H. BENTON.

GRATE.

APPLICATION FILED JULY 2, 1909.

987,945. **Patented Mar. 28, 1911.**

4 SHEETS—SHEET 1.

FIG. 1.

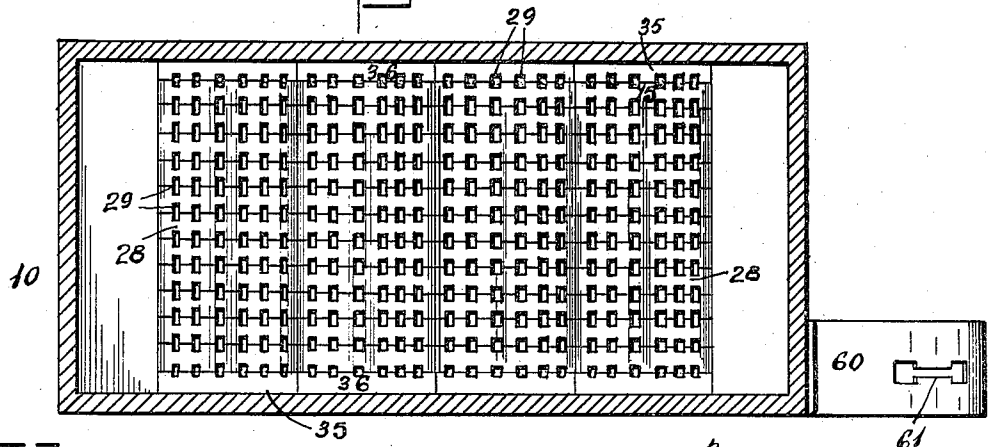


FIG. 2.

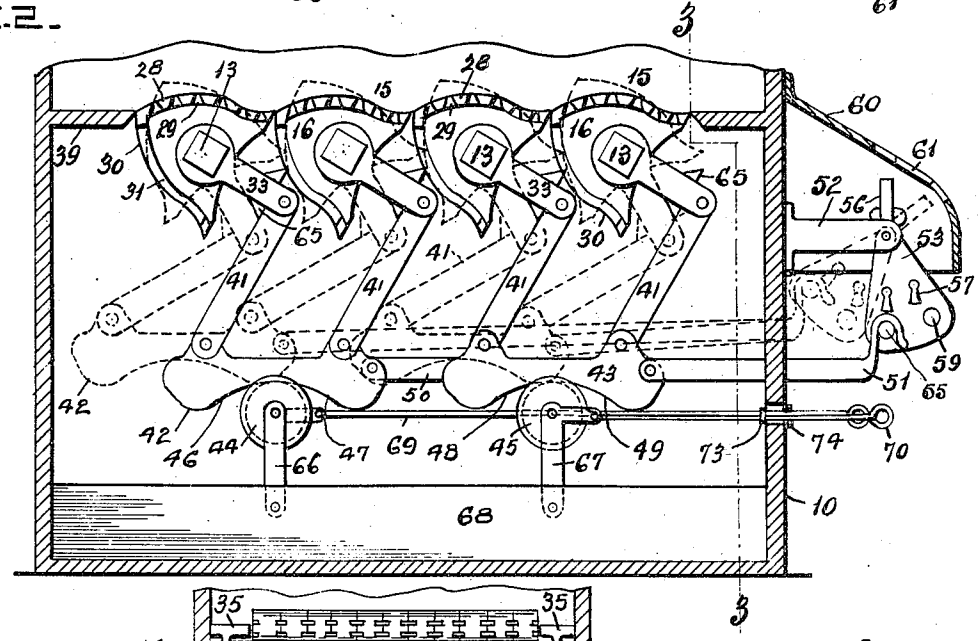
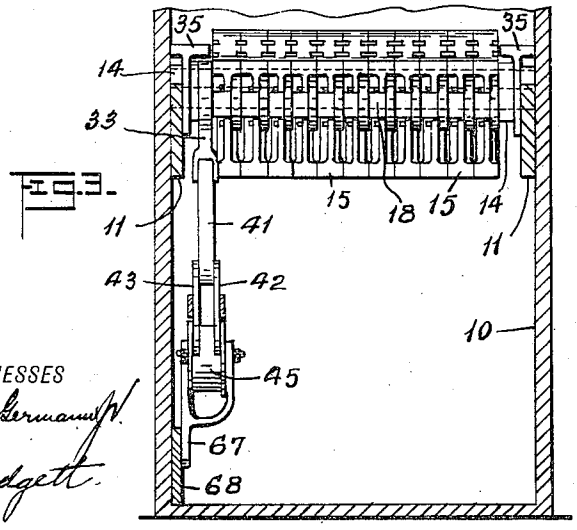


FIG. 3.



