

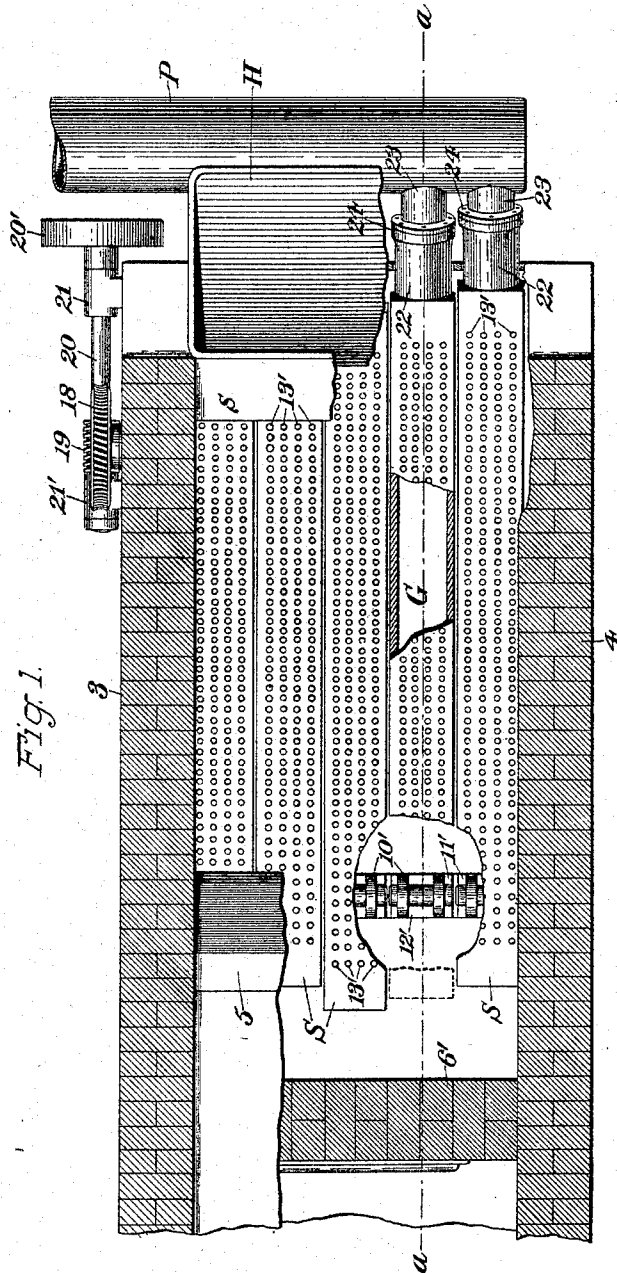
(No Model.)

3 Sheets—Sheet 1.

F. H. RICHARDS.
TRAVELING FLOOR FURNACE.

No. 527,453.

Patented Oct. 16, 1894.



Witnesses:
J. L. Edwards Jr.
Fred. J. Dole.

