(No Model.)

6 Sheets—Sheet 1.

E. B. COXE.

TRAVELING GRATE FURNACE.

No. 510,569. Patented Dec. 12, 1893.

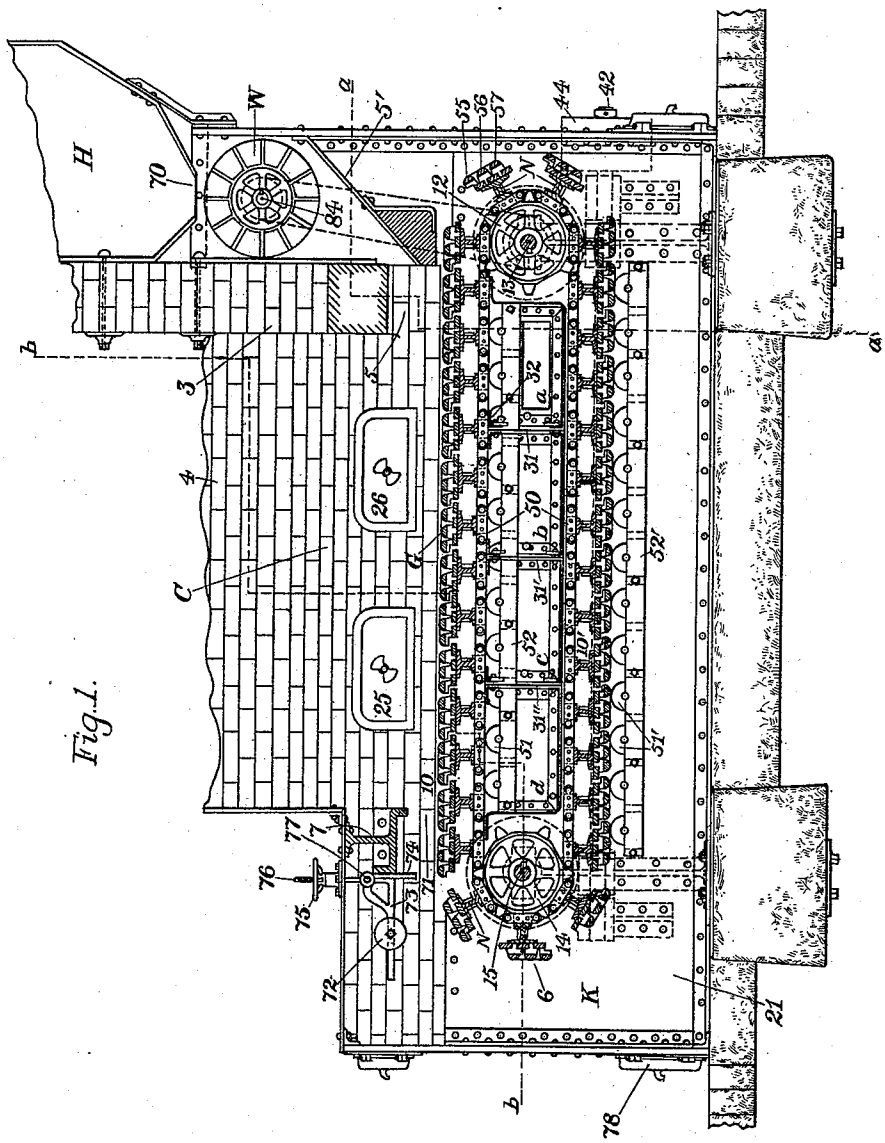

Fig. 1.

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6 Sheets—Sheet 2.

E. B. COXE.

TRAVELING GRATE FURNACE.

No. 510,569. Patented Dec. 12, 1893.

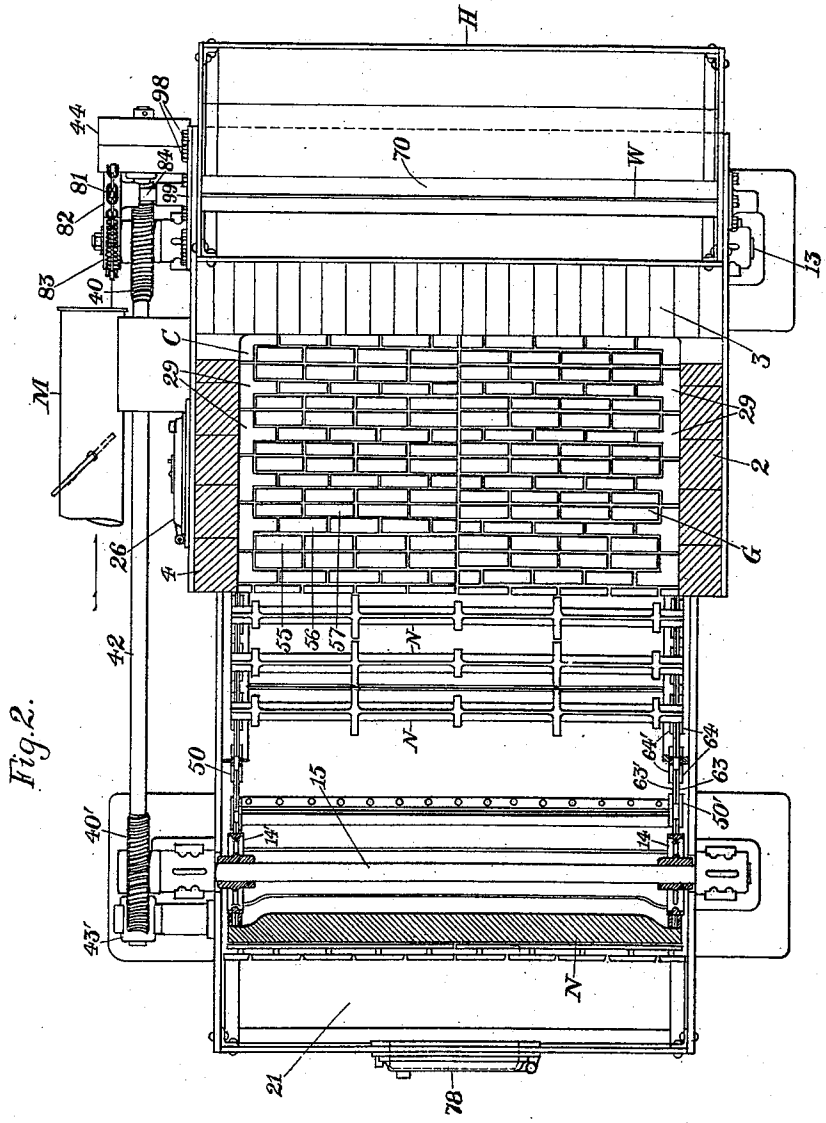

Fig. 2.

