(No Model.) 2 Sheets—Sheet 1

A. K. MURRAY.

FURNACE.

No. 546,178. Patented Sept. 10, 1895.

Fig. 1.

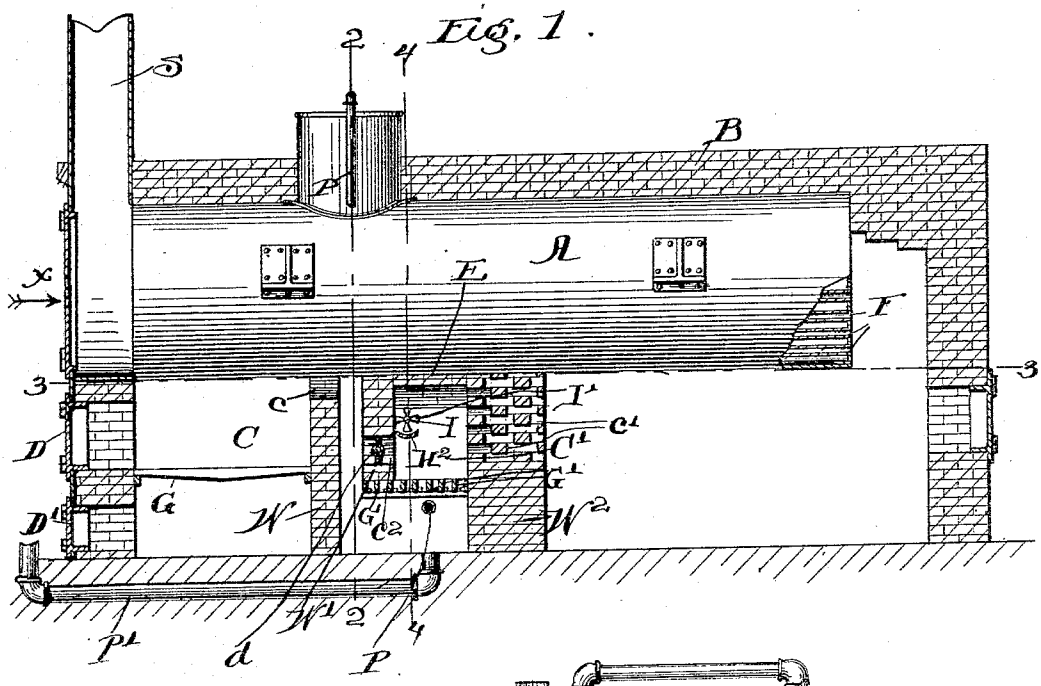
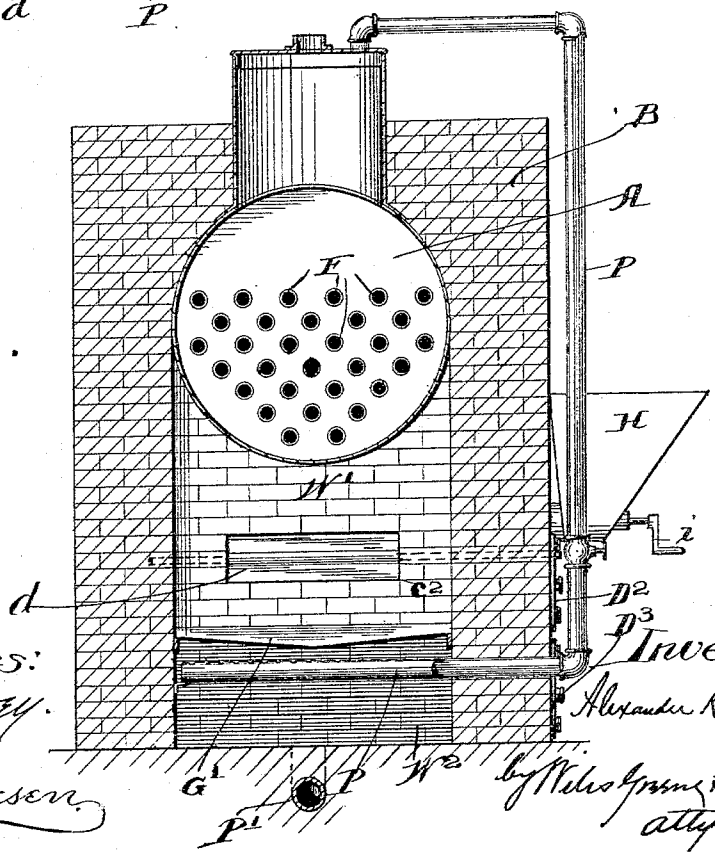


