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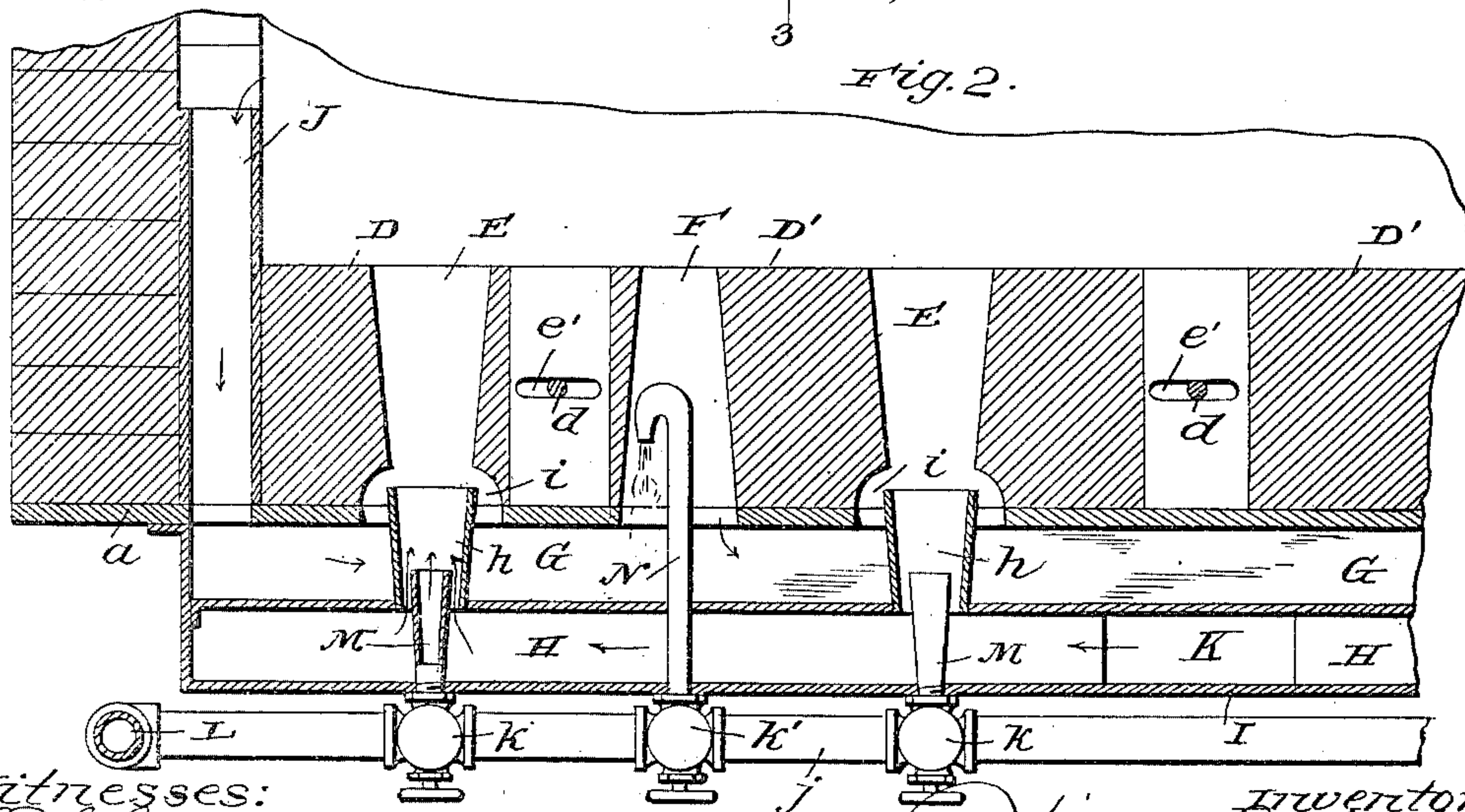
