(No Model.)

A. B. CROWDER.

SMOKELESS BOILER FURNACE.

No. 490,544. Patented Jan. 24, 1893.

Fig. 1

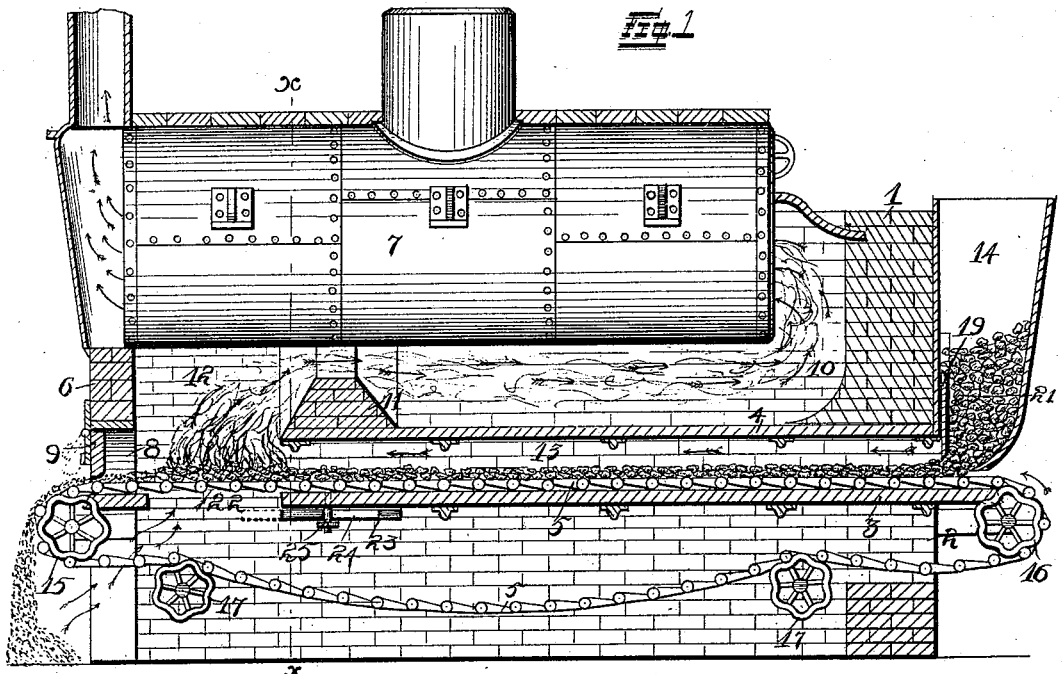


Fig. 3

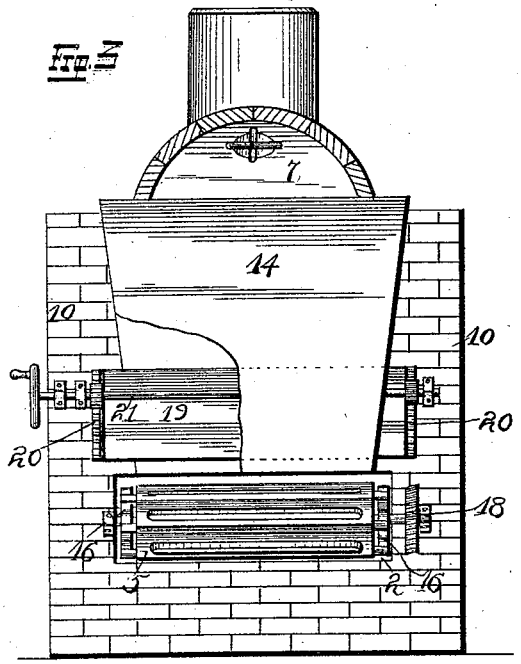
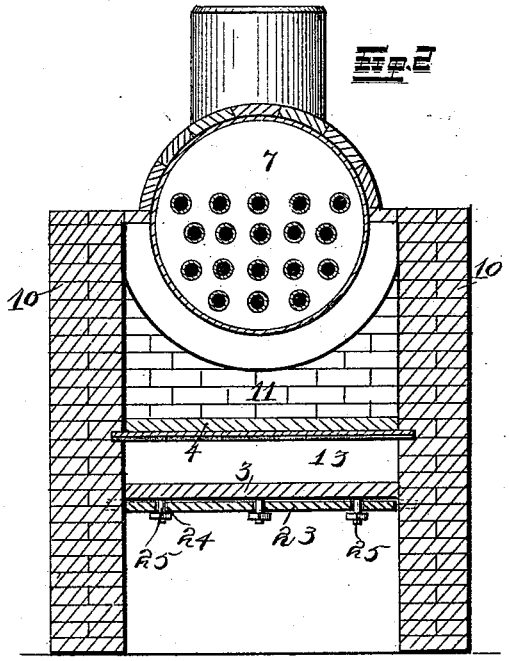