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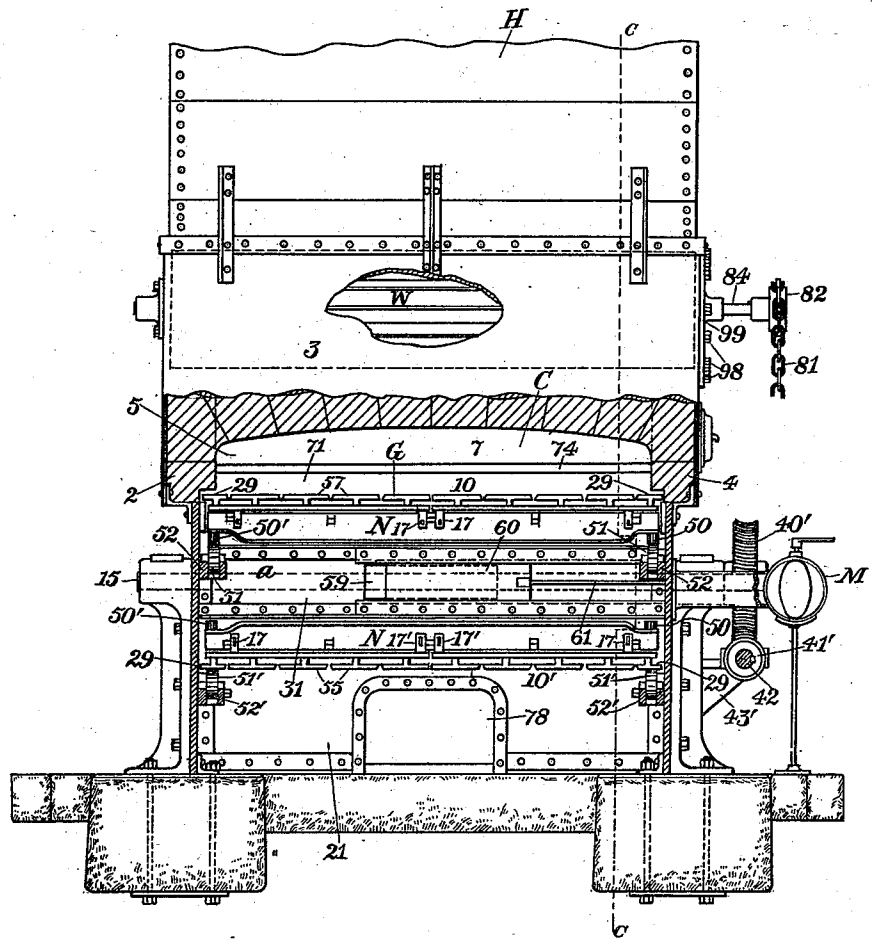
E. B. COXE.

TRAVELING GRATE FURNACE.

No. 510,569. Patented Dec. 12, 1893.

Fig. 3.



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6 Sheets—Sheet 4.

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TRAVELING GRATE FURNACE.

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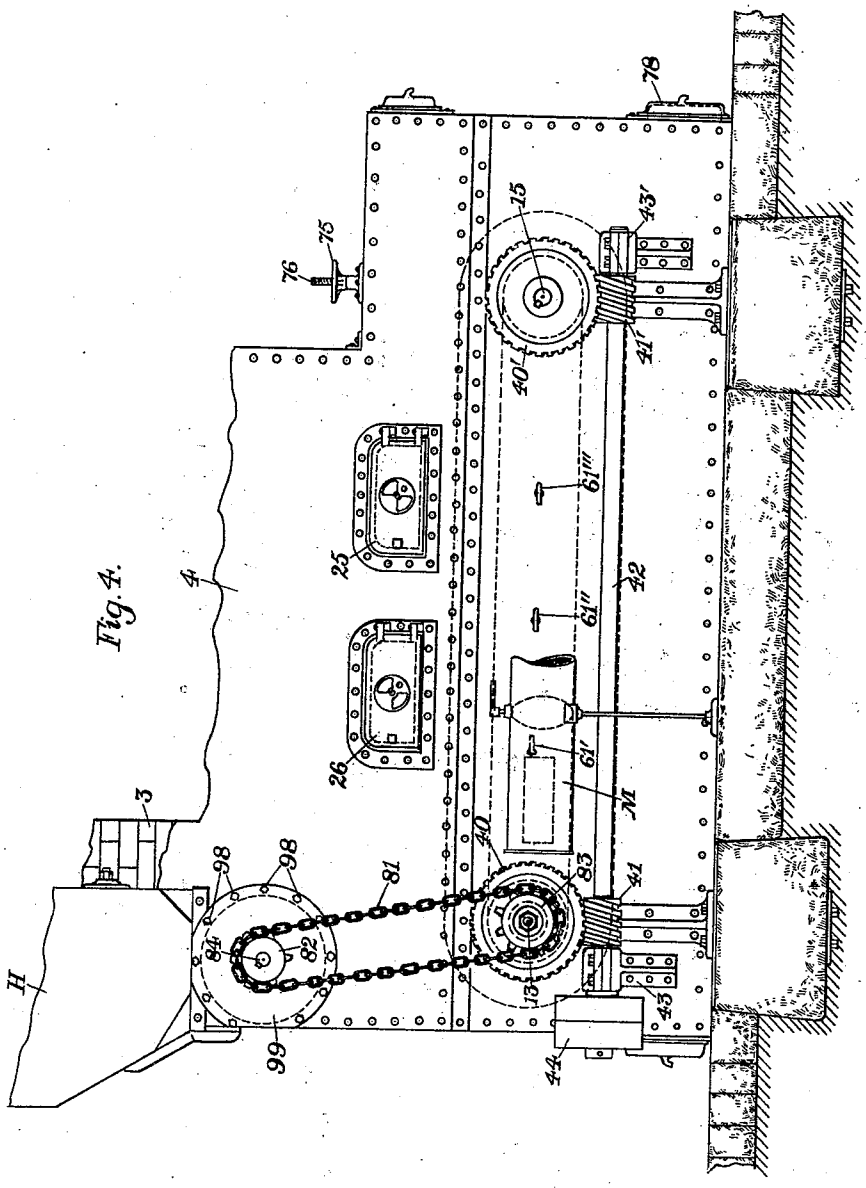

