(No Model.) 2 Sheets—Sheet 1.

ORLAND D. ORVIS & OREL D. ORVIS.

DOWNDRAFT FURNACE.

No. 486,122. Patented Nov. 15, 1892.

Fig. 1.

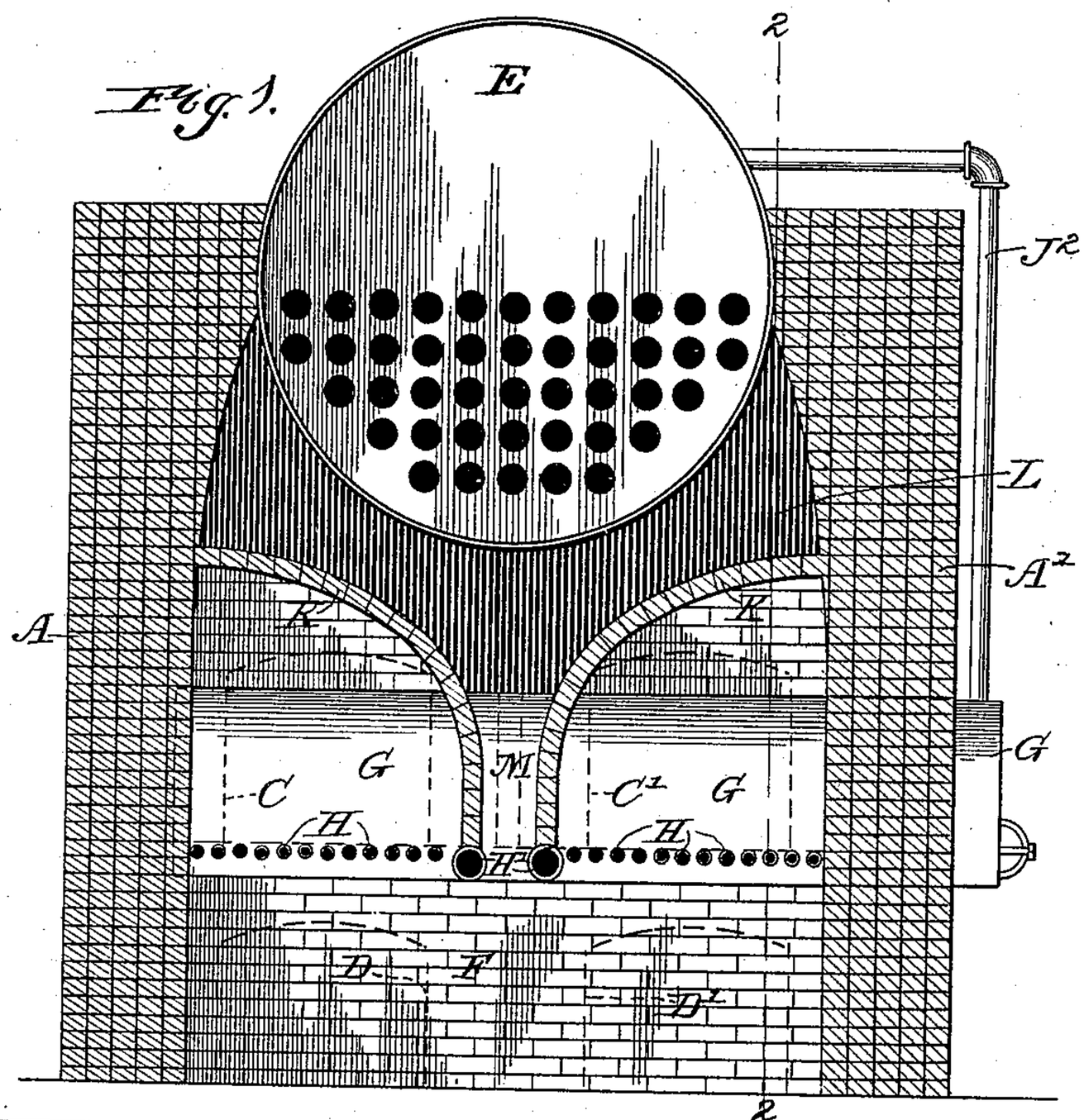
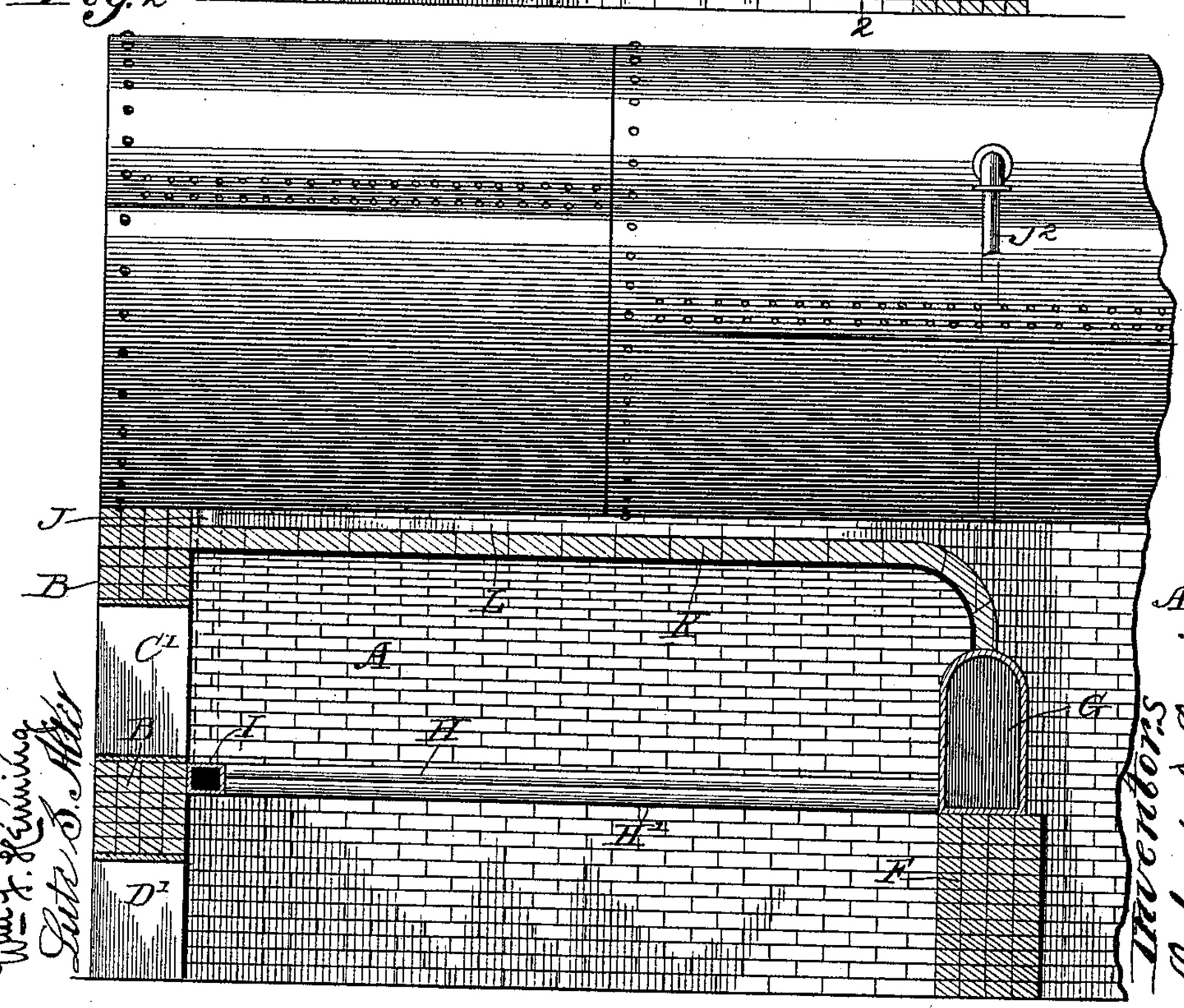


