(No Model.) 2 Sheets—Sheet 1.

G. FARR.

SMOKE AND GAS CONSUMING FURNACE.

No. 272,035. Patented Feb. 13, 1883.

Fig. 1.

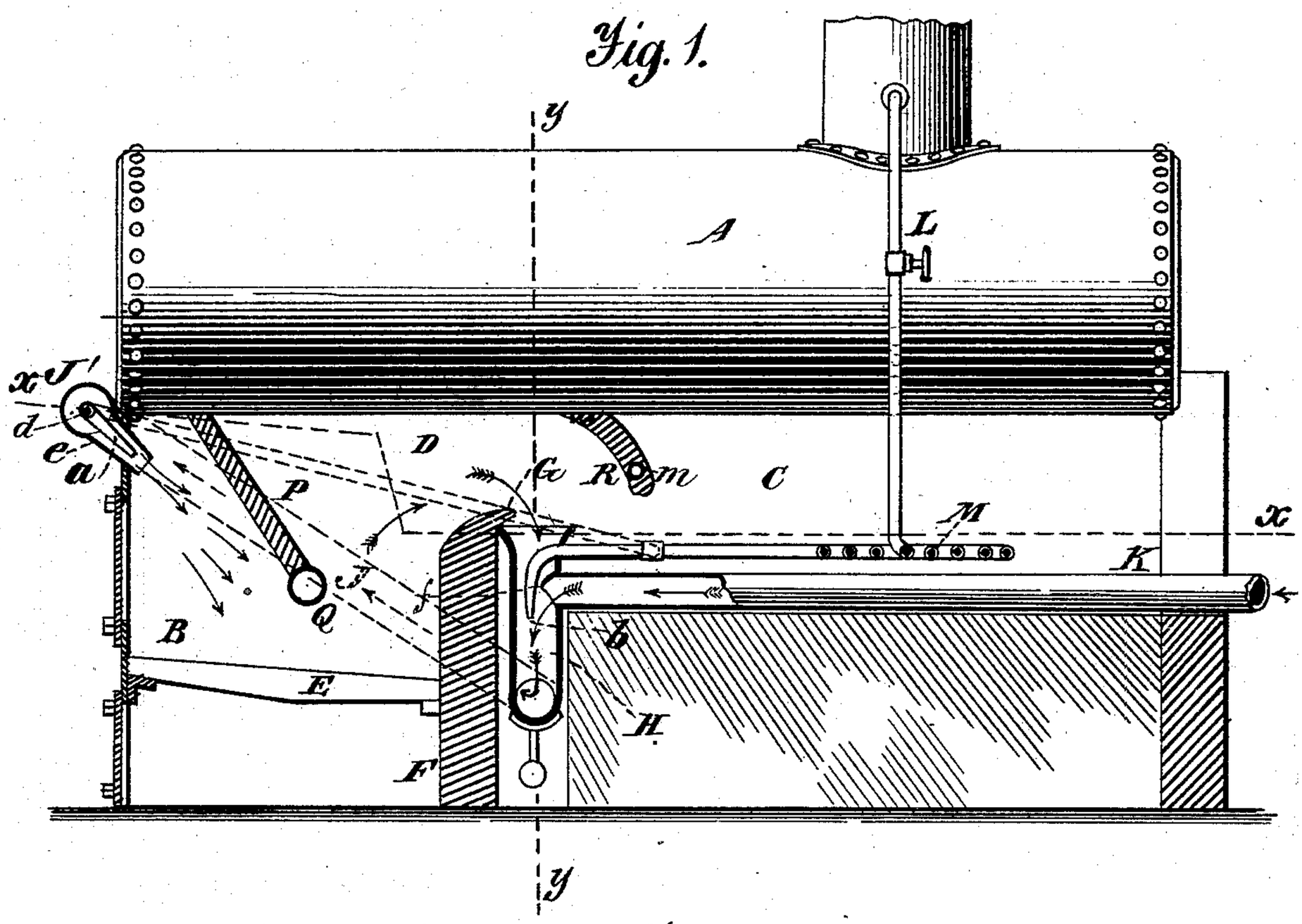
