(No Model.) 2 Sheets—Sheet 1.

J. W. UPSON.

FURNACE.

No. 523,249. Patented July 17, 1894.

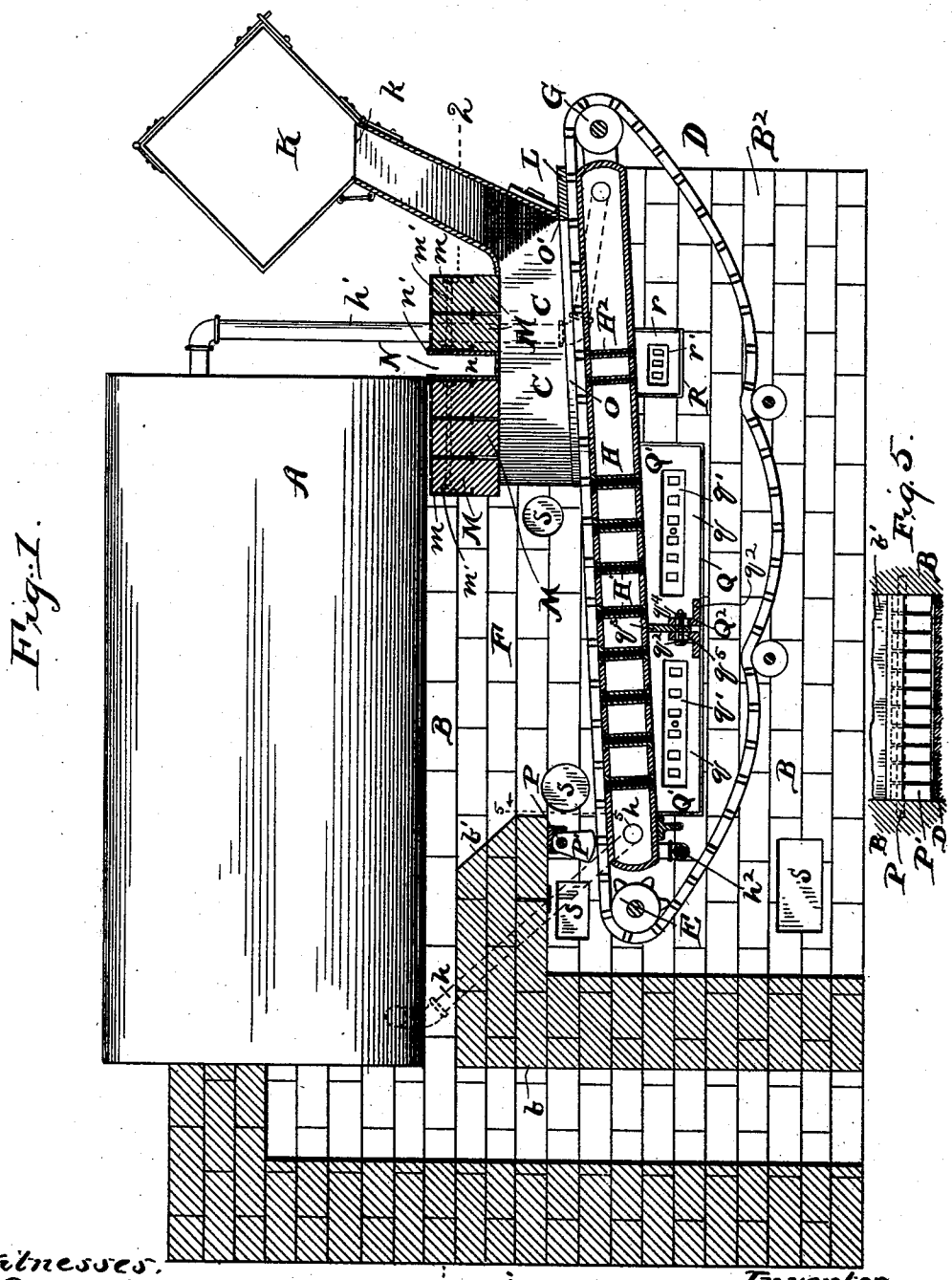


Fig. 1.

