

(No Model.)

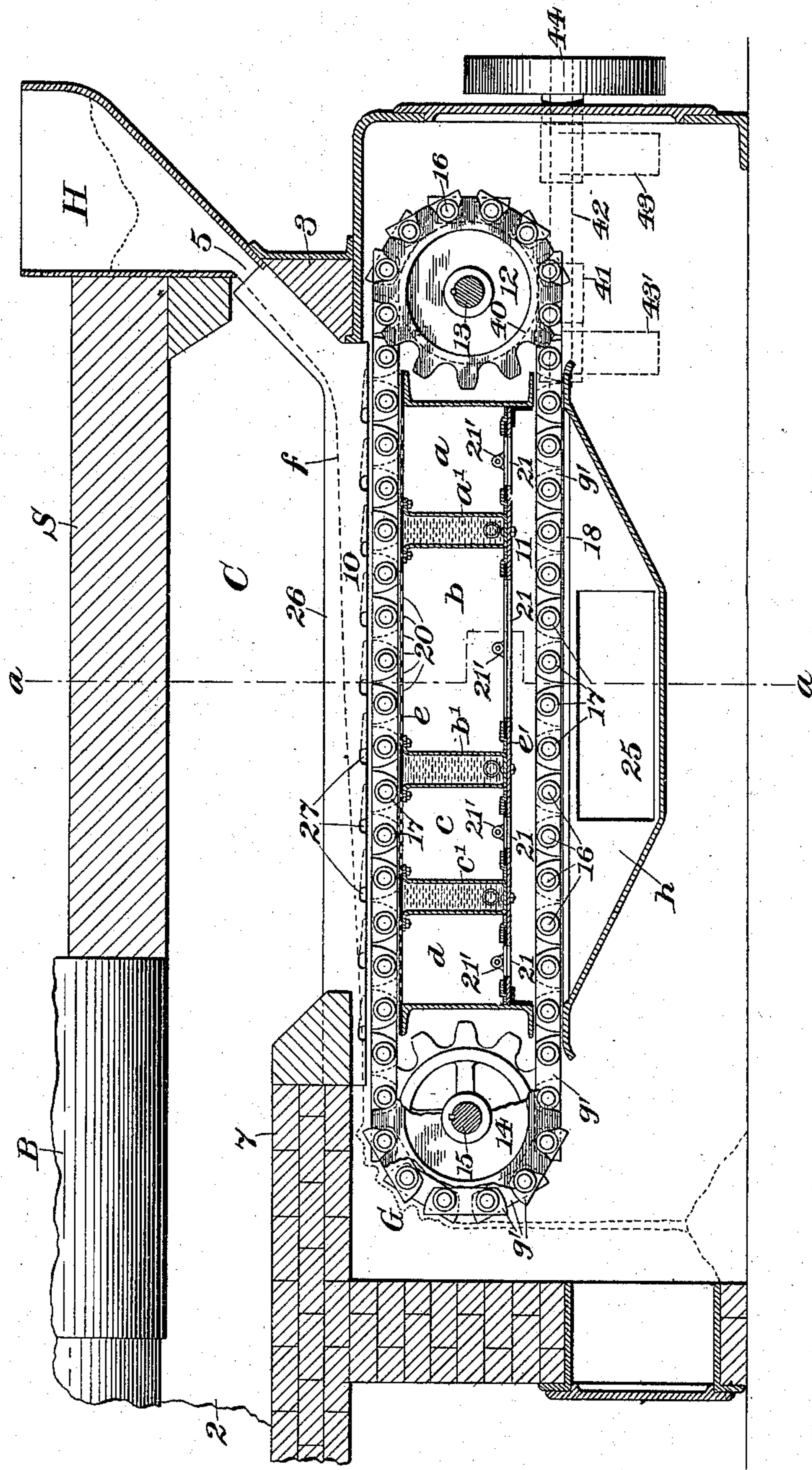
2 Sheets—Sheet 1.

F. H. RICHARDS.  
FURNACE.

No. 535,412.

Patented Mar. 12, 1895.

Fig. 1.



Witnesses.

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(No Model.)

