(No Model.)

W. JOHNSTON.

FURNACE.

No. 418,570. Patented Dec. 31, 1889.

FIG. 1.

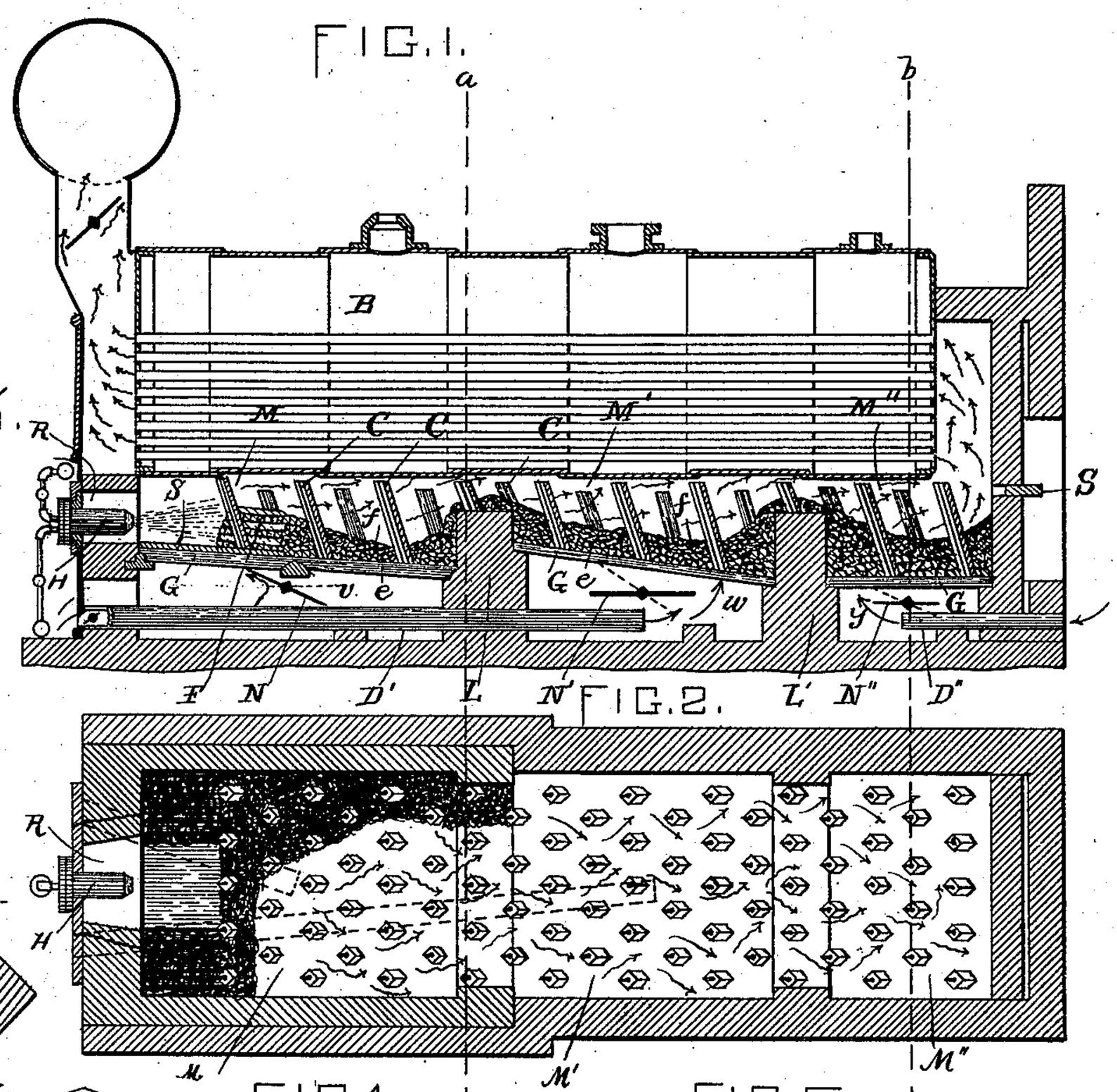


FIG. 6.

FIG. 2.

FIG. 7.

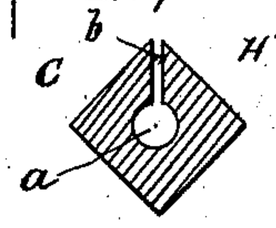


FIG. 3.

