May 16, 1933. J. MARTIN 1,908,992

STOKING GRATE

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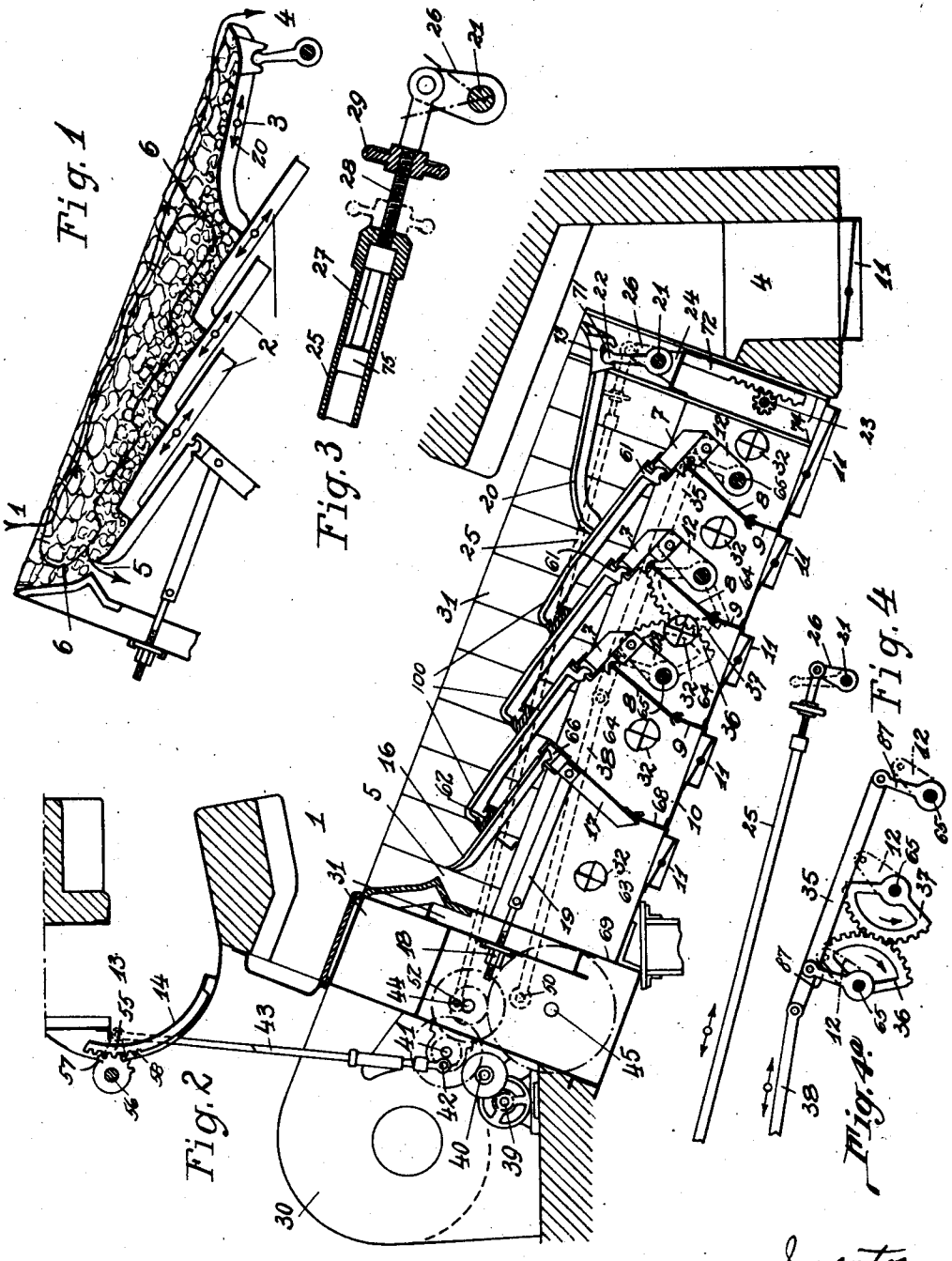