Fig. 2



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

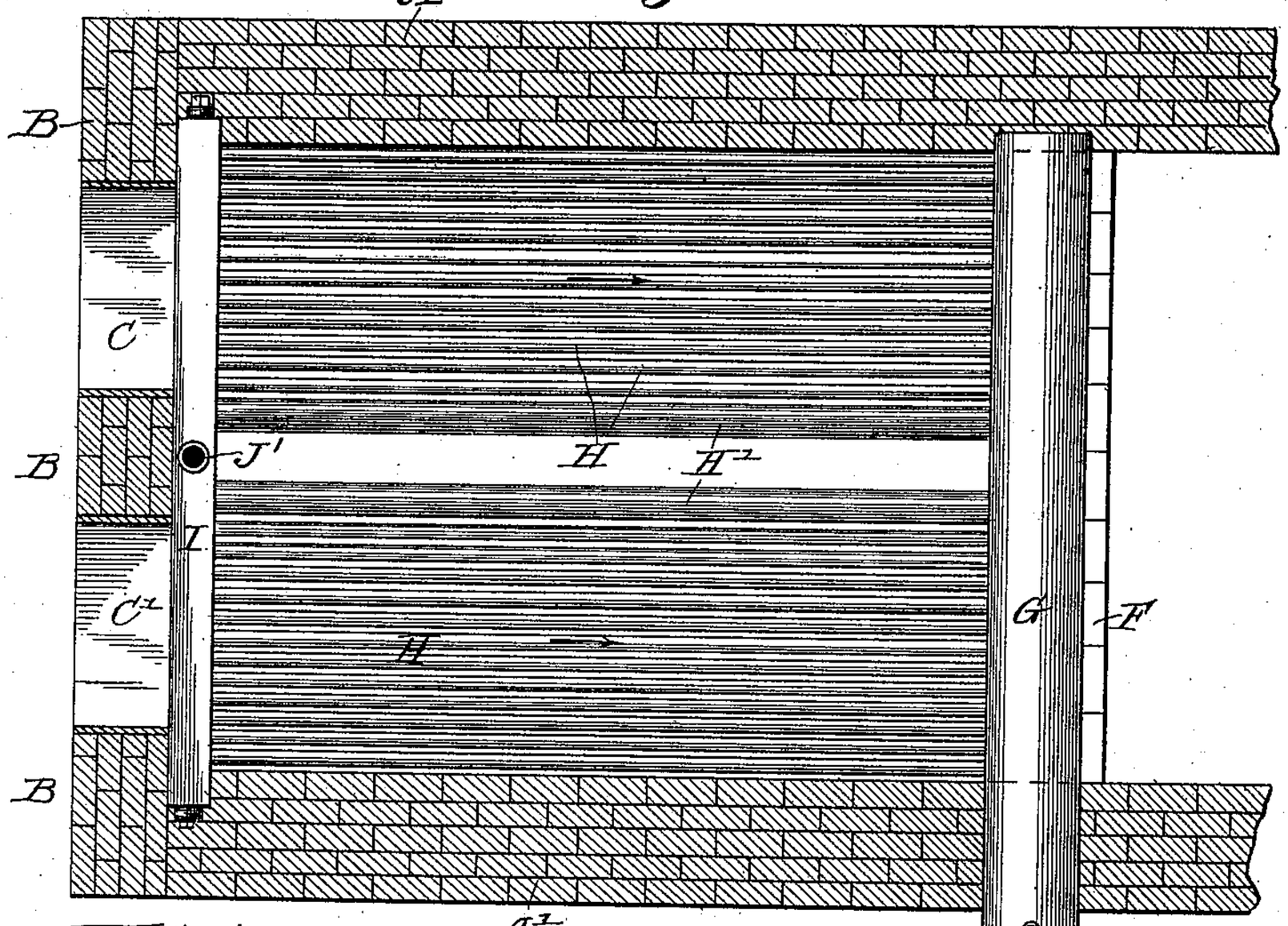


Fig. 4.