Fig. 2



Witnesses
Alfred A. Eicher
Herbert L. Robinson.

Inventor
Albert B. Crowder,
By his Attorneys
Higdon & Higdon & Longan.

UNITED STATES PATENT OFFICE.

ALBERT B. CROWDER, OF ST. LOUIS, MISSOURI.

SMOKELESS BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 490,544, dated January 24, 1893.

Application filed July 20, 1892. Serial No. 440,616. (No model.)

To all whom it may concern:

Be it known that I, ALBERT B. CROWDER, of St. Louis, in the State of Missouri, have invented certain new and useful Improvements in Smokeless Boiler-Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to endless-grate stoking-mechanism for furnaces, and consists in the improved apparatus for and mode of subjecting the fuel to the heat of the furnace itself, in a coking or heating chamber beneath the boiler, and continuously feeding a thin layer of previously prepared fuel from said coking-chamber into the fire to the combustion-chamber, all as hereinafter set forth and claimed.

In the drawings, Figure 1 is a vertical longitudinal section through a boiler-furnace, having my invention applied thereto. Fig. 2 is a vertical transverse-section, on line *x x* of Fig. 1. Fig. 3 is an elevation of the rear-end of the furnace, with parts broken away.

My invention exhibits several peculiar points, in that the extreme rear-wall 1 is constructed to form an opening 2, unobstructed from side-wall to side-wall in which is located the rear-portion of a flat dead-plate 3, a roof-plate 4, and the continuously moving endless-grate 5, which latter is of such length and construction as to extend from end to end of the furnace walls and project beyond same at opposite ends.

6 indicates an arched-wall under the front end of the horizontal-boiler 7.

8 indicates an opening formed beneath the arched-wall 6, in which is located the forward-portion of the endless grate 5. A swinging-door 9 is hinged at its upper edge to the boiler-front, so that it will gravitate downward and normally tend to close the passage above said endless grate.

10 indicates the side-walls of the furnace: 11 the bridge-wall: 12 the combustion-chamber, and 13 a wide coking-chamber located in rear of said bridge-wall and beneath the boiler 7. The coking-chamber 13 preferably consists of a rectangular chamber having a clear width several times greater than its height, and in excess of the width of the grate, and having flat imperforate lower and upper dead-plates 3 and 4, respectively, extending from the rear of the furnace beneath the boiler to, and under the arched bridge-wall 11, terminating forward of the front-side of said bridge-wall, and extending transversely the full width of the furnace. It will be observed that the forward-end of the coking-chamber 13 opens into the combustion-chamber, at the bridge-wall, and that the rear end of same opens into a hopper 14, which latter is located exterior of the rear-wall 1, but with its lower end above the rear-portion of the endless-grate, so that fuel placed in said hopper may be discharged upon said grate and carried into the coking-chamber. This hopper may be of any ordinary construction, or it may be dispensed with entirely and fuel thrown upon the projecting-portion of the endless-grate as fast as combustion necessitates.