Fig. 4.

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TRAVELING GRATE FURNACE.

No. 510,569. Patented Dec. 12, 1893.

Fig. 6.

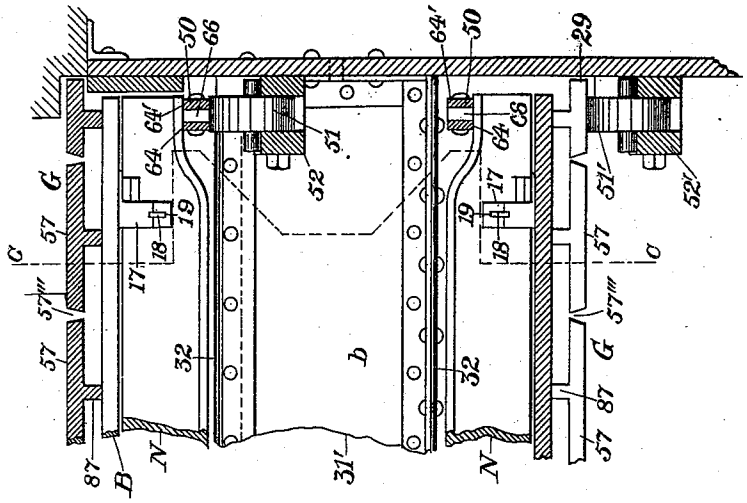
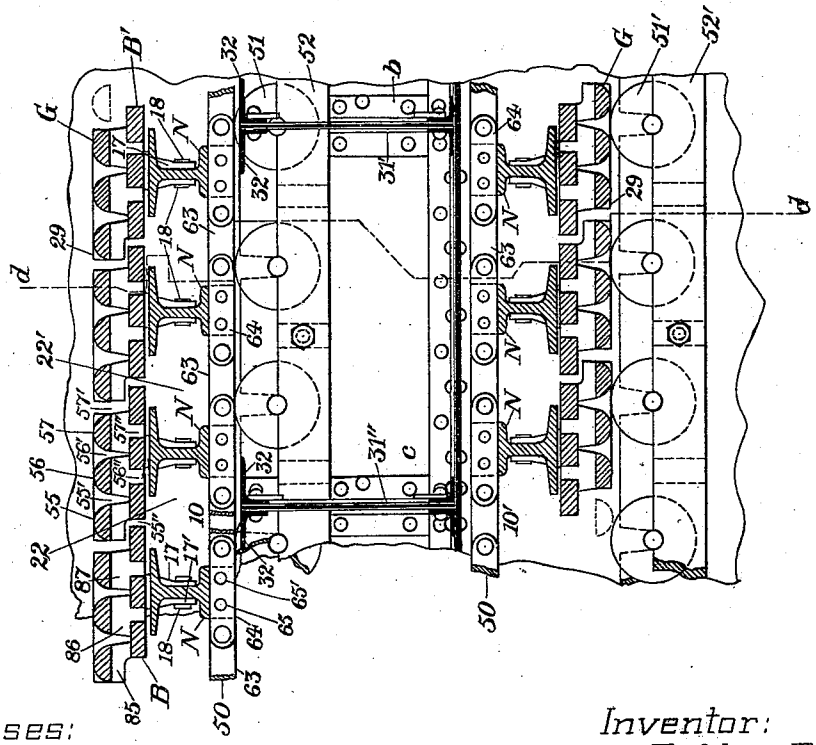


Fig. 5.



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(No Model.) 6 Sheets—Sheet 6.

E. B. COXE.

TRAVELING GRATE FURNACE.