Fig. 1

Fig. 3

Fig. 4

Fig. 4a

Fig. 2

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Fig. 5

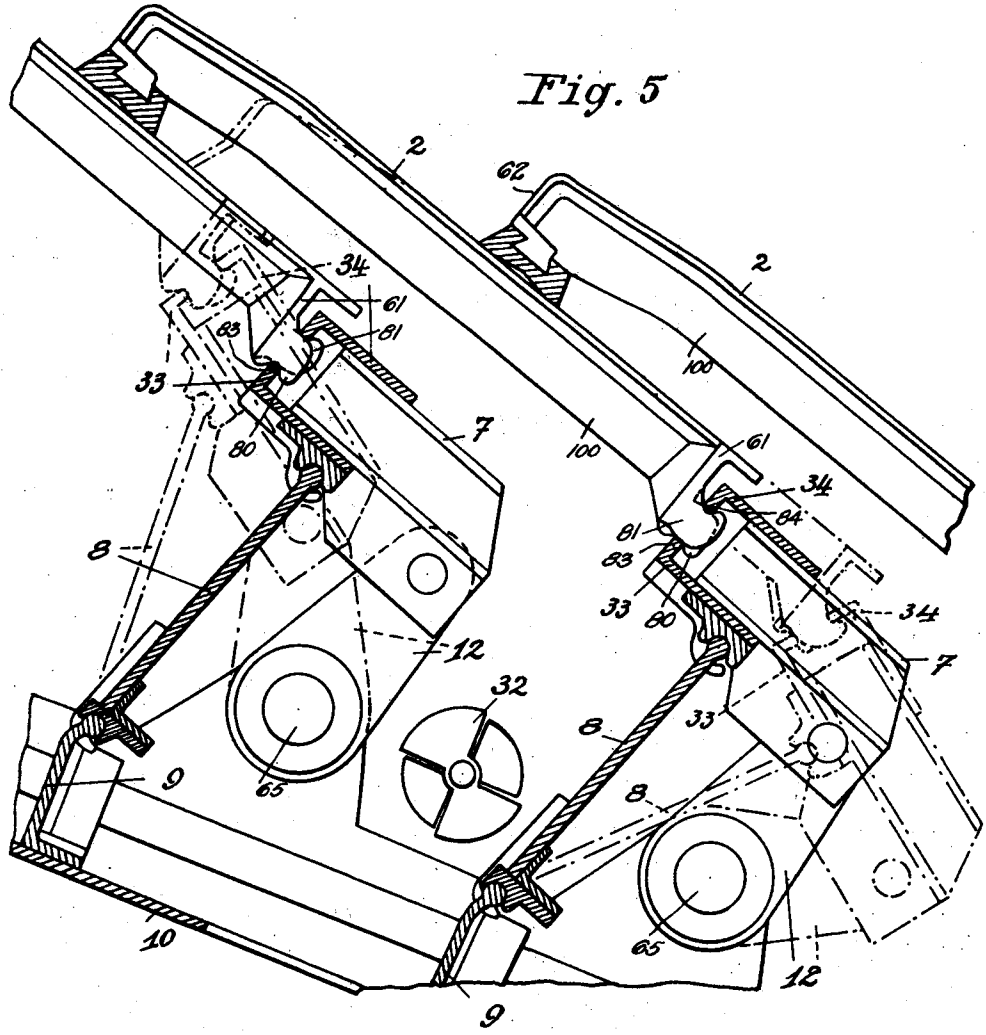

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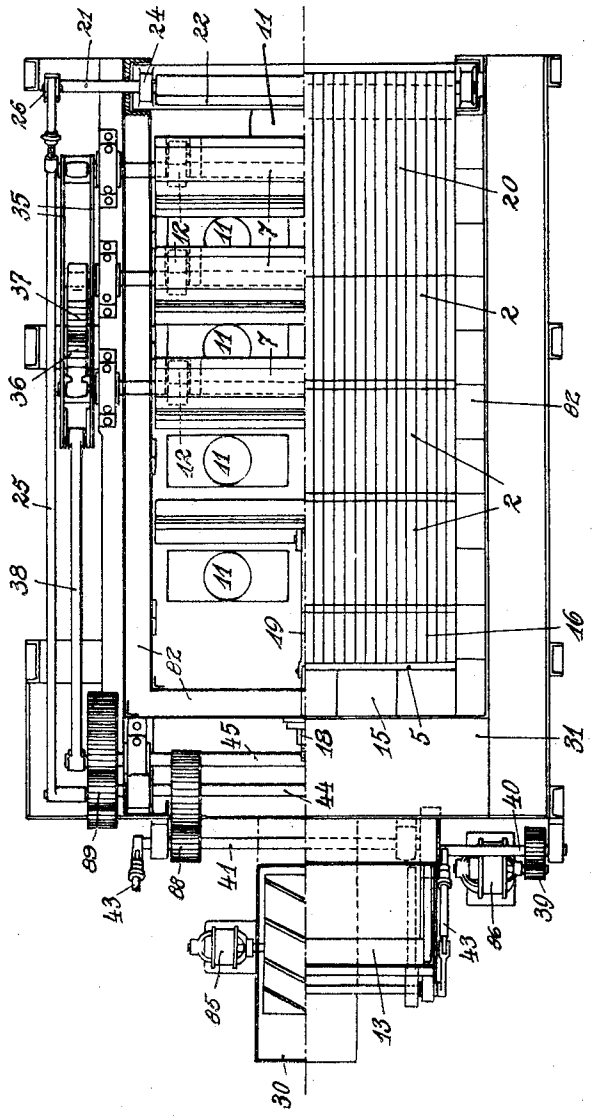
Fig. 6.



