(No Model.) 2 Sheets—Sheet 1.

W. W. DEAN.

BOILER FURNACE.

No. 523,808. Patented July 31, 1894.

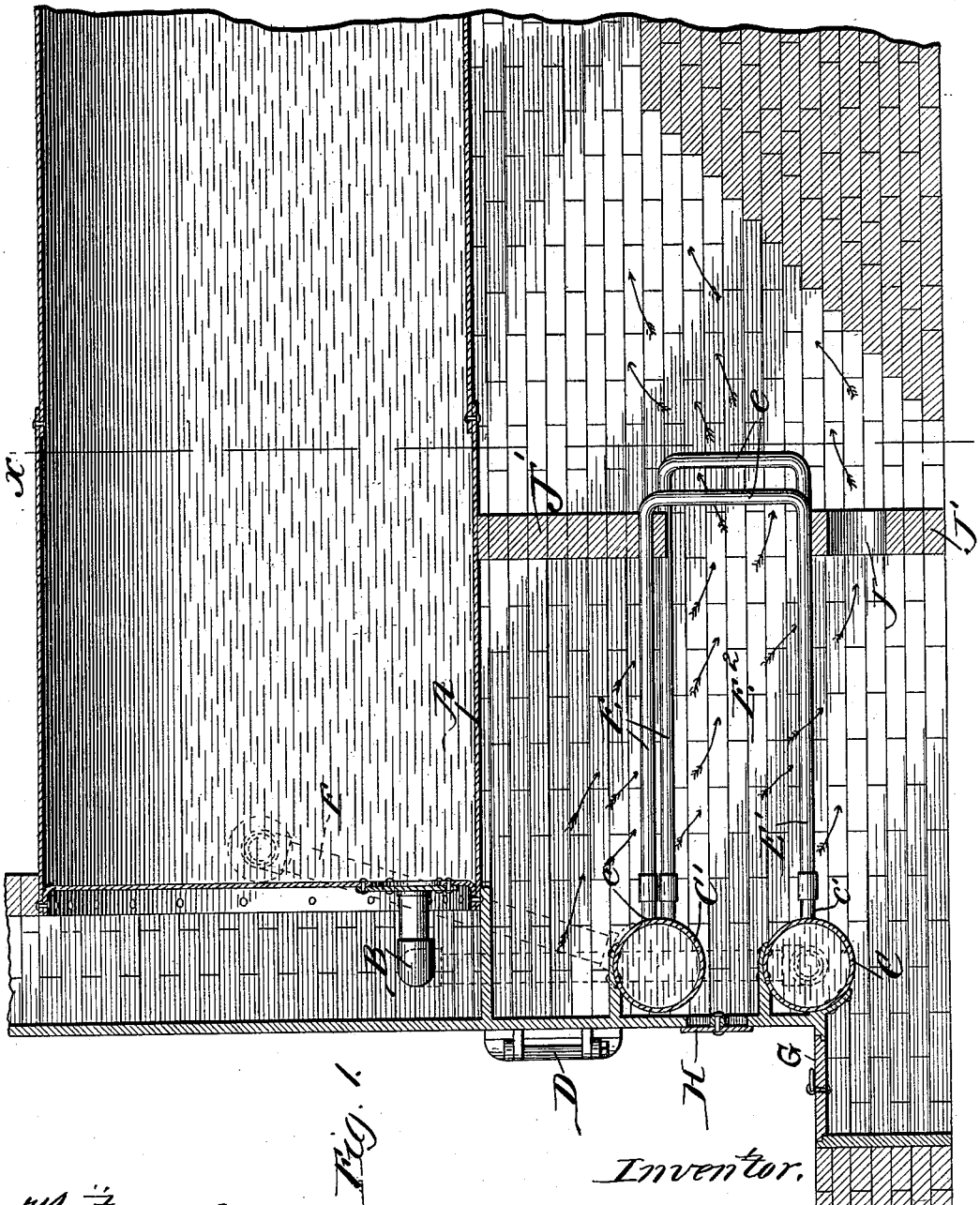


Fig. 1.

Witnesses.
Fredk. F. Mills.
M. Chamberlin

Inventor.
William W. Dean.
By Walter H. Chamberlin
Atty.