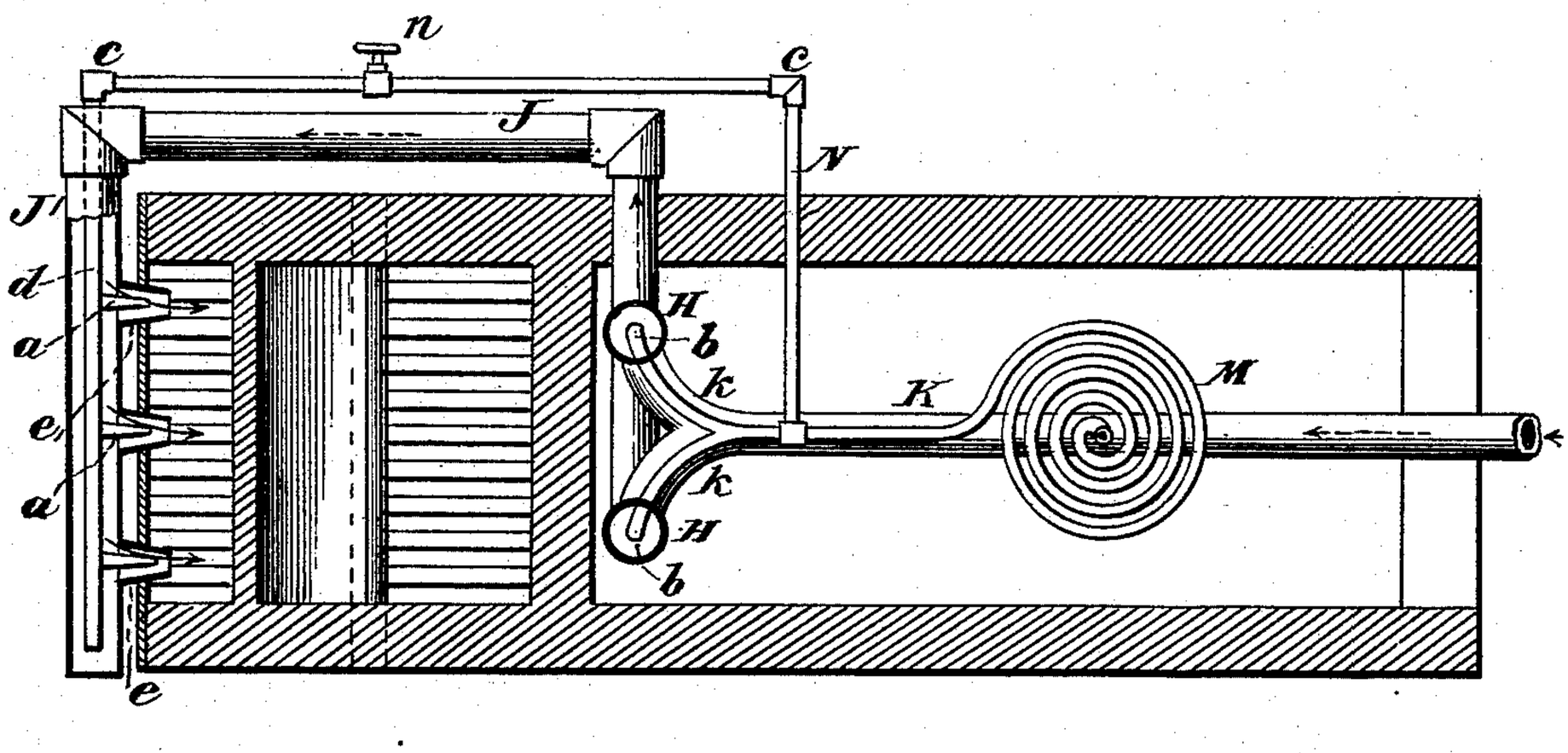


Fig. 2.



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H. C. McArthur

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Fig. 3.