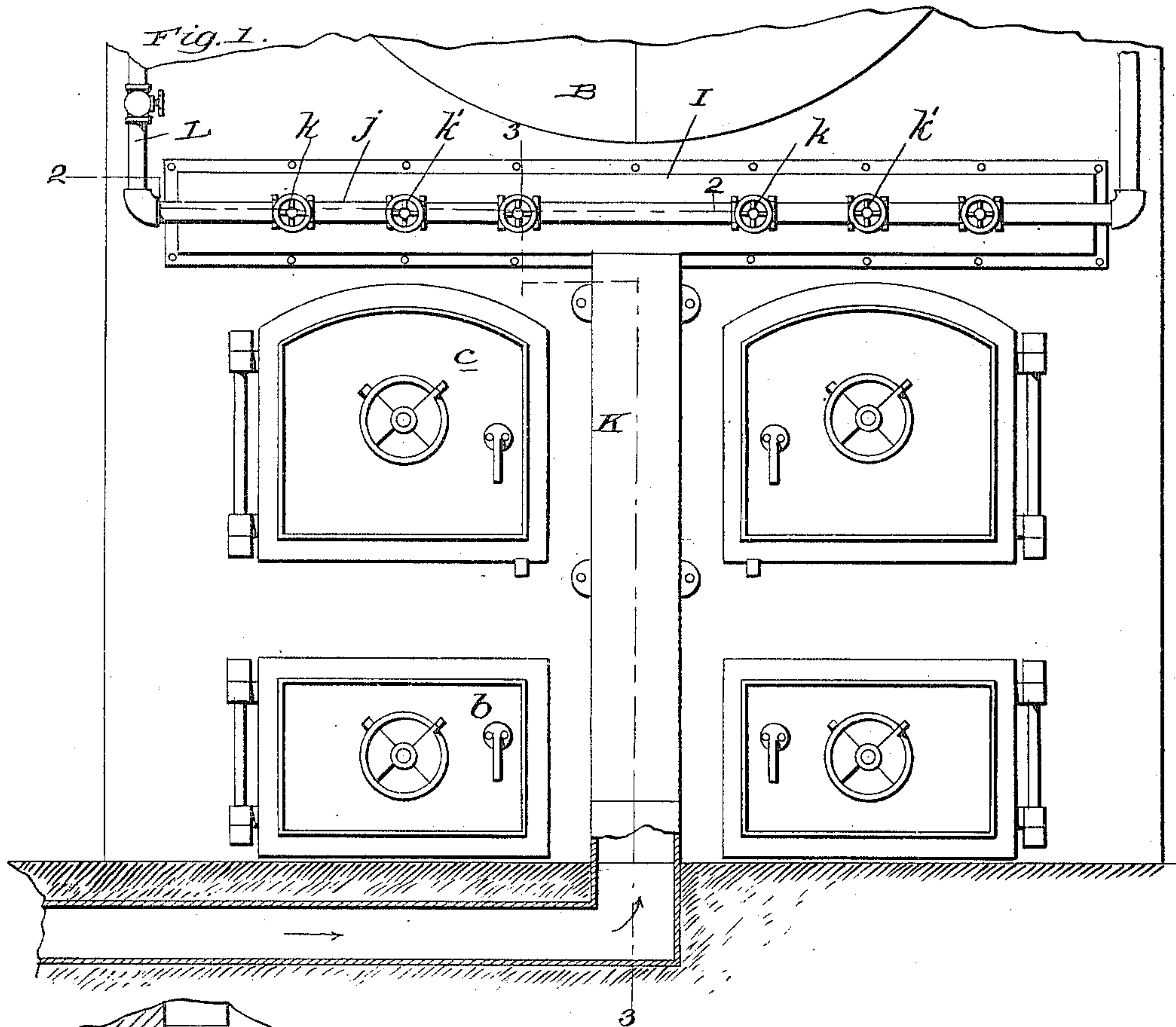
Patented Nov. 6, 1900.