Fig. 5.

Witnesses:
E. B. Gilchrist
C. F. Wooster

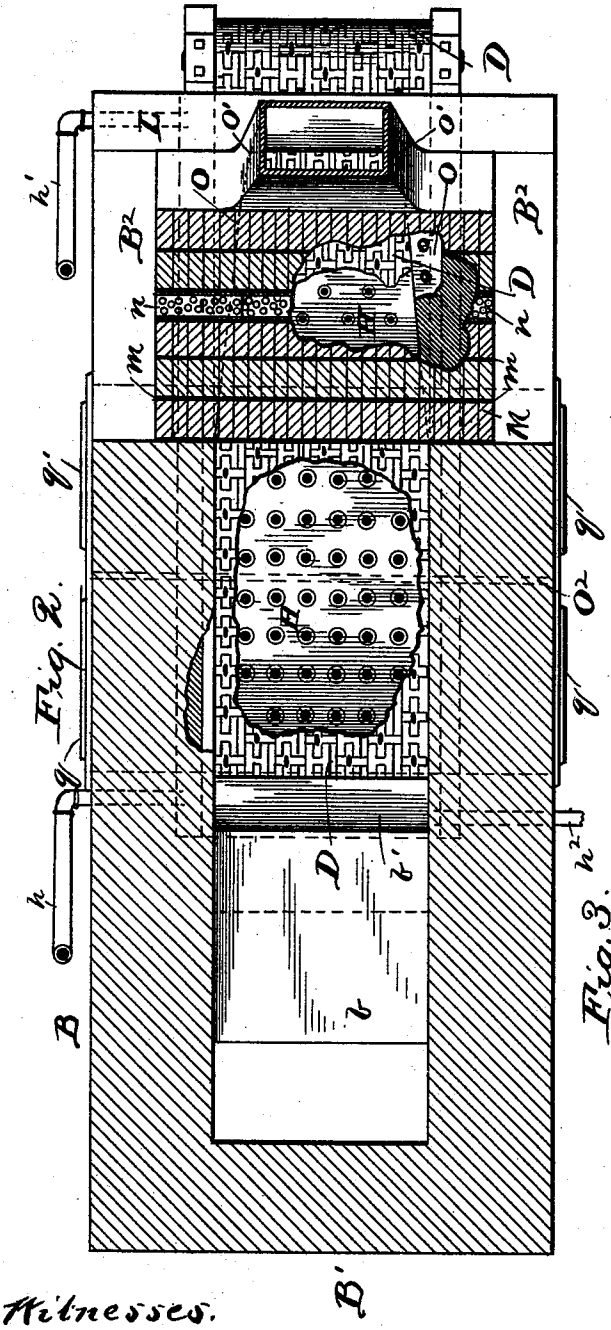
Inventor:
James W. Upson
By Seggett & Seggett
his attorneys

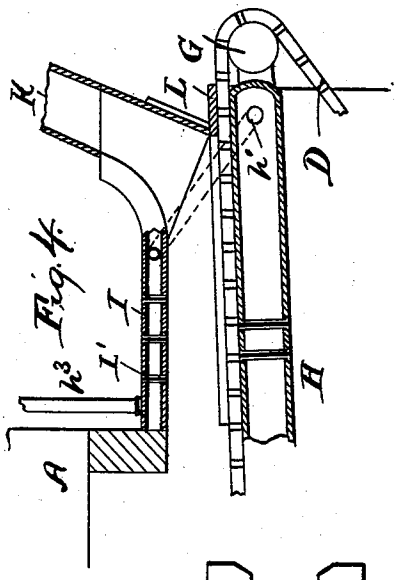
(No Model.) 2 Sheets—Sheet 2.