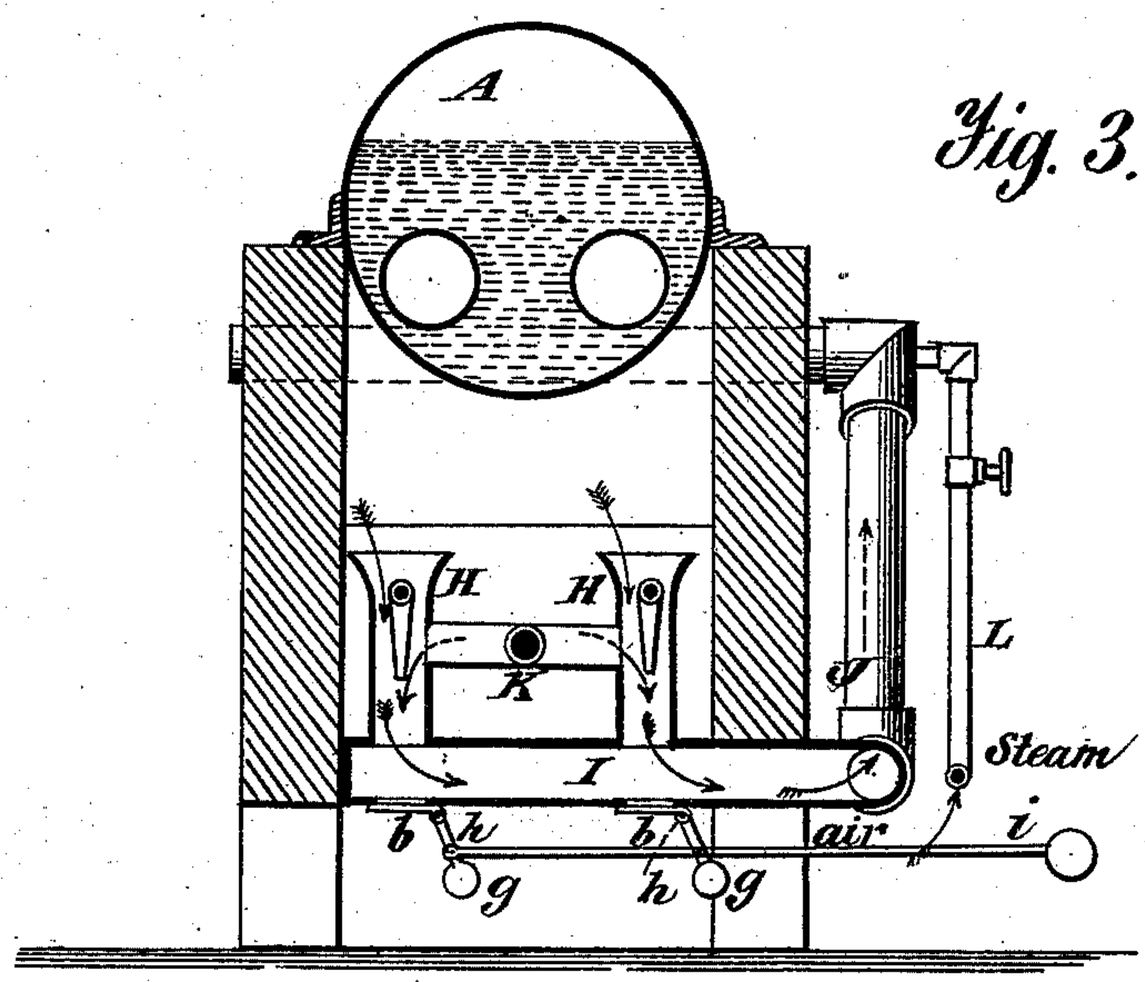