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

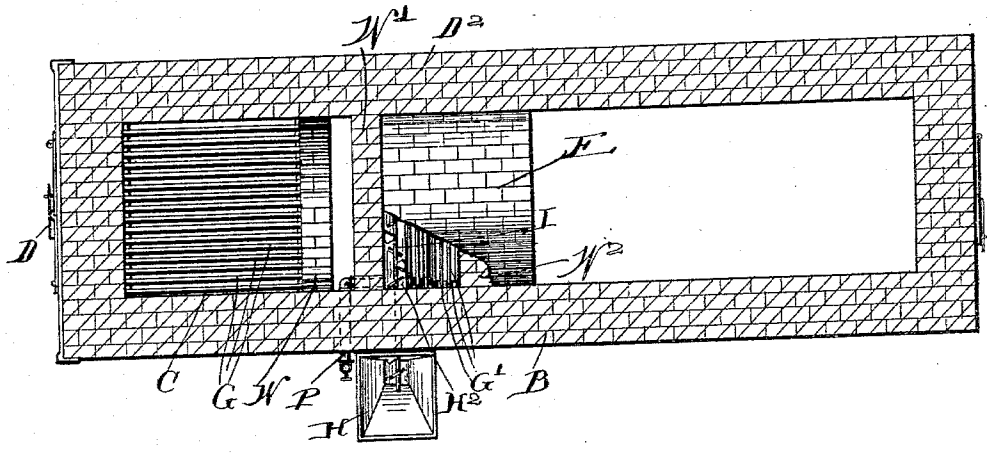
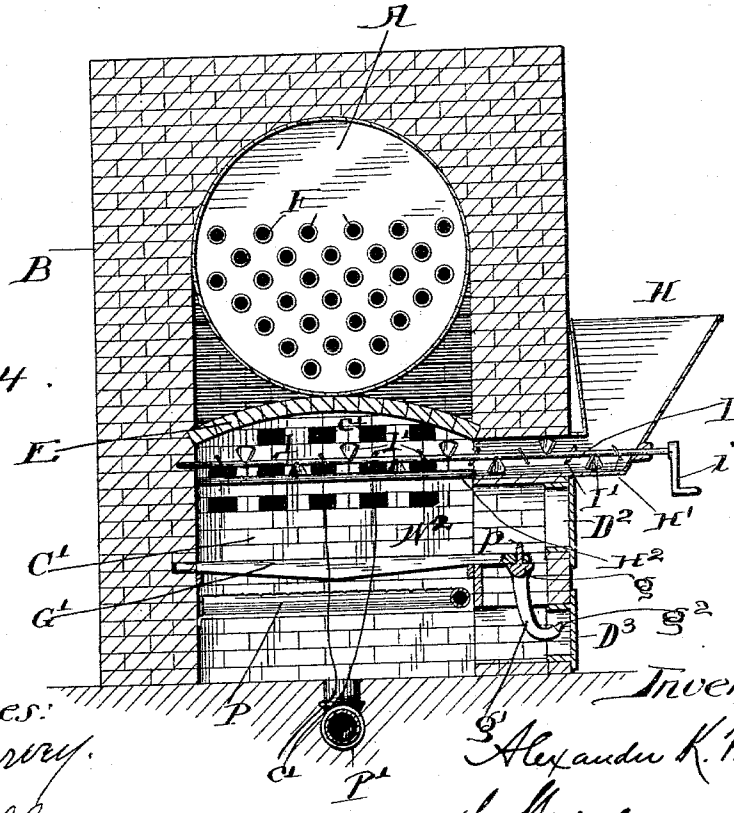


Fig. 4.



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UNITED STATES PATENT OFFICE.

ALEXANDER K. MURRAY, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE ECONOMIC SMOKE PREVENTING FURNACE COMPANY, OF SAME PLACE.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 546,178, dated September 10, 1895.

Application filed July 14, 1894. Serial No. 517,565. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER K. MURRAY, a citizen of the United States of America, residing at 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 specification.

My invention relates to improvements in furnaces and more particularly to improvements in furnaces for boilers, its object being to insure complete combustion of the fuel employed, thereby preventing smoke and securing the greatest possible economy.