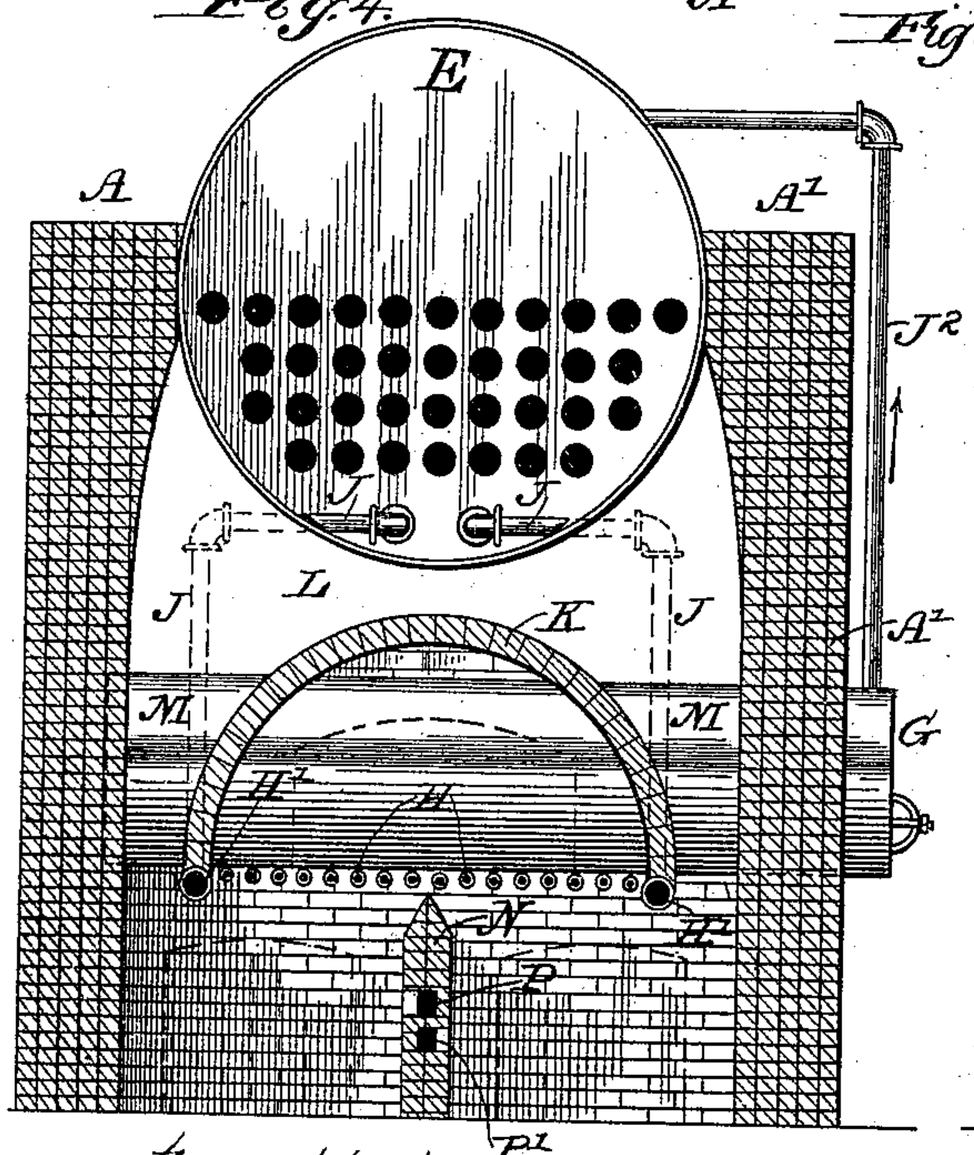