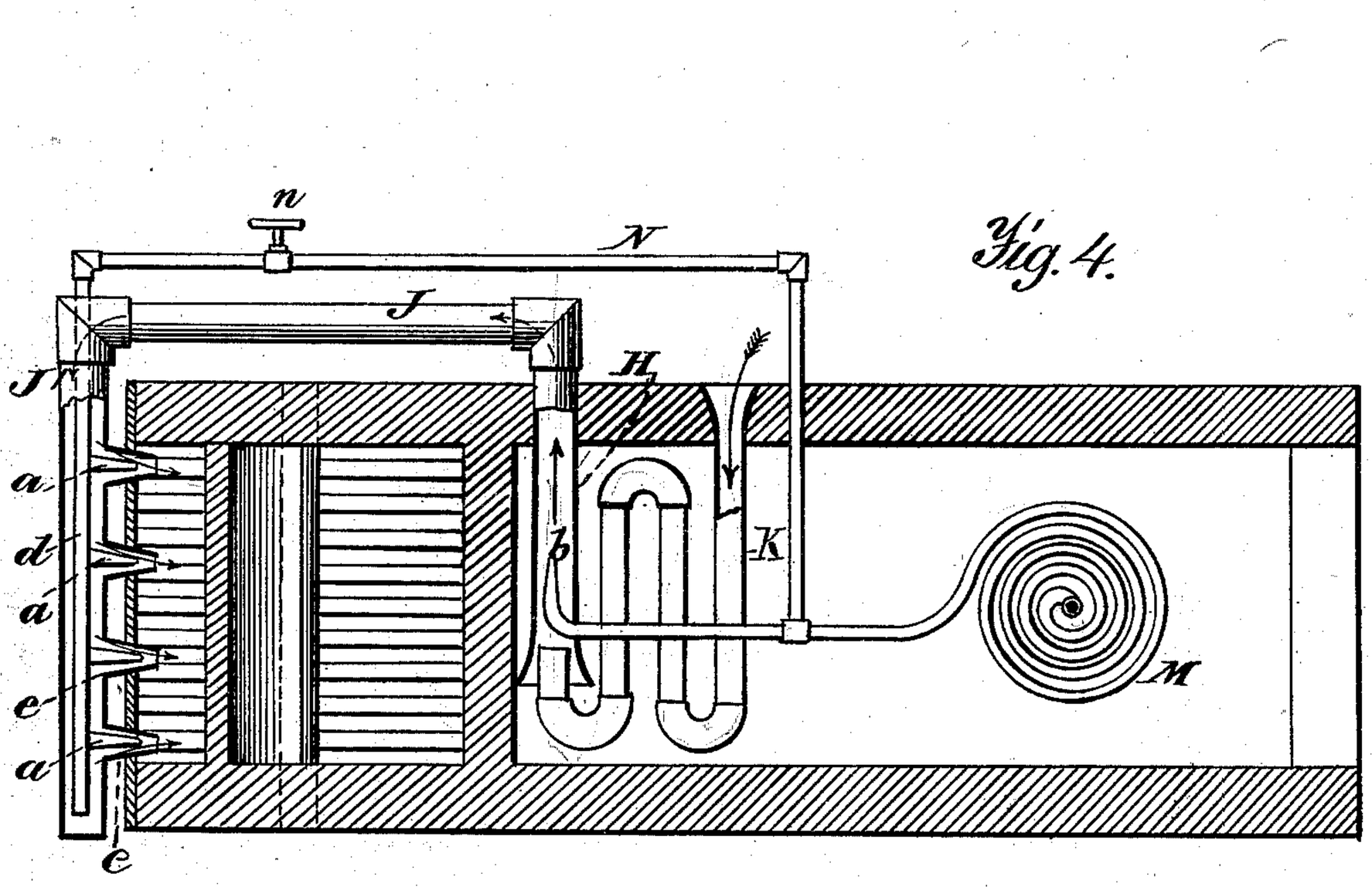