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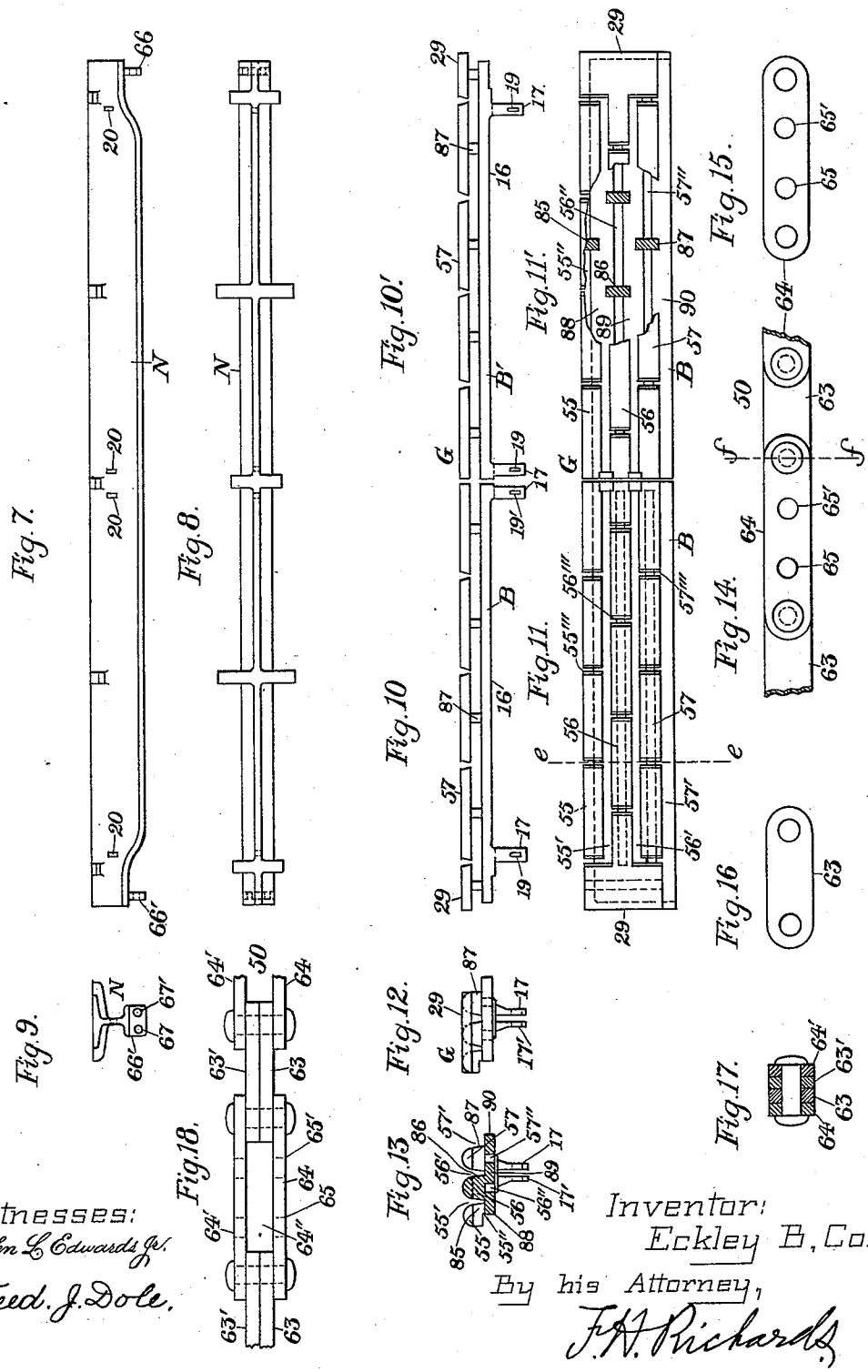

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UNITED STATES PATENT OFFICE.

ECKLEY B. COXE, OF DRIFTON, PENNSYLVANIA.

TRAVELING-GRATE FURNACE.

SPECIFICATION forming part of Letters Patent No. 510,569, dated December 12, 1893.

Application filed June 12, 1893. Serial No. 477,264. (No model.)

To all whom it may concern:

Be it known that I, ECKLEY B. COXE, a citizen of the United States, residing at Drifton, in the county of Luzerne and State of Pennsylvania, have invented certain new and useful Improvements in Traveling-Grate Furnaces, of which the following is a specification.

This invention relates to that class of traveling-grate furnaces which are more especially designed for burning the finer sizes of anthracite coal; the object being to furnish an improved furnace of that class, adapted to be manufactured of large size and having a traveling-grate, or furnace-floor, composed of removable sections, and having improved means for supporting and operating the grate-mechanism.

My present invention is in the nature of an improvement upon the furnace described and claimed in Letters Patent of the United States, Serial No. 499,716, granted to me June 20, 1893.

In the drawings accompanying and forming a part of this specification, Figure 1 is a sectional side elevation of a traveling-grate furnace embodying my present improvements, the view being taken on the line *c c*, Fig. 3. Fig. 2 is a plan view of the furnace, with the upper and rearward portions removed about down to the broken line *b b*, Fig. 1, and showing some of the details in section. Fig. 3 is a front elevation of the furnace as seen from the right hand in Figs. 1 and 2, and showing the forward and lower portions of the furnace removed about to the line *a a*, Fig. 1, for illustrating more in detail the internal construction of the furnace and of its mechanism Fig. 4 is a side elevation of the furnace as seen from the right hand in Fig. 3 and from above in Fig. 2. Fig. 5 is an enlarged sectional view, similar to a portion of Fig. 1, of a portion of the grate-mechanism, for more fully illustrating certain details of the grate-mechanism. Fig. 6 is a sectional elevation, on the line *d d*, Fig. 5, showing the parts at the left hand of said line as seen from a point of view at the right hand of Fig. 5; and the view, Fig. 5, corresponds to a section, on the line *c c* of Fig. 6, of the parts at the right hand of said line as seen from a point at the left hand of said Fig. 6; these views, Figs. 5 and 6, are shown drawn in alignment or projection the one with the other. Fig. 7 is a side view of one of the floor-plate beams of the traveling grate or furnace floor. Fig. 8 is a plan view of the grate-beam shown in Fig. 7. Fig. 9 is an end elevation of the grate-beam as seen from the left-hand in Fig. 7. Fig. 10 is a side or edge view of one of the left hand floor-plates or grate-bars, and Fig. 10′ is a similar view of one of the right-hand floor-plates or grate-bars; these two plates or bars together extend across the furnace and constitute one section of the furnace-floor. Fig. 11 is a plan view of the floor-plate or grate-bar shown in edge view in Fig. 10; and Fig. 11′ is a plan view, partially in section, of the floor-plate or grate-bar shown in Fig. 10′. Fig. 12 is an end view of the grate-bar, and is drawn in projection with Fig. 10. Fig. 13 is a transverse section of the grate-bar, in the line *e e*, Fig. 11. Fig. 14 is a side view of a portion of one of the grate-carrying chains by which the grate-beams are carried. Fig. 15 is a side view of one of the separate links of said chain, to which the grate-beam is attached. Fig. 16 is a similar view of one of the intermediate links of the chain. Fig. 17 is a transverse section in line *f f*, Fig. 14. Fig. 18 is a plan view of the chain, showing the preferred arrangement of the links and their connecting pivot-pins.