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STOKING GRATE

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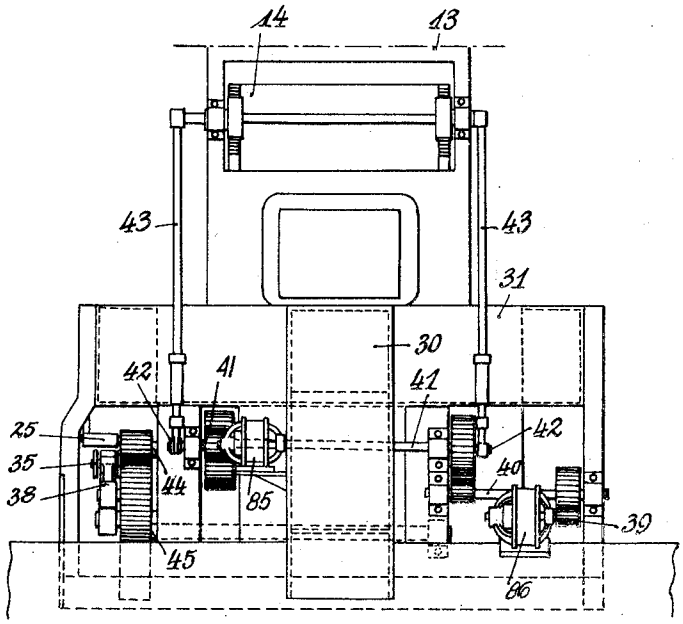
Fig. 7



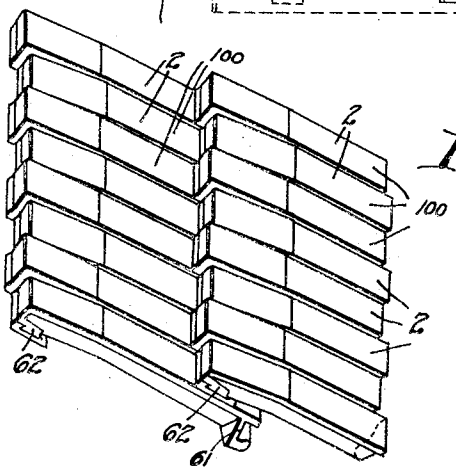


Fig. 8.

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UNITED STATES PATENT OFFICE

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STOKING GRATE

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This invention has reference to means of facilitating and accelerating the combustion of fuel by a peculiar kind of mechanical agitation of the mass of fuel.

It is an object of the invention to provide means for the removal, the sifting out and the assorting of the slags during operation of the furnace.

The treatment of the solid fuel according to this invention, is preferably carried out on an inclined grate between two slag or clinker discharging sections provided at the opposite ends of the grate, and in such a manner that means are provided for mechanically disturbing the layer of fuel for the separation and assorting of the particles according to size and specific gravity, this action being combined with a propelling action in the direction of the two slag or clinker discharging sections.

In connection therewith a feeding and propelling or pushing action is produced upon the lower layer of fuel in the direction from the lower end of the grate towards the upper charging and discharging instrumentalities, while at the same time the upper layer of fuel, particularly at the lower end of the grate is likewise undergoing a kind of pushing and propelling action in the direction towards another kind of discharging means provided at the lower end of the grate.

These and other important objects and advantages of the invention will appear from the drawing and as the specification proceeds.

The invention will be more fully described by reference to the accompanying drawings showing by way of exemplification some of the several means and ways of accomplishing the object of the present invention.