Fig. 4.



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UNITED STATES PATENT OFFICE.

GEORGE FARR, OF CINCINNATI, OHIO.

SMOKE AND GAS CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 272,035, dated February 13, 1883.

Application filed July 8, 1882. (No model.)

To all whom it may concern:

Be it known that I, GEORGE FARR, of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Furnaces for Consuming Smoke and Gases; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification.

This invention has for its objects to economize fuel and to prevent the formation of smoke in steam-boilers and other furnaces.

The specific objects to be attained by this invention are perfect combustion of the gases arising from the heated fuel in steam-engine and other furnaces for the purpose of preventing smoke and economizing fuel; to retain within such furnaces much of the heat which now passes away to the chimney without producing any useful effect; to arrest a portion of the smoke and gases and mix them with highly-heated air and superheated steam before supplying the mixture caused thereby to the furnace, and to facilitate the evaporation of steam by an evenly-distributed heat to all the heating-surfaces of the boiler. Heretofore when burning fuel for the purpose of generating steam and for other purposes the products of such combustion have been at once carried away by the ordinary pressure of the atmosphere with greater or less rapidity from the furnace through the flues in or around the generator to the chimney or uptake; and it is well known that when generating steam by the methods heretofore practiced there is a very considerable waste of fuel, much of the heat developed by the combustion of the fuel passing away through the chimney both in an active and latent form. Now, according to my invention, I carry on the combustion of the fuel in the furnace at a higher atmospheric pressure than the ordinary atmosphere; and by means of my trapping devices and my forced blast I cause the products of combustion to travel from the furnace through the flues at a higher pressure than the ordinary pressure of the atmosphere, and still at the same time retard their escape, by means of which the gases are made to give up more of their heat than when allowed to pass off in the ordinary way.

To these ends my invention consists in the peculiar construction and arrangement of the flame-bed of furnaces, by means of which I am enabled to heat a large body of air, and in devices for employing this highly-heated air to mix with a portion of the gases passing off through the furnace, and also with means for superheating steam, which is employed for forcing, impelling, and exhausting the said portion of the gases from the flame-bed, whereby the combined mixture of hot gases, highly-heated air, and superheated steam is forced into the primary combustion-chamber under pressure, as before described.

The invention further consists in the construction and arrangement of inverted bridge-walls or diaphragms arranged in front and rear of bridge-wall proper, and in other details of construction, as will hereinafter more fully appear.

And that my said improvement may be fully understood, I will now proceed to describe the accompanying drawings hereunto annexed, reference being had to the letters and figures marked thereon, like letters denoting the like parts in all the figures, which will be referred to further on.

Touching the first part of these improvements, the principal gases we have to deal with in a furnace of this character are carbureted hydrogen and carbonic oxide, the atoms of which must be chemically united with oxygen derived from the air, and be supplied with the requisite temperature before combustion can take place. The difficulty heretofore has been to accomplish this union; owing to the gases sweeping along in a body toward the uptake with great rapidity, there is not time for a thorough mixture of them with the air to take place while in contact with the degree of heat necessary for their ignition. My object, therefore, is to prevent this rapid transit, and by intercepting the gases on their way from the fire-place to the chimney dividing them into a number of streams or bodies, and forcing them into mechanical mixture with the highly-heated air and superheated steam, breaking

them up into small currents, in order to facilitate the chemical union of said elements, and thus produce a combustible mixture, and to do this in such place and manner as to insure the necessary heat for their combustion.

The means I adopt to secure the above results are shown in the drawings.

Figure 1 is a side elevation of a cylindrical boiler mounted over one of my improved furnaces, the furnace being in longitudinal section and exhibiting my several improvements. Fig. 2 is a plan view, in horizontal section, of the furnace with the boiler removed, taken on the line *x x* of Fig. 1. Fig. 3 is a transverse section taken on the line *y y* of Fig. 1, plainly showing the smoke and gas induction pipes, their steam-nozzles, and the spark and cinder emptying valves; and Fig. 4 shows a modification of the method of inducing currents of air and gases, and of the means of heating the air and of forcing the combined mixture into the furnace.

A represents an ordinary boiler, and B the furnace; C, the flame-chamber; D, the intermediate combustion-chamber, and E the grate-bars.