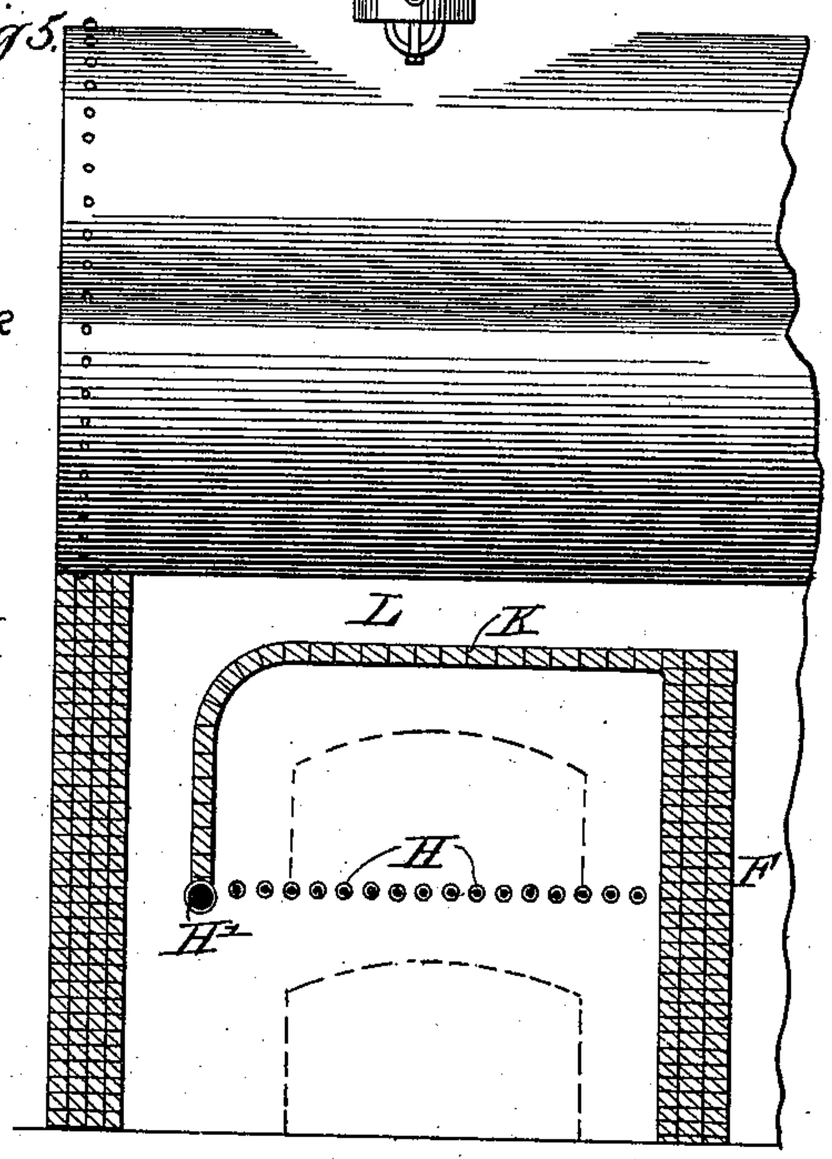