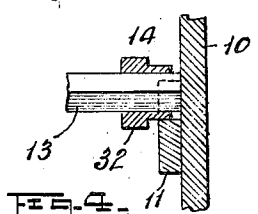


FIG. 4.

WITNESSES

Frederick Germann Jr.

F. B. Dodgett.

INVENTOR

Henry Benton,

BY

Russell M. Everett,

ATTORNEY.

H. BENTON.

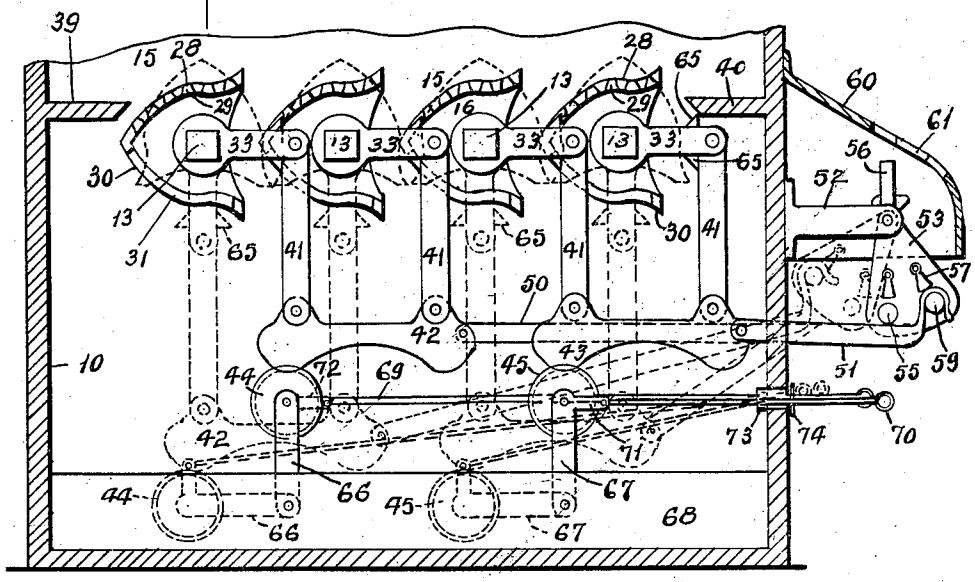
GRATE.

APPLICATION FILED JULY 2, 1909.

987,945. Patented Mar. 28, 1911.

4 SHEETS—SHEET 2.

FIG. 5.



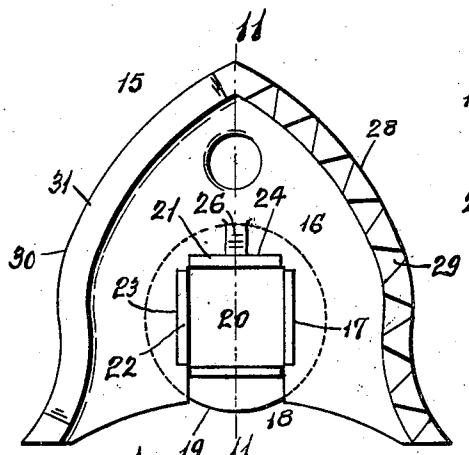


FIG. 6.

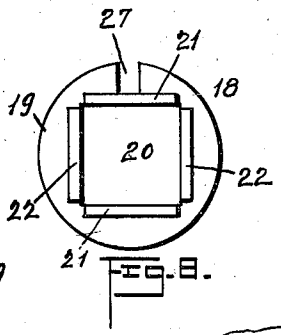


FIG. 8.

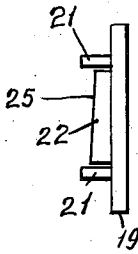


FIG. 9.

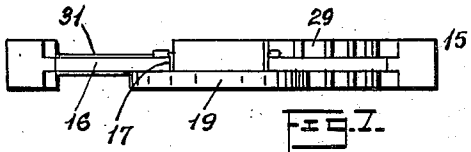


FIG. 7.

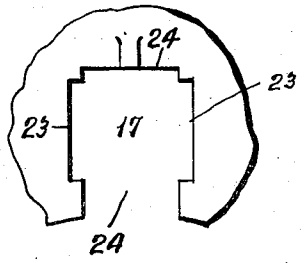


FIG. 10.