2 Sheets—Sheet 2.

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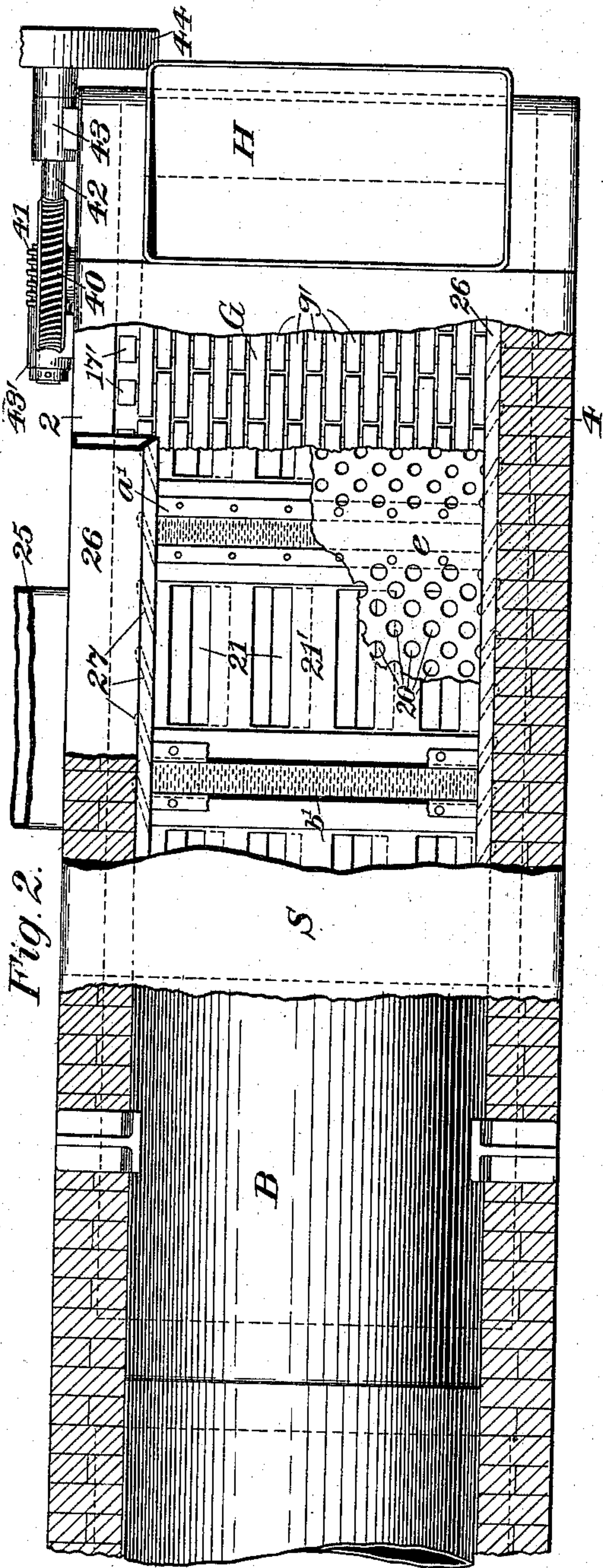


Fig. 2.