Inventor:
F. H. Richards

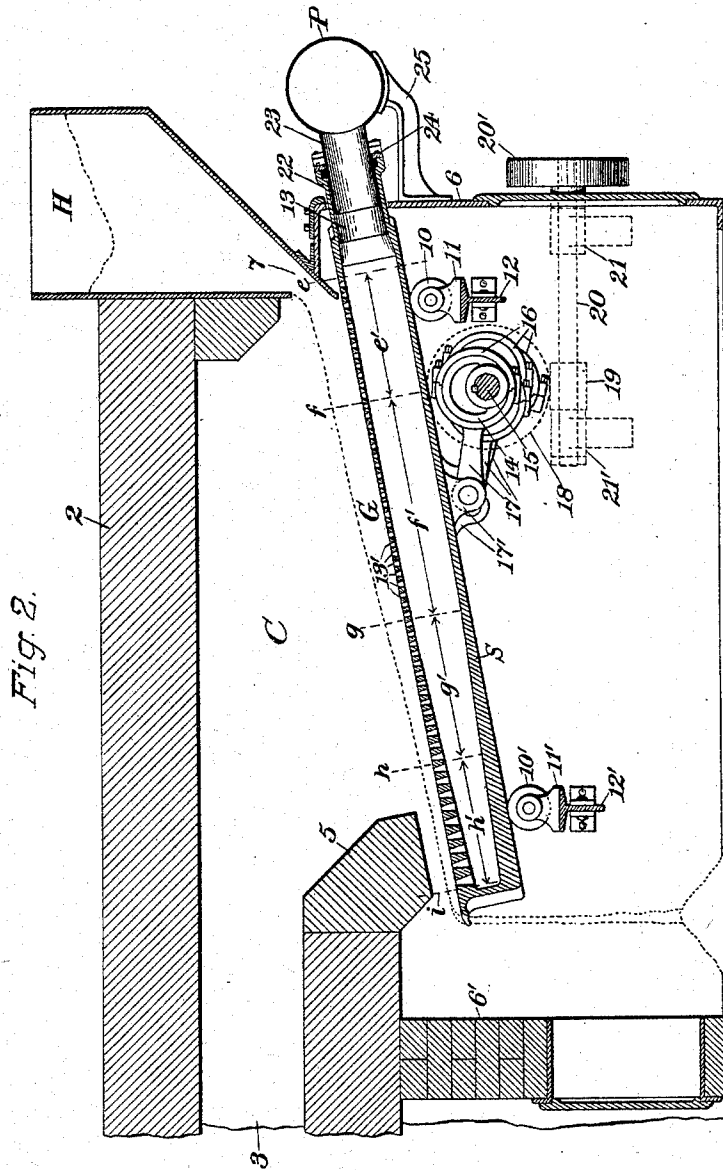
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3 Sheets—Sheet 2.

F. H. RICHARDS.
TRAVELING FLOOR FURNACE.

No. 527,453.

Patented Oct. 16, 1894.



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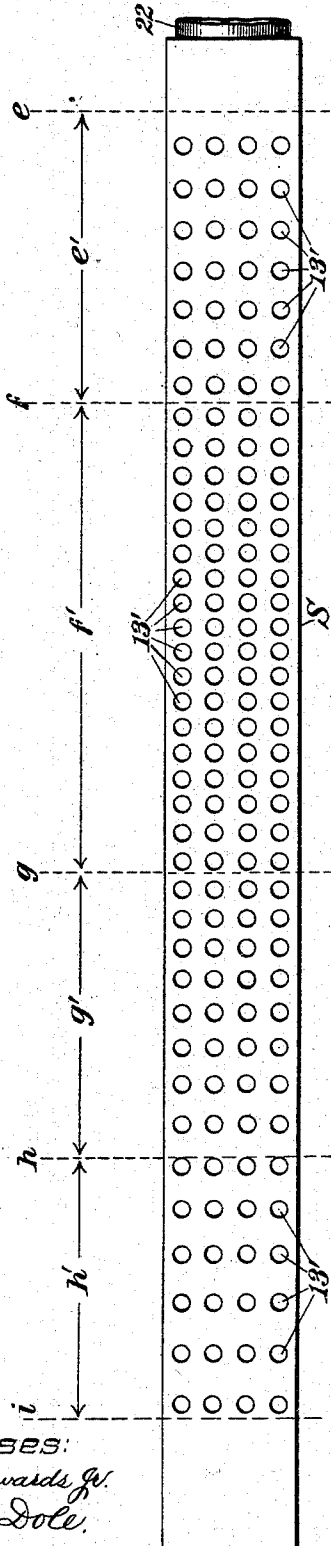
3 Sheets—Sheet 3.