WITNESSES

Frederick Kermann Jr.

F. C. Blodgett.

INVENTOR

Henry Benton,

BY

Russell M. Everett,

ATTORNEY.

H. BENTON.

GRATE.

APPLICATION FILED JULY 2, 1909.

987,945. Patented Mar. 28, 1911.

4 SHEETS—SHEET 3.

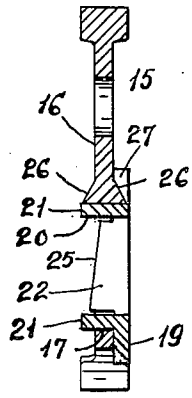


FIG. 11.

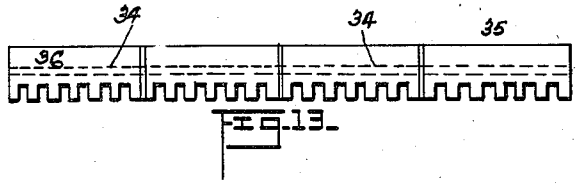


FIG. 13.

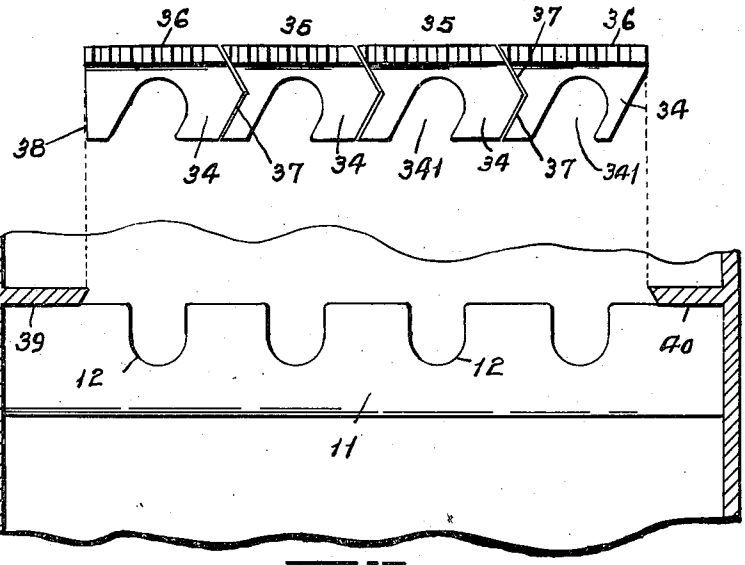


FIG. 12.

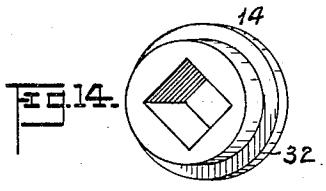


FIG. 14.

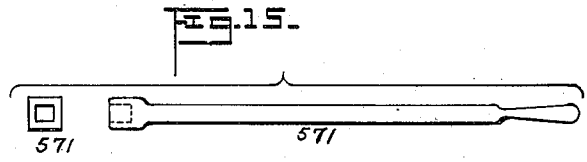


FIG. 15.

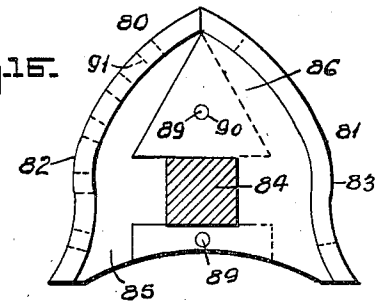


FIG. 16.

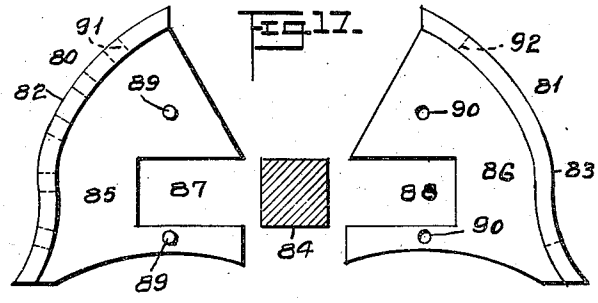


FIG. 17.

WITNESSES

Frederick Germans Jr.

F. E. Hodgett.

INVENTOR

Henry Benton,

BY

Russell M. Everett,

ATTORNEY.

H. BENTON.

GRATE.

APPLICATION FILED JULY 2, 1909.