Fig. 5.



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UNITED STATES PATENT OFFICE.

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DOWNDRAFT-FURNACE.

SPECIFICATION forming part of Letters Patent No. 486,122, dated November 15, 1892.

Application filed April 19, 1892. Serial No. 429,735. (No model.)

To all whom it may concern:

Be it known that we, ORLAND D. ORVIS and OREL D. ORVIS, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Downdraft-Furnaces, of which the following is a full, clear, and exact specification.

This invention relates to improvements in downdraft-furnaces in which a steam-boiler, as illustrated, extends directly over the fire-chamber—more specifically stated, to that class of downdraft steam-boiler furnaces in which said boiler, by an arch or diaphragm, is isolated from the direct exposure to the burning fuel on the grate-bars, and the cold air necessarily admitted through the furnace-doors or other opening in the fire-chamber above the burning fuel to produce a downward draft of the products of combustion through grate-bars. In these arch and diaphragm structures as heretofore arranged there is formed between the arch and the boiler an air-chamber, the only opening to which, like the entire chamber, is rearward of the line of draft of the furnace—that is to say, rearward of the line of draft of the products of combustion as they ascend from the grate-bars and move onward to the rear of the furnace—and the result is that said chamber is practically a dead-air chamber. In other words, such a chamber isolates all that portion of the boiler-surface immediately over the fire-chamber from the draft heat to such a degree that such surface is quite cool as compared with all other portions beyond the chamber, and certainly the steam-boiler is not heated throughout with that uniformity necessary for the best results, nor are the products of combustion utilized to anything like the extent they may be capable of in raising the temperature of the contents of the boiler. The seriousness of the objection to this isolation of heat is all the more obvious when it is borne in mind that as usually and ordinarily constructed the boiler-surface of a flueless boiler directly over the fire-chamber and then isolated from the draft heat thereof represents about one-fourth of its entire directly-heatable surface, and that although in flue-boilers such as is shown the proportions of surface is somewhat lessened it still remains a fact that a substantial proportion of the otherwise directly-heatable boiler-surface will be practically entirely isolated from draft heat.

The prime object of our invention is to isolate the entire surface of a steam-boiler within a furnace, and particularly that and whatever portion may be directly over the fire-chamber, from all cold air admitted and admittable to the furnace, both from above the grate-bars to produce a downdraft or from below the grate-bars to supply oxygen to promote combustion or air for reducing the furnace heat during combustion, and at the same time subject that entire boiler-surface to all of the draft heat—in other words, to subject all that portion of a steam-boiler surface ordinarily over the fire-chamber of a downdraft-furnace to all of the heat escaping from the grate-bars to the combustion-chamber and to do this without subjecting any portion of said boiler-surface to any cold air admitted to the furnace during its operation.

A further object, in addition to securing these desirable results, is to at the same time prevent the formation of smoke during the operation of firing or raking down the furnace.

Another object is to insure as nearly as may be a uniform distribution of the heat to the boiler to be heated as it escapes from the grate-bars thereto.

A still further object is in the utilization of hollow grate-bars for heating boiler-water and to prevent the accumulation of mud and the sediment therein, and at the same time likewise free the boiler from similar accumulation and increase the heating-surface for the water, and finally to secure other and minor objects by devices and combinations of devices hereinafter described, claimed, and shown in the accompanying drawings, forming a part hereof, and in which—

Figure 1 represents a vertical transverse section of a double fire-chamber furnace embodying our invention in connection with a boiler shown in end elevation; Fig. 2, a central longitudinal section of said furnace on

the line 2 2 of Fig. 1; Fig. 3, a detail plan view of the grate-bar construction and of the mud-drum of the same; Fig. 4, a vertical transverse section of a single fire-chamber furnace embodying our invention with a steam-boiler in end elevation, and Fig. 5 a detail longitudinal section of the same with said boiler shown in side elevation.