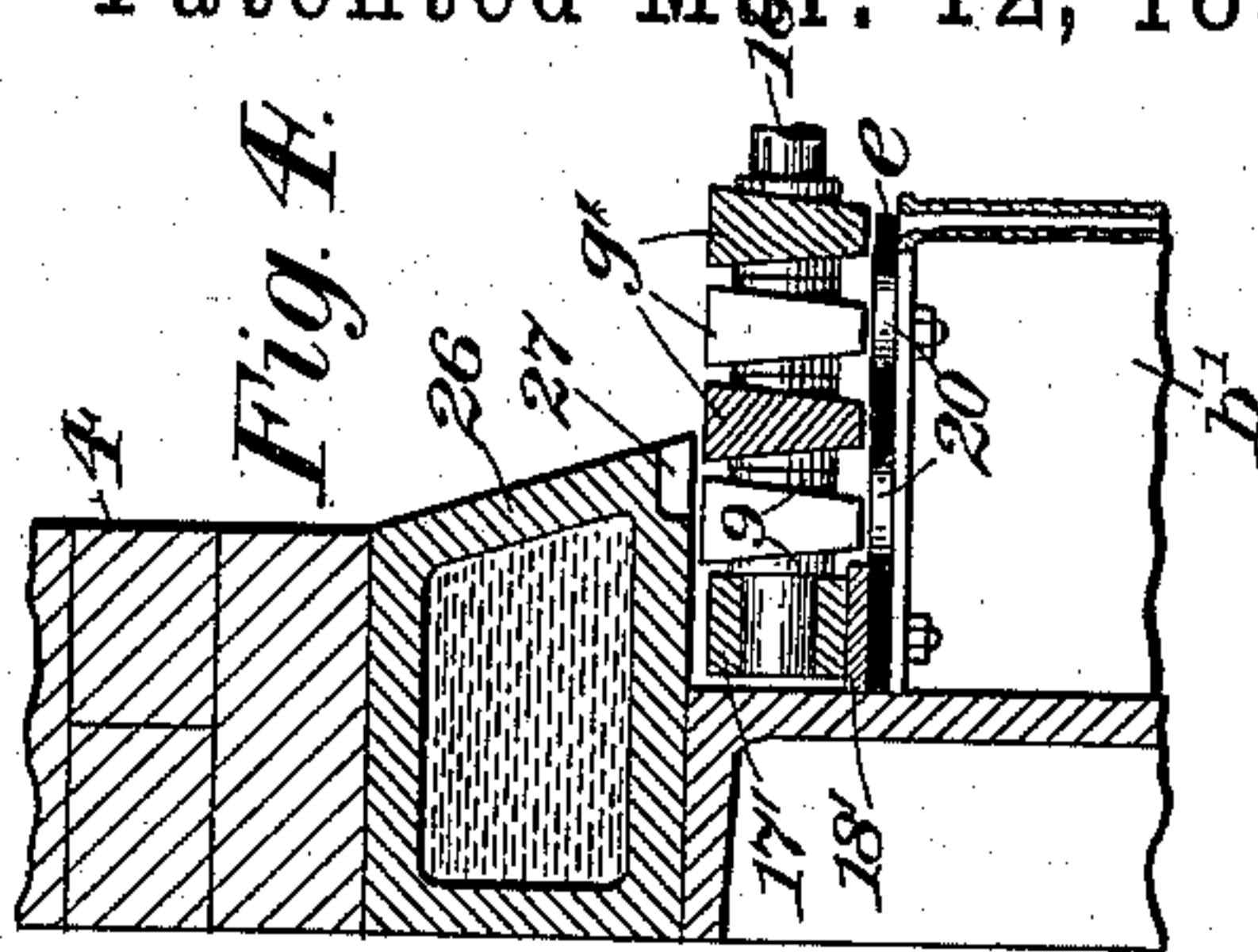


Fig. 4.