987,945. Patented Mar. 28, 1911.

4 SHEETS—SHEET 4.

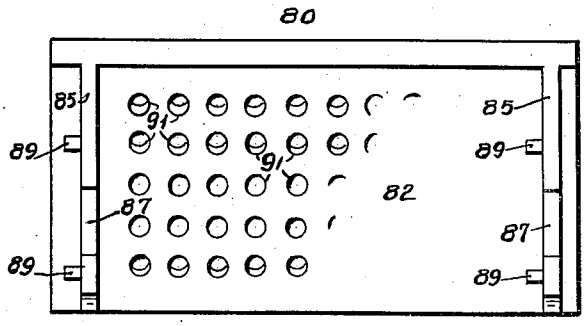


Fig. 18.

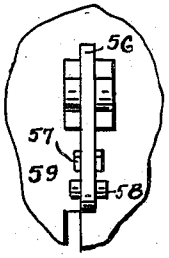


Fig. 21.

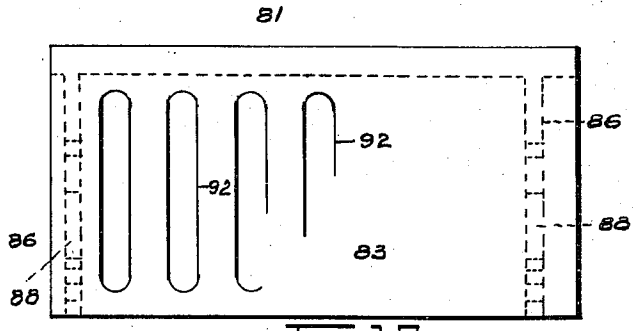
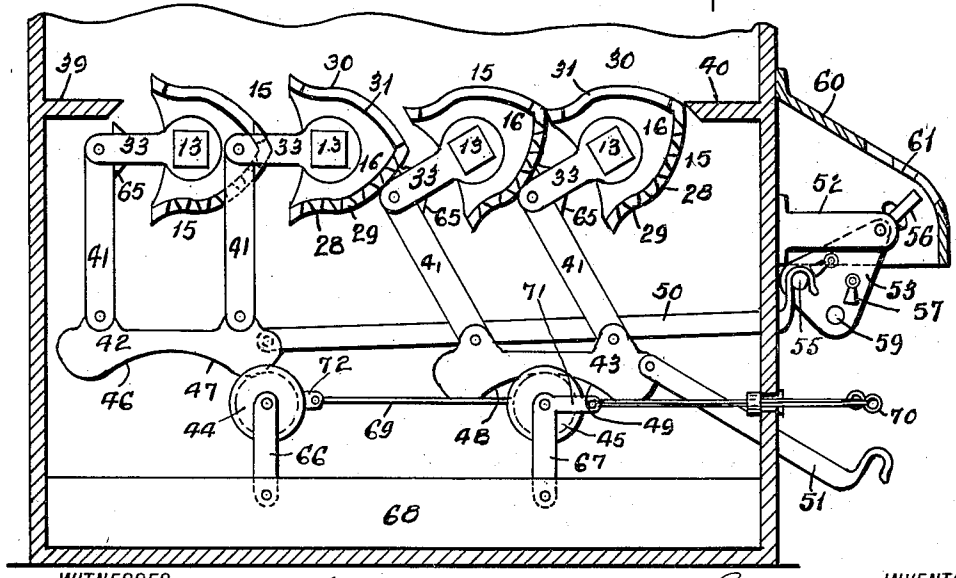


Fig. 19.

Fig. 20.



WITNESSES

Frederick Germano Jr.

F. C. Hodgett.

INVENTOR

Henry Benton,

BY

Russell W. Everett,

ATTORNEY.

UNITED STATES PATENT OFFICE.

HENRY BENTON, OF ELIZABETH, NEW JERSEY.

GRATE.

987,945. Specification of Letters Patent. Patented Mar. 28, 1911.

Application filed July 2, 1909. Serial No. 505,561.

To all whom it may concern:

Be it known that I, HENRY BENTON, a citizen of the United States, residing at Elizabeth, in the county of Union and State of New Jersey, have invented certain Improvements in Grates, of which the following is a specification.

This invention relates to that class of grates for furnaces and the like which are composed of a series of parallel bars which can be oscillated when desired to shake the grate or to dump the fire thereon, said bars being of such cross-sectional shape as to vary the spaces between themselves when oscillated.