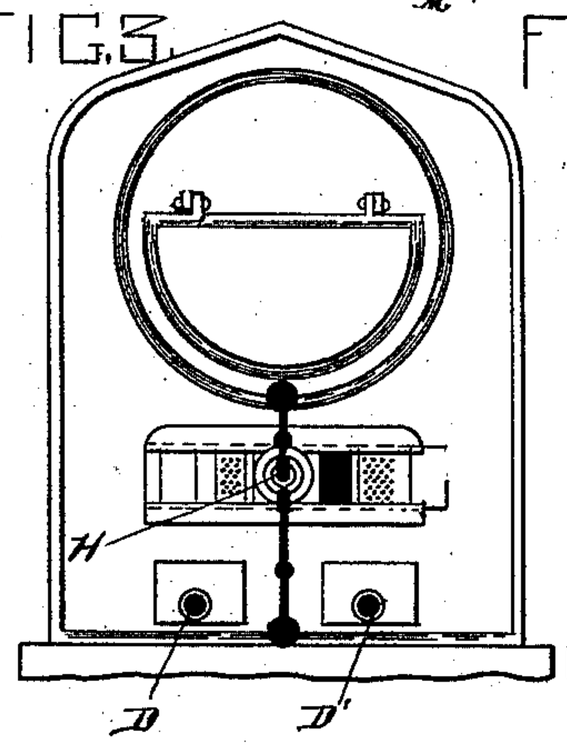


FIG. 4.

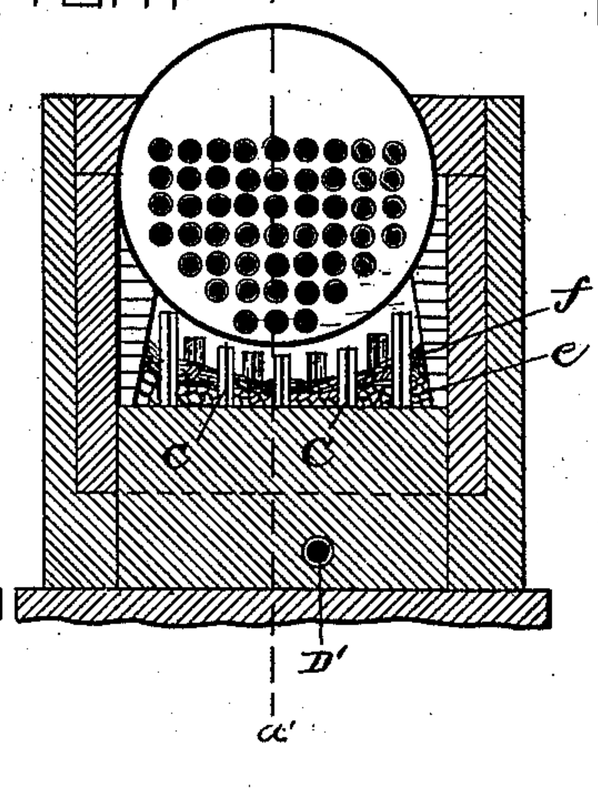
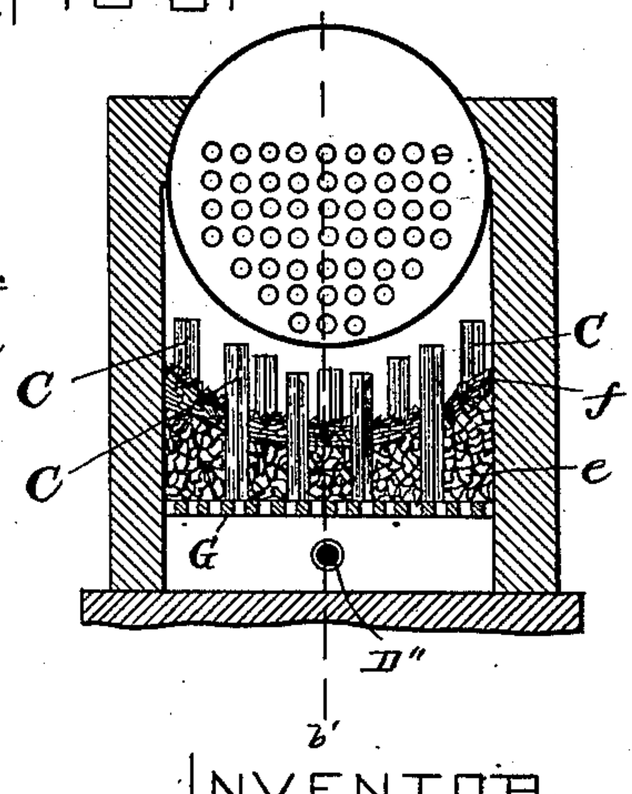


FIG. 5.



