, by means of which the quantity of air passing through the pipe G can be controlled and regulated, and the pipe *f'* has therein a gate or other valve *h*, by means of which the escape of air direct from the fan into the pipe H can be shut off entirely or can be partially shut off and regulated and controlled, it being understood that when hot air is to be supplied the valve *g* is opened and the valve *h* is closed, and when cold air is to be supplied the valve *g* is closed and the valve *h* is opened, and for a mixture of hot and cold air both valves can be opened or only partially closed.

The pipe H is connected with a branch *i* of a Y connection at the end of the blast-supply pipe I, and the other branch *i'* of the Y connection has at its end a valve i^2, which when the pressure is not excessive remains closed; but in case of overpressure from the closing of the valves or otherwise the extra pressure operates to automatically open the valve *i'* for the extra amount of air to escape, thereby rendering it impossible to force through the pipe I into the fire-pot an excess of air over what is required for perfect and complete combustion. The pipe I has therein a regulating and controlling gate or valve i^3, by means of which the amount of air forced through the pipe can be regulated and controlled. The pipe I is connected to and has communication with a horizontal header J, which, as shown, is of a rectangular shape in cross-section, but could be otherwise formed. The header J has on its rear side adjacent to the furnace a thimble or rim *j* for the attachment of connecting-tubes K, the arrangement shown providing a connecting-tube over each feed-door of the furnace equidistant from the longitudinal vertical center of the fire-pot. Each tube K has located and operated therein a regulating and controlling gate or valve *k*, which works in a guideway *k'* on the inside of the tube, and each gate or valve has on its side face on one side a scale k^2, by which the degree of opening in the connecting-tube for the passage of air through the tube can be regulated to suit the requirements for the quantity of air to be projected into the fire-pot to create perfect combustion therein. The gates or valves *g*, *h*, and i^3 are of the same general construction as the gate or valve *k*, each having on its face a scale similar to the scale on the face of the valves *k*, so that the degree of opening in the pipes G, H, and I can be regulated as desired, and this arrangement of scale-controlled or regulating gates or valves enables the supply of air to be properly and correctly estimated by a careful adjustment of the several gates or valves to regulate or control the amount of air passing through the pipes into the header and from the header into the fire-pot.

The front end of each connecting-tube H in the construction shown enters a tube or thimble L, passing through the front wall of the furnace, each tube or thimble having a screw-thread on its front end in the construction shown to receive a discharge-nozzle M, the mouth *m* of which preferably is of a flat or fan shape, as shown in Figs. 4 and 5; but other shapes of discharge-nozzle can be employed—as, for instance, a discharge-nozzle M', having a circular or full mouth *m'*, as shown in Fig. 6; but with any form of construction for the nozzle it has to be turned so as to have a deflection downward, as shown in the drawings, in order to project the blast of air from each nozzle downwardly and rearwardly over the fuel on the grate. The projection of the discharge-blast of air from each nozzle is such as to direct the blast of air properly into and over the fuel on the grate, so as to commingle the supply of air with the escaped products of combustion and furnish sufficient oxygen to insure perfect combustion and prevent the escape of smoke to any marked or appreciable extent, as the smoke-producing products will be effectually consumed by the increased quantities of air supplied through the discharge-nozzles, and this extra supply of air not only effectually con-

sumes the escaped products of combustion, but increases the heat, creating, in fact, an incandescent heat which also aids materially the prevention of smoke, as with incandescent or white heat the products of combustion which cause smoke are consumed. The tubes or thimbles L in the arrangement shown are held in place in the wall by the lock-nuts *l* on the outer and inner ends of the tubes or thimbles, and, as shown, the lock-nut on the outer end of the tube or thimble abuts against a metal plate encircling the tube.