Similar characters designate like parts in all the figures.

For the purpose of providing a framework suitable for carrying the operative parts of the furnace-mechanism, and also for protecting said mechanism and preventing the efflux of the air-blast, I have shown my improved furnace provided with inclosing-walls at the sides and end thereof; which walls may consist, as indicated in the drawings, of relatively thin plates connected together at their edges by angle-bars and rivets, after the usual manner of erecting wrought-iron structural work. The side-walls are designated in a general way by 2 and 4, respectively, and the furnace-chamber, C, is shown uncovered. The forward end of the furnace-chamber, is provided with the end-wall 3, under which is a passage-way at 5, through which to supply fuel to the grate, the supply being usually delivered from some suitable hopper, as H, at the end of the furnace. Below said hopper is shown a chute or inclined lower wall 5′, for

delivering the fuel from the hopper through said opening 5 onto thetraveling-grate, this being designated in a general way by G.

For the purpose of regulating the discharge of the fuel from the hopper H onto the chute 5′, I have shown a bucket-wheel, W, revolubly supported immediately under the outlet 70, of the hopper H, for receiving the fuel therefrom and delivering it onto said chute. Said bucket-wheel, or feed-wheel, W, is carried by a shaft 84, journaled in bearings on the framework; and it is driven by a drive-chain, 81, engaging the driven-wheel 82 on said bucket-wheel shaft 84, and also engaging a driving-wheel, 83, that is carried upon one of the shafts, 13, of the grate-mechanism. In Fig. 4 the framework of the furnace is shown provided with a removable plate, 99, held in place by bolts, 98; said plate carries one of the bearings for the shaft of the bucket-wheel, which on removal of the plate may be withdrawn longitudinally thereof from the furnace. By substituting a drive-chain and other chain-wheels of suitable proportions, the speed of the bucket-wheel may be regulated to deliver the fuel to the grate in any required quantities. The feed-wheel is set at a distance below and free of the contracted delivery-end, or discharge-chute, of the hopper H, and also at a distance above and free of the inclined chute leading to the furnace-chamber. By this means, the cutting or breaking up of the lumps of coal by the feed-wheel is avoided, and the fuel is delivered to the chute 5′ with the least possible agitation, so as not to separate, to any material extent, the larger from the smaller portions thereof, but to deliver the fuel in a continuous mass properly spread upon the grate, with the different sizes or portions of the fuel thoroughly mixed as the same comes from the supply-hopper.

At the rearward end of the furnace-chamber C is shown a bridge-wall beam, 7, which connects together the side-walls of the furnace and is adapted for carrying the bricks (not shown) for a transverse wall at the rearward end of said chamber C. Said transverse beam (see Fig. 1) is furnished on the rearward side thereof with a swinging plate or gate, 74, which is pivotally supported adjacent to the rearward side of said beam and is provided with a weight-arm, 73, carrying a weight, 72, for normally holding said gate 74 in its closed or lowermost position. The flap or outlet-gate 74 is shown pivoted at 77 to the lower end of a vertically-adjustable rod, 76, whose threaded upper end engages in the threaded hub of a hand-wheel or nut, 75. By turning said hand-wheel or nut, the rod 76 is raised or lowered, as the case may be, for regulating the distance between the lower edge of the gate 74 and the upper side of the furnace-floor; this regulation is for the purpose of adjusting the space between said outlet-gate and the furnace-floor to correspond with the thickness of the layer of cinder passing out of the rearward end of the furnace-chamber. If said gate 74 should be lowered somewhat more than necessary, or if the layer of cinder should be irregular in thickness, the higher portions of the cinder-layer, by impinging against the lower edge of the gate 74, will swing back the same, thereby increasing the vertical height of the outlet-space, the gate being returned by its said weight and arm. By means of the described closing device, the said outlet-passage, is vertically closed against any material circulation of the furnace-gases through the same.

The traveling-grate consists of a series of transverse beams, N, carrying the floor-plates, or grate-bars proper, of the furnace-floor; which beams are carried by a pair of endless chains, 50 and 50′, consisting, in the form thereof herein shown, of a series of alternating links, 63 and 64 (see Figs. 15 and 16), connected together by pivot-pins or rivets, preferably as shown in Fig. 18. In this preferred form of the grate-mechanism chains, said intermediate link 63 is double, consisting of two plates, 63—63′ (Fig. 18) placed side by side as there shown; and the beam-carrying links 64—64′ are placed outside of said intermediate links to form the space 64″ for receiving the depending lugs 66—66′ (see Figs. 7 and 9) of said beam. Said depending lugs are shown perforated with the holes 67—67′, corresponding to the holes 65—65′ of said beam-carrying links, the described parts being held together by ordinary bolts removably inserted in said holes, whereby the beams, together with the furnace-floor plates carried thereby, may be removed from the chains and replaced thereon as occasion may require. This operation is, in practice, best carried out at the rearward end of the furnace, the workmen, for this purpose, entering the rearward portion K of the grate-mechanism chamber.