F. H. RICHARDS.
TRAVELING FLOOR FURNACE.

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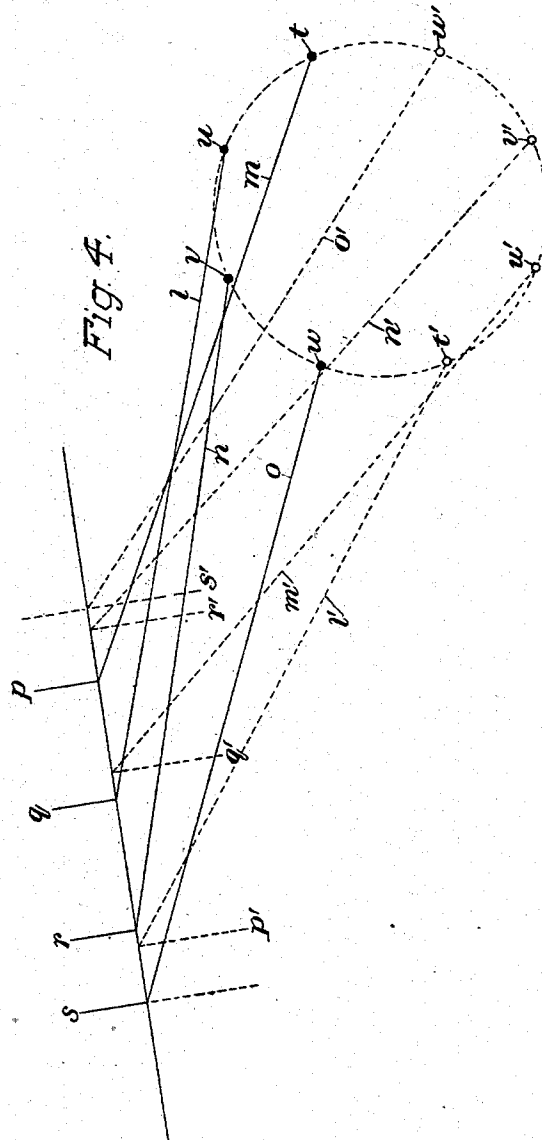
Patented Oct. 16, 1894.

Fig. 3.



Witnesses:
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Fred. J. Dole.

Fig. 4.



Inventor:
F. H. Richards

UNITED STATES PATENT OFFICE.

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

TRAVELING-FLOOR FURNACE.

SPECIFICATION forming part of Letters Patent No. 527,453, dated October 16, 1894.

Application filed July 16, 1894. Serial No. 517,641. (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 Traveling-Floor Furnaces, of which the following is a specification.

This invention relates to traveling-floor furnaces of that class in which the fuel is supported upon, and carried forward in the furnace-chamber by, a reciprocatory furnace-floor having a relatively slow advancing movement and relatively rapid retractive movement, as described, for instance, in my prior application, Serial No. 500,887, filed February 20, 1894, to which reference may be had.

The object of my present invention is to provide, in connection with a furnace-chamber, a non-rotary traveling furnace-floor comprising one or more inclosed fuel-carrying air-chambers, or chambered floor-sections, having inlet and outlet openings and supported for longitudinal reciprocatory movements, and to provide means for supplying air to said chamber or chambers during the reciprocatory movements thereof, and also to provide improved means in connection with, and adapted for imparting a relatively slow advancing movement and a relatively rapid retractive movement to, said air-chambers, as will be hereinafter fully described.

Another object of the invention is to furnish each floor-section of the several floor-sections comprising the furnace-floor with successive series of outlet-openings of varying aggregate areas through the fuel-supporting portions thereof, to regulate the supply of air to the fuel at successive points in the travel of the fuel.

In the drawings accompanying and forming a part of this specification, Figure 1 is a sectional plan view of a furnace embodying my present invention. Fig. 2 is a vertical longitudinal section of the furnace, taken in line a-a, Fig. 1, looking from the under side in said figure. Fig. 3 is an enlarged plan view of one of the furnace floor-sections, showing the disposition of the outlet-openings or air-spaces. Fig. 4 is a diagrammatic view illus-

trating the successive movements of one of the floor-sections and its actuating device.

Similar characters designate like parts in all the figures.

For the purpose of illustrating the application and utility of my present invention, I have, in the drawings, shown my improvements applied to a furnace similar to the one described in my prior application, Serial No. 500,887, hereinbefore referred to. It will be understood, however, that my improvements are applicable to other forms of furnaces than that described in said application. Therefore it is not desired to confine this invention to any particular kind of furnace.