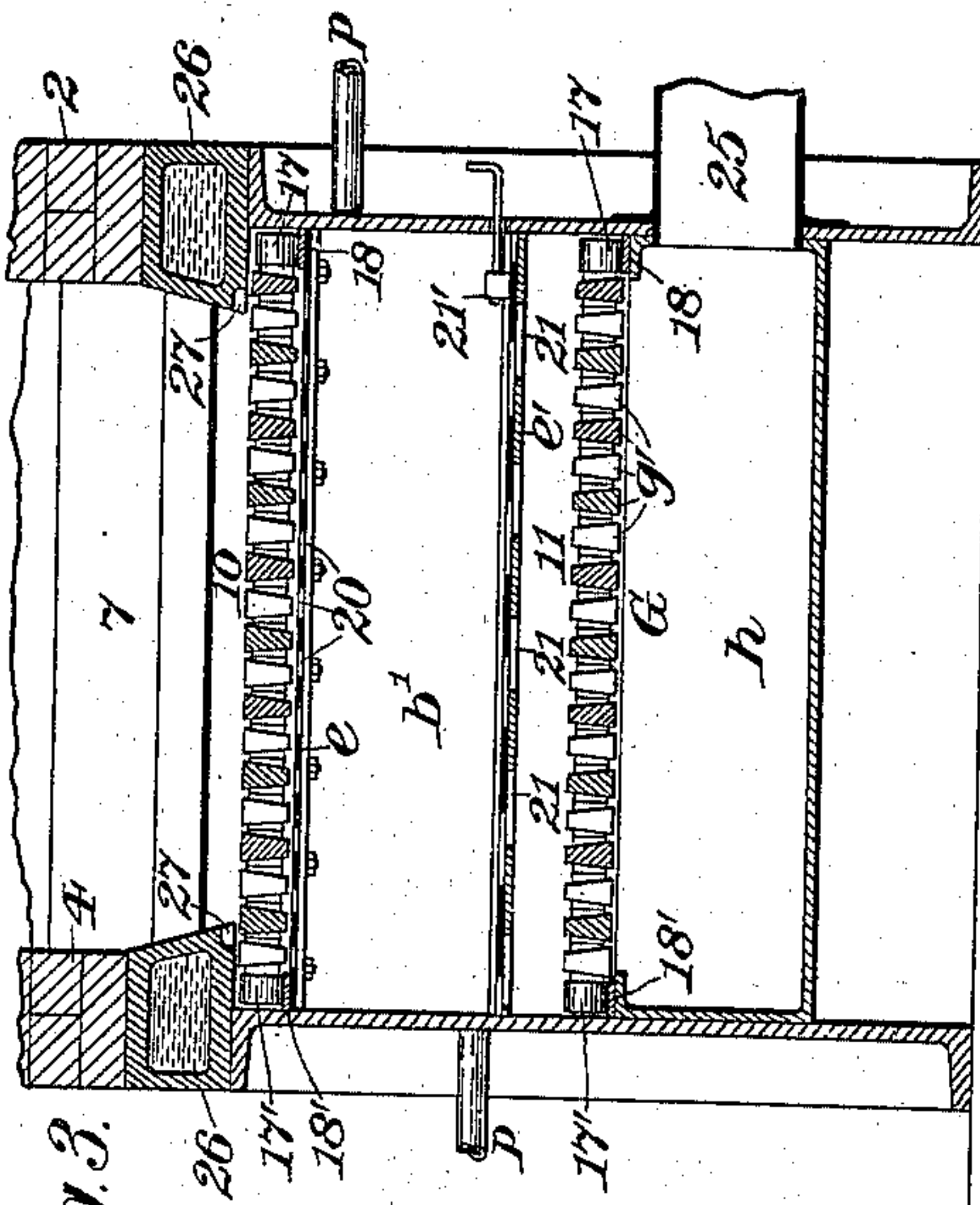


Fig. 3.



Fig. 7.

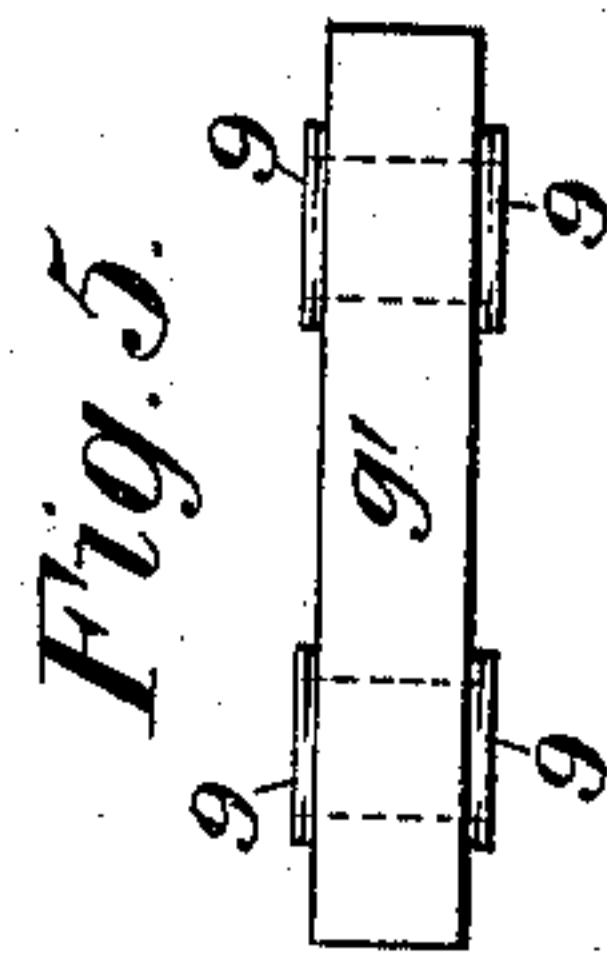


Fig. 5.