In the drawings, each of the grate-beams N is shown adapted for carrying the two similar floor-plates or bars which are designated in Figs. 10 and 11, and 10′ and 11′, by B and B′, respectively; these two plates being of the same construction, with the single exception that one is constructed "right-hand" and the other "left-hand." A detailed description of one of them will suffice for a description of both. The floor-plate, or grate-bar proper, designated in a general way by B, consists essentially of a perforated floor-plate 16 having its perforations (which, in the present instance, are in the form of long slots, 55″, 56″, 57″) covered by corresponding bars, 55, 56 and 57, respectively, having at the sides of and between the same the spaces 55′, 56′ and 57′, respectively; said upper bars being supported at a slight distance (usually about one-half of an inch) above the lower plate by suitable connecting supports, or uprights, 85, 86 and 87, respectively, which, in the form of the plate herein shown, also serve to connect the respective bars or portions, 88, 89 and 90, of said lower plate with each other, as well shown in Figs. 10 and 11. The upper or pro-

tecting bars of the floor-plate are divided transversely at intervals by narrow spaces, as 55‴, 56‴ and 57‴, into relatively short sections, and each of these sections is shown supported at some distance from the ends thereof by the uprights or connecting supports before mentioned. This construction of said features provides for the expansion and warping of said upper protecting bars by continued subjection to the heat of the furnace without thereby distorting the lower plate 16. The width of the spaces 56″ and 57″ between the bars 88 89 and 90 of the lower plate, is less than the width of the corresponding protecting bars 55, 56 and 57, respectively, which stand over said slots or openings. By means of this construction of the grate-bars, the fine coal lying down between the upper bars is supported upon the longitudinal bars of the lower plate, and is prevented from passing through said lower plate and being lost; and by means of the same construction, when the grate-bars pass over the rearward end of their circuit and stand edgewise as at 6, Fig. 1, the fine material lodging between the lower plate and said upper bars of the grate falls out, leaving the grate free for other use.

The space, designated by 55″, between the bars of the lower floor-plates is the space shown in Fig. 5 between the lower plates 16 of the successive floor-plates; so that the upper bar 55 at the edge of one of said floor-plates overlaps the opposite lower bar 90 of the adjacent floor-plate. And in like manner, one of the spaces between said upper bars of the floor-plates is between the forward upper bar of one plate and the rearward upper bar of the adjacent plate, as will be fully understood by comparison of these details as shown in the several figures of drawings.

The grate-bars B are shown furnished with the depending lugs 17 and 17′, adapted for receiving between them the upper edge of the beam N, to which beam said plates are secured by means of a suitable key, as 18, inserted in the mortises 19 in said lugs and passing through the corresponding mortises 20 of said beams, as illustrated, for instance, in Figs. 5 and 6, said mortises being shown also in some of the detail views, Figs. 7 to 13.

It is not desired to broadly claim herein the improved grate-bar described in the present application. In so far as such feature may embody patentable invention it will form the subject matter of a separate application.

As a means for actuating the described chains of the grate-mechanism, these are shown carried by the wheels 12—12′ and 14—14′, which are fixed on the forward and rearward chain-wheel shafts 13 and 15, respectively. These shafts are supported in ordinary bearings on the framework, and are provided at one end with the worm-wheels 40 and 40′, respectively, which mesh with the driving-worms 41 and 41′ on the feed-shaft 42; this shaft is shown supported in the bearings 43 and 43′, (also carried by the framework of the furnace) and is provided with suitable means, as, for instance, the pulley 44, whereby it may be actuated for driving the grate-mechanism. The transversely-disposed grate-beams N being set upon their carrying-chains 50 and 50′ edgewise thereto and to extend outwardly therefrom, and the furnace-floor plates being carried on the projecting edges of said beams at some distance from the chains, these plates are naturally separated by a considerable distance while passing over the chain-wheels, as will be understood by examination of Fig. 1. This separation of the beams and plates serves to break up the layer of cinder as this passes out of the furnace-chamber, and also to provide at that part of the furnace a sufficient space between the successive floor-plates to permit of the removal and replacing of these plates (when these are separably carried on the beam as herein shown) during the operation of the furnace.

For supporting the upper and lower runs 10 and 10′ of the endless traveling grate, the furnace-frame is provided on either side thereof with the upper and lower roller-beams 52, 52′, respectively. The upper roller-beam is provided with suitable rollers, 51, best shown in Figs. 1, 5 and 6, for supporting the upper-run of the endless beam-carrying chain. The corresponding rollers 51′, which are supported by the lower roller-beam 52′, run against the under sides of the track-plates, 29, which form the outer end-portions of the floor-plates B, as more clearly illustrated in Figs. 5 and 6.

For protection, in practice, of the ends of the grate-bars, and also for preventing the fine fuel passing over the ends thereof, the side-walls of the furnace are brought inwardly over the grate-bars as shown in the sectional view, Fig. 3.

By means of the longitudinal shaft geared through the worms carried thereon and the worm-wheels meshing with said worms, with the two chain-wheel shafts, both of said chain-wheel shafts are positively and simultaneously rotated and the grate is independently fed at each end thereof, thereby subjecting the grate-chains to the least tension and securing the smooth and regular operation of the grate-mechanism.

A series of air-supply chambers, *a*, *b*, *c*, *d*, are located side by side under the upper or fuel-carrying run, 10, of the traveling grate; this run being also designated as the "furnace-floor." Said air-supply chambers may be two or more in number, four of them being shown in the present instance; in general I prefer to use not less than three such chambers. For supplying said air-chambers, each of them may have a separate pipe, as described in my aforesaid Patent No. 499,716. In the present instance, however, the chamber *a* is shown provided with a large supply-pipe M, which will be connected with a suitable air-supply, as, for instance, an air-pump

or blower not shown. In some cases it is preferable to connect said air-supply M with the second chamber *b* of the series, so that the highest pressure of the air-blast will be supplied to the grate over said chamber *b*. For properly distributing the supply of air to the several air-chambers, the partition-walls 31, 31′ and 31″ between said chambers are to be provided with suitable valves, one of which is shown in side view in Fig. 3 and consists of a sliding gate, 60, suitably supported for sliding over the opening 59 in the partition-wall 31; said sliding gate is shown provided with a rod, 61, which extends through the side of the furnace and outside thereof is provided with a handle 61′, whereby to adjust the gate or valve. The corresponding gates of the succeeding partitions 31′ and 31″ are similarly furnished with handles, 61″ and 61‴, respectively, for operating the same. See Fig. 4.