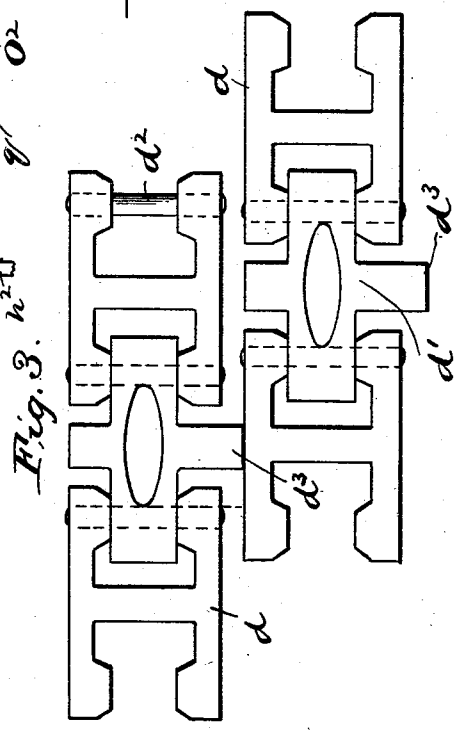
J. W. UPSON.

FURNACE.

No. 523,249. Patented July 17, 1894.







Witnesses.
E. B. Gilchrist.
C. F. Wood.

Inventor.
James W. Upson
By Seggett & Seggett
his attorneys.

UNITED STATES PATENT OFFICE.

JAMES W. UPSON, OF CLEVELAND, OHIO, ASSIGNOR TO GEORGE D. UPSON, OF SAME PLACE.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 523,249, dated July 17, 1894.

Application filed April 10, 1893. Serial No. 469,741. (No model.)

To all whom it may concern:

Be it known that I, JAMES W. UPSON, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Furnaces; and I do hereby 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.

My invention relates to improvements in smokeless furnaces; and it consists in the improved apparatus for and mode of feeding the fuel through a coking-chamber preparatory to its introduction into the fire or combustion-chamber and continuously feeding a suitable layer of fuel from said coking-chamber into the fire of the combustion-chamber, and it also consists in the peculiarities of construction and combinations of parts hereinafter described and pointed out in the claims.

In the accompanying drawings, Figure 1 is an elevation in central longitudinal section of a boiler-furnace embodying my invention. Fig. 2 is a top plan partly in section on line 2—2, Fig. 1, and partly broken away to more clearly show the construction. Fig. 3 is an enlarged plan in detail of a portion of the endless grate. Fig. 4 is a central longitudinal section of the coking-chamber, exhibiting a somewhat modified construction of top or roof for said chamber. Fig. 5 is a section on line 5—5, Fig. 1.

Referring to the drawings, A represents a steam-boiler of the horizontal tubular variety. The boiler, however, may be of any suitable construction or form.

B B represent the side-walls; B′ the rear end-wall of the setting, and *b* a bridge-wall at the rear of the fire or combustion-chamber F. The fire or combustion-chamber, at its forward end, is in open relation with the coking-chamber C that, in turn, is in open relation with the feed-hopper or magazine. The grate consists of a series of endless chains D arranged side by side, as shown in Figs. 2 and 3, and preferably declining somewhat toward the rear of the combustion-chamber, as shown in Fig. 1, the chain-grate passing over the operating sprocket-drum, E, at the rear of the combustion-chamber, and leading over a roller, G, at the front of the furnace-setting, said sprocket-drum and roller being supported, respectively, in any suitable manner. The power for operating the chain-grate in moving the fuel-feeding-section thereof rearward is applied by means of any suitable mechanism to sprocket-drum E, and hence said section of the grate is kept taut. The side-walls of the setting extend some distance forward of the boiler, but at a reduced height, as shown at B^2.

The fuel-carrying or tight section of the endless-grate passes through the coking and combustion-chamber and rests upon the bottoms or floors of said chambers, said floors declining rearwardly to conform to the declination of said section of the grate.