In the drawings:

Fig. 1 is a diagrammatic representation of the fire-bed in longitudinal section;

Fig. 2 shows the furnace and grate according to this invention in longitudinal section with parts of the several grate units and connected parts shown in elevation;

Fig. 3 shows a portion of the driving means of the rear section of the grate in accordance with Fig. 2, partly in section and on an enlarged scale;

Figures 4 and 4*a* are respectively side elevations illustrating part of the operating means for the grate bars;

Fig. 5 shows partly in elevation and partly in longitudinal section and on an enlarged scale a portion of the grate proper for the better illustration of the connection of the individual grate-bars to the moving means therefor.

Fig. 6 is partly a horizontal section of certain parts below the grate, with some details shown in plan view, and partly it is a top plan view of the grate;

Fig. 7 is a front elevation of the grate actuating means, and

Fig. 8 is a perspective illustration of the relative position of some of the grate bars.

The invention will best be explained with reference to the diagrammatic representation of Fig. 1 of the drawings. In this figure the grate is shown in the form of an assembly of bars in stepped progressive arrangement, the entire set of bars being downwardly inclined from the charging end 1, the inclined movable sections 2 of the grate, however, being operated to feed solid fuel towards the upper charging end 1. At the lower end of the grate a movable grate section, generally designated in Fig. 1 at 3, is advisably formed of reversely curved bars resembling an inverted S-shape, as seen in side elevation, and oppositely inclined with respect to the sections 2. This lower section is adapted to act as a shaking device, and during operation of the furnace it is vibrated or rocked to aid in feeding the fuel in direction of the discharge end 4 situated at the lower terminal of the grate. At the upper or charging end 1 of the grate, the latter is provided with a controllable passage or drop opening 5. Owing to the movements of the bars in the sections 2 of the grate, the entire layer of fuel is agitated, inasmuch as the lower stratum of the mass of fuel is thereby propelled upwardly countercurrent to the gravitational movement which the upper stratum is permitted to make, the upper stratum or layer being permitted to travel slowly and continuously downward.

As an additional result of this mechanical agitation of the fuel body, an assorting ac-

tion of the particles of fuel, and particularly of the slags, is effected, in such manner that the smaller pieces and finer particles are working their way down into the lower layer of fuel, while the coarser pieces are pushed into the upper layer of the same. Thus, a lower layer of fine slag is continually produced which is propelled upwardly towards the passage 5, and these particles drop through the passage the width or area of which may be selectively determined during the operation of the furnace. When this discharge passage 5 is greatly reduced in area or entirely closed, the particles in the lower layer of fuel are forced upward again into the top layer, as indicated diagrammatically by the hairpin bend in the line of movement 6 in Figure 1, and owing to this reversal of the movement of the lower layer of fuel, the smaller particles enter, and become part of, the upper layer of fuel at the charging end 1 of the grate.

The coarse slag particles slide down with the upper layer of fuel, and at the lower end 4 of the grate they are brought under the influence of the shaker section 3 constituted by bars 20, this section being actuated by means of an arm 22, Fig. 2, whereby the top layer is gradually discharged at the lower outlet 4.

When, however, the shaking movement of this section 3 is greatly reduced or entirely stopped, the pieces constituting the upper layer will have a tendency to turn downward into the lower layer of fuel at this point.

Depending upon the nature of the fuel and the progress of the combustion and upon the size—grading action produced on the particles of fuel, this inversion of the respective layers of the material may occur repeatedly at the opposite ends of the grate, if required, so that the fuel, as roughly indicated by the line 6 in Fig. 1, is caused to travel substantially through a closed path or in a cycle on the grate.

Fig. 2 shows an embodiment of the invention more in detail. Three units 2 of alternately reciprocating grate bar sets are shown by way of example, but it is obvious that any other number thereof may be employed. The sections or units 2 constitute in their combination with other sections, a downwardly inclined grate.

These stoking units or grate sections 2 are formed of closely juxtaposed bars 100 which are slidably supported only and readily exchangeable. The bars 100 are of substantially triangular cross-section, Fig. 8, with a truncated tip directed downward; the gaps between laterally adjacent bars therefore, are also of substantially triangular cross-sectional area. The several bars 100 are provided at their rear ends with hook shaped extensions 61, Fig. 5, which are engaged by frames or pushing brackets 7, while their upper tips or heads 62 rest slidably on the top surface of the corresponding bars in the next upward section or unit 2.