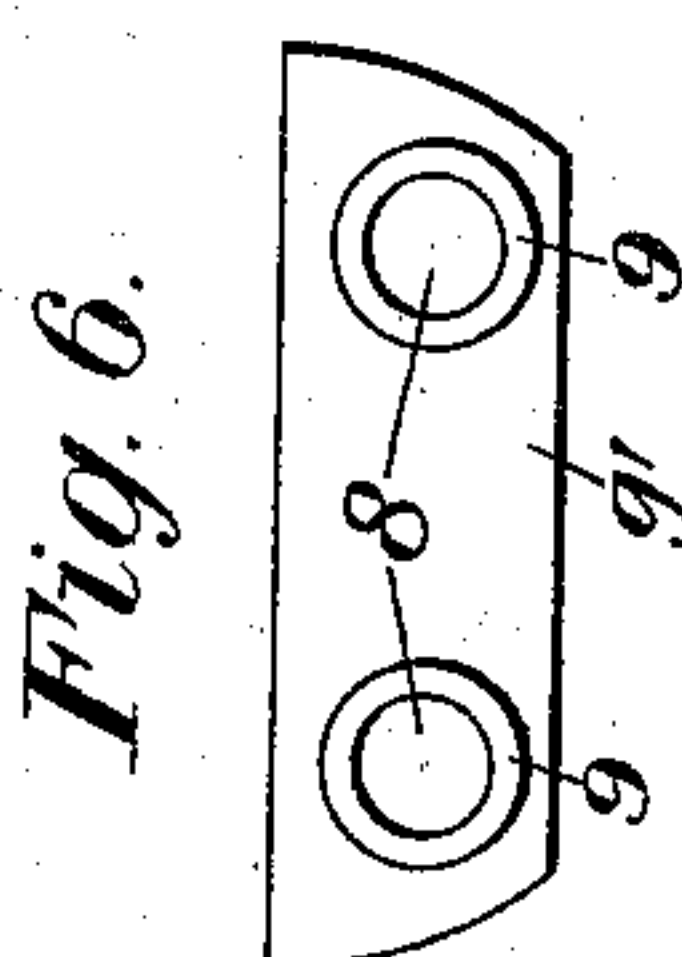


Fig. 6.

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# UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT, ASSIGNOR TO ECKLEY B. COXE, OF DRIFTON, PENNSYLVANIA.

## FURNACE.

SPECIFICATION forming part of Letters Patent No. 535,412, dated March 12, 1895.

Application filed October 23, 1894. Serial No. 526,696. (No model.)

*To all whom it may concern:*

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

This invention relates to that class of furnaces adapted for burning the lower grades and smaller sizes of fuel, in accordance with the process described in Letters Patent of the United States No. 499,715, granted to Eckley B. Coxe June 20, 1893, or to that class of furnaces in which a fuel-traveling grate or furnace-floor is employed for carrying the fuel forward in the furnace-chamber, and in which means are employed for supplying air to the fuel, during the traveling movement thereof, at varying pressures at successive points in the length of the furnace-floor or grate.

The objects of my present invention are, primarily, to provide, in connection with a furnace of the class above specified, a fuel-traveling furnace-floor or grate of improved construction and organization adapted for carrying the fuel forward in the furnace-chamber; also to provide in connection with the furnace-floor, improved means for supplying air to the fuel, carried upon the said furnace-floor, at varying pressures at successive points in the length thereof; and also to provide means in connection with said furnace-floor for reducing the normally high temperature of said furnace-floor without injuriously affecting the combustion of the fuel.

Another object of my present invention is to provide means in connection with the fuel-traveling furnace-floor for preventing the fuel from working sidewise, or transversely of the floor, over and around the side edges thereof, and to so construct and organize the several component parts of the furnace-floor that said furnace-floor will be practically self-cleaning.

In the drawings accompanying and forming part of this specification, Figure 1 is a sectional side-elevation of a traveling grate furnace embodying my present improvements. Fig. 2 is a sectional plan view of the same, parts being broken away to more clearly show certain of the details thereof. Fig. 3 is a vertical transverse section of the lower portion

of the furnace, taken in line *a—a*, Fig. 1, looking toward the right hand in said figure. Fig. 4 is a cross-sectional view similar to Fig. 3, but on a relatively large scale, of a portion of one side of the furnace, showing a portion of the grate-mechanism, and Figs. 5, 6 and 7 are plan, side and end views, respectively, of one of the series of grate-bars which comprise the furnace-floor.

Similar characters designate like parts in all of the figures of the drawings.

For the purpose of illustrating the application and mode of operation of my present improvements, I have shown the same applied to a furnace which is, in a general way, similar to the furnace described in Letters Patent of the United States No. 499,716, granted to Eckley B. Coxe June 20, 1893, but it will be understood that my improvements are applicable to other forms of furnaces than that shown and described in said patent.

