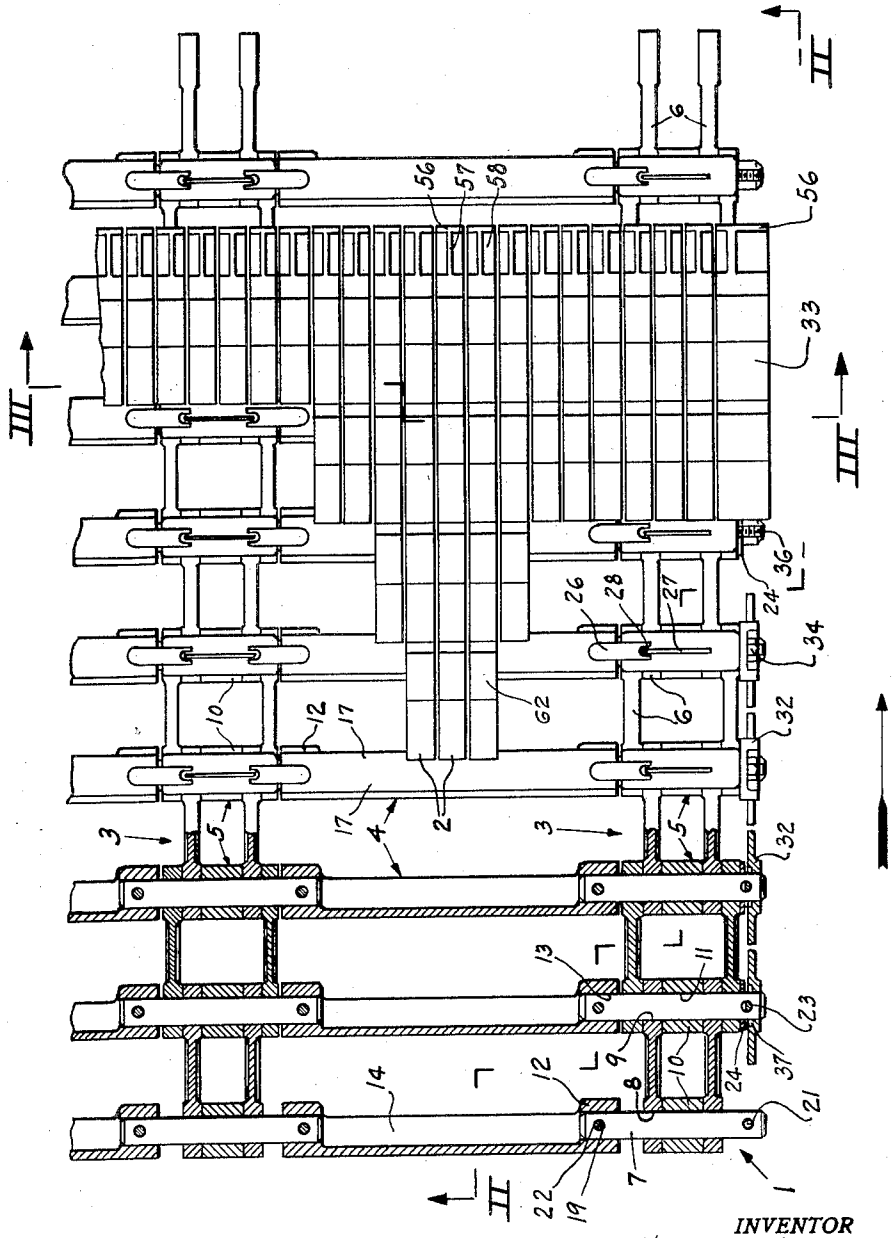
Aug. 28, 1934. H. B. HOLT 1,971,374

FURNACE GRATE

Filed June 27, 1933 4 Sheets-Sheet 1

FIG. 1



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FURNACE