The endless-grate may be formed of grate-bars of any known style. It is mounted upon suitable sprocket-wheels 15 and 16, placed respectively at the front and rear of the furnace upon suitable shafts journaled in bearings. A number of supporting-wheels 17 are mounted beneath the slack-side of the endless-grate, and serve to support same during operation, and prevent contact thereof with the floor and walls of the furnace. The tight side of the endless-grate 5 rests in contact with, and is supported by, the lower dead-plate 3 throughout the length of said plate, and extends in a direct line from end wall to end wall of the furnace, the forward portion of said tight-side extending forward of said dead-plate and forming the grate-surface in the combustion-chamber.

An important portion of my invention lies in the relative direction of travel of the endless-grate and the direction of draft in the combustion-chamber and in the space beneath the boiler, or other thing to be heated. These relative directions are clearly shown by the arrows—the direction of draft in the combustion-chamber and in the space beneath the boiler being from front to rear, and the direction of travel of said endless-grate being from rear to front through the coking-chamber and the combustion-chamber.

As the arrangement of mechanism for im-

parting a continuous movement to the endless-grate does not involve invention, and can be devised by any skilled mechanic, I do not show or describe any complete mechanism for such purpose, except that in Fig. 3 I show a gear or worm wheel 18 mounted on the shaft which carries the sprocket wheels at the rear of the furnace, and which may of course be engaged by driving-mechanism in any known manner.

The amount of fuel permitted to enter the coking-chamber can be regulated in various well-known manners—for instance, in case no hopper is employed the amount can be controlled by throwing more or less fuel onto the projecting-portion of the endless-grate at the rear of the furnace.

Another construction is that which I here show, consisting of a vertically-adjustable feed-gate 19 mounted within suitable guides within the hopper 14, with its opposite ends projecting on opposite sides of said hopper and provided with a toothed-rack 20, which latter is engaged by a pinion mounted on a transverse-shaft 21. This shaft is mounted to revolve in bearings fixed to the rear of the furnace, or to some other adjacent support, and is provided with a hand-wheel, or other device by means of which it may be revolved in either direction. The function of this feed gate is to admit no more fuel than its determinate height above the endless-grate will permit, and to level and smooth the fuel upon the grate. It also acts to exclude air from the coking-chamber to a more or less degree.

The upper and lower dead-plates of the coking-chamber may be constructed of iron boiler-plate, or of fire-clay or other material suitable supported in the positions before described.

It is essential to the coking operation that the upper dead-plate of the coking-chamber be constructed quite thin of good heat-conducting material, if such a plate is used at all, otherwise the object of such chamber will be defeated and the fuel that is being continuously passed to the fire will not receive a previous heating and coking in the coking-chamber.

In practice I have found, that in some cases the upper dead-plate 4 of the coking-chamber may be discarded, leaving said chamber open on its upper side, so that the fuel carried into it by the forwardly-moving endless-grate will immediately upon its entrance into said coking chamber be subjected to the direct action of the heat and flame issuing from the combustion-chamber. Such construction will cause the fuel to be more rapidly heated and coked than if the upper dead-plate were employed.

In some cases I may discard the bridge-wall 11, ordinarily built of brick, and utilize the forward-end of the coking chamber as a bridge-wall. It is essential, however, that the lower dead-plate be utilized, whether it be in the form here shown, or whether it consist of a dead-wall of brick or fire-clay, as otherwise the fuel would ignite and burn from front to rear of the furnace.

22 indicates an open space between the forward end of the lower dead-plate and the passage 8 in the front-wall of the furnace, the function of which is obviously to permit free passage of air upward from the ash-pit through the grate to the combustion-chamber. Although the furnace will operate satisfactorily with this opening, or space, fixed in length and area, yet I have found it desirable in some cases to enlarge and diminish this space. For instance, in situations where the furnace is being worked to its full capacity said space should be enlarged to the greatest extent, while if there be but slight demand made upon the furnace, then said space may be diminished in area. Diminishing or enlarging the space 22 acts to diminish the grate-surface, as is readily observable, and with results well known to those skilled in the care of furnaces.

To accomplish the enlargement of the space 22 I have provided a sliding plate 23, which is here shown provided with slots 24 and held in position beneath the forward portion of the lower dead-plate 3 by means of bolts 25 engaging said slots and securing said plate in said position.