The floors of the coking and combustion-chambers are composed preferably of a single water bottom, H, as shown in Fig. 1, said bottom being suitably supported between and adjoining the side-walls of the setting and extending between and preferably as close to sprocket-drum E and roller G as is practicable, the top side of the water-bottom being flush, or approximately so, with the top of said drum and roller, so that the endless grate passing over said bottom shall nicely rest upon the bottom. The water-bottom, by pipes or otherwise, is in open relation with the top and bottom of the boiler to insure circulation. For instance, pipe, *h*, establishes open relation between the lower end of the water-bottom and bottom of the boiler, and pipe, *h′*, establishes open relation between the upper or forward end of the water-bottom and the upper portion of the boiler, and the feed-water for the boiler is introduced into the water-bottom, for instance, by means of a pipe, h^2, at or near the lower or rear end of said bottom.

The section of the water-bottom that forms the floor of the fire or combustion-chamber has a cluster of vertical tubes H′ (see Figs. 1 and 4) fastened in the usual manner to the top and bottom plates of the water-bottom, said tubes serving as air-ducts or passage-ways for supplying air to the combustion-chamber from underneath the chain-grate. Water-bottom H constitutes a feature of vast importance, in that it prevents the grate from becoming overheated.

K represents the fuel-hopper or magazine that discharges onto the chain-grate at the

forward end of the coking-chamber. Usually a plate, L, is laid across on top of the chain-grate just forward of hopper K for excluding air as far as possible from entering through the interstices of the grate, and through any space between the grate and fuel-hopper.

The top or roof of the coking-chamber is preferably constructed as shown in Figs. 1 and 6, wherein the same is principally composed of several courses of fire-brick M arranged transversely of and supported by the side-walls of the coking-chamber. Two of the courses of brick of said roof or top are separated a suitable distance, as at N, and the coking-chamber, between said sections of its top or roof, is closed by one or more perforated plates, *n*, preferably a series of plates, as shown more clearly in Fig. 2. The brick and the courses of brick at either side of space N are bound and secured together, the means of binding or securing together the respective courses, consisting, preferably of channel-beams, *m*, and assembling-bolts, *m'*. Perforated plates N are preferably **U**-shaped, with the end-members thereof flanged outwardly at their free ends as at *n'*, and with the flanges resting upon the adjacent channel-beams employed in holding together the bricks of the respective adjacent courses of brick.

The perforations in plates *n* admit air to the coking-chamber from above, and by removing one of said plates the coking-chamber or coking-process may be readily inspected.

The aggregate capacity of the air passage-ways provided by perforated plates N should be ample for supplying air for supporting the combustion in the coking-chamber and more especially for igniting the gases expelled from the coal during the coking-process. The draft of air through perforated plates *n* may be easily regulated by closing or partially closing more or less of the perforations by dampers (not shown) or any means suitable for the purpose.

A somewhat modified construction of top or roof for the coking-chamber is shown in Fig. 6, wherein the same consists of a water-cover or top, I, with a cluster of small vertical tubes, I', for the admission of air from above into the coking-chamber, and wherein pipe *h'*, instead of leading directly from water-bottom H to the top of the boiler, leads from said bottom into top or cover I and another pipe, h^3, leads from said top or cover into the boiler.

The fuel-hopper or magazine, at its lower end, is less in lateral dimensions than the chain-grate and thence upward, for a suitable distance, say to point *k*, the hopper decreases in size so that the fuel, as it becomes heated and expanded in its passage to the coking-chamber, shall not clog in the lower portion of the hopper or magazine. To prevent the expanding coal or fuel from crowding against the side-walls of the coking-chamber, I provide as follows:—Plates, O, are secured to the water-bottom on each side of the grate, and extend above and over-lap the grate, and extend from the lowermost portion of the hopper at O' to the rear end wall of the coking-chamber, the plates diverging rearwardly from point O' to the width of the grate at the rear of the coking-chamber. The inner edges of said plates, where they join the fuel-hopper, being preferably flush with the sides of the hopper. Plates O support the side-walls of the coking-chamber, said walls being composed of fire-brick, slabs of soap-stone, or other refractory material, and diverge rearwardly and have their inner surfaces preferably flush with the inner edges of the supporting-plates. Said diverging walls of the coking-chamber confine the coal or fuel laterally and admit of the fuel expanding as it is conveyed rearwardly. The coking-chamber is preferably of such length that the coking-process is completed before the fuel passes out of said chamber, after which there is no more expansion of the fuel, and consequently no tendency of the fuel to crowd against the side walls of the setting. Plates O may be said to constitute a part of the side-walls of the coking-chamber and the side-walls may be said to be under cut where the plates over-lap the endless grate.