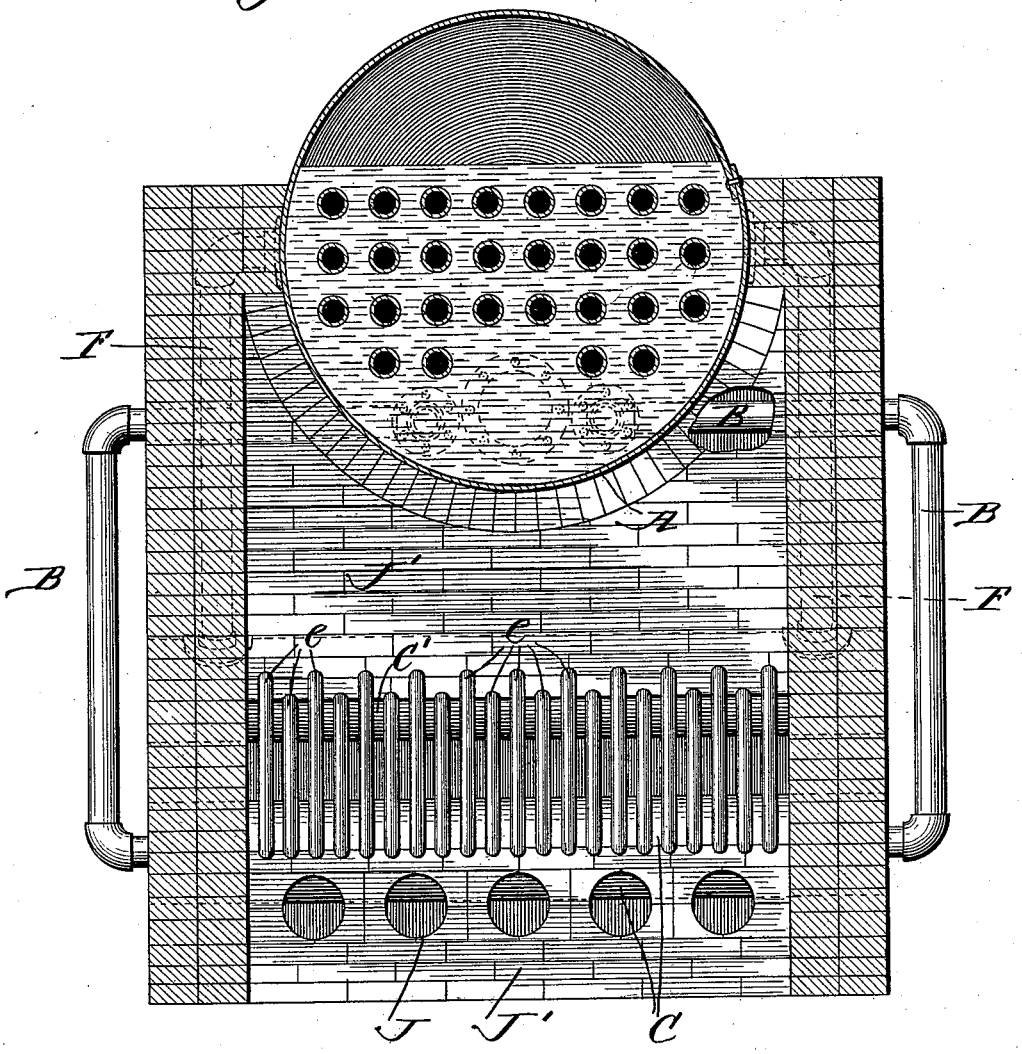
(No Model.) 2 Sheets—Sheet 2.

W. W. DEAN.

BOILER FURNACE.

No. 523,808. Patented July 31, 1894.

Fig. 2.



Witnesses.
Fredk. A. Mills.
M. Chamberlin.

Inventor:
William W. Dean.
By Walter A. Lamberton
Atty.

UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF CHICAGO, ILLINOIS.

BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 523,808, dated July 31, 1894.

Application filed July 23, 1892. Serial No. 440,973. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented a certain new and useful Improvement in Boiler-Furnaces; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention has for its object the production of a furnace of that class popularly known as "down draft" furnaces and it consists essentially in the provision of two sets of grate bars of tubular form, or what are popularly known as water grates, one located substantially above the other so that the droppings from the upper grate will be consumed by the lower grate and both of them being "down draft," that is to say the draft in each grate being from the top down instead of from the bottom up as is now the case.

The invention also consists in so connecting the tubular bars of each grate that the water will first pass through the tubes of one grate and then through the tubes of the other grate. The invention also consists in certain other appliances and devices hereinafter described and claimed.

In the drawings: Figure 1 is a side elevation of my furnace with parts in section. Fig. 2 is a vertical section with parts in elevation on the line *x*—*x* of Fig. 1.

In carrying out my invention A represents the shell of the boiler proper, of any desirable construction. Tapping this boiler shell adjacent to the bottom is the pipe or conduit B extending down to the tank or cylinder C. The latter as well as the tank or cylinder C′ extends across the front of the furnace as shown, the tank C′ being substantially below the fuel door D of the furnace while the tank C is below the tank C′. E are the grate bars. They are in the form of tubes and tap the tank C as at *c*. They extend rearwardly, then downwardly and then forward to the tank C with which they are connected as at *c*′. A tube or conduit F extends from the tank C′ to a point in the boiler above the point where the conduit B taps the boiler. The circulation of the water would therefore necessarily be through the conduit B into the tank C rearwardly through the portion E′ of the same into the tank C′ and up to the boiler through the conduit F. G is a plate whereby access may be had to the ash-pit and H a damper. In order to accomplish the desired object of my invention it is necessary that this opening into the ash-pit be substantially air tight and that the amount of air admitted through the damper H be very small if indeed any is admitted at this point.

J are port-holes through the fire wall J′.

