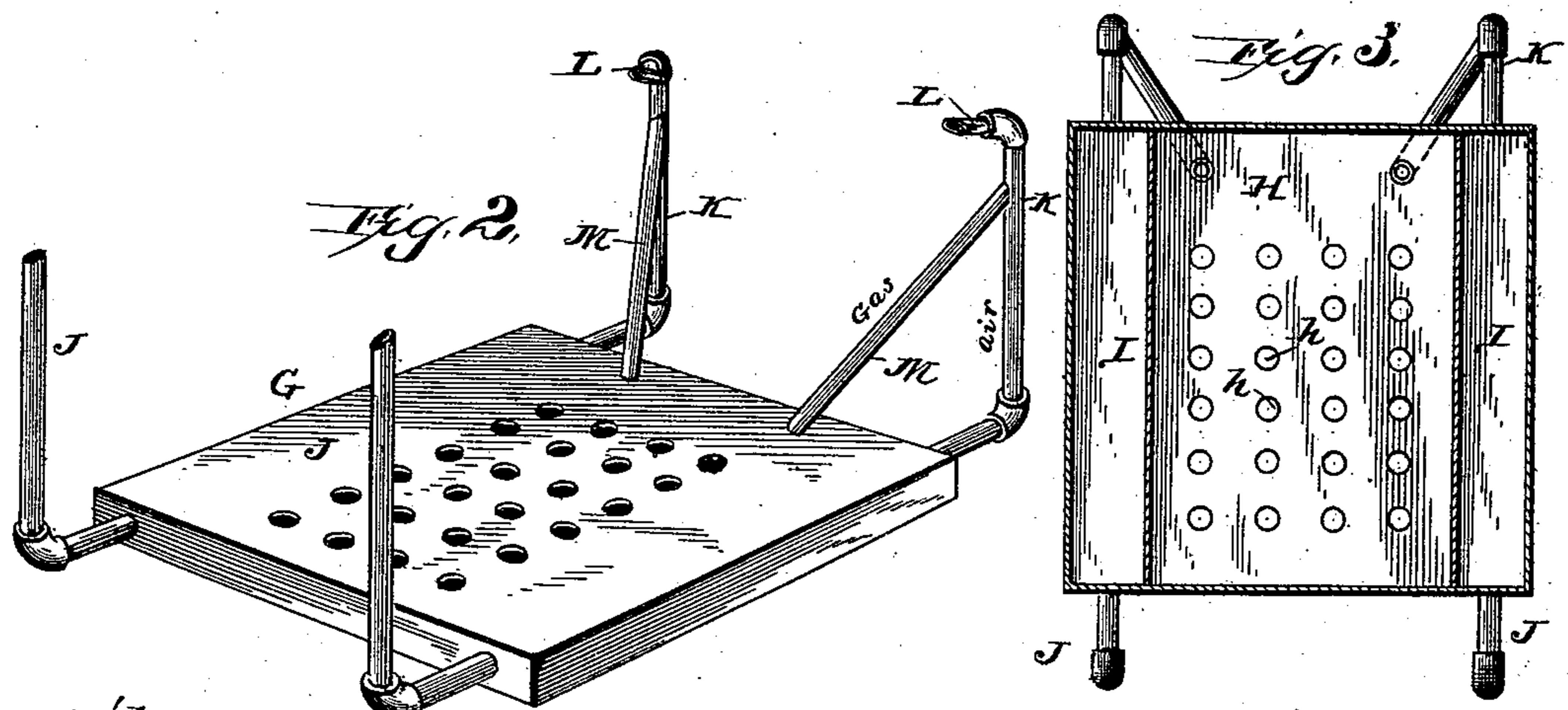
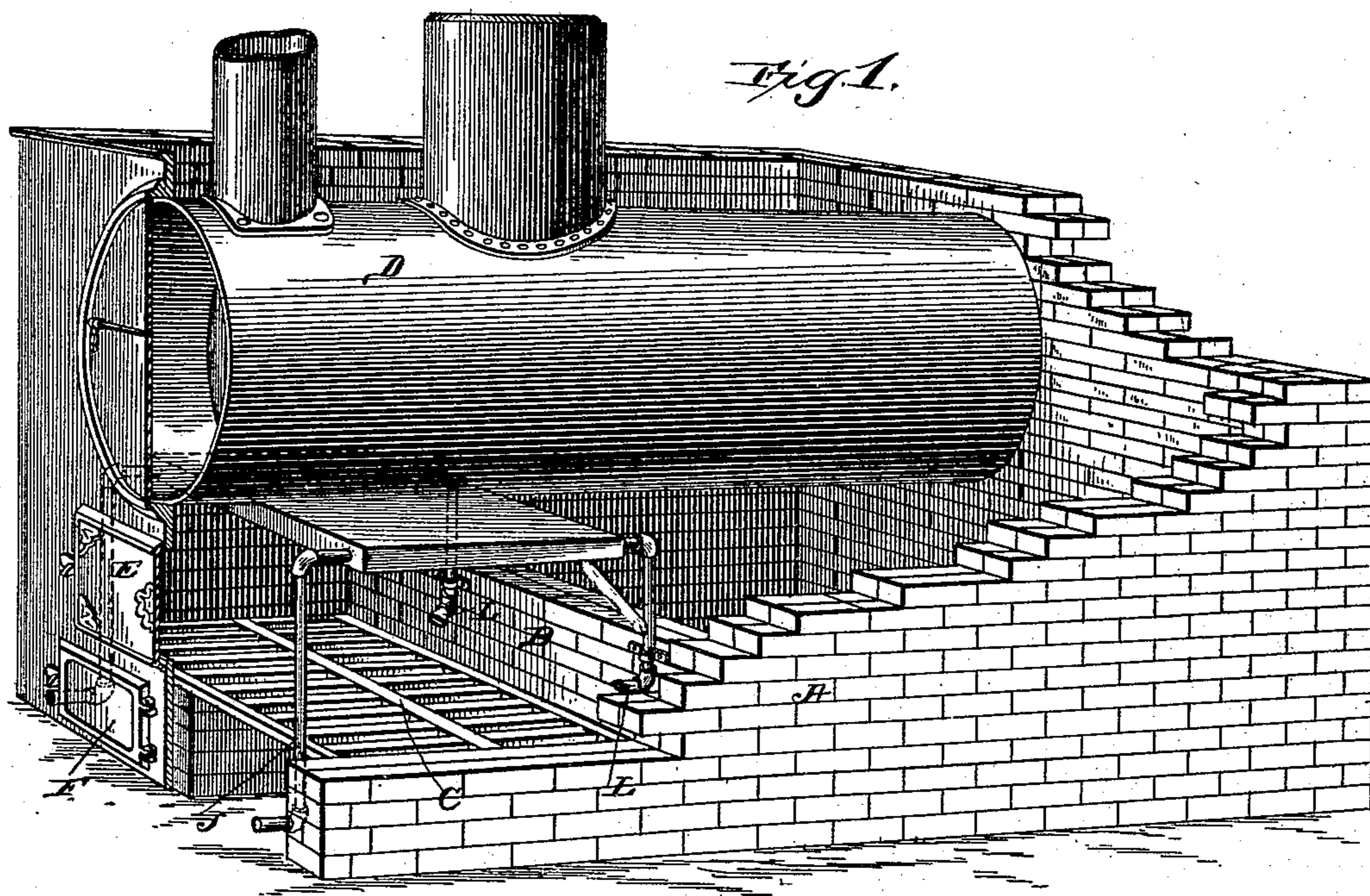