The furnace-chamber C, of the furnace illustrated in the drawings, has the usual inclosing-walls at the sides and ends thereof, and is shown provided with the ordinary furnace-roof. The side-walls are designated in a general way by 3 and 4, respectively; the roof by 2; the usual bridge-wall by 5, and the front and back-walls by 6 and 6', respectively. At the forward end of the furnace, this is shown provided with the usual fuel-supply hopper, H, from which fuel is supplied to the furnace-floor through the inclined chute or opening 7, in a well-known manner.

The furnace is shown provided with a fuel-traveling furnace-floor, or grate, designated in a general way by G, and which, in accordance with my present invention and in the preferred form thereof herein shown, comprises a series of independent inclosed fuel-carrying chambers, or chambered floor-sections, S, arranged side by side longitudinally of the furnace-chamber C. These furnace-floor sections, or inclosed air-chambers, will preferably be supported at opposite ends thereof upon rollers, 10 and 10', which rollers may, as herein shown, be carried in brackets, 11 and 11', of transverse beams, 12 and 12', supported at their ends in the side-walls 3 and 4 of the furnace, and are adapted to have longitudinally-reciprocatory movements imparted to them, as will be hereinafter described.

In the form thereof herein shown, each floor-section of the series which constitute the furnace-floor is in the nature of a beam in-

ternally recessed or chambered to form a fuel-supporting air-chamber, the main body or fuel-supporting portion of which is preferably rectangular in cross-section. Each beam has an inlet or air-supply opening, 13, at one end thereof, through which air is supplied to the interior of said beam, whence it is delivered to the fuel carried upon said beam, at successively varying pressures at successive points in the length of said beam, through discharge-openings or air-spaces, 13', formed through the top or fuel-carrying wall of said beam, as will be hereinafter more fully described. These beams or floor-sections are shown with their open ends adjacent to the forward or fuel-receiving end of the furnace-chamber, and are shown set at an inclination to a horizontal line.

As a means for imparting the requisite reciprocatory movements to the several floor-sections, and to secure thereto a relatively slow forward movement and a relatively rapid retractive or backward movement, I have shown in connection with said sections reciprocating mechanism preferably consisting of a series of eccentrics, 14, carried by a transverse shaft, 15, journaled in bearings in the side-walls of the furnace; which eccentrics are furnished with eccentric-straps, 16, which are connected with the grate-sections by means of connecting-rods, 17, and means for rotating the eccentrics, consisting, preferably, of a worm-wheel, 18, carried at one end of the shaft 15 and meshing with a worm, 19, upon a driving-shaft, 20, journaled in bearings, 21 and 21', secured to the side-wall of the furnace, which driving-shaft 20 is provided with a pulley, 20', by means of which it is rotated from any suitable source of power. (Not shown.)

The connections of the floor-section-operating levers 17 with said sections will preferably be made midway of the length of said sections, said levers being pivotally-secured at one of their ends to depending brackets, 17', upon said sections, as illustrated in Fig. 2 of the drawings.

As a means for supplying air to the interior of the floor-sections during the reciprocatory movement thereof, said sections are herein shown having longitudinal tubular extensions, 22, at the open ends thereof, which are shown extending through openings in the front-wall of the furnace; and air-supply apparatus is provided, having supply-pipes, 23, extending into the tubular extensions 22, as clearly shown in Figs. 1 and 2 of the drawings, the supply-pipes being supplied with air from a main supply-pipe, P, which may be connected with any suitable air-supply, such, for instance, as a pump or blower. (Not shown.) The supply-pipes 23 which communicate with the interiors of the floor-sections will have a sliding-fit in the tubular extensions 22 of said sections; stuffing-boxes, 24, being preferably provided at the ends of

the tubular extensions 22 of said sections to prevent the escape of air at these points.