The objects of the invention are to provide bars of such cross-sectional shape that they present a plurality of fire-supporting surfaces, any one of which may be used as desired; to thus enable a single grate to provide a plurality of fire surfaces adapted to the burning of different kinds of coal; to secure means by which the grate bars can be changed from one fire-supporting surface to another; to form the grate bars of transverse sections, each of which can be removed independently of the rest, so that the whole grate bar need not be taken out if a portion of it is burned out or otherwise injured; to secure a simple, durable and efficient construction, and to obtain other advantages and results as may be brought out in the following description.

Referring to the accompanying drawings, in which like numerals of reference indicate corresponding parts in each of the several figures, Figure 1 is a plan of a grate of my improved construction; Fig. 2 is a view in side elevation, looking at the ends of the grate bars with the side wall of the furnace and the journal supports for the ends of the grate bars removed, said figure showing in full lines the grate bars in normal position to support a fire upon one surface and showing in dotted lines their corresponding shaking position; Fig. 3 is a vertical section on line 3—3 of Fig. 2, looking from the front of the furnace rearward; Fig. 4 is a detail vertical section taken centrally and longitudinally through an end portion of one of the grate bars and its supporting means; Fig. 5 is a view similar to Fig. 2, except that it shows in full lines the grate bars in dumping position, and in dotted lines the bars in process of being reversed to bring the other fire-supporting surface uppermost; Fig. 6 is a side view of one of the grate bar sections and its separable hub; Fig. 7 is an edge view of the same, looking in the direction indicated by the arrow on Fig. 6; Fig. 8 is an end view of the said hub, detached from the grate bar section; Fig. 9 is an edge view of said hub; Fig. 10 is a side view of a portion of the grate bar section with its hub removed, showing the seat for said hub; Fig. 11 is a section of a grate bar section and its hub taken on line 11, 11 of Fig. 6; Fig. 12 is an interior view of the side wall of the furnace, showing the journal supports for the ends of the grate bars, certain upper fillers being shown lifted out of their normal position; Fig. 13 is a plan of said fillers; Fig. 14 is a detail perspective view of one of the bushings for said journal supports; Fig. 15 illustrates in side end view a shaker handle employed with my grate; Fig. 16 is an end view of a grate bar section of modified construction in normal position upon the longitudinal grate bar shaft; Fig. 17 shows the two parts of such modified grate bar construction being separated for removal from said longitudinal shaft; Fig. 18 is a view of one part or half of such modified grate bar section from its inside; Fig. 19 is a view of the other part or half of such modified grate bar section from its outside; Fig. 20 is a view similar to Figs. 2 and 5 showing the bars of a grate in reversed position, one-half of them being in normal position to support a fire and the other half being shown in the act of dumping, and Fig. 21 is an edge view of a certain shaking head, looking at the front of the furnace.

In said drawings, 10 indicates the walls of the ash-pit of a furnace, and 11, 11 are horizontally disposed supports on the inner sides of said walls at opposite sides of the ash-pit, said supports providing at their upper edges seats 12 for the ends of the grate bar shafts 13 or bushings 14 upon said shafts. It will be understood that these shafts extend across the ash-pit parallel to each other, and are of angular cross section, not round. Upon each shaft is mounted a longitudinal series of grate bar sections 15, said sections being at their sides in such relation to each other as to give the necessary

closeness or openness of a fire supporting surface.

The relation of the sections of one grate bar to those of the next adjacent grate bar is such that in a certain position they approach closely enough to support a fire, and yet by oscillation of the grate bars spaces between can be opened up sufficient to shake the fire or even to dump it. Each grate bar section 15 has two fire supporting surfaces which are different, or adapted for different kinds of coal, and either one of which can be used as desired.

Each grate bar section 15 comprises a thin, flat casting adapted to stand transversely of a grate bar, and having in its web 16 an aperture 17 to receive a detachable hub 18. This hub 18 comprises a circular plate 19 adapted to lie against one side of the web of the grate bar section, and having a square hole 20 to receive the shaft 13. At the edges of said hole 20 the circular plate 19 has top and bottom flanges 21 and side flanges 22, which flanges fit in recesses 23 and 24 in the side walls of the aperture 17 in the web of the grate bar section, the recess 24 for the bottom flange 21 being cut clear through the edge of the web. The side flanges 22 are not as deep as the top and bottom flanges and are decreased in depth upwardly or inclined at their edges 25, as shown in Fig. 9.