W. E. MINSHALL.
SMOKE CONSUMING FURNACE.

(Application filed July 12, 1900.)

(No Model.)

2 Sheets—Sheet 1.



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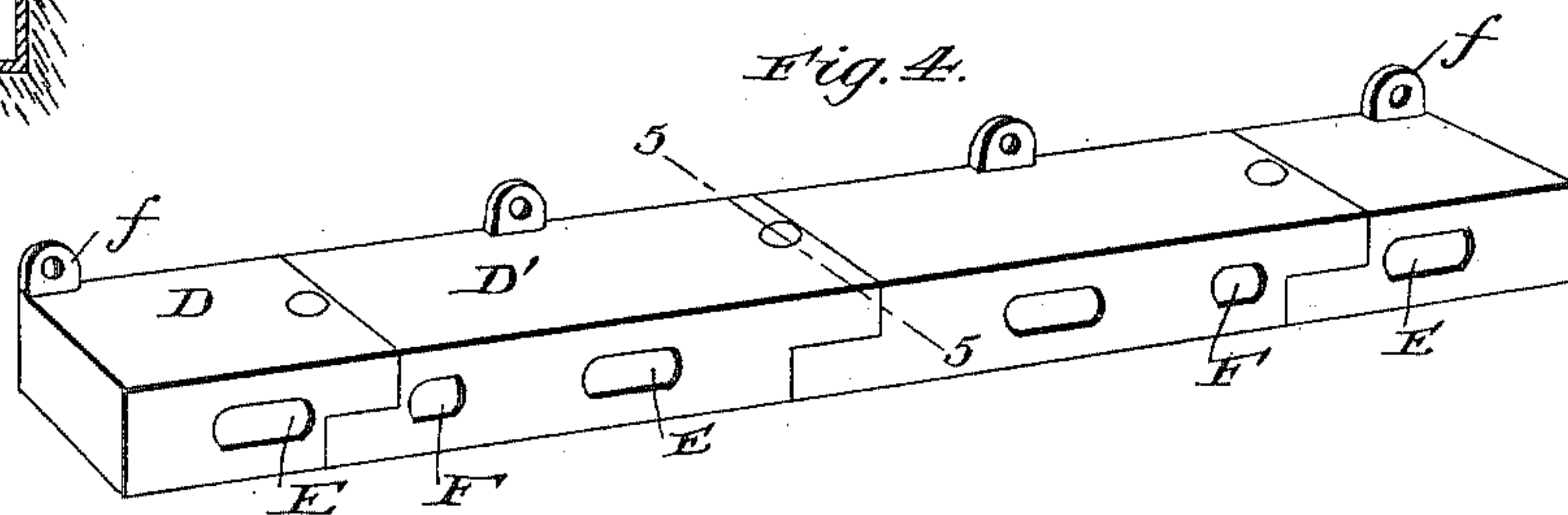