The invention is fully described and explained in this specification and shown in the accompanying drawings, in which—

Figure 1 is a view, partly in side elevation and partly in vertical section, showing a boiler and its casing in operative relation to my improved furnace. Fig. 2 is a transverse vertical section through the line 2 2, Fig. 1, the view being in the direction indicated by the arrow *x* in said figure. Fig. 3 is a horizontal section through the line 3 3, Fig. 1, the view being downward and certain parts broken away to show construction. Fig. 4 is a transverse vertical section through the line 4 4, Fig. 1, the view being in the same direction as in Fig. 2.

In the views A is a horizontal boiler of ordinary construction and B the brick casing which incloses and supports it.

C is the usual combustion-chamber, preferably provided with grate-bars G and doors D D′ and bounded at its rear end by a bridge-wall W, having at its upper edge an opening *c* for the rearward escape of the products of combustion. As thus constructed the primary chamber is intended for the combustion of coal or other solid fuel, but liquid fuel or gas may be employed, if desired, and in this case the grate-bars may, of course, be dispensed with. A second wall W′, separated from the wall W by a suitable space, extends downward from the boiler and rests upon the margin of a second set of grate-bars G′, and a third wall W^2, extending from the floor to the boiler, forms the rear boundary of a second combustion-chamber C′ lying between the two walls W′ W^2. The wall W^2 is formed with a series of openings *c′* for the rearward escape of the products of combustion of the secondary chamber, which are thus free to pass to the rear end of the boiler and to flow forward through the flues F to the smoke-stack S, which is placed at the front end of the boiler in the ordinary manner. The secondary chamber C′ has the usual feeding and ash-pit doors D^2 D^3 and is formed with an arch E of fire-brick, separating the chamber from the boiler and adapted to assist in the development of a high degree of heat in the chamber.

From the foregoing description it is evident that the smoke and gases escaping from the combustion-chamber C must pass along the space between the walls W W′ and thence between the grate-bars G′ and through the chamber C′ in order to reach the rear end of the boiler and pass outward through the boiler-flues and smokestack, and it is equally evident that if a sufficient heat be generated in the chamber C′ all carbon and other combustible elements in the smoke and gases must be completely consumed. Furthermore, it is evident that air in any desired proportion may be admitted to the grate G′ and chamber C′ in any way, either by opening the ash-pit door D^3 to the necessary extent or by providing a forced draft in any suitable manner. I prefer the latter method, and for this purpose a steam-pipe P, leading from the dome of the boiler, extends immediately under the grate-bars G′, and is perforated to permit escape of steam. By means of this pipe or a suitable modification thereof a forced draft of steam may be introduced immediately beneath the grate-bars G′ and by means of a second pipe P′ and a fan or other pump a suitable proportion of air may also be introduced and any desired degree of combustion may thus be produced and any degree of heat within necessary working limits may be developed. This having been accomplished, it is evident that as the smoke and gases from the chamber C pass through the grate G′ and the highly heated fuel resting thereon all their combustible elements must be completely consumed and the escaping gases passing out at the smokestack must be substantially free from carbon. I have subjected the furnace thus constructed to thorough and

severe tests and have found that, in fact, it accomplishes complete combustion and consumption of ordinary soft coal and gives off no smoke whatever when fired in the ordinary way and without any special care. The secondary chamber may be supplied with fuel from time to time through the door D^2 in the usual way, but as the opening of the door temporarily interrupts the draft, I prefer to provide some means whereby the fuel may be supplied without the admission of any appreciable amount of air. Such a device is shown in the drawings and comprises a hopper H, lying outside the casing, a hopper-spout H′ passing through the wall, a trough or ledge H^2 extending from the spout across the chamber and a conveyer-shaft I having blades I′ and a crank *i* or other suitable means for turning it. The hopper being filled with coal, the rotation of the shaft carries it along the ledge H^2 and distributes it with practical regularity over the surface of the grate-bars, and while the fuel does not form an air-tight closure of the spout H′, it closes it with sufficient accuracy to prevent any such entering current of air as might interfere with the draft.