As in the patent just referred to, the furnace-chamber, designated by C, is inclosed at the sides and ends thereof by the usual side-walls, 2 and 4, the front end-wall, 3, and the rear-wall or bridge-wall, 7, and is covered by an ordinary roof, S. Over the rearward portion of the furnace-chamber C is shown the forward end of the steam-boiler, B, which may be of any well known type.

The floor of the furnace-chamber, in the preferred form thereof herein shown and described, consists of the upper run 10, of an endless traveling grate, designated in a general way by G, which endless grate is carried at the opposite ends of its circuit, or at the front and rear ends of the furnace-chamber, upon suitable grate-carrying wheels or chain-wheels, 12 and 14, respectively, that are carried by shafts 13 and 15, respectively, journaled in suitable bearings (not shown) on the frame-work of the furnace-structure.

As a means for imparting a traveling movement to the endless grate, to feed the fuel carried upon the upper run thereof forward in the furnace-chamber with a uniform movement, the chain-wheel shaft 13 is shown provided at one end thereof with a worm-wheel, 40, that meshes with a worm, 41, on a driving-shaft, 42, journaled in bearings, 43 and 43', on the frame-work of the furnace. Said shaft



42 is shown provided with a pulley, 44, which may be driven from any suitable source of power (not shown).

As a means for supplying fuel to the ignition area or forward end of the furnace-floor, the furnace-chamber C is shown provided, at the forward end thereof, with a fuel-supply hopper, H, the delivering end of which communicates with said chamber, and is adapted for supplying fuel to the furnace-floor through the chute or opening, 5, extending through the front-end-wall, 3, of said furnace-chamber, after the manner described in the patents hereinbefore referred to.

In the preferred form thereof herein shown and described, the endless chain grate consists of a series of grate-sections, pivotally connected together and comprising, each, a series of duplicate grate-bars,  $g'$ , which grate-bars are longitudinally disposed relatively to the furnace-chamber. The grate-bars of adjacent grate-sections are so disposed, relatively to each other, that the grate-bars of one section will lie intermediate to and overlap, in a horizontal plane, the grate-bars of the next adjacent section. These grate-bars have each transverse openings through opposite ends thereof as shown at 8, which form bearings for the carrier rods, hereinafter described, and said bars have spacing-flanges, 9, which are preferably in the nature of bosses concentric to said openings, said bosses or flanges keeping the adjacent side edges of adjacent grate-bars separated the requisite distance to form air-spaces of the required area between adjacent grate-bars.

As a simple and effective means for pivotally connecting the grate-bars of adjacent sections of alternating disposition as shown in Figs. 2, 3 and 4, I have provided carriers for said grate-bars which, in the form thereof herein shown, are in the nature of cross-sectionally cylindrical rods, 16, extending through the openings, 8, of the overlapping ends of the adjacent grate-bars, as will be understood by reference to said figures, said grate-bar carrying rods being projected at opposite ends somewhat beyond the outer faces of the outside grate-bars of the grate-sections, and being provided at these ends with rollers, 17 and 17', which ride upon tracks, 18 and 18', respectively, upon the inner faces of the side walls of the furnace-structure, as is most clearly shown in Fig. 4. The grate-bars,  $g'$ , will preferably be wedge-shaped in cross-section, their inner faces being of less width than their outer or fuel-supporting faces. By this construction and organization of furnace-floor, it will be seen that the grate-bars, during the traveling movement thereof, maintain a parallel relation intermediate to the ends of the circuit, thereby forming a furnace-floor having a level fuel-supporting surface, and that said grate-bars in passing around the rearward end of the circuit, assume various angles

relatively to each other, thereby loosening up the material that might otherwise adhere to the surface of said bars, and also clearing the spaces between said bars, as will be readily understood by reference to Fig. 1 of the drawings, the dotted line,  $f$ , in said figure illustrating fuel, and showing its various positions during the traveling movement thereof.