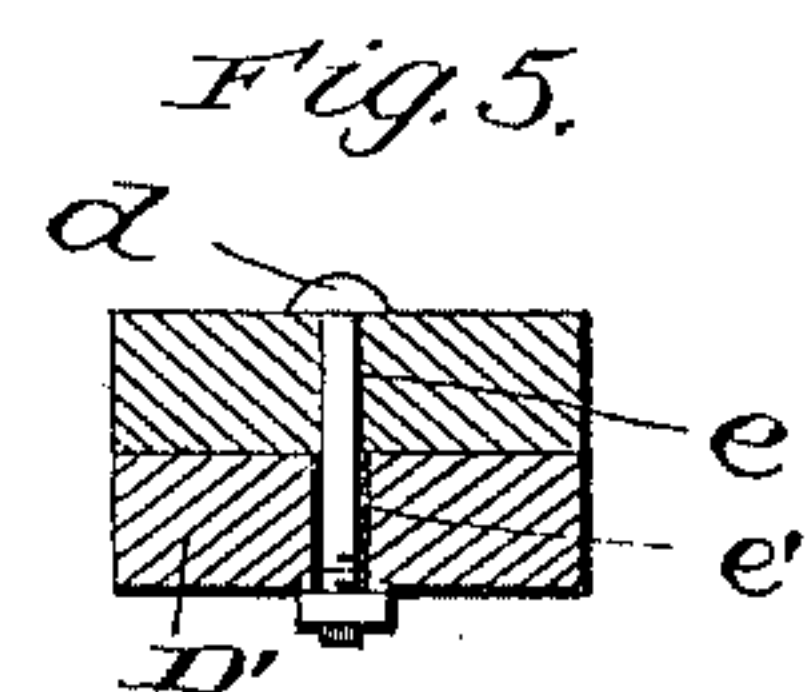
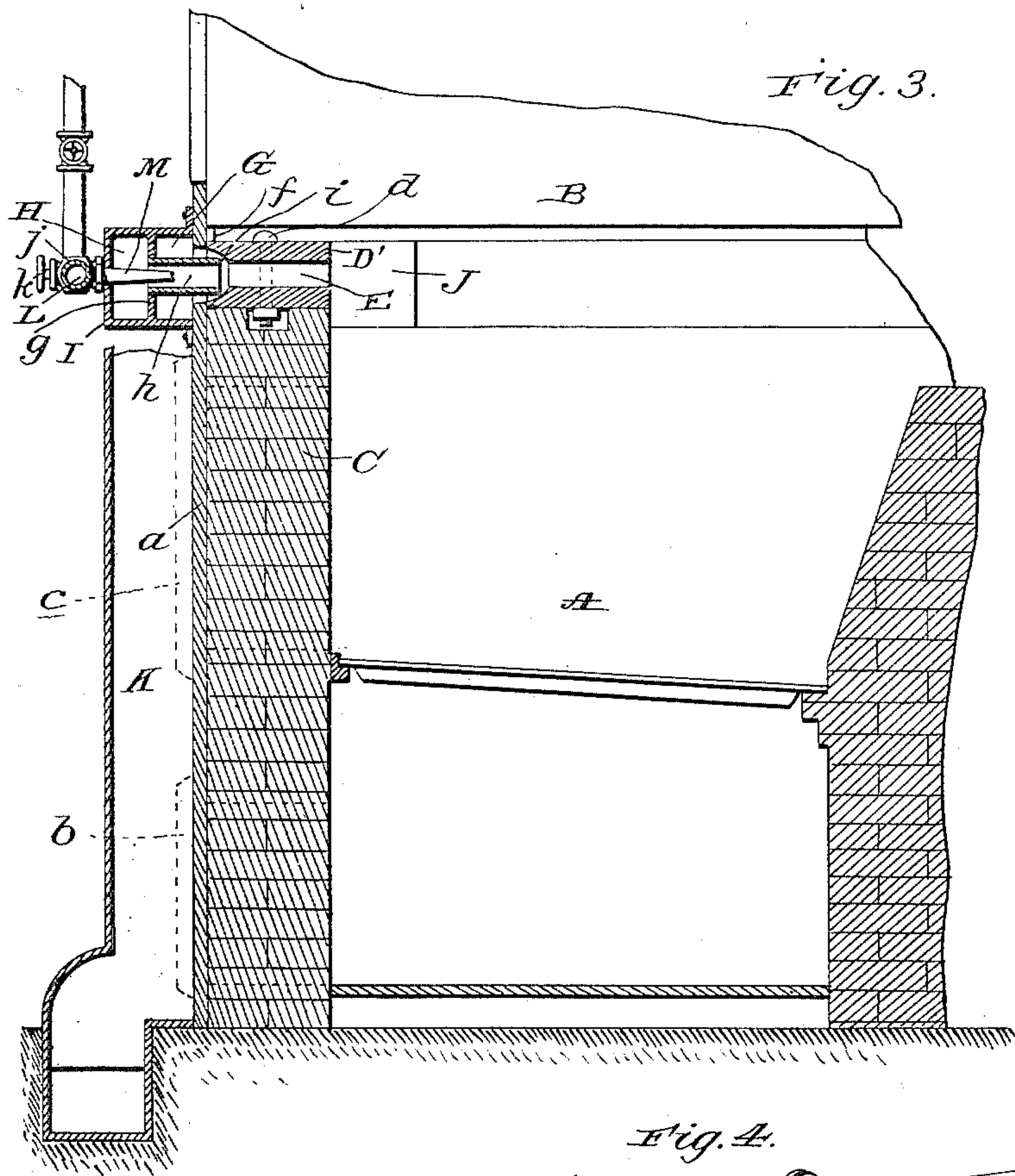
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UNITED STATES PATENT OFFICE.