F is the bridge-wall, provided at its top with a rearwardly-projecting lip, G, extending partly over the gas-induction pipes H H. These pipes or flues are flaring at their mouths for the more ready induction of the gases. They connect with a cross-pipe, I, at their lower ends, which conveys the gases, hot air, and superheated steam to the side pipes, J J, and connect also to a pipe, K, which supplies hot air to the mixture. This pipe K, as may be seen at Fig. 2, is somewhat T-shaped in plan view, only slightly curving to adapt it to the natural flow of the air passing through it. *k k* show the branches united to the main air-pipe K.

L shows the steam-pipe, which conveys steam to the superheating-coil M. This superheater heats steam both for exhausting-nozzles *a* and for the impelling-nozzles *b*. The steam from the superheater for supplying the exhausting-nozzles *a* is conveyed through branch pipe N, which connects by elbow *c* with a pipe, *d*, concentrically arranged in the air, gas, and steam pipe J′. The pipe J′ is also provided with nozzles *e*, into which steam-nozzles *a* enter and through which the combined mixture is introduced into the furnace. At this junction of the hot-air pipe K with the hot-gas-induction pipe H will be seen an overhanging lip, *f*. The object of this lip is to deflect the air downward in the direction of the steam-nozzle. This lip *f* also prevents any dust or cinders from entering the air-pipes.

At the bottom of pipe I and immediately under the gas-induction pipes H H, I arrange dampers O O, provided with weights *g g*. These weights are arranged at such an angle that they overbalance the weight of the valve, and they are hinged or fulcrumed at *h* and operated by a lever, *i*. Their principal object is to clean out the pipes H H of any cinders that may fall into them from over the bridge-wall. Although most of the cinders will be deflected off by the lip or hood G, a further use of the valves or dampers O O is that an additional supply of air may be admitted through them, according to the kind of fuel used, as it is well known that some fuel requires more oxygen of atmospheric air than others, or that the air, gases, and steam may require to be modified by an additional supply of cold air direct from the outside. The weights *g g* will automatically retain the valves in position, and they may be opened by means of rod *i*.

The supply of air may be controlled by valves on the mouths of air-pipes. These valves being in common use, none are shown.

Referring again to the furnace-chambers, P represents an inverted bridge-wall or diaphragm, which divides the fire-box transversely. This diaphragm is preferably made of the best refractory material, and rests upon a pipe, Q, located across the furnace. This pipe may be perforated for the supply of air, if desired; and when the fire-box has side water-legs the pipe may be used for a stay, and also for the circulation of water through it. It is obvious that it may be supported by any well-known means. I prefer to incline the diaphragm or partition-plate P toward the front of the furnace, for the reason that the heat is greater back of the partition than in front of it. By this means I expose a larger portion of the boiler to a greater heat than would be the case if the partition were perpendicular; and by this means a greater evaporation of the water into steam takes place.

In rear of the bridge-wall and beyond the induction-pipes I arrange a pendent curved partition or diaphragm, R, which I prefer to support by a water-circulating pipe, *m*, although it may be supported by any approved means. The object of this partition is to cause the gases to eddy, and cause them to deflect into the mouths of the gas-induction pipes H H. The reason of locating it so far from the mouths of the pipes H H is that any sparks, cinders, or dust thrown off by the hood G from entering the said pipes will strike the curve of the deflector R and fall beyond the mouths of said pipes, and thus partially prevent them from filling up with cinders. The second reason for locating the partition R where it is, is that the cinders and dust deflected from it fall upon the air and steam pipes, covering them and protecting them from the intense heat passing over them between the top of the bridge-wall and the bottom of partition R.