The movement of the chain-grate is slow, say six inches, more or less, per hour, according to circumstances. It will be readily understood that with such slow movement there is ample time for the coking of the coal or fuel while the latter is passing through the coking-chamber, and for consuming the coal or fuel before it reaches the dumping place at the rear of the chain-operating-drum, so that only ashes, cinders and refuse are dumped.

To exclude the entrance of air into the combustion-chamber from between the grate-operating-drum and bridge-wall, the latter is provided with a forward extension *b'* overhanging the rear portion of the bottom of the combustion-chamber and supporting a horizontal rod, P, extending from side to side of the settting and having loosely mounted thereon oscillating or swinging blocks, P', that normally hang with their lower ends in such proximity to the chain-grate as to permit only ashes to be carried underneath the same without causing their oscillation. Blocks P' are placed as closely together as is practicable without interfering with their capability of independent oscillation, and hence it will be observed that they efficiently prevent the passage of a current of air into the combustion-chamber from between the grate-operating-drum and bridge-wall. Blocks P', by virtue of their capability to swing or oscillate, do not obstruct the escape of stones and clinkers. Tubes H', that extend through the water-bottom under the fire-chamber, also permit the escape of ashes into a pan, Q, suitably supported below the portion of the water-bottom that contains said vertical tubes, pan

Q extending from one side wall to the other side-wall of the furnace-setting, the latter being provided with doors q for access to said pan. Said ash-pan is preferably divided by means of a laterally-sliding partition, Q^2, into two compartments, Q', extending from end to end of the pan, and a door q is preferably provided at each end of each compartment. Hence, it will be observed, that, upon opening said doors, or dampers q' with which they are provided, the compartments of pan Q are converted into air-ducts for conducting air to tubes or passage-ways H', and that by closing the doors or door-dampers leading to one of said ducts or compartments, the passage of air, into the lower portion of the combustion-chamber, from underneath the water-bottom, is materially reduced, as the passage of air to the vertical tubes in the water-bottom leading from the compartment or duct closed as just indicated, is cut off entirely. Partition Q^2 is preferably capable of being slid laterally to enlarge or reduce the size of either one of the compartments of the ash-pan, and owing to the rearward declination of the water-bottom, as hereinbefore indicated, it follows that in order that partition Q^2, if moved laterally to enlarge or reduce one of the ash-compartments, shall not establish open communication between the two compartments, said partition must be adjustable in height, and a suitable construction is shown in Fig. 1, wherein the partition is composed of two angle-plates, q^2, and a plate q^3 adjustable up and down between said angle-plates, said vertically-movable member being secured to the angle-plates by means of bolts and nuts, as at q^4, and the angle-plates being slotted, as at q^5, to accommodate the said vertical adjustment of the middle plate.

An air-duct, R, is preferably provided underneath that portion of the water-bottom that forms the floor of the coking-chamber, said duct extending transversely of the furnace and being provided at one or both ends with doors r having dampers r'. Several small vertical tubes, H^2, extending through and secured to the top and bottom plates of the water-bottom, establish open relation between duct R and the coking-chamber. The air passing into the coking-chamber through the perforations in its roof or top and such air as passes down between the interstices of the coal, are usually amply sufficient for supporting combustion in the coking-chamber, but if more air is wanted it is admitted through tubes H^2.

By means of the provisions of a water-bottom and the connection of said bottom with the boiler, as shown, a circulation is had whereby the water-bottom utilizes a large amount of heat that would, otherwise, be wasted.

I would remark that by my improved construction of furnace there is a constant liberation of gases in the coking-chamber, and said gases, commingling with the air introduced as hereinbefore described, are heated to ignition or combustion before they enter the combustion-chamber below the comparatively cool boiler-surface, and consequently little or no smoke is formed.