(No Model.)

J. N. RUEBHAUSEN.
FURNACE.

No. 464,187.

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FURNACE.

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To all whom it may concern:

Be it known that I, JOHN N. RUEBHAUSEN, a citizen of the United States, residing at the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Furnaces, of which the following is a full and complete specification.

This invention relates to improvements in furnaces provided with means for directly supplying the products of combustion in the fire-chamber immediately above the burning fuel with a supply of heated air for promoting perfect combustion, and while hereinafter particularly shown and described in its application to steam-boiler furnaces my invention is equally applicable to the fire-chambers of railroad-engines, metallurgic furnaces, &c., wherein the perfect combustion may be promoted by combining air with the burning products of combustion.

One object of this invention is to utilize the greatest possible heat area and, as nearly as practicable, the hottest portion of the fire-chamber for heating a supply of air prior to its discharge into the burning products of combustion.

Another object is to not only utilize the greatest possible area and hottest portion of a fire-chamber for raising the temperature of the air discharged into the burning products, but at the same time to substantially protect that portion of the furnace immediately over the fire-chamber from the destructive effect of the intense heat thereunder, and to do all this by simple and effective devices, which by their construction, operation, and arrangement may successfully resist the destructive influences, although located nearer the surface of the burning fuel than is a boiler. The most important object of my invention, however, is the successful accumulation of the ignited products of combustion before their escape from the fire-chamber, and while at the highest degree of temperature that it is possible to accumulate them, and then combining said unignited gases with oxygen, also heated to a maximum degree, and discharging the gases and air so combined into the fire-chamber immediately over the burning fuel.

More specifically stated, the prime object of my invention is to accumulate unignited gases, combine them with a continuous supply of fresh air, and discharge said gases immediately over the burning fuel in the fire-chamber before said gases have escaped from the bridge-wall or combustion-chamber of the furnace, whereby the combined unignited gases and oxygen, while at their highest possible temperature, may be discharged and ignited in the fire-chamber, and, finally, to provide certain details of construction, promote the efficiency, durability, and cost of the devices for attaining these objects, all as hereinafter described and illustrated in the accompanying drawings, in which—

Figure 1 represents in perspective, with parts broken away, a steam-boiler furnace embodying my invention; Fig. 2, a perspective view of the accumulator and air-supply devices as they appear from an under view when detached from the furnace, and Fig. 3 a sectional top plan view of the same.