The frames 7 are pivotally supported on the top edges of edgewise positioned transverse plates 8 which are pivotally supported at their lower edges on stationary transverse bars 9 of angular cross-section, Fig. 5. The plates 8 extend transversely from one side wall 63 of the chamber below the grate to the opposite side wall and constitute movable partitions for said chamber 64, Fig. 1. The chambers 64 below the grate have a bottom wall 10 in which outlets 11 for the slags or clinkers are provided.

The frames or pushing brackets 7 are oscillated by means of cranks or arms 12 mounted on transverse shafts 65 adjacent the side walls 63 of the chambers 64, one set of these arms only being indicated in Fig. 6.

At the very top end of the grate, a section 16 in the form of a plate is arranged upon which the fuel to be charged is deposited. The bars 100 of the foremost reciprocating section 2 rest with their heads 62 slidably on this plate section 16. The rear end of this section is engaged by brackets 66 fixed on top of a transverse partition 17. The latter is pivotally seated on a transverse bar 68 rising from the bottom wall 10 of the chamber, and it may be angularly adjusted by means of a bar 19 pivotally connected to the partition 17 near the top of the latter, and also extending through the front wall 69 of the chamber 64, where it has a screw threaded extension 18 for receiving the adjusting nut. If the bar 19 is moved forward or back by turning the nut, the front section 16 is also set forward or backward to adjust the width of the passage 5 for the slag.

The bars 20 of the grate section 3 at the lower end of the grate are provided with actuating means somewhat different from those of the stoking units 2 referred to. The section 3 comprises a plurality of juxtaposed bars 20 which are slidingly supported at their front ends on the lowermost stoking grate unit 2 while at their rear ends they are supported in loose pivotal connection with a suitable operating device.

This device comprises a transverse rock shaft 21 upon which an arm 22 for the entire grate section 3 is secured. The rounded head of this arm 22 engages a recess 71 of an enlargement 73 of each bar 20, which recess is of greater width than the head. Hence, upon each rocking movement of the shaft 21 a blow is struck by the arm against all bars of the section 3 before the arm 22 begins to move the said bars backward or forward respectively.

The shaft 21 is mounted in a bearing bracket 24 fastened to a rack bar 72 which meshes with a pinion 23. Owing to this arrangement, upon rotating the pinion 23, the

rack bar 72 and hence also the shaft 21 may be set at different selectively determined heights within a channel formed by the parallel bars 74 at the rear of the grate. This adjustment also will bring about a variation of the angular relation of the section 3 relatively to the other sections 2 of the grate.

In order to vary the throw of the crank arm 22 and the stroke of the grate section 3, an arm 26 fixed to the rock shaft 21 is actuated in the following way. As shown in Fig. 3, a bar 27 is pivotally connected at one end with the arm 26 and is provided at the other end with a piston head 75 slidable in the tube 25. This rod 27 has a screw threaded portion 28 intermediate its ends on which a stop nut 29 is adjustably mounted. The threaded portion 28 of the spindle extends loosely through the closed end of the tube 25. By changing the position of the adjustable nut 29 with respect to the end of the tube 25, a variable idle movement of the tube within the limits from zero up to a maximum may be obtained, in respect to the rod 27 and so as to permit a change in the stroke of the arm 26 and consequently in the stroke of the grate section 3.

The several bars 100 of the stoking grate units 2 are provided with hook shaped extensions 61, Fig. 5, at those ends at which they are engaged by the pushing brackets 7. In each section 2 alternate bars 100 have similar hooks 80, while the bars between them have hooks 81 opening in the opposite direction, as shown in Fig. 5. The brackets 7 carry at their front portions in opposition to the rear ends of the pertaining bars two flanges 33 and 34 with oppositelv directed angle edge portions 83, 84 respectively. The hooks 81 with a concave upper edge are adapted to embrace loosely the angle edge 84 of flange 34 while the bars 100 alternating with the just mentioned bars have their hooks 80 curved concavely downward so as to be adapted to rest loosely and pivotally on the angle edge 83 of the flange 33. As the pushing brackets 7 swing about the axes of the shafts 65 and also about their pivotal connection with the arms 12, and as they also are supported loosely by the oscillatable partition plates 8, the resulting movement of the brackets 7 will be partly a reciprocating and partly a turning movement.