The chains that form the chain-grate consist, respectively, of links d d' pivotally secured together, as at d^2. The different chains are alike, excepting that the small projecting parts d^3, that hold the contiguous or adjacent chains separated, are omitted on the outside chain next to one of the side-walls of the setting.

S represents doors that lead to different parts of the furnace, respectively.

What I claim is—

1. A furnace having a combustion-chamber, a coking-chamber located forward of said combustion-chamber, an endless-grate arranged to travel in contact with the floors or bottoms of said chambers and carry the fuel through the coking-chamber into the combustion-chamber, and suitable means for supplying a cooling agent underneath said floors or bottoms to prevent the latter and the grate thereon, from being overheated, substantially as set forth.

2. A furnace having a combustion-chamber, and a coking-chamber, a water-bottom for said chambers, and an endless-grate arranged to travel in contact with said bottom and carry fuel through the coking-chamber into the combustion-chamber, substantially as set forth.

3. A furnace having a combustion-chamber, a coking-chamber located forward of said combustion-chamber, a rearwardly-declining continuous bottom for said chambers, and an endless grate arranged to travel in contact with said bottom and carry fuel through the coking-chamber into the combustion-chamber, substantially as set forth.

4. In a furnace, the combination with the combustion-chamber, an endless-grate, and suitable means for operating or moving said grate, of a water-bottom supporting the upper or feeding-section of the grate and extending from end to end and from side to side of the combustion-chamber or approximately so, substantially as set forth.

5. In a furnace, the combination with the boiler and endless grate arranged to carry fuel into the combustion chamber, the upper or feeding-section of said grate declining substantially as indicated, of a water-bottom supporting said section of the grate, and pipes establishing open relation between the upper and lower ends of said bottom and the boiler, substantially as set forth.

6. In a furnace, the combination with a combustion-chamber and endless-grate arranged to carry fuel into said chamber, of a water-bottom or cooling-chamber below the feeding-section of said grate and extending from end to end and from side to side of said chamber, substantially as set forth.

7. A furnace having a coking-chamber for-

ward of the combustion-chamber, an endless grate arranged to carry fuel from the coking-chamber into the combustion-chamber, of a water-bottom or cooling-chamber under the feeding-section of said grate, said cooling-chamber extending from the forward end of the coking-chamber to the rear end of the combustion-chamber, or approximately so, substantially as set forth.

8. In a furnace, the combination with a combustion-chamber having a water-bottom and endless-grate for carrying fuel into said chamber, of air-ducts or passage-ways extending through said bottom and adapted to discharge air into the combustion-chamber through the grate, substantially as set forth.

9. In a furnace, the combination with a coking-chamber having a water-bottom and endless-grate for carrying the fuel through said chamber into the combustion-chamber, of air-ducts or passage-ways extending through said bottom and discharging into the coking-chamber, substantially as set forth.

10. In a furnace, the combination with a coking-chamber having a top or roof composed of one or more perforated plates or castings and one or more courses of fire-brick at either side of said perforate portion, the bricks and courses of bricks, at either side of said perforate portion, being held and bound together by metallic beams or bars and assembling bolts, substantially as set forth.

11. In a furnace, the combination with a coking-chamber and endless-grate arranged to carry fuel through said coking-chamber into the combustion-chamber, of plates or members overlapping the grate at the sides of the coking-chamber, said overlapping members, at their inner edges diverging from the receiving toward the delivering end of said chamber, substantially as set forth.

12. In a furnace, the combination with a combustion-chamber, coking-chamber and fuel-hopper or magazine arranged, substantially as indicated, and an endless-grate arranged to carry fuel through the coking-chamber into the combustion-chamber, the discharging-end of the fuel-hopper or magazine being less in width than the endless-grate, and the side-walls of the coking-chamber diverging from the receiving-end of said chamber at the hopper toward the discharging-end of the chamber, substantially as set forth.

In testimony whereof I sign this specification, in the presence of two witnesses, this 14th day of March, 1893.

JAMES W. UPSON.

Witnesses:
C. H. DORER,
WARD HOOVER.