GRATE

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FIG. 2

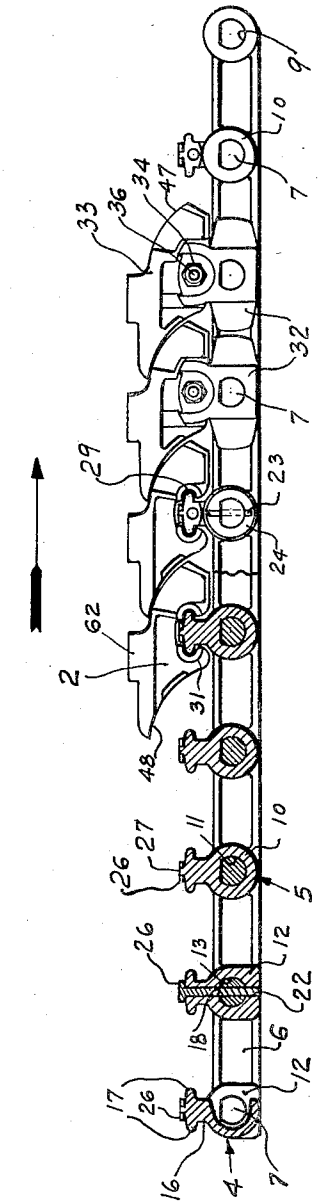
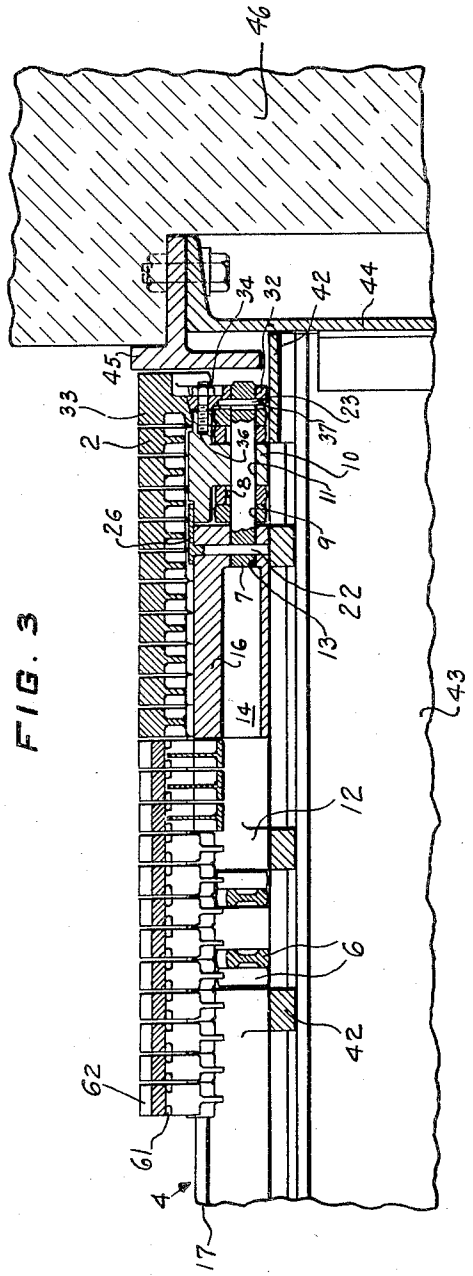