Similar letters of reference indicate the same parts in the several figures of the drawings.

Referring by letter to the accompanying drawings, A indicates a steam-boiler furnace; B, the bridge-wall thereof; C, the grate-bars, over which is located the fire-chamber, and D a boiler, all of the ordinary construction and provided with one or more fire-chamber doors E and ash-pit door F, usually employed.

Immediately above the grate-bars and at such a distance as not to interfere with the ignition of the products of combustion and the draft of the furnace is a box G, which may be of any suitable material, such as sheet or boiler iron or vitrified clay, suitably divided to form therein a gas-accumulating chamber H and air-chambers I I, the gas-accumulating chamber, as shown, occupying a central position between the air-chambers I I; but it is proper to remark that my invention is not confined to the particular arrangement of these chambers relative to each other or to the form of the chambers themselves, as shown in the drawings, for any other form of arrangement would obviously be within the spirit of my invention, whenever by their operation the air is heated and the accumu-

lated gas is combined therewith prior to its discharge into the fire-chamber, as hereinafter described.

The bottom of the gas-accumulator, whatever may be its form or arrangement relative to the other devices embodying my invention, is provided with a series of perforations *h* upon its under side, through which the unignited gases in the fire-chamber may pass into the accumulator, and to this end said perforations may be of any form securing that result.

Opening into the forward ends of each of the air-chambers, which may be one or more in number, are pipes *J J*, the other ends of which are open and communicate with the open air, so that said pipes in effect form air-supply passages to the air-chambers. As shown, these pipes extend downwardly through the fire-chamber into the ash-pit, and thence downwardly from the furnace, thereby serving as a means for supporting one end of the gas-accumulating and air chambers; but it would be no departure from my invention to support the box *G* by brackets or other equivalent means, or have the air-supply pipes *J* projecting downwardly of the furnace in a horizontal or other line from the accumulator.

At the opposite and rear end of the air-chambers and communicating therewith are discharge-pipes *K K*, extending downwardly in the fire-chamber and provided at their lower ends with nozzles *L L*, so arranged that their discharge shall be in or substantially in a horizontal plane with reference to and above the bed of burning fuel, and, as shown, preferably converging on lines centering at or about the middle of the fire-chamber, where under ordinary circumstances there is the most perfect combustion and therefore highest degree of heat; but my invention is not limited to the relative angles of discharge of these nozzles so long as their discharge is not a horizontal or practically horizontal plane or a line parallel with the bed of burning fuel. These nozzles are preferably flattened, so that their discharge shall be in a sheet-like form over the burning fuel; but my invention in this respect is not confined to any particular form of nozzle.

Communicating with the discharge-pipes *K K* at a point removed from the nozzles are pipes *M M*, which open in or toward the rear end of the gas-accumulator and serve as a passage for the gas from the accumulator to the discharge-pipes, whereby the gas in the accumulator is combined with the heated air in the discharge-pipes and injected through the nozzles into the fire-chamber.

In operation the heating of the air in the air-chambers produces a strong draft through this chamber and the supply and discharge pipes, which air-draft in turn produces a draft through the gas-accumulator and discharge-pipes *M M* thereof, and as a result the unig-

nited gases rising from the burning fuel are drawn from the fire-chamber into the accumulator, and thence, after being combined with the heated air, discharged with sufficient force to spread them out over substantially the entire surface of the burning fuel, or in any event over the surface of so much of it as is required to thoroughly unite the combined gas and air and cause them to perfectly ignite. The forcible discharge of the combined air from the nozzles toward the front of the furnace and the upward draft causing the unignited gases to ascend into the accumulator does not retard, but, on the contrary, results in a promotion of, the regular and forward draft of the furnace, for whatever resistance to that draft the ascending and discharge current may have is more than compensated for by the increased combustion and draft produced thereby from the combustion of these before-unignited gases. The unignited gases ascending into the accumulator are those which without the accumulator would be waste products of combustion—that is to say, which would otherwise escape over the bridge-wall unignited and afterward become visible to some extent in the form of smoke. A large portion of these unignited gases will not ignite without first being combined with air, and there is still another portion that even when combined with air will not ignite unless at a very high temperature, when it will thoroughly combine with air at a very high temperature, and while many structures have been devised in efforts to supply furnaces with sufficient oxygen at a temperature designed to cause the ignition of these waste products of combustion they have been substantially unsuccessful, because the air so supplied could not be distributed to and combined with these gases in sufficient volume to cause their ignition. In other words, efforts to produce perfect combustion in the fire-chamber of furnaces have heretofore been confined to the direct discharge of that air, heated or otherwise, indiscriminately among all of the products of combustion rising from the burning fuel, and the result is that much of that air is expended on gases not requiring it, so that it is not sufficient to supply the gases not ignited without it. When cold air is injected, the gases that are unignitable without a substantial supply of air are reduced to a temperature below which they will ignite when combined with air, and they therefore become waste products of combustion, whereas when hot air is introduced the air is expanded to such an extent that it does not contain sufficient oxygen to cause the combustion of these unignited gases at the highest temperature they are subjected to while in the fire-chamber. By my invention, however, the unignited gases are first separated from the ignitable gases, then thoroughly combined with sufficient oxygen at a temperature which insures their ignition when discharged into the