It will be understood that the hubs 18 are permanently upon the grate bar shaft 13, and that upon each hub a grate bar section is removably seated. Obviously by a little sidewise movement of the web 16 of the section away from the plate 19 of the hub, said section can be slid upwardly, its recess 24 passing the top and bottom flanges 21. At the upper edge of the aperture 17 for the hub 18, shoulders 26 are provided upon the opposite sides of the web to form a broad bearing for the top flange 21, and the plate 19 is notched as at 27 to receive such shoulders.

In shape each grate bar section 15 is of somewhat triangular form and provides two symmetrically disposed side edges, each of which has the shape of an ogee curve, the upper or adjacent parts of said edges being rounded outwardly or convex, and the lower parts curved inwardly toward each other or concave, as shown particularly in Fig. 6. Each edge provides a laterally thickened rib, and the sides of this rib are suitably cut away or notched to permit the passage of air to a fire. It will be understood that either of the edges described is adapted to form a fire supporting surface, and by my invention these edges are made different or adapted to the burning of different kinds of coal. For instance, one edge 28 has the opposite sides of its rib provided with a series of small notches 29, so that a large number of little air spaces are formed, while the rib 30 of the opposite edge is cut away continuously at its opposite sides, as at 31, so as to provide long, large air slots.

The sections 15 are arranged upon shaft 13 with their edge ribs lying against one another, as shown in Fig. 1, and the end ones engage the inner flanged ends 32 of the bushings 14 for journaling said shaft, except that at one side of the furnace certain shaking arms 33 which will be hereinafter described project from the shafts 13 between the grate bar sections 15 and the bushings 14. The flange 32 of said bushing provides between itself and the support 11 a space adapted to receive the slotted web 34 of a filler 35, said filler having at its top a horizontal rib 36 adapted to fill the space between the furnace wall and the end grate bar sections. There is preferably one filler for each grate bar, their lines of end contact being V-shaped as at 37, whereby they lock one another in place. The front end filler is beveled inwardly downward at its extremity 38 to allow it to be removed first, and the slots 341 are correspondingly slanted.

When the filler 35 at either end of a grate bar is removed, and the bushing 14 slid away from the sections 15, looseness enough is provided to enable any section to be removed from its hub and a new one inserted. In this way any damaged portion of the grate can be repaired without sacrificing uninjured portions. Ledges 39, 40 project inward from the front and rear walls of the furnace to fill the space between said walls and the grate bars.

I have illustrated the normal position of the grate bar sections in Fig. 2, where their edges 28 are shown uppermost and in horizontal alinement to form a fire-supporting surface. The grate bars are then shaken by turning them into the positions shown by dotted lines in said Fig. 2, and the grate is dumped by turning the grate-bars the opposite way, into the position shown in Fig. 5. To reverse the grate bars, or to bring the edges 30 of the sections uppermost, they are first brought into the position shown in dotted lines in Fig. 5, and then tipped up as shown in Fig. 20. Preferably the grate bars are coupled up in two sets for dumping or shaking, so that half the grate can be cleaned while the fire is raked over onto the other half.

Each grate bar shaft 13 has one of the arms 33 upon itself and to the end of each arm is pivoted a link 41. To the inner sides of these links 41 of one set of the grate bars is pivoted a rear slide 42, and to the outer sides of the links 41 of the grate bars of the other set is pivoted a forward slide 43. This brings the said two slides out of alinement with each other, so that they will not interfere in operation, as clearly shown in Fig. 3. Each slide is supported at its lower edge

upon suitable anti-friction means, such as flanged wheels 44, or 45, and has near the front and rear ends of its lower edge inclines or cam surfaces 46, 47, or 48, 49, adapted to raise and lower the slide as it moves horizontally, and operate the grate bars as hereinafter particularly described.

Each slide is operated by a connecting rod 50 or 51 extending from itself forwardly through a slot in the front wall of the furnace. Outside said wall is a bracket 52 in which is pivoted a shaking lever head 53 having upon opposite sides of itself rear studs 54, 55 and forward studs 58, 59 adapted to pivotally and detachably receive the forward ends of the connecting rods 50 and 51. A stem 56 projects above the fulcrum of the bracket 52 and is adapted to receive a shaking handle 571. When said handle is oscillated, with the connecting rods upon the rear studs 54, 55, as shown in Fig. 2, the grate bars are shaken. If the connecting rods are detached from the rear studs 54 and 55 and attached to the forward ones 58, 59, oscillation of the shaking handle will dump the grate, as shown in Fig. 5. In case it is desired to shake or dump only one set of grate bars, without disturbing the other set, the connecting rod of the set to be left undisturbed is detached from the shaking head 53 entirely. Pivoted detents 57, 57 hold the hooked ends of the connecting rods 50 and 51 upon their studs on the shaking head 53. Preferably a hood 60 projects over the shaking head 53, and in said hood is a slot 61 to allow for swinging the shaking handle, said slot being enlarged at its ends to permit application of the shaking handle to the stem 56 of the head 53.