In this embodiment of my invention, the air-blast or air-supply apparatus is shown located at the forward end of the furnace, the main pipe P being shown supported upon brackets, 25, (one only of which is shown,) secured to the front end-wall of the furnace.

One of the most important features of my present invention is the means provided for automatically regulating the supply of air to the fuel at predetermined pressures or in predetermined volumes at given points in the length of the furnace-chamber, and to accomplish this without the employment of valves heretofore employed for this purpose.

To secure the best practical results in the combustion of the fuel, it is not only necessary to impart a relatively slow traveling movement to the fuel, (which is accomplished by the reciprocations of the furnace floor-sections, as will be hereinafter more fully described,) but is necessary to regulate the supply of air to the fuel at successive points in the length of the furnace-chamber to degrees according with the successive degrees of the combustion of the traveling fuel; that is to say,—the supply of air should be so regulated and supplied to the fuel, which is spread in a layer and maintained substantially in *statu quo* during the successive stages of combustion, that, at the ignition-point or at that point adjacent to the receiving-end of the furnace-floor, a relatively low pressure is maintained, or a pressure sufficient to gently blow the fuel during the first stage of combustion; and at the middle stages of combustion, or at points between the ignition and last stage of combustion, air should be supplied in relatively large volumes or at materially increased pressure, which pressure should be gradually reduced thereafter during the succeeding stages of combustion, and until all the combustible material is consumed. This method of securing the best practical results in the combustion of fuel is fully described and claimed in United States Letters Patent No. 499,715, granted to Eckley B. Coxé June 20, 1893, to which for a more detailed description of the process of burning fuel (which is substantially the same process carried out with my present improvement) reference may be had.

To supply air at varying pressures at given points in the length of the furnace-chamber during the successive stages of combustion, so as to secure the best practical results in the combustion of the fuel as hereinbefore noted, each floor-section is herein shown having a multiplicity of outlet-openings or air-spaces, 13', through the fuel-supporting wall thereof. These openings or air-spaces will, in practice, be so formed and disposed with reference to successive fuel-supporting portions of said floor-sections that the resultant areas or pressures of air-supply at different

points in the length of the said floor-sections, as deduced from the aggregate areas of the multiplicity of air-spaces contained in said successive portions, will be varied at these successive points in the length of the floor-section. In practice, the air-spaces at the fuel-receiving end of the floor-section, or the air-spaces contained in the space e' or in that portion of the floor-section between the transverse dotted lines e and f , will be of such aggregate area as to permit a relatively small quantity of air or a relatively reduced air-blast to be supplied to the fuel supported upon this portion of the floor-section. The air-spaces contained in the space f' or that portion of the floor-section intermediate to the transverse lines f and g and adjacent to the floor-space e' , will be of such greater aggregate area as to supply a relatively large quantity of air, or a relatively increased air-blast, to the fuel supported upon this portion of the floor-section; and the next successive series of air-spaces contained in the spaces g' and h' , or in those portions of the floor-section located between the dotted lines g , h , and h , i , respectively, will be of such aggregate areas, respectively, as to cause a gradual reduction in the pressure of air-blasts supplied to the fuel supported upon this portion of the floor-section, the last-mentioned series of air-spaces being adjacent to the delivering-end of the floor-section. These successive portions e' , f' , g' and h' , whose air-spaces are, in aggregate, of varying areas, correspond in position with the successive positions assumed by the fuel in its traveling movement during the successive stages of its combustion periods.

The construction of floor-sections with successive series of air-spaces of varying aggregate areas, as hereinbefore described, provides for the requisite supply of air to the fuel at varying pressures as required at successive fuel-supporting portions of the furnace-floor, without the employment of an outside agency for regulating said supply of air.