In operation the nozzles are turned or adjusted so as to give the proper direction for the projection of the blast to enter and pass over the fuel on the grate, and when the nozzles are in place the centrifugal or blower fan or other pressure-producing means is started, forcing air either through the pipe G to be heated or direct through the pipe H into the conducting or air-blast pipe I, as already described. The created blast of air is forced into the header J and from the header passes through the connecting-tubes and thimbles and the discharge-nozzles into the fire-box in the proper amount for creating and maintaining perfect combustion, the amount of air supplied being regulated and controlled by the gates or valves in the various pipes, as already described, and this blast of air can be maintained as long as it is desired to operate the furnace. The fresh air thus supplied under pressure and projected into the fire-pot through the nozzle furnishes the requisite amount of additional oxygen necessary to commingle with the escaping products of combustion to increase the heat and insure the elimination of smoke. The regulating and controlling graduated gates or dampers enable a perfect control of the delivered air to be secured, so that the amount of air supplied to the fire-pot will be in quantities sufficient for perfect combustion without any injurious excess, and the gates, dampers, or valves can be located wherever desired in the various pipes between the blower and the discharge-nozzles for the blast, so long as they are within reach of the operator in charge of the boiler and furnace or subject to the control of the operator. The injectors or discharge-nozzles can be located one on each side of the vertical longitudinal center of the fire-pot, or more than one injector or discharge-nozzle can be used, though preferably and in general use an injector or discharge-nozzle on each side is all that will be required, and instead of having the injectors or discharge-nozzles enter the fire-pot from the front they could be entered from the side or from the top, so long as the deflection of the discharge is such as to furnish a supply of air to be projected over the fuel on the grate and act properly on the escaping products of combustion to create perfect combustion and practically consume the carbonaceous products that ordinarily escape as smoke.

The operation of the apparatus as a whole can be varied to suit the location and style of the heating appliance with which the apparatus is to be used, and the fan or other pressure-producing means can be arranged to suit the convenience of the operator and the location of the heating appliance. The quantity of air projected into the fire-pot is to be regulated and controlled to suit the requirements of the fuel and so as to render the furnace or other heating appliance practically smokeless by causing a perfect combustion, and thereby consuming the carbonaceous products of combustion, and by properly regulating and controlling the air-blast the apparatus is applicable to all sorts of fuels and to furnaces and heating appliances generally. The apparatus can be connected with furnaces and other heaters of ordinary and well-known forms of construction and will be operative therewith when the force-blast is properly regulated and controlled to suit the furnace and the fuel used, it being understood that the volume of air admitted should be proportioned to add to the combustible nature of the fuel employed, some kinds of fuel throwing off more carbon or carbonaceous products than others and require a greater volume of air to create perfect combustion and consume the carbonaceous products, so as to practically eliminate smoke, and the volume of air can be accurately regulated and controlled as required for the fuel by the graduated gates, dampers, or valves, thereby rendering the apparatus efficient, practical, and reliable for eliminating smoke by creating perfect combustion.

We claim—

1. In a smoke-consumer, the combination of an air-blast pipe leading from a source of air-supply under pressure, a horizontal cross-header at the front and outside of the furnace into which the supply-pipe leads, a delivery-tube leading from the cross-header into the furnace at the front above the grate, a discharge-nozzle having a full exit or mouth for projecting a solid stream of air and connected with the terminal of the delivery-tube in the fire-pot and having a deflection for projecting the stream of air under pressure downwardly and over the bed of fuel in the fire-pot, the stream of air flowing forward under pressure in the direction to only discharge finally above the grate, and a scaled graduating-valve controlling the passage of air through the delivery-tube for discharge at the nozzle, substantially as described.

2. In a smoke-consumer, the combination of an air-blast pipe leading from a source of air-supply under pressure, a horizontal cross-header at the front and outside of the furnace, having a greater diameter than the diameter of the blast-pipe and into which the blast-pipe leads, delivery-tubes, one at each end of and leading from the header into the fire-pot, a nozzle for each delivery-tube at its entered terminal in the fire-pot, each nozzle having a full exit or mouth for projecting a solid

stream of air and having a downward deflection for projecting the stream of air downwardly and rearwardly above the bed of fuel in the fire-pot, the stream of air flowing forward under pressure in the direction to only discharge finally above the grate, and a scaled graduating-valve for each delivery-tube controlling the passage of air through the delivery-tube for discharge at the nozzle, substantially as described.

3. In a smoke-consumer, the combination of an air-blast pipe, a pressure-blower, a pipe connecting the discharge of the pressure-blower with the air-blast pipe, a scaled graduating-valve in the air-blast pipe, a horizontal cross-header at the front and outside of the furnace and into which the blast-pipe leads, delivery-tubes leading from the header into the fire-pot of the furnace above the grate, an adjustable nozzle on the inner end of each delivery-tube within the fire-pot and having a full exit or mouth for projecting a solid stream of air and having a deflection for projecting the stream of air over the bed of fuel in the fire-pot, the stream of air flowing forward under pressure in the direction to only discharge finally above the grate, and a scaled graduating-valve in each delivery-tube controlling the passage of air through the tube for discharge from the nozzle, substantially as described.