With the sides 28 of the grate bars uppermost and in normal fire supporting position, the shaking handle extends vertically upright and is to be pulled forward to shake the grate, as shown in Fig. 2. For dumping the grate bars, when their same sides are uppermost, the lever 571 stands in its forwardly inclined position at the beginning of action, and in vertical upright position when the grate bars are swung into dumping position, as shown in Fig. 5, it being remembered that the connecting rods 50, 51 have been shifted to the forward studs 58, 59, as explained above. It will be noted that the arms 33 on the grate bar shaft have at their upper and lower edges projecting shoulders or lugs 65 adjacent to their extremities which are pivoted to the links 41, and the effect of these shoulders or stops is to limit their angular movement of the links with respect to the arms. The links can project at the rear or upon either side of the arms, but cannot double forward against the arms beyond a certain fixed angle, which is preferably a right angle.

Referring to Fig. 2, it will be noticed that in shaking, each slide 42 or 43 first moves rearwardly upon the friction wheel 44 or 45, and also upwardly by virtue of the incline 47 or 49. The angle between the arms 33 and links 41 is at the same time kept fixed by the stops 65 before described, so that no bending takes place. In dumping the grate, as shown in Fig. 5, the slides move forward upon the friction wheels 44 or 45, and also move upward by virtue of their inclines 46 and 48, whereby the arms 33 of the grate bars are pushed upward into horizontal position. The freedom of movement necessary for this motion results from the links 41 connecting the said arms 33 to the slides, since each link is pivoted at its opposite ends to an arm and slide and thus gives a flexible connection which permits a wide range of movement. When it is desired to shift from one side or fire-supporting surface of the grate bars to the other, the friction wheels 44 and 45 are first lowered by swinging their supports 66 or 67, which are pivoted to a lower side plate 68, rearward, as shown in outline in Fig. 5. The slides 42 and 43 then drop to their lowest positions, with the arms 33 and links 41 depending in vertical lines from the grate bars, and said grate bars being half-way between their two normal fire supporting positions, all as shown in dotted lines in Fig. 5. The bend or angle between the arms 33 and links 41 are then made to project toward the rear of the furnace, and the friction wheels 44 and 45 again elevated, so that the various parts are in the positions shown in Fig. 20. The edges 30 of the grate bars are now uppermost, and yet dumping and shaking can occur as already described except that the direction of swinging of the handle or lever 571 is reversed for the same operation from what it was before. The friction wheels 44 and 45 are lowered and raised by means of rods 69, 70 attached to projections 72, 71 on the supports 66, 67, respectively, and extending forward through the wall 10 of the ash-pit. Stops 73 upon said rods engage the inner side of the wall to hold the friction wheels in proper upright position, and removable pins 74 are inserted at the outer or front side of the wall.

In Figs. 16 to 19 inclusive, I have shown a slightly different form of grate bar section, the division being longitudinal of the grate bar shaft. Each section 80 or 81 is a foot more or less in length and provides an outer wall 82 or 83 lying with respect to the grate bar shaft 84 in substantially the same surfaces as provided by the grate bar sections already described. From the inner side of each wall 82 or 83 project wings 85, 85 or 86, 86, which are notched or recessed at their adjacent edges to receive the shaft 84, as shown at 87 or 88. Two wings 85 and 86

which form a transverse pair on the grate bar are adapted to overlap or lie against each other, and when the sections 80, 81 are closed together, pins 89 on one wing enter seats 90 in the other. One of the outer walls, as 82, has numerous little perforations 91 to provide a large number of small air spaces, while the other outer wall 83 is provided with large open slots 92 to afford greater air space, and thus the two sides of this form of grate bar section are adapted to be used alternately for burning different kinds of coal. The bars are to be shaken, and dumped and reversed in the same manner as those already described.

Having thus described the invention, what I claim is—

1. The combination with an angular grate bar shaft, bushings for the ends of said shaft, each having a cylindrical portion and a stop at its end next the other bushing, supporting bearings for said bushings, grate bar sections on said shaft between said stop ends of the bushings each comprising a hub and separable body portion, said sections being contiguous to each other and to said bushings, and removable members between said supporting bearings for the bushings and the said end stops of said bushings.