As a means for supplying air to the fuel-carrying run of the grate at varying pressures at successive points in the length thereof, and also as a means for reducing the normally high temperature of the fuel-carrying run of the said grate, I have provided in connection with the fuel-carrying run of said grate, an air-blast apparatus which, in the preferred form thereof herein shown, consists of a series of air-supply chambers, designated by  $a$ ,  $b$ ,  $c$  and  $d$ , respectively, located underneath the fuel-carrying run of said grate, and each having a top and bottom wall,  $e$  and  $e'$ , respectively, the top wall of which is contiguous to and practically constitutes a support for the grate-bars of the upper run of said grate, and has a series of outlet-openings, 20, therethrough, and the bottom wall of which has one or more valve-regulated inlet openings, 21, therethrough. These air-supply chambers, which are of relatively large areas, extend from side to side of the grate, and are separated from one another by transverse water-chambers,  $a'$ ,  $b'$  and  $c'$ , respectively, whose upper and lower ends are contiguous to and closed by the upper and lower plates,  $e$  and  $e'$ , respectively, which constitute the upper and lower walls of the air-supply chambers. These water-compartments will be supplied with water from any suitable source of supply, as, for instance, from the boiler, by means of the supply-pipes,  $p$ .

As a means for supplying air to the successive air-supply chambers, I have provided a main air-compartment or chamber,  $h$ , which is preferably located underneath the lower run 11, of the grate, and extends approximately from end to end of said lower run, or covers the space coinciding with the space occupied by the entire series of air-supply chambers  $a$ ,  $b$ ,  $c$  and  $d$ , located above this main air-supply chamber, as will be readily understood by reference to Fig. 1 of the drawings. This main air-supply chamber,  $h$ , is, in turn, supplied with air by a conduit, 25, in communication therewith, which conduit leads to any suitable source of air-supply, such as a blower (not shown).

One of the important features of my present invention is the improved means employed in connection with the apparatus just described for regulating the influx of air to the successive air-supply chambers  $a$ ,  $b$ ,  $c$  and  $d$ , respectively, to secure varying pressures in the successive chambers, and also the means employed for regulating the efflux of air from said chambers, to secure relatively varying



air-blasts contiguous to the fuel, at successive points in the length of the fuel-carrying run of the grate.

To secure the requisite relative variation of air-pressure in the successive air-supply chambers, I have provided, as hereinbefore described, the valve regulated inlet openings, 21, in the bottom walls of said chambers, said inlet openings being usually provided with ordinary gates or slide-valves, 21', adapted to be operated in the usual manner for increasing or decreasing the effective areas of said inlet openings, as will be understood by reference to Figs. 1, 2 and 3 of the drawings, and to secure the requisite relative variation in the efflux of air from the successive air-supply chambers, *a, b, c* and *d*, to thereby vary the effective supply of air to the fuel, at successive points in the length of the furnace-chamber, the successive series of outlet openings through the upper walls of the successive air-supply chambers are of relatively varying aggregate areas; that is to say, the effective outlet areas of the successive air-supply chambers vary relatively to each other.

Another important feature of my present invention is the means employed in connection with the fuel-carrying run of the grate for preventing the fuel from being carried sidewise over the extreme side edges of said upper run. This means, in the form thereof herein shown and described, consists preferably of the two hollow beams, 26, which are somewhat similar to the hollow "side-bars" or air-checks described in Letters Patent of the United States No. 510,566, granted to Eckley B. Coxe December 12, 1893. These beams are supported, one at each side of the upper run of the grate, by the frame-work of the furnace, as shown most clearly in Figs. 3 and 4, with their inner adjacent ends in close proximity to, and overlying the upper side edges of, the upper run of the grate; said beam extending longitudinally of the furnace and constituting not only clearing-beams for the furnace-floor, but, also constituting water-walls adjacent to the fuel-supporting surface of the said furnace-floor; a circulation of water being maintained in the said beams by means (not shown) in any suitable manner. As shown in the drawings, these beams, 26, have a series of grooves 27, formed in the under faces thereof which extend from the extreme inner edges thereof and are in the direction of the width of the beams, but in horizontal planes, they being inclined inwardly in the direction of the traveling movement of the grate, as shown by dotted lines in Fig. 2 of the drawings.

By forming the grooves, 27, in the under sides of the overhanging side beams, 26, and inclining them horizontally in the direction of the traveling movement of the grate, as described, it will be seen that any fuel working sidewise upon the fuel-supporting run of, and toward the outside edges of, the grate, at

successive points in the length thereof, will naturally fill these grooves, 27, and, owing to the traveling movement of the grate, the fuel contained in these grooves will be forced inward toward the middle portion of the grate by the succeeding particles of fuel coming in contact therewith; thereby limiting the transverse movement of the traveling fuel, and preventing the same from running over the side edges of the fuel-carrying run of the grate.