The several division-walls or partitions of the air-supply chambers come up close to the under side of the grate beams N, and are shown furnished at their upper edges with the horizontal tables or ribs 32, of a width about equal to the distance, longitudinally of the furnace, between said grate-beams. By this means, when the grate-mechanism is carried along over the air-chambers and the beams come to the position shown, for instance, in Fig. 5, said tables cut off any strong currents of air from one chamber to another by way of the spaces as 22 and 22′, between the grate-bars. In practice, however, the leakage between the partition-walls and the lower edge of one of the beams N, when this beam stands over said partition-wall, together with the leakage through the spaces in the furnace-floor plates, is sufficient to furnish the necessary air-blast for the narrow portion of the grate thus temporarily cut off from the main air-supply. But any such leakage from one chamber to the next succeeding chamber is not usually sufficient, in practice, especially when the parts are fitted as they should be to run in close proximity the one to the other, to furnish the second air-chamber with a sufficient air-supply; this deficiency is made up by a proper adjustment of the described sliding gates in the partition-walls between the air-supply chambers. Those features herein described comprising the improvements which are embodied in the grate-bar or floor-plate, are not claimed herein, but constitute in part the subject-matter of a separate application, Serial No. 481,527, filed July 26, 1893.

The mode of operation of my invention is as follows:—The fuel is fed to the grate at a point adjacent to the first air-supply chamber, each section of the grate receiving its fuel at or before the time it reaches the first air-supply chamber *a*, and being then carried along over that chamber and the succeeding chambers *b*, *c* and *d*. During this period the combustible material of the fuel is consumed, and the resulting cinder, or ash, is afterward carried under the bridge-plate 7, and finally delivered over the rearward end of the grate into the ash-pit 21. In practice, the combustion goes on, at one stage or another, throughout nearly the entire length of the furnace-chamber, the ignition taking place within a short distance of the point where the fuel falls upon the grate, and the fuel being completely reduced to cinder over the last chamber *d*, of the series. The reduction of the fuel by combustion gradually lowers the same on the grate, (by an amount depending on the particular nature of the fuel,) so that at the point 71, where the cinder passes under the bridge-plate, the thickness of the cinder is generally much less than the height of the layer of fuel on the forward end of the furnace-floor. The cinder is carried back upon the traveling grate, under the wall 7, at the rearward end of the grate, as shown at the left-hand in Fig. 1, is discharged from the grate-sections into a pile, which may be removed from time to time, by any convenient means, as through the door 78, without interrupting the operation of the furnace. After the furnace has been put into complete operation, the fireman, by occasional observation of the burning fuel through the observation-doors at 25 and 26 in the side-wall of the furnace, can, by means of the air-valves in the air-supply partitions, readily regulate or vary the pressure in the successive air-chambers, to produce the best results and completely reduce the fuel to cinder before it reaches the wall 7; also to keep the furnace-floor well covered, and to burn the combustible portion of the fuel with a high degree of economy. By increasing the air-blast during the earlier portion of the combustion period, the fuel will be more rapidly consumed; or, by decreasing the pressure in the rearward air-supply chambers, the grate may be traveled more slowly and the combustion prolonged so as only to consume the combustible portion of the fuel just before this reaches the bridge-wall.

Having thus described my invention, I claim—

1. The combination in a furnace, of an endless traveling-grate comprising chains running longitudinally of the furnace, transversely-disposed grate-beams secured to and carried by said chains, independent grate-bars carried by said grate-beams, and means for supporting and actuating the chains, substantially as described.

2. The combination in a furnace, of an endless traveling-grate comprising two or more endless chains disposed longitudinally of the furnace and composed of a series of pivoted links having the alternating spaces or openings 64″, the transversely-disposed grate-beams supported by said chains and having depending flanges which fit and are secured in said openings between the link-plates, grate-bars removably supported on the grate-beams, and means for supporting and actuating said chain, substantially as described.

3. The combination in a furnace, of an endless traveling-grate comprising a series of chains running over vertically rotating sprocket-wheels, a series of transverse grate-beams secured to said chains and having flanges contiguous to said chains, a series of grate-bars secured to each grate-beam and relatively so disposed that the grate-bars of one beam will, when the grate-bars are in horizontal alignment, partially over-lie the grate-bars of the next adjacent grate-beam to cover the space between beams and prevent the fuel from passing through the grate and being wasted, chain-wheels for driving said chains, and means for actuating said wheels, substantially as described.

4. In a furnace, the combination with an endless traveling-grate having transverse grate-bar-supporting beams of a series of air-supply chambers located under the fuel-carrying run of the grate, the walls of which chambers have flanges or tables at their upper ends of sufficient width to cover the space between the adjacent grate-beams, substantially as and for the purpose described.

5. In a furnace, a series of longitudinally-traveling endless-chains mounted upon, and running over vertically rotating sprocket-wheels supported upon shafts journaled in bearings outside the frame or walls of the furnace, grate-beams, transversely and remotely-disposed, secured to said endless-chains, in combination with an air-receptacle interposed between the upper and lower runs of said endless-chains and divided into a series of air-chambers by vertical transverse partitions having flanges or tables at their upper ends of sufficient width to cover the space between adjacent grate-beams, substantially as and for the purpose described.

6. In a furnace, the combination with longitudinally-traveling endless-chains, having a series of transversely-disposed grate-beams secured thereto remote from one another of a series of air-supply chambers located intermediate to said chains with their upper sides in close proximity to, the chains and the supported grate-beams, flanges or tables at the upper ends of the transverse walls of said air-supply chambers to cover the space between adjacent grate-beams, and friction-rollers located below and supporting the upper run of the chains, to hold the grate-beams in close proximity to, the air-chambers, substantially as and for the purpose described.