WITNESSES.

H. Brown.

A. D. Harrison.

INVENTOR.

Wm Johnston.

By Wright, Brown & Crosby

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM JOHNSTON, OF SEYMOUR, CONNECTICUT, ASSIGNOR OF ONE-HALF TO EDWARD J. HICKEY, OF HYDE PARK, MASSACHUSETTS.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 418,570, dated December 31, 1889.

Application filed June 30, 1888. Serial No. 278,658. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM JOHNSTON, of Seymour, in the State of Connecticut, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

My invention relates particularly to furnaces in which crude petroleum or any inflammable gas is used as fuel to produce heat under steam-boilers, or in furnaces for smelting or annealing glass-ovens, forges, brick and lime kilns, &c., where it is of the utmost importance to utilize the heat contained in the fuel as far as practical; and it consists in the several improvements which I will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a longitudinal section of a horizontal tubular steam boiler and furnace, showing the sectional arrangement of the furnace after the alterations made from a coal-burning furnace to one capable of burning petroleum. Fig. 2 is a horizontal plan of the furnace, showing the distribution of the staggered bars for the deflecting of the burning gases and the admission of air. Fig 3 is a front view of the furnace and boiler, showing the position of the petroleum-burner and tubes for the admission of air. Figs. 4 and 5 are cross-sections of Figs. 1 and 2, through lines *a a'* and *b b'*. Fig. 6 is an enlarged perspective view of the gas-deflecting and ventilating bars of the furnace. Fig. 7 is an enlarged cross-section of Fig. 6.

In the description of the drawings the same letters refer to the same parts in the different views.

In the drawings, B represents a steam-boiler with a furnace under the same, in which are two fire-bridges L L', dividing the furnace into three separate compartments or divisions M M' M''. Between the front of the furnace and bridge L are the usual grate-bars, on which rests an iron plate S, about two feet long by eighteen inches wide, according to the proportions of the furnace. On the end of this plate is a wall or ridge F, composed of any kind of small pieces of iron, old chains, old cast or wrought iron, &c., so as to make a loose breaker for the petroleum or gas to be blown upon from a burner H, from which petroleum or other hydrocarbon liquid is ejected by steam under pressure, or compressed air admitted around a small stream of the liquid fuel supplied through the center of the burner H. I prefer to use steam as the forcing agent, as it will both heat and break up the liquid fuel into a fine spray, which, by the reflection of the heat of the iron ridge F, extending across the grate-bars in front of the burner, and the heat in chamber M, is instantly converted into a hydrocarbon gas. The combustion of said gas begins at once in the chamber M and continues during the passage of the gas all along the entire length of the furnace and boiler. The volume of the flame thus produced will depend upon the quantity of oil or gaseous fuel supplied by the burner H. The heat in the chamber M will highly superheat the steam surrounding the central oil-tube in the burner by reflection into the space R, Figs. 1 and 2, thus heating the liquid fuel before the latter is forced out of the nozzle of the burner, and also keeping the steam perfectly dry.

C C represent bars projecting upwardly from the grate of the chambers or compartments M M' M'', said bars being staggered or arranged on zigzag lines and having air-channels *a* extending through them, and side openings or slots *b* for the escape of air passing upwardly through the bars from below the grates. The object of the staggered bars C is to deflect the gas and air as much as possible and insure their thorough mixture and retard their progress through the furnace, thus preventing an undue proportion of free air from going through the furnace. The bars also admit a fresh supply of air to the furnace through their channels and side openings, the air being thus caused to enter all parts of the furnace in small streams.

Bars of any form and of any material which resists the heat can be used; but I prefer to make them of cast-iron if for steam-boiler furnaces, where the heat does not exceed a clear red; but in furnaces where a great heat is an object—such as for smelting metals, glass, or puddling iron, &c.—I prefer to make the bars of a refractory material, such as fire-

brick or crucible-clay. In furnaces where there is a plenty of draft of air or the air is forced the central longitudinal air-channel and side opening can be dispensed with. The bars may have any suitable form in cross-section, such as round or any irregular form; but I prefer to make them square, as shown in Figs. 6 and 7.

When there are only one or two furnaces or compartments M M side by side, the bars can be arranged horizontally from side to side through the furnace-walls like steps, their ends left open for the admission of air, which can be regulated by partly opening or closing the end openings. When arranged as last described, the bars can be removed or put in place during the time the furnace is in operation, their effect being similar to that of the inclined bars above mentioned—that is, they cause a thorough mixture of air and gases and a supply of air to the heated gases during combustion.