This combined reciprocating and turning movement of the brackets influences the grate bars connected with the same differentially, depending upon the engagement of the bracket 7 with a hook 80 which opens downward, or with a hook 81 opening downward. In certain portions of the stroke of the bracket, the latter will slide on the convex edge of the pertaining hook 80, or 81 respectively, thereby permitting the movement of the grate bar to be slightly less than that of the bracket. A bar 100 resting by means of hook 80 on flange 33 will be pushed forward a greater stretch when the brackets 7 are rocked forward from their middle position than the adjacent bar 100 whose hook 81 is concave upward and engages flange 34, while upon the returned combined swing and slide of the brackets 7, the bar 100 loosely embracing the angle edge 84 of the upper flange 34, is retracted to a slightly greater extent to the rear of the middle position than the bar 100 resting by means of hook 80 on the lower edge 83. In a position occupied by the grate midway between the ends of the stroke, the front ends of the constituent bars will be disposed in alinement with each other. But they will be staggered with respect to each other at the end of each stroke.

Owing to this relative alternating and bidirectional movement of the bars, the spaces between the same are thoroughly cleaned, and particles of coal and slag retained and jammed between the bars will be automatically forced out. Fig. 8 illustrates two grate sections, the bars of which occupy this staggered relation to each other.

The actuation of the entire device for stoking operation may be effected in any desired way. A mechanism for this purpose is conventionally illustrated in Figs. 2, 6 and 7.

A motor 86 drives through gearing 39 a countershaft 40, from which through another set of gears 88 the shaft 41 extending crosswise in front of the furnace is rotated. This shaft drives through gearing 88, another shaft 44, and from the latter, rotation is transmitted through gearing 89 to a shaft 45.

A crank pin 50, Fig. 2, driven from shaft 45 actuates by means of two serially connected links 38, 35, the rock shafts 65 from which the arms 12 extend to the brackets 7. For this purpose some of these rock shafts 65 are provided with arms 87 extending to the link 35, Fig. 4*a*. One of the shafts 65 is shown to be actuated from a companion shaft 65 by means of intermeshing gear segments 36, 37, so that the crank arms 12 extending from these two shafts to the pertaining brackets 7 are caused to be rocked in opposite direction. Hence, the second grate unit 2 of the three grate units shown by way of example in Fig. 2 (and 4*a*) is moved in a direction opposite to the first and third grate units 2.

A crank pin 52 driven from shaft 44 is connected with the tubular rod 25 for rocking the grate section 20.

From shaft 41 motion is transmitted through crank pins 42, one at each end of the shaft, to connecting rods 43. The upper ends of these rods are connected by arms 55 to a rock shaft 56 on which a pinion 57 is secured. This pinion engages an arcuate rack bar 58 associated with a curved feed slide 14 in the fuel hopper 13. The fuel from

the hopper is thereby supplied automatically and intermittently to the grate.

The air for combustion is forced by means of a blower 30 driven by motor 85 to a box 31, Fig. 6, at the front of the grating and flows into a box-like enclosure 82 surrounding the combustion space. This enclosure communicates through adjustable rotatable shutters 32 with the space below the grate. The combustion air flows from this space upward between the bars of the grate units and into the mass of fuel positioned on the grate.

The manner of operating the grate will be apparent from the above. The lower stratum of the mass of fuel is being continuously pushed upward, Fig. 1, while being agitated, so that the upper stratum will slide downwards. This disturbance results in an assorting action on the mass, so that the lower layer will be mainly composed of fine particles of slag or clinkers which drop out through the upper outlet 5, if this outlet is open. Burnt-out coarse lumps of slag or clinkers travel to the lower end of the grate where they are ejected from the grate section 3. The combustion air to the grate may be selectively admitted in different quantities to the various compartments 64 below the grate formed by the partitions 8 which extend from side to side to substantially avoid the occurrence of air leaks between them.

Broadly considered, an upward pushing and undulatory movement substantially in parallelism to the grate is imparted to the bed of fuel upon the grate and particularly to the lower stratum thereof, so that this layer is pushed upwards and continually turned over in opposition to the descending movement of the remainder of the charge, thereby causing some of the particles of the lower layer to be forced into the upper layer of the bed of fuel.

It will have to be understood that the invention is not restricted to the particular forms of embodiment and to the relative arrangement, size and operative connection of its different parts, but it is susceptible of modifications and changes in accordance with varying conditions of application without deviating from the spirit and scope of the invention, except as otherwise stated in the appended claims.