The operation is as follows: The fire being kindled in the furnace in the usual way, and steam being raised sufficient for working operations, steam is turned onto pipe L. Atmospheric air is at once drawn into pipe K. A portion of the smoke and gases is also drawn into pipes H H from over the bridge-wall. Valve *n* is then opened, which lets steam onto the nozzles *a* and *e*, which draws the gaseous mixture from pipes H H J J′, and forces them into the front chamber of the fire-box, under

the inclined partition, and down on the top surface of the fuel. This mixture is then made to mingle again with the gases arising from the fuel, which is not so hot as the gaseous mixture, which is nearly 1,000° Fahrenheit. These gases thoroughly mix, and as soon as brought in contact with each other they are ignited and are entirely consumed. The heat and flame thus produced are both impelled and drawn through the burning fuel, and under the front partition, and into and over the incandescent fuel in chamber D, where they receive additional units of heat, the gases becoming more completely burned than before, if possible, so that by the time the flame reaches the flame-chamber C there is nothing but pure heat, without smoke or any of the combustible gases.

The above-described process is continuously repeated during the working-hours of the apparatus, or as long as the steam is let onto the conveying-pipes. When all the fuel is in a state of incandescence, and the gases from the fuel are not voluminous, the flow of steam may be modified by the controlling steam-valves, which also control the supply of air through the pipes.

Other forms of superheaters, and also of induction-pipes, may be used without departing from the spirit of my invention. I do not therefore desire to be confined to the exact form or arrangement shown.

I am aware that it is not broadly new to exhaust a portion of the unconsumed gases from the combustion-chamber, nor from the smoke flues of steam-boilers; but I am not aware that the same means were ever before employed, nor that the same arrangements were ever before designed, nor that the resultant action was ever before so complete as in the present invention. I do not therefore claim broadly taking waste or escaping gases from the combustion chamber or flues of steam-boilers; but

What I do claim, and desire to secure by Letters Patent, is—

1. The combination, in a smoke and gas consuming furnace, of the inclined partition, the curved pendent partition, and the bridge-wall provided with the overhanging lip, with the induction-tubes, substantially as described, and for the purpose set forth.

2. In a smoke and gas consuming furnace, the combination of the front and rear pendent partitions, forming combustion-chambers B D and flame-chamber C, the bridge-wall being intermediate of the two said pendent partitions, with a smoke and gas induction chamber or flue in rear of said bridge-wall, substantially as described.

3. A smoke and gas consuming furnace consisting of the front combustion-chamber, intermediate combustion-chamber, and rear flame-chamber, a smoke and gas conduit, an air-heating conduit, and superheated-steam-injecting nozzles, whereby the combined heated air, superheated steam, and unconsumed hot gases are forced in among the burning fuel, substantially as described.

4. The combination, in a smoke and gas consuming furnace, of the chambers D C, the curved pendent deflector R, bridge-wall F, induction-conduits H H, and air-pipe K, provided with branches *k k*, and pipe J, substantially as shown and described.

5. The combination, in a smoke-consuming furnace, of the combustion-chamber, the flame-chamber, the curved pendent partition R, the bridge-wall provided with the overhanging lip G, the smoke and gas induction chambers, and the hot-air conduit, with a superheating device and injecting-nozzles, whereby a combined mixture of superheated steam, highly-heated air, and unconsumed smoke and gases is impelled and exhausted from the flame-chamber and forced into the combustion-chamber in the manner set forth and described.

6. The combination, in a smoke and gas consuming furnace, of the smoke and gas induction conduit or conduits H, the air heating conduit K, having branches *k k*, the said branches having hood or lip *f*, the superheater M, side pipes, J J′, and impelling and exhausting nozzles *a b* and gaseous-mixture nozzles *e e*, all arranged in the manner set forth and described.

7. The combination, with a smoke and gas consuming furnace, of the chambers D and C, the smoke and gas conduits H H, the branched hot-air pipe K *k k*, and superheater and steam nozzles, the said smoke and gas conduits being provided with valves or dampers O O and weights *g g*, in the manner set forth and described.

8. The combination, in a smoke and gas consuming furnace, of a combustion-chamber, a bridge-wall having an overhanging lip or hood, one or more smoke and gas induction conduits, hot-air-inducting flues, branched as described, steam-jet nozzles, a cross-pipe, I, provided with weighted valves O O, (see Fig. 3,) with a conveying-pipe, J, all arranged as set forth and shown.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

GEORGE FARR.

Witnesses:
O. E. DUFFY,
M. P. CALLAN.