The currents of air would be as follows: Air is admitted through the fire door D and passes downward through the fuel on the grate E into the combustion chamber E^2. The larger part of the products of combustion would then pass rearwardly through between the upright portions *e*— of the water tubes and off through the usual outlet. A portion of the air and products of combustion would however pass downward through the grate E′ and consume the fuel that is thereon, or in other words the "droppings" from the grate E. Should it be desired to admit fresh air onto the grate E′ the damper H may be used for that purpose. After passing through the grate E′ the products of combustion would be consumed in the combustion chamber beneath and would then pass off through the port-holes J and out through the usual outlet.

It will be observed that the tubes composing the grate E are arranged in the well known "zig-zag" form that is to say each alternate tube being at a higher elevation than the adjacent one. It will also be observed that the upright portions *e*— of the tubes are arranged in substantially the same way thereby greatly increasing the capacity for heating the water which is passing through the tubes and utilizing to a greater extent the heat produced by the combustion as well as leaving plenty free space so that the draft will not be obstructed. It will also be observed that the portions E′ of the tubes are substantially on a line. This would necessarily bring them closer together so that they would catch and hold the finer fuel that has dropped from the grate above.

It will be observed that by the above con-

struction I have produced a boiler furnace in which is provided a grate for consuming the droppings from the main grate and have also made this grate "down draft" thereby utilizing in the combustion of the droppings, the many advantages obtained by the use of the "down draft" in the main grate. I have also produced a construction wherein the cold water from the boiler has a maximum amount of surface exposed to the fire while passing through the tubes forming the grates and consequently divided into small streams. I have also produced a construction in which the cold water instead of passing through the main grate and consequently through an intense heat before it has been warmed to any great extent, is first passed through the tubes composing the "dropping" grate where it is heated to some considerable extent and then up through the more intense heat of the main grate. By this latter arrangement the highly heated tubes are not subjected to the shock which would result if the cold water from the boiler was introduced directly into them. This latter advantage, that is to say passing the water first through the tubes composing the lower grate, while an advantage, is not essential to the main part of my invention and I would therefore have it understood that while I prefer the circulation of water shown and described, yet I would contemplate by my invention the extension of the conduit B to a higher level than the conduit F and thus insure the reverse circulation of the water. So also while I have shown the tubes composing the grates E E′ of one piece and connected yet it is obvious that the two grates might be made up of separate sets of tubes each set having an independent circulation of water. I am aware that a construction has heretofore been made in which there are two grates one above the other the upper one formed of water tubes and the lower one formed of solid grate bars and adapted to consume the droppings from the upper grate. But in the construction which I have just described, while the upper grate is a "down draft" grate the lower grate is an "up draft" grate and the products of combustion from both grates join each other in a common combustion chamber between the two grates. Such a construction I do not claim.

What I claim is—

1. In a boiler furnace the combination of two grates one located substantially above the other with a combustion chamber between them, said grates formed of a single set of tubes each end of said tubes having independent connections with the boiler and each connection being beyond both grates whereby the circulation of water will pass successively through each grate, substantially as described.

2. In a boiler furnace the combination of two grates each having a combustion chamber beneath it, said grates formed of a single set of water tubes independently connected at each end with the boiler and each connection being beyond both grates whereby the circulation of water will pass successively through each grate, substantially as described.

3. In a boiler furnace the combination with the wall of the furnace provided with an opening above the grate, and a combustion chamber beneath the grate, of the grate composed of a series of water tubes bent at right angles to themselves so arranged that there is a substantially horizontal portion to form the grate and a substantially vertical portion extending below the horizontal portion and in the path of the products of combustion, said tubes connected with the boiler whereby they will have a circulation of water through them, substantially as described.

4. In a boiler furnace the combination with the wall provided with an opening above the grate and a combustion chamber beneath the grate, of the grate composed of a series of water tubes each tube bent at an angle to itself one portion of the tube arranged in a substantially horizontal position to form the grate and the other portion extending downward from the horizontal portion and located in the path of the products of combustion both the horizontal and the vertical portions of said tubes being arranged in zig-zag form, substantially as described.

5. In a boiler furnace the combination of the wall thereof provided with an opening a cylinder or tank substantially beneath said opening and connected with the boiler, another tank beneath the first, a series of water tubes tapping the upper tank extending rearwardly, downwardly and then forward and tapping the lower tank, and a connection from the lower tank to the boiler said tubes tapping only the tanks mentioned whereby the horizontal portion of the tubes form an upper and lower grate and the space between them forms a combustion chamber and the water must pass successively through both grates, substantially as described.

6. In a boiler furnace the combination of a furnace wall provided with an opening, a tank or cylinder substantially beneath said opening and connected with the boiler, another tank or cylinder beneath the first tank and connected with the boiler at a lower point than the connection of the first cylinder, a series of tubes tapping the upper tank extending without other connections rearwardly, downwardly and forward and tapping the lower tank thereby forming a combustion chamber between the two horizontal portions, and a combustion chamber beneath the lower horizontal portions of the tubes, said two combustion chambers being connected with the outlet, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:
W. H. CHAMBERLIN,
M. CHAMBERLIN.