FIG. 3



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FURNACE GRATE

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FIG. 5

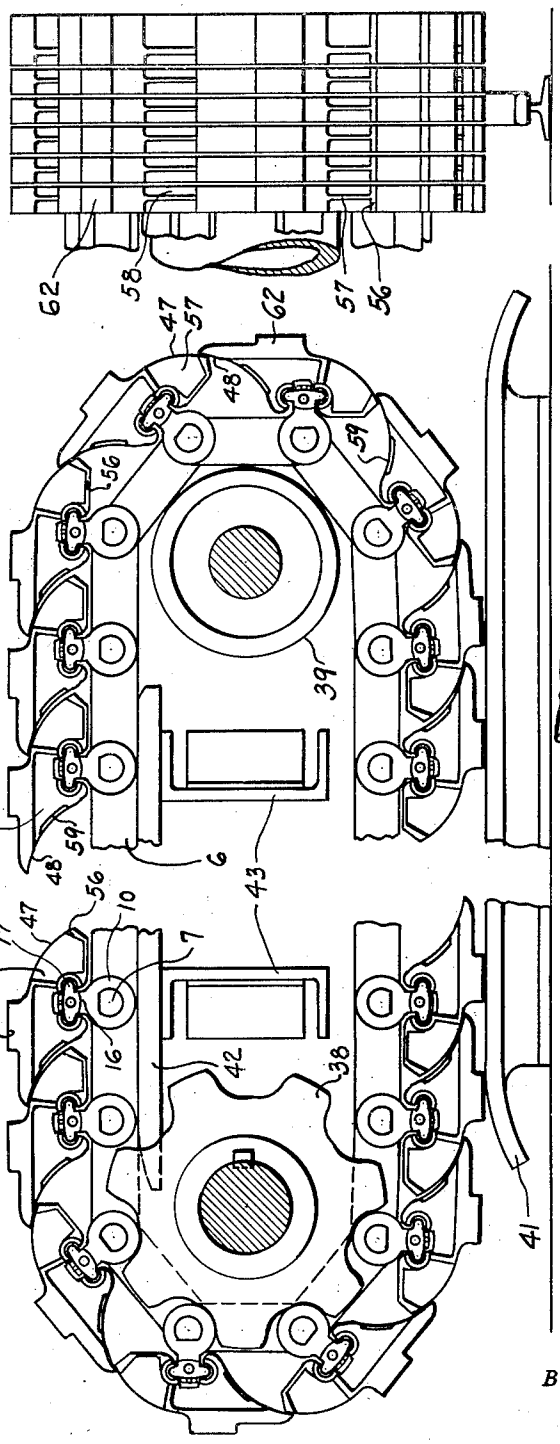


FIG. 4

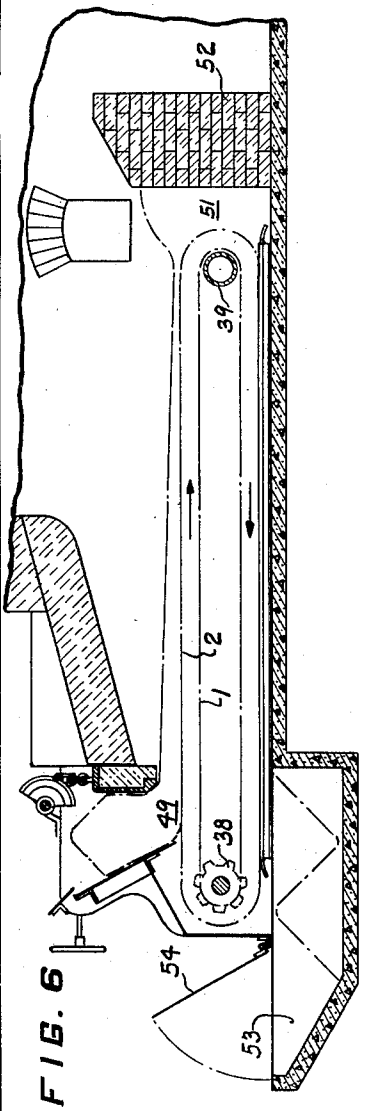


FIG. 6

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FURNACE GRATE

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FIG. 7

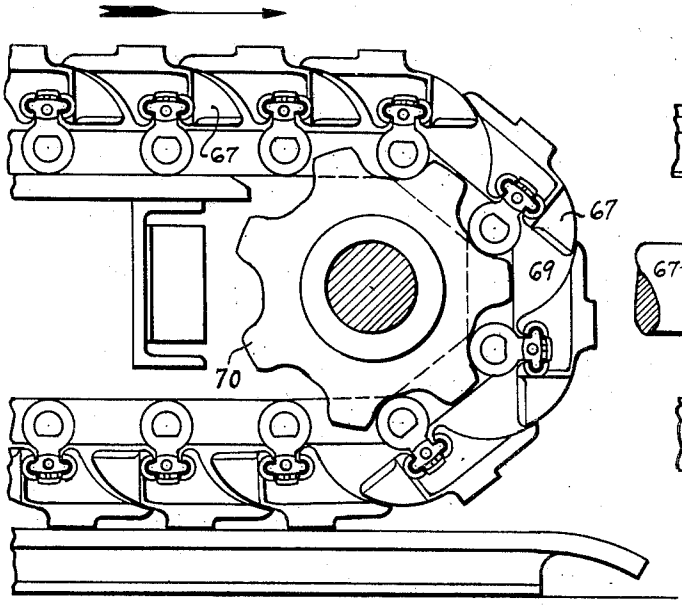


FIG. 8

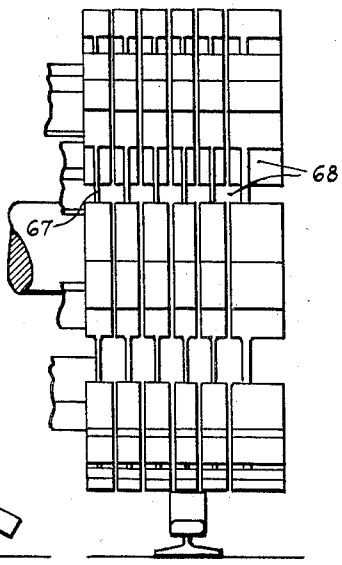


FIG. 9

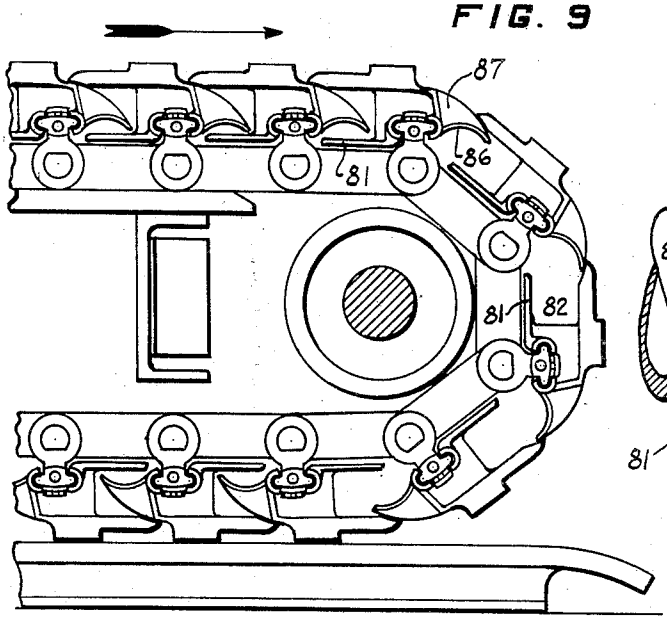


FIG. 10

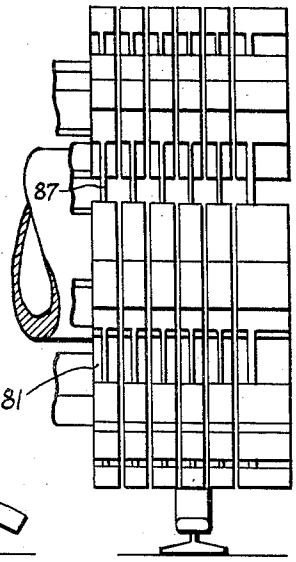
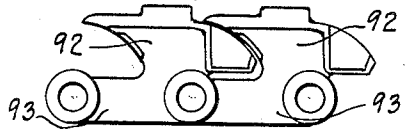


FIG. 11



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UNITED STATES PATENT OFFICE

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FURNACE GRATE

Harris B. Holt, Pittsburgh, Pa.

Application June 27, 1933, Serial No. 677,803

10 Claims. (Cl. 110—40)

This invention relates to endless traveling grates adapted to extend from front to rear of a furnace in upper and lower reaches, and more particularly to such grates which take ashes from the rear of a furnace and discharge them at its front.