In practice, after the clearing-grooves, 27, in the side beams, 26, are filled with material, during the traveling movement of the grate, it will be seen that the material contained in said grooves will practically constitute a series of horizontally inclined projecting ribs or brushes adapted for sweeping the fuel-supporting face of the upper run of the grate at the sides thereof, and which will deflect the outward movement of the material, at the side edges of said grate, and cause the same to move inward toward the middle portion thereof.

Having thus described my invention, I claim—

1. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing walls, of grate-supporting tracks in fixed relation with the side-walls of the furnace-chamber, an endless grate comprising a series of overlapping cross-sectionally wedge-shaped grate-bars pivotally-connected together by transverse grate-bar-carrying rods extending through said bars and from side to side of the furnace-chamber and having rollers at opposite ends thereof supported upon said tracks, and grate-driving mechanism carried by the side-walls of the furnace-chamber, substantially as described and for the purpose set forth.

2. In a furnace of the class specified, the combination with the furnace-chamber, and the fuel-traveling furnace-floor, of side beams overlapping the opposite upper side edges of the furnace-floor, and each having a series of clearing-grooves in the under faces thereof, substantially as described and for the purpose set forth.

3. In a furnace of the class specified, the combination with the furnace-chamber and the fuel-traveling furnace-floor, of side beams overlapping the opposite under side edges of the furnace-floor, and each having a series of horizontally-inclined clearing-grooves in the lower faces thereof, substantially as described and for the purpose set forth.

4. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing-walls, of a grate supported for traveling movement longitudinally of the furnace-chamber, and side-beams supported above and at each side of the grate, and each having a series of clearing-grooves in the under faces thereof, adjacent to the upper face of the grate, and horizontally inclined inward in the



direction of the traveling movement of said grate, substantially as described and for the purpose set forth.

5. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing-walls, of a furnace-floor supported for movement longitudinally of the furnace-chamber, and two hollow side-beams located one at each side of and overlapping the upper surface of the furnace-floor, and each having a series of horizontally inclined clearing-grooves formed in the under faces, at the inner edges thereof, the grooves of one beam being oppositely inclined relatively to those of the other beam, substantially as described and for the purpose set forth.

6. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing walls, of a fuel-traveling furnace-floor, supported for movement within and longitudinally of said furnace-chamber, a series of air-supply chambers located underneath the furnace-floor, and having outlet openings, of relatively varying areas, contiguous to the furnace-floor, a series of water-compartments intermediate to said air-supply chambers, and means for supplying air to said air-supply chambers, substantially as described and for the purpose set forth.

7. In a furnace of the class specified, the combination with the furnace-chamber and the traveling-grate supported therein, of a transverse plate located underneath and in close proximity to the under face of the grate, and having successive series of outlet openings therethrough, of relatively varying aggregate areas, air-supply chambers supported below said transverse plate, and having water-walls contiguous to said plate, and means for supplying air to the traveling grate through the outlet openings in the transverse plate, substantially as described.

8. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing-walls, of a fuel-traveling furnace-floor supported for movement within, and longitudinally of, said furnace-chamber, a series of successive air-supply chambers located

underneath the furnace-floor and having outlets contiguous to said furnace-floor, of relatively varying areas, substantially as described, a series of water-compartments intermediate to and separating said air-supply chambers, means for supplying air to the successive chambers, means in connection with said air-supply chambers and adapted for regulating the supply of air to said chambers, substantially as described and for the purpose set forth.

9. In a furnace of the class specified, the combination with the furnace-chamber and with the fuel-traveling grate supported therein, of a series of alternating air-compartments and water-compartments, supported below and contiguous to, said furnace-floor, the air-compartments of which have outlets contiguous to the furnace-floor at relatively varying areas adapted for regulating the efflux of air from said chambers, respectively, and have valve-regulated inlets adapted for regulating the influx of air to said chambers, and means in position and adapted for supplying air to said chambers through said valve-regulated openings, substantially as described and for the purpose set forth.

10. In a furnace of the class specified, the combination with the furnace-floor and with the fuel-traveling grate supported therein, of a series of successive air-supply chambers of relatively varying capacities located below said furnace-floor and each having a series of outlet openings contiguous to said furnace-floor, the aggregate area of the series of outlet openings in one chamber varying relatively to the aggregate area of the series of outlet openings in the other chamber or chambers, water compartments located intermediate to said air-supply chambers, means for supplying air to said chambers and means for supplying water to said water-compartments, substantially as described and for the purpose set forth.

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