It will be seen that iron grate-bars G extend throughout the entire length of the furnace, excepting the space occupied by the fire-bridges L L′. The object of said grate-bars is to let a supply of air pass in numerous thin streams through a layer *e* of broken fire-brick or other refractory material which is a bad conductor of heat spread upon said grate-bars, said material preventing the loss of heat by radiation into the cold bottom or ash-pit of the furnace under the grate-bars. This layer of broken refractory material should be about three to four inches in thickness at the longitudinal center of the furnace, but thickening toward the side walls of the same to make the upper surface of the layer substantially parallel with the bottom of the boiler, which is exposed to the heat of the combustible gases. Above this layer of broken brick or other refractory material I lay another course or layer *f* of small or broken-up pieces of cast or wrought iron, the former being preferable, because it is not so easily oxidized when exposed to heat as the latter. Both layers together should be about from six to eight inches in thickness at their center line.

The bars C are embedded in the two layers of brick and iron, their lower ends resting on the grate-bars, while their upper ends reach to within half an inch, or thereabout, of the boiler-shell. The irregular layers of iron and broken brick below it will greatly help to keep the heat in the furnace at a high and equal temperature, and also help to produce an intimate mixture of the volatile hydrocarbon gas with the atmospheric air, which, by entering from below the grate-bars, is subdivided into numberless streams by the obstructions caused by the two layers of small fragments of brick and iron with natural small and irregular openings between them, and is heated by its passage through said openings.

By means of the fire-brick bridges L L′, which approach the bottom of the boiler more closely than the broken material between said bridges, the gases and air are caused to more thoroughly mingle than they would if they were not caused to pass through the contracted throats between the bridges and the bottom of the boiler. The rugged surface presented by the irregular pieces of iron and the air-currents through said surface helps to mix and throw the burning gases at nearly right angles against the lower shell of the boilers.

In Figs. 1, 2, 3, 4, and 5 will be seen the air-supplying tubes D, D′, and D″, which have ordinary dampers at their outer ends, so as to regulate the air-supply in the different air-combustion chambers between the fire-bridges L L′ and the fore and back end of the furnace. In the division-chambers *v*, *w*, and *y*, and under the grate-bars, will also be seen plates of sheet-iron N N′ N″, which cross the furnace at right angles to within three or four inches of the lower side walls of the furnace and between the grate and ventilating tubes D, D′, and D″. The plates N N′ N″ are pivoted like dampers, so as to be partially movable by rod or handle provided for that purpose and passing to the front, back, or side of the furnace. The plates may thus be inclined or held horizontally to give the air any desired direction as it emerges from the tubes D D′ D″. Said plates also spread the entering air evenly under the lower part of the grate-bars, the amount of air-draft being regulated by the dampers at the outer end of each air-tube D D′ D″.

At the back end of the furnace, Fig. 1, will be seen a loose brick S. This, by removal, will enable an attendant to see if the air is admitted in due proportion. A small circular hole can be bored in the front smoke-door of the boiler to permit an attendant to look through one or more of the boiler-tubes and thus ascertain whether there is any smoke in said tubes or not. The presence of smoke would indicate that too little air is being admitted or too much oil or gas.

Having thus fully described my invention, what I claim as new is—

1. In a furnace, the combination, with the combustion-chamber, the boiler, and the series of supporting-bars located beneath said boiler, of a porous or air-conducting bed or bottom composed of fragments of refractory material, and deflecting-bars projecting through and above said bed to cause a commingling of air and gases passing thereover, substantially as set forth.

2. In a furnace, the combination, with the combustion-chamber and the boiler, of a series of supporting-bars located beneath said boiler and separated by air-spaces, the porous or air-conducting bed or bottom resting on said bars and composed of fragments of refractory material, and deflecting-bars projecting upward through said bed or bottom and having air-channels therein, substantially as set forth.

3. In a furnace, the combination of a burner, a porous or air-conducting bed, substantially as described, and a series of bars provided with air-channels, said bars having their lower portions inserted in said bed and their upper portions projecting above the same, said air-channels permitting the upward passage of air through the bed and into the combustion-space above the same, as set forth.

4. In a furnace, the combination, with the boiler, of a liquid or gaseous fuel burner, a series of bridge-walls forming contracted throats beneath said boiler, grates between the bridge-walls, broken refractory material spread upon said grates, and staggered bars C, projecting above said refractory material and arranged to deflect and mingle the air and gases above the surface thereof, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 22d day of June, 1888.

WILLIAM JOHNSTON.

Witnesses:
C. F. BROWN,
A. D. HARRISON.