I claim:

1. In a progressive feed grate, a plurality of inclined grate units extending transversely of the grate, each unit resting at its upper margin upon an adjacent unit, pushing means hingedly engaging the opposite margin of each of said units, air-admitting means below said units, rockingly disposed partitions, intermediate the air admitting means and pivotally supporting the pushing means and constituting air-chambers, operating means for the pushing means and feeding means for the grate.

2. In a progressive feed grate inclined from its fuel receiving end, a plurality of inclined grate units extending transversely of the grate, each unit resting at its upper, fuel-receiving margin upon an adjacent unit, pushing and operating means hingedly connected to the opposite margin of each unit, air-admitting means below said units, rockingly disposed partitions, intermediate the air admitting means and pivotally supporting the pushing and operating means and constituting air-chambers, feeding means for the grate, a front wall plate the confronting margin of the grate being spaced from said plate to provide a discharge opening, and means for varying the size of said opening.

3. In a progressive feed grate, the combination of a plurality of stoking grate units, said units being in overlapping arrangement and inclined downward from the front to the rear each unit overlapping the unit in front thereof, supporting brackets loosely engaging the rear ends of said units, means intermediate the ends of said supporting brackets for pivotally supporting the latter, and means operative at the rear ends of said supporting brackets for imparting a rocking movement to the same.

4. In a progressive feed grate, the combination of a plurality of stoking grate units in overlapping relation to each other and inclined from the front towards the rear each unit overlapping the unit in front thereof. brackets loosely and pivotally engaging said units at their rear ends, shafts extending transversely of said units below the same, arms fixed to said shafts and operatively connected with said brackets, plates positioned edgewise to pivotally engage at their upper edges the brackets intermediate the ends thereof to support the same, said supporting plates being pivotally supported on their lower edges, and means for imparting a rocking movement to said shafts.

5. In a progressive feed grate a plurality of grate units inclined downward from front to rear and rockingly mounted at their lower margins, each of said units overlappingly reciprocating upon the upper surface of the adjacent unit in front thereof, a longitudinally adjustable supporting member at the upper part of the grate, overlapped by the adjacent grate unit to the rear thereof, and means for reciprocating said grate units.

6. In a progressive feed grate a plurality of grate units inclined downward from front to rear, means hingedly engaging the lower margins of said grate units for rocking the same, the upper margins of said units overlappingly engaging the upper surface of the respective units in front thereof, discharging sections at both ends of the grate, the upper discharging section being overlappingly en-

gaged by the upper margin of the grate unit to the rear thereof.

7. In a progressive feed grate, a plurality of grate units inclined downward from front to rear, rockable supporting means for the lower margin of each of said grate units, and hingedly engaging therewith, the upper margins of the grate units reciprocatingly engaging the upper surfaces of the respective grate units in front thereof, feeding means at the upper end of the grate, a supporting section for the grate unit adjacent the feeding means, a discharging grate unit at the lower end of the grate, at an angle to the grate unit in front thereof and having one of its margins resting upon said last named unit, and means operative at the other margin of said discharging grate unit for imparting a rocking movement to said unit.

8. In a progressive feed grate, a plurality of substantially parallel grate units downwardly inclined from front to rear and supported for longitudinal reciprocation on the upper surfaces of the respective grate units in front thereof, and means hingedly supporting the lower margins of said grate units for rocking said units, separate end discharging sections at both ends of the grate, adjustable supporting means for the upper end section, oscillatable shaking means for the other discharging section, said section engaging the grate unit in front thereof, and means for varying the throw of said shaking means.

9. In a progressive feed grate, a plurality of grate units inclined downwardly from front to rear, the upper margin of each grate unit resting upon the surface of the grate unit in front thereof, separate means operatively connected with the lower margins of the grate units for rocking said units, links connecting certain of said rocking means, and a pair of gears of which one is actuated by said rocking means and is operatively associated with one unit, while another gear is associated with another unit and in mesh with said first named gear to move the unit associated therewith in opposition to the other unit.

10. In a progressive feed grate a plurality of groups of grate bars inclined downwardly from front to rear, slidingly connected for movement longitudinally of the grate, and constituting overlappingly disposed grate units, means engaging the lower margins if said grate units for rocking the same, hook-shaped projections on the lower ends of the grate bars and in loose engagement with said rocking means, and adjustable grate supporting means below the uppermost grate unit and engaged by the upper margin thereof.

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