4. In a smoke-consumer, the combination of an air-blast pipe, a pressure-blower, a pipe connecting the discharge of the pressure-blower with the air-blast pipe, a scaled graduating-valve in the pipe of the discharge from the blower, a pipe connected with the discharge of the blower and leading into the furnace and subjected to the heat of the furnace and connected with the air-blast pipe, a scaled graduating-valve in the pipe leading into the furnace, a horizontal cross-header at the front and outside of the furnace and into which the air-blast pipe leads, delivery-tubes leading from the header into the fire-pot of the furnace above the grate, an adjustable nozzle on the inner end of each delivery-tube within the fire-pot and having a full exit or mouth for projecting a solid stream of air and having a deflection therein for projecting the stream of air over the bed of fuel in the fire-pot, the stream of air flowing forward under pressure in the direction to only discharge finally above the fuel, and scaled graduating-valves controlling the pressure of air passing through the delivery-tubes for discharge at the nozzles, substantially as described.

5. In a smoke-consumer, the combination of an air-blast pipe leading from a source of air-supply under pressure, a two-branch connection interposed in the blast-pipe, one branch forming an elbow for the air-blast pipe, and the other branch having a pressure-release valve at its end, a horizontal cross-header at the front and outside of the furnace and into which the air-blast pipe leads, delivery-tubes leading from the header into the fire-pot above the grate, a discharge-nozzle on the inner end of each delivery-tube in the fire-pot, and having a full exit or mouth for projecting a solid stream of air, and a scaled graduating-valve controlling the pressure of air passing through each delivery-tube for discharge from the nozzle, substantially as described.

6. In a smoke-consumer, the combination of an air-blast pipe leading from a source of air-supply under pressure, a horizontal cross-header at the front and outside of the furnace and into which the blast-pipe leads, two delivery-pipes leading from the header and entering the furnace above the grate, one on each side of the vertical center of the fire-pot, a discharge-nozzle having a full exit or mouth for projecting a stream of air, one for each delivery-tube, each nozzle adjustably connected with its tube and having a downward deflection discharging the stream of air downwardly and over the fuel in the fire-pot, the stream of air flowing forward under pressure in the direction to only discharge finally above the grate, and a scaled graduating gate or valve for each delivery-tube controlling the discharge of air from the nozzle, substantially as described.

7. In a smoke-consumer, the combination of an air-blast pipe, a pressure-blower connected with the air-blast pipe, a horizontal cross-header at the front and outside of the furnace and into which the air-blast pipe leads, delivery-tubes leading from the header, one on each side of its vertical center, each tube entering the fire-pot of the furnace above the grate, a discharge-nozzle having a full exit or mouth, for projecting a solid stream of air at the inner end of each delivery-tube, discharging downwardly into and over the bed of fuel, the stream of air flowing forward under pressure in the direction to only discharge finally above the grate, a scaled graduating gate or valve for each delivery-tube controlling the passage of air through the discharge-nozzle, a pressure-relief valve for the air-blast pipe, and a scaled graduating gate or valve controlling and regulating the amount of air passing to the header for discharging a regulated blast of air from each nozzle to commingle with the escaping products of combustion in the fire-pot and consume the products of combustion, substantially as described.

8. In a smoke-consumer, the combination of an air-blast pipe, a pressure-blower, a pipe connecting the discharge of the pressure-blower with the air-blast pipe, a scaled graduating-valve in the discharge-pipe from the blower, a pipe connected with the discharge-pipe of the blower and leading into the furnace and subjected to the heat of the furnace, and connected with the air-blast pipe, a scaled graduating-valve in the pipe leading into the furnace, a horizontal cross-header at the front and outside of the furnace and into which the air-blast pipe leads, delivery-tubes leading from the header into the fire-pot above the

grate, a discharge-nozzle, having a full exit or mouth for projecting a solid stream of air, on the end of each delivery-tube within the fire-pot, each nozzle having a deflection for projecting the stream of air over the bed of fuel in the fire-pot, the stream of air flowing forward under pressure in the direction to only discharge finally above the grate, a scaled valve in each delivery-tube controlling the pressure of air to the nozzles, and a depending bridge-wall at the rear of the primary bridge-wall, substantially as described.

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