In practice, the interior chamber of the floor-section will be of varying areas at successive portions in the length thereof, said chamber being herein shown tapered or inclined at opposite ends thereof, the greatest area thereof being adjacent to these portions of the chamber marked e' and f' , respectively. This particular formation of the interior of the air-chamber of the floor-section, while it facilitates, to some extent, the regulation of the air-pressure at successive portions in the length of said chamber, is not, it will be obvious, absolutely essential to the practical regulation of the supply of air to the fuel, which regulation can be, and will usually be, secured by forming in each of the successive fuel-supporting portions e' , f' , g' and h' of the floor-sections, a series of air-spaces, the aggregate area of each successive series varying with relation to the aggregate area of the next adjacent series to thereby regulate

the outflow of air and produce the desired variation in air-pressures contiguous to these fuel-supporting portions of the grate-sections, as will be clearly understood by reference to Figs. 1, 2 and 3 of the drawings.

In operation, the fuel-supporting floor-sections will each have, either simultaneously, or separately and successively, a relatively slow advancing movement to carry the fuel forward in the furnace-chamber, and will have a relatively rapid retractive movement, so that each will assume its extreme backward position without materially disturbing the fuel supported thereon; and to accomplish this, I have shown the floor-section provided with actuating-mechanism which operates after the well-known manner of the so-called "Whitworth movement," as will be understood by reference to the diagram, Fig. 4, the heavy full lines l , m , n and o representing the successive positions of the crank-connection during the forward movement of the floor-section, and the dotted lines l' , m' , n' and o' representing the successive positions of said connection during the retractive movement of the floor-sections; the spaces between the lines p , q , r , s , and p' , q' , r' , s' , representing the successive distances traveled by the floor-section during its forward and backward movements, respectively; and the dots t , u , v , w , and t' , u' , v' , w' , upon the dotted circle, which represents the circuit of the crank-center, denoting the relative positions of the crank and the distance traveled thereby to produce the positions of the floor-section represented by the lines p , q , r and s , and p' , q' , r' and s' , as will be readily apparent by reference to said diagrammatic figure.

In practice, fuel is fed from the hopper H through the passage-way 7 to the fuel-receiving end of the furnace-floor adjacent to the series of air-spaces in that portion of the several floor-sections designated by e' , after which it is carried forward by the reciprocatory movement of said floor-sections to and over the succeeding series of air-spaces until it reaches the delivering-end of the furnace-floor. During this traveling movement of the fuel, air is supplied thereto through the successive series of air-spaces at varying pressures as required to facilitate the combustion of the fuel, the pressures of air at successive points in the length of the furnace-floor being regulated to produce the best results in the combustion of the fuel at successive points in the travel thereof, which may be more readily understood by reference to the patent, No. 499,715, hereinbefore referred to.

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 a furnace-floor comprising a series of longitudinally-disposed chambered floor-sections supported within the furnace-chamber and each floor-section of which series is closed at its delivering-end and has

an air-supply opening or inlet in its receiving-end, and has successive series of outlet openings or air-spaces of varying aggregate areas through the fuel-supporting side thereof, and an air-supply apparatus in position and adapted for supplying air to the interior of said sections through the inlet openings thereof, substantially as described and for the purpose set forth.

2. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing walls, of a furnace-floor comprising a series of longitudinally-disposed chambered floor-sections supported for reciprocatory movement in the furnace-chamber, and each floor-section being closed at its delivering-end and having an air-supply opening or inlet in its receiving-end, and successive series of outlet openings or air-spaces of varying aggregate areas through the fuel-supporting sides thereof, means for imparting a reciprocatory movement to said floor-sections, and an air-supply apparatus in position and adapted for supplying air to the interior of said sections through their forward inlet openings and during the reciprocatory movement thereof, substantially as described and for the purpose set forth.

3. The herein-described floor-section for floors of furnaces of the class specified, it consisting of a chambered beam having an inlet opening at one end thereof and having successive series of outlet openings through successive fuel-supporting portions thereof which gradually diminish in aggregate areas from the middle portion of said beam toward and at both ends thereof, substantially as described and for the purpose set forth.

4. The herein-described floor-section for floors of furnaces of the class specified, it consisting of a chambered beam having an inlet opening at one end thereof and having a series of outlet openings through the fuel-supporting portions of its forward or fuel-receiving end of relatively small aggregate area and having a series of outlet openings through the middle fuel-supporting portion thereof of relatively large aggregate area, and having outlet openings through the fuel-supporting portion at the delivering-end thereof of relatively small aggregate area, substantially as described and for the purpose set forth.