I have found in practice that a forced draft is practically essential to the successful operation of the secondary chamber in the manner above described, as the ordinary draft is sometimes insufficient to draw the products of combustion of the first chamber between the grate-bars and through the fuel of the secondary chamber. When the furnace is in full operation and there is a working pressure of steam in the boiler, this pressure offers the means for providing the necessary forced draft; but in starting the fire when the water in the boiler is still cold, the furnace has no forced draft unless power is supplied from some independent source, which is frequently not the case. Under such circumstances it is desirable to pass the products of combustion of the primary chamber through the secondary chamber by as direct a passage as possible, and for this purpose I form in the bridge-wall W′ an opening or openings c^2, Figs. 1 and 2, and provide the opening with a damper *d*, so arranged as to either close the opening or leave it free. As shown in Figs. 1 and 2, the damper is closed and the products of combustion pass from the chamber C through the grate G′ to the chamber C′. If, however, the damper be rotated into a horizontal position, the products of combustion will pass from the chamber C through the openings *c* c^2 to the chamber C′ and thence through the openings *c*′ to the rear end of the boiler. In starting a fire in the furnace it is preferable to bring the damper *d* into its horizontal position, then to start a fire in the secondary chamber, and, lastly, to start the fire in the primary chamber; and I have found that when thus operated the carbon in the smoke from the primary chamber is substantially all consumed in the secondary chamber. The efficiency of the secondary chamber is largely due to the arch which retains and radiates a great amount of heat, and also to the arrangement of the openings *c*′, which are so constructed and disposed that their walls also become highly heated and assist in the complete combustion of the gases from the primary chamber.

The grate G′ may be cleared of ashes from time to time in any usual manner, but I prefer the very simple means for that purpose illustrated in Fig. 4, in which *g* is a transverse bar supporting the ends of the grate-bars G′. The bar *g* is supplied with pins *p* projecting upward from its surface and entering the ends of the alternate grate-bars. The bar is further provided with a dependent arm *g*′, having at its end a nipple g^2, adapted to receive the end of a shaking-lever. By means of the arm *g*′ the transverse bar *g* may be rocked in its bearings, thus moving backward and forward longitudinally the alternate grate-bars with which it is connected, the other grate-bars remaining stationary. This movement of the bars is sufficient to shake down the fine ashes which might otherwise impede the draft.

I am aware that various features of construction of the device shown in the drawings and hereinbefore described may be altered, both as to relative proportions and in other ways, without affecting its principle of operation, and I desire, therefore, to limit my invention only to the scope set forth in the following claims, and not to the precise form or combination of forms set forth in the drawings and description.

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

1. In a furnace the combination with a primary combustion chamber and a secondary combustion chamber provided with grate bars adapted to support solid fuel, of a passage from said primary chamber to the lower surface of said grate bars, means substantially as shown and described for introducing a forced draft beneath said grate bars and a conveyer entering said secondary chamber and adapted to supply it with fuel.

2. The combination with the casing and the primary and secondary combustion chambers, C, C′, and grate bars, G′, arranged substantially as described, of the hopper, H, having the spout, H′, the ledge, H^2, and the conveyer shaft I, having blades, I′; substantially as shown and described.

3. In a furnace, the combination with a primary combustion chamber, and a secondary combustion chamber provided with a grate, of a passage from the primary chamber to the exterior of the secondary chamber, an opening from said passage to the space below the grate of the secondary chamber, a second opening from the passage to the space above the grate of the secondary chamber, and a damper adapted to close said second opening or to leave it open, whereby the products of

combustion from the primary chamber in their passage to the smoke stack may be passed through the grate of said secondary chamber or through the space above the grate.

4. The combination with the primary chamber, C, and the secondary chamber, C′, having the grate bars, G′, of the transverse bar, *g*, supporting the ends of the grate bars and connected with the alternate grate bars substantially as shown and described, the arm, *g′*, depending from the transverse bar, *g*, and means for rocking said arm and the bar to which it is attached and thereby reciprocating the alternate grate bars, substantially as shown and described.

5. The combination with the boiler and its casing, of the bridge walls, W, W′, W², forming the chambers, C, C′, and the passage way between them, the walls, W², being formed with off-set openings for the escape of the products of combustion from the chamber, C′, whereby the products of combustion from the chamber, C, pass through the chamber C′, and the products of combustion of both chambers pass through the openings, *c′*, and the heated surfaces of the walls of said openings.

6. The combination with the boiler and its casing of the walls, W, W′, W², forming the chambers, C, C′, and the passage way between them the chamber, C′, being provided with the arch, E, and the wall, W², being provided with the offset openings, *c′*, the heat received and radiated by the arch, E, and the walls of the openings, *c′*, being adapted to assist in the combustion of the gases from the chamber, C, substantially as shown and described.

7. The combination with a boiler and its casing, of bridge walls forming two combustion chambers, C, C′, provided with grate bars, the rear wall of the chamber, C′, being formed with offset openings, *c′*, and the two chambers being in communication, whereby the products of combustion from the chamber, C, must pass through the chamber, C′, and the products of combustion from both chambers must pass through the offset openings, *c′*, in their passage to the smoke stack.

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