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

A and A′ indicate the side walls, and B the front end wall; C and C′, the fire-chamber, and D D′ ash-pit doorways, the positions of which are indicated by dotted lines in Figs. 1 and 4, and E a steam-boiler, all of which are of the usual construction and arrangement. At the rear end and rising to the top of the ash-pit is a solid wall F, extending from side wall to side wall of the furnace, upon which is supported a mud-drum G, in turn supporting and in open communication with hollow grate-bars H, which may be pipes in open communication at their forward ends with and attached to a transverse header I, forming a water-chamber common to all of said grate-bars, and in turn supported by the walls of the furnace, as indicated in Fig. 3, or in any other suitable manner adapted for its support of the grate-bars. The grate-bar structure may be inclined, and instead of having all of the bars in the same plane, as shown, adjacent bars may be in differing planes and the alternate bars in the same plane. At that point where there is the greatest concentration of heat upon the grate-bars in the passage of the products of combustion from the grate-bar surface to the combustion-chamber—that is to say, over which all the furnace heat must pass in escaping to the combustion-chamber—said bars are preferably of larger size and greater internal water capacity, as shown at H′, to increase the heating-surface for the boiler-water. The supply-water to the grate-bars is preferably taken from below the water-line in the boiler, as indicated, by the water-supply pipe or pipes J, which open into the header I, as indicated at J′ (shown in Fig. 3,) and indicated by dotted lines in Fig. 2. In its passage through the grate-bars back to the boiler, in the direction indicated by the arrows in Fig. 3, the water enters the mud-drum G, and, depositing the mud and other sediment therein, ascends through the pipe J^2, directly from the mud-drum to the boiler at a point preferably above the water-line and certainly above the plane of the grate-bar supply-pipes, in order to induce the necessary circulation, it having been found in practice that the water heated by the grate-bars is of a very much higher temperature when entering the boiler from the mud-drum than when it enters the grate-bars from the boiler.

The mud-drum G, as shown in Figs. 1 to 4, inclusive, serves as a support for one side or end of an arch or arches K, which arch or arches, as the case may be, in connection with the mud-drum, inclose the fire chamber or chambers, so as to prevent the escape of any of the products of combustion therein except downwardly through the grate-bars. The arch or arches K may be of fire-brick or other material commonly used for such purposes and are so arranged with reference to the boiler immediately over the fire-chamber as to provide a combustion-chamber L between said arch or arches and the boiler, to which chamber the downdraft products of combustion are conducted, as herein described.

In Fig. 1 our invention is illustrated in connection with a double fire-chamber furnace in which there is an open space between the grate-bars centrally the length of the furnace, and the arches K, supported upon the grate-bars H′ at their lower edges and joining the side walls of the furnace at their upper edges, by which arrangement is provided at a point midway between the grate-bars a passage M, of the same length as the fire-chambers upwardly, through which the downdraft products of combustion from the grate-bars ascend into the combustion-chamber over the fire-chambers and have a downdraft therethrough in contact with the boiler as they move onwardly toward the rear of the furnace. By this construction and arrangement of the grate-bars and the arches we have not only the advantage of subjecting the entire length of the combustion-chamber immediately over the fire-chamber to the circulation of the products of combustion by a downdraft thereof, and at the same time the isolation of the boiler from cold air admitted to the fire-chambers, but the advantages due to the use of separated fire-chambers within the same general furnace structure. These advantages will be understood when it is borne in mind that during the firing of one chamber the hot products of combustion, passing from the other fire-chamber to the passage M, not only serve to maintain a uniformity of heat throughout the combustion-chamber and exclude cold air therefrom, but will ignite in the passage M any waste products due to the use of fresh fuel and escaping therefrom into the passage M, and hence before they can possibly escape into the combustion-chamber. In the use of such double fire-chambers it may also be added that separated fire-chambers may be more thoroughly raked down and uniformly fired than could be a single fire-chamber embracing the area of both, and this because there is less fuel to handle at a time and more time to do the raking and firing without reducing the temperature in the combustion-chamber than is possible by the use of a single fire-chamber. Single fire-chambers, however, being frequently desirable, are provided for by our invention, as shown in Figs. 4 and 5, in Fig. 4 of which is shown a single fire-

chamber, access to which is provided for through furnace and ash-pit doors at the front end of the furnace, as indicated by the dotted lines therein. In this construction there is a space between the side grate-bars H′ and the walls of the furnace, which bars support the arch K, inclosing the fire-chamber, the products of combustion from which fire-chamber, after passing downwardly through the grate-bars, ascend to the combustion-chamber L through the passages M at each side thereof and for the entire length of the fire-chamber.