WILLIAM ELLIS MINSHALL, OF MINONK, ILLINOIS.

SMOKE-CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 661,379, dated November 6, 1900.

Application filed July 12, 1900. Serial No. 23,396. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ELLIS MINSHALL, a citizen of the United States, residing at Minonk, in the county of Woodford and State of Illinois, have invented new and useful Improvements in Smoke-Consuming Furnaces, of which the following is a specification.

My invention relates to improvements in that class of furnaces which are provided with smoke-consuming means; and it consists in the combination, with the fire-box or combustion-chamber of a furnace, of a smoke-consumer, the novelty, utility, and advantages of which will be fully understood from the following description and claims when taken in connection with the accompanying drawings, in which—

Figure 1 is a front elevation of so much of a steam-boiler furnace as is necessary to illustrate my improved smoke-consuming means, the cold-air-induction conduit of such means being shown partly in section. Fig. 2 is an enlarged detail horizontal section taken in the plane indicated by the broken line 2 2 of Fig. 1 and illustrating one-half of my improved smoke-consumer—that is, the half of the same at the left of the median line of the furnace. Fig. 3 is a detail longitudinal and vertical section taken in the plane indicated by the broken line 3 3 of Fig. 1. Fig. 4 is a detail perspective view of a series of connected castings which are embodied in my improvements and form part of the front wall of the fire-box or combustion-chamber of the furnace. Fig. 5 is a transverse section taken in the plane indicated by the broken line 5 5 of Fig. 4 and illustrating the manner in which the lapped rabbeted ends of the castings are connected.

In the said drawings similar letters of reference designate corresponding parts in all of the several views, referring to which—

A is the fire-box or combustion-chamber of the steam-boiler furnace. B is the boiler. C is the front wall, provided with the usual face-plate *a*, ash-doors *b*, and fire-doors *c*, and D D' are end and intermediate castings which are embodied in my improvements and are arranged end to end upon and form part of the front wall C, as shown. The said castings have their ends rabbeted and lapped and connected through the medium of bolts *d*,

which take through apertures *e* in the one and slots *e'* in the other after the manner shown in Figs. 2 and 5. They are provided with apertured lugs *f* for the passage of bolts, through the medium of which they are connected to the face-plate *a* and secured in position on the wall C, and they are also provided with ports or passages E F, arranged in the manner illustrated—that is to say, each of the end sections D has a port or passage E, which is flared or gradually increased in size from its outer to its inner end, while each of the intermediate sections or castings D' is provided with a port or passage E, similar to those of the end sections or castings, and also with a port or passage F, which is gradually diminished in size from its outer to its inner end.

While I have shown and described four castings D D', it is obvious that more or less of the same may be employed, according to the size of the furnace to be equipped with my improvements, and it will also be observed that by virtue of the slots *e'* a series of connected castings may be adjusted as to length in order to properly fit a furnace.

G H designate the hot-air chamber and cold-air chamber, respectively, of the smoke-consumer, the said chambers being by preference inclosed in a single casing I and separated by a longitudinal central partition-wall *g*, as shown in Figs. 2 and 3. The cold-air chamber H is connected with the ports or passages E, and hence with the fire-box, by tubes *h*, which extend from the partition-wall *g* inwardly to a position within the enlargements *i* at the outer ends of the said passages E. The hot-air chamber is connected with the fire-box by the passages F and the passages E, it being connected with the latter by the enlargements *i* at the outer ends of the same. Said hot-air chamber is also connected at its ends with the interior of the fire-box by return passages or conduits J. These passages or conduits J are shown in the form of tubes open at their inner ends and communicating at their outer ends with the hot-air chamber; but it is obvious that they might be formed in the side walls of the furnace, in which event they would be connected with the fire-box by a single large opening or a plurality of small openings, as preferred.

K is a cold-air-supply conduit. This conduit K communicates with the cold-air chamber and extends downwardly from the same and thence by preference underground to a
 5 suitable well or pit, (not shown,) down into which it is carried a suitable distance. The location of the receiving end of the cold-air-supply conduit in a well or pit has for its purpose to afford a strong draft, and it will be
 10 readily observed that the greater the distance the pipe K is carried below the cold-air chamber H the greater will be the draft afforded.

L is a steam-supply pipe which is connected at one or both of its ends to the boiler B and
 15 has a transverse portion *j* disposed in front of the casing I and equipped with suitable valves *k k'*.

M represents jet-tubes, which are connected to the valves *k* and extend therefrom through
 20 the cold-air chamber H to a point within the tubes *h*, and N represents pipes which are connected to the valves *k'* and extend therefrom through the cold and hot air chambers and into the passages F and have crooks at their ends,
 25 so as to enable them to discharge outwardly in said passages F. By virtue of the transverse portion of the steam-supply pipe L being provided with the valves *k k'* it will be seen that the boiler-pressure is brought very near to
 30 the discharges, and by virtue of the provision of the valves *k* it will be observed that the passages E may be changed from hot-air passages into cold-air passages, and vice versa, by simply closing and opening the said
 35 valves *k*.