fire-chamber, and the result is that perfect combustion is materially and substantially promoted in the fire-chamber.

In actual practice it has been found that in the use of my device in an ordinary furnace there are no perceptible waste products of combustion after firing from the moment the doors are closed long enough to permit the natural draft of the furnace to assert itself—that is, to come into full operation—for although there may be a large amount of unignited fuel and the gases rising above that fuel be chilled much below a temperature they will ever ignite the suction produced in the fire-chamber by and the force of the current of air through the air-discharge pipe causes practically all of said gases to rise into the accumulator and in consequence prevent their escape from the bridge-wall.

From the foregoing it will be understood that my invention broadly includes a device of any suitable construction by which unignited gases are extracted from the fire-chamber before they can escape into the combustion-chamber and afterward combined with sufficient oxygen to produce their ignition at a temperature and in a volume sufficient to produce the combustion of these gases when they are again discharged over the burning fuel in the fire-chamber; and to this end the form of the gas-accumulating chamber and the device supplying the air for combining with accumulated gas and the arrangement of these devices relative to each other and to the fire-chamber or the fuel thereof are immaterial so long as the accumulation of the gas, its combination with the air, and its discharge into the fire-chamber at a point where it will ignite is successfully accomplished.

My invention is broadly distinguished from the devices heretofore employed whereby the waste products of combustion are taken from the breeching or combustion chamber of the furnace, for in both instances the unignited gases escape into the combustion-chamber before they are combined with air, and as a result are so reduced in temperature that a large portion of them will not ignite when combined with air prior to their discharge into the fire-chamber, because depending upon the temperature of the air to raise them to the point at which they will ignite and an air-temperature so high that it cannot supply sufficient oxygen to cause them to ignite, whereas in my devices the unignited gases are never exposed to the combustion-chamber and are combined with the requisite volume of oxygen and at a temperature insuring their perfect combustion.

In conclusion, it may be observed that for steam-boiler furnaces it is of advantage to have the gas-accumulator or the box combining a gas-accumulator and air-heating chambers extend substantially or entirely across the fire-chamber, because by so extending

these devices the unignited gases, which tend to corrode the boiler, and the direct heat of the fire-chamber, which is very destructive to the boiler-sheets, are both isolated therefrom, the result being that the durability and safety of the boiler are promoted, while at the same time it is sufficiently hot for all practical purposes.

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

1. The herein-described method for promoting perfect combustion, the same consisting in conducting from a fire-chamber the unignited gases through openings directly above the bed of burning fuel and in the path of travel of said gases rising therefrom, then combining said gases with oxygen, and finally discharging the gases and air thus combined in the fire-chamber in the proportions and at a temperature insuring their perfect combustion, substantially as described.

2. The combination, with the fire-chamber of the furnace, of a gas-accumulator having receiving-openings immediately over the bed of burning fuel, a discharge-passage from said gas-accumulator into the fire-chamber, and an air-supply passage communicating with said discharge-passage at a point next removed from the discharge-orifice thereof, substantially as described.

3. In a furnace, the combination of the fire-chamber, a gas-accumulator arranged above the same, an air-supply passage terminating in a discharge-passage opening into the fire-chamber, and an accumulator-discharge-pipe passage adjacent to and opening into said air-discharge passage at a point next removed from the discharge-orifice thereof, substantially as described.

4. In a furnace, the combination, with the fire-chamber, of a gas-accumulator arranged above the bed of burning fuel and having a series of openings or inlets on its under side only, an air-supply passage terminating in a nozzle opening into the fire-chamber, and a discharge-passage for said accumulator, communicating with said air-supply passage at a point removed from said nozzle, substantially as described.

5. In a steam-boiler furnace, the combination of the fire-chamber, a gas-accumulator, and an air-supply opening into the fire-chamber and communicating with the gas-accumulator, said accumulator being provided on its under side with a series of inlets and arranged between the bed of burning fuel and the boiler, whereby the boiler is protected from the intense heat in the fire-chamber and isolated from contact with the unignited gases, substantially as described.

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