The operation is as follows: The hopper 14 being supplied with fuel in the form of small lump bituminous-coal, or "slack" or wood saw-dust or shavings, such fuel gravitates downward into the endless grate, and as said grate continuously travels toward the forward end of the boiler said fuel is carried first into the rear portion of the coking-chamber, and passing slowly therethrough is thoroughly heated and coked and prepared for introduction to the combustion chamber, into which latter its previously heated body is then carried in the form of a charred thin layer or mass of a temperature near to that of the combustion-chamber. In this prepared condition the charred-mass of fuel is in condition to become quickly ignited, and to burn without the production of smoke, all of which it does. After reaching the combustion-chamber the fuel is carried, slowly but continuously, in a state of combustion, toward the front of the furnace (in a direction opposite to that of the draft), and the residue is deposited in the form of ashes upon the ground or floor in front of furnace, having automatically elevated and swung outward (as shown by dotted lines) the swinging-door 9. The coking-operation is constant, being accomplished by the heat of the furnace in its passage above the coking-chamber. There will be no intervals of smoking, so long as fuel is in the hopper and is fed as above described.

I am aware that a furnace having a bridge-wall arched across it and an endless-grate traveling beneath said bridge-wall, is not broadly new. But in such arrangements having an arched bridge-wall, the endless-grate does not extend from end to end of the fur-

nace-walls and project beyond same at opposite ends; and said grate did not travel continuously over and in contact with a dead-plate or through a chamber arranged to coke or char the fuel; in some of such arrangements there was no coking-chamber; and in others there was no endless-grate traveling therein.

What I claim is:—

1. A furnace having a combustion-chamber in which the draft is in a given direction, a coking-chamber constructed with a lower dead-plate or wall, to coke and expose fuel to the heat of this combustion-chamber, and an endless-grate arranged to travel in contact with said dead-plate or wall of the coking-chamber and carry raw fuel thereinto, and coked fuel from same into the combustion-chamber, substantially as specified.

2. A furnace having a combustion-chamber at its front-end in which the direction of the draft is fixed, a coking-chamber constructed with a dead-plate to coke and expose fuel to the heat of the combustion-chamber in rear of said combustion-chamber, beneath the object to be heated and having a width equal to or in excess of the width of the grate in the combustion-chamber, and an endless-grate arranged to travel in a direction opposite to the direction of draft in said combustion-chamber and to carry fuel from the rear end of the furnace first into said coking-chamber and then into the combustion-chamber, substantially as and for the purpose set forth.

3. A furnace having a feed-hopper at its rear, a combustion-chamber at its front in which the direction of draft is in a certain direction, a coking-chamber constructed with a dead-plate to coke and expose fuel to the heat of the combustion-chamber and located intermediate of said combustion-chamber and the rear of the furnace beneath the object to be heated, and an endless-grate mounted to travel from rear to front of said furnace in said coking and combustion chambers and carry raw fuel into the coking-chamber and remove coked fuel from same, substantially as set forth.

4. A furnace having a combustion-chamber, a dead-plate or wall approximating in width the width of and located in rear of said chamber, beneath the object to be heated, and an endless-grate approximating in width the width of and arranged to travel in close contact with said dead-plate and carry fuel to said combustion-chamber, the direction of movement of said grate and the fuel carried thereby being opposite to the direction of draft in said combustion-chamber, substantially as set forth.

5. The mode of continuously treating and feeding fuel in a furnace, which consists in first preparing a uniform thin layer of raw fuel approximating in width the width of the furnace-grate, subjecting this uniform thin layer of fuel to direct heat of the furnace in a coking-chamber beneath the object to be heated, heating and coking it in said coking chamber, and continuously conveying the thin layer of fuel as fast as prepared uninterruptedly toward said combustion-chamber and into the same in a direction opposite the direction of draft in said combustion-chamber, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

ALBERT B. CROWDER.

Witnesses:
H. A. LOEVY,
JNO. C. HIGDON.