5. In a furnace of the class specified, a reciprocatory furnace-floor consisting of one or more chambered floor-beams, having an inlet opening at one end thereof, and means substantially as described in connection with each chambered floor-beam and adapted for supplying air to the fuel supported upon said beam at varying pressures at successive points in the length of said 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 reciprocatory furnace-floor supported within said chamber and com-

prising a series of hollow floor-beams each of which has an inlet opening at one end thereof, and has successive series of outlet openings through the fuel-supporting portions thereof, the aggregate areas of each series of which are gradually reduced in a given ratio from the middle fuel-supporting portion of said beam toward and at both ends thereof, and means in position and adapted for supplying air to the interior of each of said beams through their respective inlet openings, substantially as described and for the purpose set forth.

7. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing walls, of a fuel-traveling furnace-floor comprising a series of longitudinally-disposed hollow floor-beams supported for longitudinal reciprocation in the furnace-chamber and each of which beams has an inlet opening at one end thereof and has successive series of outlet openings through the successive fuel-supporting portions thereof which are of relatively large aggregate area at the middle fuel-supporting portion and are of gradually-reduced aggregate area from the middle portion toward and at opposite ends of said beams, means for imparting a reciprocatory movement to said floor-beams, and an air-supply apparatus in connection with and adapted for supplying air through the inlet openings to the interior of said beams, substantially as described and for the purpose set forth.

8. In a furnace of the class specified, the combination with the furnace-chamber, of a reciprocatory furnace-floor comprising a series of floor-sections each having an internal chamber which varies in area at different points in the length thereof, and having an inlet-opening communicating with said chamber and a series of outlet-openings or air-spaces, an air-supply in communication with the chambers of the floor-sections through the inlet-opening and adapted for supplying air to said chambers during the reciprocatory movements of said sections, and means for reciprocating said floor-sections, substantially as described and for the purpose set forth.

9. In a furnace of the class specified, a furnace floor-section having an interior chamber of varying areas at different points in the length thereof and having a succession of series of air-spaces of varying aggregate areas in communication with said chamber, in combination with means for reciprocating said floor-section, and means for supplying air to the interior chamber of said floor-section during the reciprocatory movement of said floor-section, substantially as described.

10. In a furnace of the class specified, the combination with the furnace-chamber, of a fuel-traveling furnace-floor comprising a series of reciprocatory chambered floor-sections supported at an inclination in the furnace-chamber upon rollers and having inlet-openings and successive series of outlet-openings

of varying aggregate areas, reciprocating mechanism for each of said sections consisting of an eccentric carried by a shaft below and intermediate to the ends of said sections, 5 and an eccentric-strap and connecting-rod connecting the floor-section with the eccentric, means for simultaneously rotating the eccentrics of each floor-section to reciprocate said sections with a relatively slow advancing movement and a relatively rapid retractive movement, and an air-supply apparatus in communication with and adapted for supplying air to theseveral floor-sections through their inlet-openings and during the reciprocating movements of said floor-sections, substantially as described. 15

11. In a furnace of the class specified, the combination with a furnace-chamber, of a series of chambered floor-sections open at one end and having outlet-openings through the fuel-supporting portions thereof, reciprocating mechanism in connection with said floor-sections, and air-supply apparatus having air-supply pipes extending into the open ends 20 of said sections and adapted for permitting a longitudinal movement of said sections with relation to said pipes, substantially as described.

12. In a furnace of the class specified, the combination with the furnace-chamber, of a chambered furnace floor-section supported for longitudinal reciprocation in said furnace chamber and having an air-supply opening at one end thereof and outlet-openings in one side thereof, means for reciprocating said section, a supply-pipe having a sliding-fit in the supply-opening of said floor-section, and an air-supply apparatus in communication with said supply-pipe and adapted for supplying 40 air to the interior of the floor-section during the reciprocating movement thereof, substantially as described.

13. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing-walls, of a fuel-traveling furnace-floor comprising a series of reciprocating chambered floor-sections having air-inlet and outlet openings substantially as described, air-supply pipes having a sliding-fit 50 in the inlet-openings of said floor-sections, a stuffing-box at the inlet of the floor-section and adapted for closing the joint between the floor-sections and air-supply pipes, and means for reciprocating said floor-sections longitudinally of the air-supply pipes, substantially as described. 55

14. In a furnace of the class specified, the combination with the furnace-chamber, and its inclosing-walls, of a furnace-floor comprising a series of longitudinally-disposed chambered floor-sections arranged side by side in the same plane and each having an inlet-opening at one end thereof adjacent to the front-wall of the furnace-chamber, an 65 air-supply apparatus adjacent to the front-wall of the furnace-chamber and having air-supply pipes extended into the inlet-open-

ings of the floor-sections and adapted for supplying air to the interior of said sections during the reciprocating movements thereof, 70 and means in connection with and adapted for imparting relatively slow advancing and relatively rapid retracting movements to said floor-sections, substantially as described.

15. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing-walls, of a chambered floor-section supported for longitudinal reciprocation in said chamber and having a longitudinal open-ended tubular extension projected 80 through the front-wall of said furnace-chamber and having successive series of outlet openings through successive fuel-supporting portions of said section, the aggregate areas of the outlet openings in the successive fuel-supporting portions each side the center of said beam being gradually reduced toward opposite ends of said beam, an air-supply apparatus adjacent to the front-wall of the furnace-chamber and having a supply-pipe 90 extending into the longitudinal extension of said floor-section in such manner as to permit a longitudinal movement of said section with relation to said pipe, and means for reciprocating said section, substantially as described. 95

16. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing walls, of a reciprocating fuel-traveling furnace-floor comprising a series of longitudinally-disposed hollow floor-beams supported for longitudinal reciprocating movement in lines parallel to the axes thereof and each beam having an inlet opening at one end thereof and having successive series of outlet openings through successive fuel-supporting portions thereof, the middle series of which outlet openings is of relatively large aggregate area and the successive series each side of which middle series are of relatively 110 small aggregate areas and are of gradually-reduced aggregate areas, respectively, from the middle fuel-supporting portion of the beam toward and at the opposite ends thereof, substantially as described and for the purpose set forth. 115

17. The herein-described grate-section for furnace-floors of furnaces of the class specified, it consisting of an oblong beam having its side edges in parallel planes and having successive air-supply openings through the successive fuel-supporting portions thereof, respectively, which openings are of greatest area at the middle portion of said beam and gradually decrease in area from said middle portion outwardly toward and at the opposite ends of said beam, substantially as described and for the purpose set forth. 125

18. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing walls, of a series of longitudinally-disposed hollow or chambered floor-sections each having an inlet opening at the forward end thereof and each having outlet 130

openings through the fuel-supporting portions thereof, actuating-mechanism in connection with and adapted for reciprocating said floor-sections, and an air-supply apparatus adjacent to the forward ends of said floor-sections and consisting of a main air-supply pipe, and a series of branch supply-pipes in communication with the interiors of the several floor-sections and the interior of the main supply pipe, substantially as described and for the purpose set forth.

19. In a furnace of the class specified, the combination with the furnace-chamber and its inclosing walls, of a series of longitudinally-disposed chambered floor-sections supported for reciprocatory movement in the furnace-chamber and each having an inlet opening at the forward end thereof, and a series of outlet openings through the fuel-support-

ing portions thereof, means in connection with and adapted for reciprocating said floor-sections, a main air-supply pipe supported adjacent and transversely disposed with relation to the forward ends of the floor-sections and having a series of communicating branch supply-pipes having a sliding connection at one end one with each floor-section and adapted for conveying air from the main supply-pipe to the interior of said section and adapted for permitting a sliding movement of said section relatively to said branch supply-pipe, substantially as described and for the purpose set forth.

FRANCIS H. RICHARDS.

Witnesses:

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