7. In a furnace, the combination with the traveling-grate, of a series of air-supply chambers underneath said grate having communicating air-passages, valves in connection with said air-passages for regulating the pressure of air in said chambers to produce different pressures in different chambers, means for supplying air to one of said chambers and means for independently operating the said valves, substantially as and for the purpose described.

8. In a furnace, the combination with an endless traveling-grate having a series of transverse grate-beams remotely-arranged, of an air-supply receptacle located below the upper-run of the grate and divided by transverse partitions into a series of pressure-reducing air-supply chambers open at their upper sides and having in the partition walls thereof communicating openings or air-passages, valves to regulate the supply of air through said wall openings, flanges at the upper ends of said partitions to cover the space between adjacent grate-beams and in position slightly below the said grate-beams on the upper-run of the grate, a supply-pipe in connection with one of said air-supply chambers, means for operating the pressure regulating valves, and means for actuating the endless traveling-grate, substantially as and for the purpose described.

9. The combination in a furnace, of two transverse horizontal shafts journaled in bearings, on the side walls at each end respectively of the furnace, chain-wheels mounted upon said shafts, endless grate-bar carrying-chains traveling over said chain-wheels, a worm-wheel secured to the end of each of said shafts, a longitudinal shaft carrying a worm meshing with, and for driving the worm-wheel, and means for rotating said shaft whereby both chain-wheel shafts are positively rotated, and the grate independently fed at each end thereof, substantially as described.

10. The combination in a furnace, of the endless longitudinally traveling grate mechanism, comprising endless chains inclosed between the walls of said furnace, transversely-disposed grate-bar-carrying beams secured to said endless-chains and remote from each other, vertically-rotating chain-wheels carrying said chains and journaled in bearings located on the furnace side-walls and having worm-wheels on their projecting ends, a worm-shaft supported in bearings on the outside of the furnace and carrying a worm in mesh with said worm-wheels, and means for actuating said worm-shaft, substantially as described.

11. In a furnace, the combination with an endless longitudinally-traveling-grate, as described, of a coal-chute located at the front end of said furnace in position to deliver coal upon the traveling-grate at the extreme forward end of its fuel-carrying run, a hopper or coal receptacle located with its contracted delivery-end above said chute, a feed-wheel located between said hopper and chute, and set at a distance below and free of said contracted delivery-end, to automatically regulate the delivery of the coal to the grate, and means for operating said feed-wheel, substantially as described.

12. In a furnace, the combination with an endless longitudinally-traveling-grate inclosed by the walls of the furnace, and means for actuating said grate, of a forward transverse end-wall 3 and a transverse rear beam 7, the lower edges of which terminate at points remote from the grate to provide entrance and

exit openings for the fuel, a chute or inclined wall located in front of the transverse wall 3 and above the grate-bars to direct the fuel into the passage between the grate-bars and wall 3, the hopper located above said chute, a feed-wheel interposed between said hopper and chute, and mechanism for actuating said wheel in connection with the endless-grate actuating-mechanism, substantially as described.

13. In a furnace, the combination with the traveling-grate and the transverse bridge-beam located above the grate at the discharge end thereof, of the hinged or pivoted gate adapted for closing the opening between the fuel and bridge-beam, a weight adjustably-connected with said gate to retain the same normally in contact with the cinder or with the bridge-beam, and an adjusting-device therefor, consisting of a supporting-bar (to which said gate is pivoted) extending through the upper wall of the furnace and screw-threaded at its upper end, and a nut on said thread for regulating the vertical adjustment of the bar and its connected gate, substantially as described.

14. In a furnace, the combination with the endless longitudinally-traveling-grate, of the roller-beams 52 and 52′ located below the upper and lower runs of said grate and secured to the framework of the furnace, rollers supporting the upper and lower fuel runs of said grate and loosely journaled in the roller-beams, and driving-wheels and shafts, for actuating said grate, substantially as described.

15. In a furnace, the combination with an endless traveling-grate traveling over chain-wheels secured to transverse shafts journaled in bearings located outside the furnace-walls, of the chute 5′ located above the front end of the traveling-grate to direct the fuel to said grate, the coal-receiver or hopper located above said chute, and the revoluble feed-wheel interposed between the hopper and chute upon a transverse shaft, said wheel being set below and free of the hopper, and above and free of said chute a sprocket-wheel upon the ends of the grate-driving-shafts and feed-wheel shaft, a sprocket-chain connecting said sprocket-wheel, and mechanism, as described, to impart movement to the traveling-grate and fuel-feeding-wheel simultaneously, substantially as and for the purpose described.

16. In a furnace, the combination with endless-traveling-chains inclosed by the walls of said furnace, of a series of transversely-disposed parallel **I**-beams resting upon, and having depending-flanges bolted to, said chains remote from each other, a series of separate grate-bars removably-secured to said **I**-beams and having a series of draft-perforations, as described, a series of air-supply chambers open at their upper sides and having dividing partitions with tables or flanges to cover the space between adjacent **I**-beams, a supply-pipe in connection with one of said chambers, passage-ways in the partitions between adjacent chambers, valves to close said passage-ways, and means, as described, to independently operate the valves to regulate the passage of air from one chamber to another, and the consequent pressure in each successive chamber, substantially as and for the purpose described.

17. The combination, in a furnace, with chain-carrying shafts and wheels, and with a pair of endless-chains carried on said wheels, of a series of transversely-disposed grate-beams carried by said chains and set vertically to, and outside of, the chains, and provided at their outer edges with furnace-floor plates of a width to form a continuous furnace-floor between the chain-wheels, whereby said furnace-floor plates on one beam are separated from the plates on the adjacent beam while passing over the chain-wheels, substantially as described.

18. In a furnace, the combination, in the grate-mechanism thereof, of the transverse beam having key-slots therein, means for carrying said beam, furnace-floor plates set upon the upper edge of the beam and having depending lugs with key-ways corresponding to said beam-slots, and keys passing through said lugs and beam for removably holding the floor-plates in place on the beam, substantially as described.

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Witnesses:
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