2. The combination with a grate bar shaft, of a series of hubs slidably fitting said shaft each comprising a plate disposed transversely of the shaft and flanges on said plate extending longitudinally of the shaft one on each of opposite sides thereof, grate bar sections each having its web slotted to straddle the grate bar and the sides of the slot recessed to receive said flanges on a hub, said hubs engaging each other and said grate bar sections also engaging each other, and removable means for holding said series of grate bar sections and series of hubs against sliding on the shaft.

3. The combination with a grate bar shaft, of a series of hubs on said shaft free to slide longitudinally thereof and held against rotation, grate bar sections each having a slotted web adapted to straddle the shaft and slide onto a hub in non-rotatable engagement therewith, said hubs engaging each other and said sections also engaging each other, and removable means for holding said series of grate bar sections and series of hubs against sliding on the shaft.

4. The combination with a grate bar shaft, of a series of removable grate bar sections on said shaft, each providing a plurality of fire-supporting edges and each comprising a web slotted to receive the shaft and a laterally thickened rib at the edges of said web, said rib having a series of notches in its opposite sides for one fire-supporting edge of the section and being cut away at its opposite sides for the entire intermediate portion of another fire-supporting edge, and means for holding said grate bar sections on said shaft.

5. The combination with a grate bar shaft, of a hub on said shaft comprising a plate disposed transversely of the shaft and separate flanges on said plate adapted to lie against the sides of the shaft longitudinally thereof, the flanges at the opposite vertical sides of the shaft being shorter than the others and having their end edges inclined upwardly toward the plate, a grate-bar section slotted from its lower edge upward to receive the top and bottom flanges and recessed at the side walls of the slot to receive the lateral flanges, said grate bar section adapted to slide onto said hub, and means for holding said grate bar section in place.

6. The combination of a grate-bar shaft, removable grate-bar sections slidably arranged on said shaft, bushings for the ends of said shaft having an inner stop and an outer bearing portion, a support for said bearing portions of the bushings, and a filler having a recessed web adapted to straddle the bearing portion of the bushing and a head adapted to lie between said support and the adjacent grate-bar section.

7. The combination with grate bars each providing a plurality of fire-supporting surfaces of different construction and trunnions at the ends of said fire-supporting surfaces, journal supports for said trunnions, arms fast on said trunnions and projecting therefrom each between the fire-supporting surfaces of a grate bar and one of the journal supports therefor, a reciprocating member, and links each pivoted at its opposite ends to said member and one of said arms.

8. The combination with grate-bars each providing a plurality of fire-supporting surfaces different in kind, means for rotatably supporting the ends of said grate-bars, arms projecting radially from said grate-bars in fixed relation thereto, links pivoted to said arms, a shoulder on one of each pair of said pivoted parts limiting angular movement of said parts with relation to each other, and a reciprocating member to which the other ends of the said links are pivoted.

9. The combination with rotary grate-bars, of arms projecting from said bars, hinged supports, slides upon said supports pivotally connected to different groups of said arms, means for reciprocating each slide independently, and means for lowering and elevating said supports to reverse the grate bars.

10. The combination with rotary grate-bars, of arms projecting from said bars, pivoted supports, slides upon said supports, links connecting said slides to different groups of said grate-bar arms, means for reciprocating each slide independently, and means for lowering and elevating said supports to reverse the grate bars.

11. The combination with rotary grate bars and supports in which said grate bars are journaled, of arms projecting one from each grate bar, slides adapted to reciprocate beneath said grate bars transversely thereof and having inclines or cam surfaces at their lower edges, supporting means for said slides, links connecting each slide to a different group of grate bar arms, and means for reciprocating each slide independently of the rest.

12. The combination with rotary grate-bars, of arms projecting from said bars, pivoted supporting brackets, wheels mounted in said brackets, slides upon said wheels, links connecting said slides to different groups of said grate-bar arms, means for reciprocating each slide independently, and draft rods connected to said supporting brackets and adapted to swing the same.

13. The combination with rotary grate-bars, of arms projecting from said bars, slides pivotally connected to different groups of said arms, connecting rods each pivoted at one end to one of said slides, and having engaging means at their other ends, and a pivoted shaking head adapted to detachably receive said last-mentioned ends of the connecting rods.

HENRY BENTON.

In the presence of—
ROBERT S. CHRISTIE,
WILLIAM R. MATTHEWS.