In order to promote a uniform distribution of the productions to the combustion-chamber L when such distribution is found necessary, there may be provided below the grate-bars, longitudinally thereof and transversely of their center, a deflector N, converging at its upper end to an edge and consisting of brick or other suitable material, which deflector may also be utilized as a supply to the products of combustion of heated air by means of one or more chambers P, formed therein, communicating with the outside air and provided with openings P′ in the ash-pit for discharging its contents, the heat in the ash-pit serving to heat said deflector, and therefore its contents. In this connection it is proper to observe that instead of utilizing said deflector for supplying heated outside air it may be connected with the rear of the furnace to draw off and return to the ash-pit any unconsumed products of combustion.

In Fig. 5 we have provided means for drawing all the products of combustion from the grate-bars to the forward end of the combustion-chamber immediately over it, whereby all products of combustion are required to traverse the full length of said combustion-chamber, and to this end the grate-bars extend transversely of the furnace, which latter is provided with side doors for firing and for the ash-pit, as indicated by dotted lines, and terminating the grate-bar surface at a point forward of the front end or wall of the furnace structure, the arch in this construction extending from side wall to side wall of the furnace and downwardly to and supporting it from the grate-bar H′, the rear end of the arch being supported by the wall F, which, instead of including the mud-drum, is above the grate-bar surface to afford such a support.

As in the construction shown in Fig. 5, it may be observed that the mud-drum may be omitted in the several other constructions shown in the drawings; or, on the other hand, the mud-drum may be used in the construction shown in Fig. 5, as shown in said other figures.

In conclusion it may be stated that our invention is not limited to the details shown, although they illustrate what we believe to be the best construction embodying our invention, for obviously it would be no departure therefrom to vary these details and arrangement so long as in a downdraft-furnace cold air admitted to the fire-chamber is isolated from the combustion-chamber and there is immediately over the fire-chamber a portion of that combustion-chamber through which there is a direct draft of the products of combustion from the grate-bar surface of such furnace. Neither is our invention limited to its use in connection with a steam-boiler such as is shown, for obviously it is adapted for and can be applied without invention to the fire-chamber of a stationary or locomotive engine or any engine wherein there is over the fire-chamber or at the sides thereof a water-chamber in direct communication with the contents of that boiler, or to any furnace over the fire-chamber and which has a heating-oven of any character or a portion of such a heating-oven or hot air chamber.

Having thus described our invention, what we claim as new therein, and desire to secure by Letters Patent, is—

1. In a downdraft-furnace, the combination of the fire-chamber and combustion-chamber separated from but directly over the fire-chamber and a draft-passage through which the downdraft products of combustion are conducted into said combustion-chamber at a point forward of its rear end during their onward passage toward the rear end of the furnace, substantially as described.

2. In a downdraft-furnace, the combination of a combustion chamber or chambers separated from but directly over the fire-chamber and a direct-draft passage at the side or sides of said fire-chamber, through which the downdraft products of combustion are conducted into said combustion-chamber in their onward passage toward the rear end of the furnace, substantially as described.

3. In a downdraft-furnace, the combination of two or more fire-chambers, a combustion-chamber separated from but directly over said fire-chambers, and a draft-passage between said fire-chambers, conducting the downdraft products of combustion from the said fire-chambers directly to the overhead combustion-chamber, substantially as described.

4. In a downdraft-furnace, the combination, with the fire-chamber, of a combustion-chamber directly over said fire-chamber, an arch or diaphragm separating said chambers, and a direct-draft passage or passages between said arch and the wall or walls of the furnace, through which the downdraft products of combustion from the grate-bars are conducted directly to said combustion-chamber, whereby said combustion-chamber throughout its length is subjected to direct-draft heat in the passage of the products of combustion from the fire-chambers to the rear portion of the furnace, substantially as described.

5. In a downdraft-furnace, the combination of the fire-chamber, an arch-like structure inclosing the same, a combustion-chamber directly over said grate-bars, and an updraft-passage directly conducting the downdraft products of combustion from the grate-bars to the forward end of the combustion-chamber immediately over the fire-chamber, substantially as described.

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