In the practical operation of my improvements steam from the boiler passes through the pipe L and valves *k* and is discharged through the jet-tubes M into the tubes *h* and
 40 thence into the passages E, with the result that suction is created in the passages E, which causes the cold and hot air to be drawn into said passages E and discharged therefrom, with the steam, into and far across the
 45 upper portion of the fire-box. From this it follows that suction is also created in the hot-air chamber G, which operates to draw the hot gases from the upper part of the fire-box through the conduits J into the hot-air chamber, wherein said hot gases are commingled
 50 with air and from which they are drawn by the suction in the passages E, before described. The air that is admitted to the fire-box through the dampers in the doors is, together with
 55 more or less of the hot gases, also drawn through the passages F into the hot-air chamber G, from whence it is discharged through the passages E, as before described. The pipes N have for their purpose to discharge
 60 steam into the chamber G, and thereby increase the suction created therein.

It will be appreciated from the foregoing that the carbonic acid and carbonic monoxid are drawn from the furnace into the hot-air
 65 chamber G and are mixed with the nitrogen of the air and hydrogen of the steam and are then by reason of the shape of the inner

ends of the passages E discharged in a broad thin sheet into the upper portion of the fire-box, with the result that all smoke and products of combustion are consumed.

The draft of cold air up the conduit K and from thence through the cold-air chamber H and tubes *h* assists materially in creating a suction in the passages E and the hot-air
 75 chamber and may, when desired, be depended on to draw the hot gases, smoke, and other products back from the fire-box into the hot-air and mixing chamber G. I prefer, however, to also employ steam for creating the
 80 suction stated; but it is obvious that by virtue of the cold-air draft much less steam need be employed than would otherwise be the case.

When desired, two additional cold-air-supply pipes, one at each end of the cold-air
 85 chamber, may be employed. I prefer, however, to employ but a single cold-air-supply pipe, as shown, and have therefore deemed it unnecessary to illustrate the additional pipes
 90 mentioned.

When desirable, the suction created by the draft of cold air in the passages E may be depended upon to draw the carbonic acid, carbonic monoxid, and other products of
 95 combustion from the fire-box back into the hot-air chamber, wherein they will be commingled with the nitrogen of the air and the hydrogen, in which case only sufficient steam to form an element of combustion need be
 100 supplied.

The arrangement of the valves *k* near the discharge-points carries the boiler-pressure very near said discharge-points, as before
 105 described, which contributes to the even distribution of the steam into the fire-box.

The passages J enable the suction created in the hot-air chamber G to draw the gases and products of combustion from the rear
 110 portion of the fire-box into the said chamber, while the passages F serve for the passage of products of combustion from the front portion of the fire-box into said chamber.

When desired, the hot and cold air chambers may be arranged at the inner side of the face-plate of the furnace, in which event it
 115 will only be necessary to form holes in said plate large enough for the passage of the jet-tubes.

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

1. In a smoke-consuming furnace, the combination of a fire-box or combustion-chamber, a hot-air chamber, passages connecting the
 125 hot-air chamber and the interior of the fire-box or combustion-chamber, a cold-air chamber open to the atmosphere, and one or more passages leading from said cold-air chamber into one or more of the passages intermediate of the hot-air chamber and fire-box.

2. In a smoke-consuming furnace, the combination of a fire-box or combustion-chamber, a hot-air chamber, a cold-air chamber, a cold-air-supply conduit open to the atmosphere

and leading from a point below the cold-air chamber to said chamber, passages intermediate of the hot-air chamber and the fire-box or combustion-chamber, and one or more passages leading from the cold-air chamber into one or more of the passages between the hot-air chamber and fire-box.

3. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber disposed transversely in front of the fire-box and in a plane above the grate thereof, a cold-air chamber arranged parallel to the hot-air chamber and adjacent thereto; said cold-air chamber being open to the atmosphere, passages intermediate of the hot-air chamber and the fire-box, and a passage leading from the cold-air chamber into one of the passages intermediate of the hot-air chamber and fire-box, substantially as specified.

4. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber, a passage leading from the hot-air chamber to the fire-box, a return-passage leading from the fire-box above the fire to the hot-air chamber, a cold-air chamber open to the atmosphere, a passage leading from the cold-air chamber into the first-named passage between the hot-air chamber and fire-box, and a steam-pipe having a jet arranged to discharge into the passage between the cold-air chamber and the passage leading from the hot-air chamber into the fire-box, substantially as specified.

5. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber, passages intermediate of the fire-box and the hot-air chamber, a cold-air chamber open to the atmosphere, a passage leading from the cold-air chamber into one of the passages between the hot-air chamber and the fire-box, a steam-pipe having a jet arranged to discharge into the passage between the cold-air chamber and the passage leading from the hot-air chamber to the fire-box, and a pipe leading from the steam-pipe into one of the passages between the hot-air chamber and the fire-box and arranged to discharge into said passage in a direction away from the fire-box, substantially as specified.

6. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber, a passage leading from the hot-air chamber to the fire-box, a return-passage leading from the fire-box to the hot-air chamber, a cold-air chamber open to the atmosphere, a passage leading from the cold-air chamber into the first-named passage between the hot-air chamber and the fire-box, a steam-pipe, a jet-tube arranged to discharge into the passage between the cold-air chamber and the passage leading from the hot-air chamber into the fire-box, and a valve interposed between the steam-pipe and the jet-tube, substantially as specified.

7. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber, passages intermediate of the fire-box and the hot-air chamber, a passage open to the atmosphere

and leading into one of the passages between the hot-air chamber and the fire-box, a steam-supply pipe, and a jet-tube arranged to discharge into the tube communicating with a source of air-supply.

8. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber, passages intermediate of the fire-box and the hot-air chamber, a passage leading from the atmosphere into one of the passages between the hot-air chamber and fire-box, a steam-supply pipe, a jet-tube arranged to discharge into the passage communicating with the atmosphere, and a valve interposed between the supply-pipe and the jet-tube, substantially as specified.

9. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber, passages intermediate of the hot-air chamber and fire-box, a cold-air chamber, a cold-air-supply conduit having its receiving end open to the atmosphere located considerably below the cold-air chamber, and a passage leading from the cold-air chamber into one of the passages between the hot-air chamber and the fire-box.

10. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber, passages intermediate of the hot-air chamber and fire-box, a cold-air chamber, a cold-air-supply conduit having its receiving end located considerably below the cold-air chamber and open to the atmosphere, a passage leading from the cold-air chamber into one of the passages between the hot-air chamber and the fire-box, and suitable means for supplying steam to the passage leading from the cold-air chamber, substantially as specified.

11. In a smoke-consuming furnace, the combination of a fire-box, a hot-air chamber disposed transversely in front of the fire-box and in a plane above the grate thereof, a cold-air chamber arranged parallel to the hot-air chamber and adjacent thereto; said cold-air chamber being open to the atmosphere, passages intermediate of the hot-air chamber and the fire-box, one or more tubes leading from the cold-air chamber into said passages, a steam-supply pipe, and one or more jets connected therewith and arranged to discharge into one or more of the said tubes, substantially as specified.

12. In a smoke-consuming furnace, the combination of a fire-box, a casing disposed transversely in front of the fire-box and in a plane above the grate thereof, and containing a longitudinal hot-air chamber connected by openings with the fire-box, a cold-air chamber open to the atmosphere and separated from the hot-air chamber by a longitudinal partition, tubes communicating with the cold-air chamber and extending into the openings between the hot-air chamber and the fire-box, and a steam-pipe having jets arranged in the said tubes, substantially as specified.

13. In a smoke-consuming furnace, the combination of a fire-box, and a plurality of

castings forming part of one of the walls of the fire-box, and having their contiguous ends rabbeted and lapped and also having apertures in the one and slots in the other; 5 said castings being provided with passages, and bolts extending through the apertures and slots of the castings, and connecting the same, substantially as specified.

10 14. In a smoke-consuming furnace, the combination of a fire-box, a plurality of castings arranged end to end and forming part of the front wall of the fire-box; said castings having passages extending from their outer to their inner sides, a casing arranged 15 at the outer side of the castings, and containing hot and cold air chambers; the hot-air chamber being in communication with the

passages in the castings, return-passages intermediate of the fire-box and hot-air chamber, passages leading from the cold-air chamber into passages of the castings, means for 20 supplying air to the cold-air chamber, and means for supplying steam to the passages leading from the cold-air chamber into passages of the castings, substantially as specified. 25

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

WILLIAM ELLIS MINSHALL.

Witnesses:

ROBERT C. GOLLIDAY,
THOMAS J. SUMNER.