Fuel is fed to the front portion of the upper reach of an endless traveling grate and is burned as it is carried by the grate to the rear of the furnace. The rate of fuel feed is such that the fuel is reduced to ash by the time it is dumped over the rear end of the grate where the grate passes from its upper to its lower reach in which it returns to the front of the furnace. Ash-removing grates of the class contemplated by this invention which have been constructed heretofore have been designed either for dragging or for transporting the ash from the rear of a furnace to its front where it can be readily removed.

A grate which transports or carries ash along its lower reach is preferred to one which drags it because considerably less power is required to operate a grate of the former type. However, grates which have been made for removing ash from the rear to the front of a furnace by transportation have been unsatisfactory. This is because the rows of grate bars which form the surface of such a grate spread apart to receive ash between them as they pass from the upper to the lower reach at the rear of the furnace. Clinkers, as herein distinguished from ordinary substantially uniform size ash, or unburnable chunks such as bricks, sometimes enter the openings between these separated rows and become lodged between the ends of opposing grate bars. In such a case the grate is jammed, that is, the rows of bars are prevented from closing up again as they pass into the lower reach of the grate. This results in stalling the grate or breaking the grate bars.

It is among the objects of this invention to provide an ash-removing traveling grate which transports substantially all ash from the rear to the front of a furnace, which pushes to the front of the furnace ash not transported by it, and which can not be jammed by ash, clinkers, or foreign matter.

The invention is illustrated in the accompanying drawings, of which Fig. 1 is a fragmentary plan view of a traveling grate shown partly in section and with some of its parts removed; Fig. 2 is a view taken on the line II—II of Fig. 1; Fig. 3 is a view taken on the line III—III of Fig. 1, and showing a portion of the adjoining furnace structure; Fig. 4 is a side view of the grate mounted in operating position, but with the outermost strand of the outside chain and the outer line of grate bars removed; Fig. 5 is a fragmentary end view of the grate of Fig. 4; Fig. 6 is a fragmentary longitudinal section of a furnace showing the grate diagrammatically; Figs. 7 and 9 are views, similar to Fig. 4, of ends of modified forms of grates; Figs. 8 and 10 are fragmentary end views of the grates of Figs. 7 and 9, respectively; and Fig. 11 is a side view of two grate bars integral with their underlying chain links.

In accordance with this invention there is provided an endless traveling grate extending from the front to the rear of a furnace in upper and lower reaches. The grate is provided with a plurality of recesses formed for receiving ash for transportation by the grate along its lower reach from the rear to the front of the furnace. The recesses open while passing from the upper to the lower reach to receive ash. Then they close and transport the ash along the lower reach to the opposite end of the grate where they again open and discharge the ash. The outer face of the grate is provided with means for breaking clinkers into pieces small enough to enter the recesses, and for pushing to the front of the grate the ash not transported by it. A feature of this invention is that no gaps are formed in the grate in which ash, clinkers, or foreign matter can be trapped and interfere with or stop the operation of the grate.

Referring to the first six figures of the drawings, a traveling chain grate is shown as being formed of two general parts, an endless chain or belt 1, and fuel-supporting grate bars 2 mounted thereon. The preferred construction of the belt is illustrated in Figs. 1, 2 and 3 where it is shown as comprising a plurality of parallel chains 3 retained in spaced relation by means of long and short spacing members or grate bar supports, 4 and 5, respectively. The chains are preferably of the double-strand type formed from a plurality of links 6 pivotally connected at their ends by flat-top pivot pins 7, both strands of each chain being connected by the same pins to bring their respective pivot axes into alignment.

The preferred direction of travel of the belt is indicated by the arrows in Figs. 1, 2 and 4. The pin-receiving opening 8 in the rear of each link is cylindrical to permit the link to pivot on its pivot pin, but the pin opening 9 in the forward end of each link is shaped to conform to

the cross-sectional contour of a pivot pin. The pivot pins are thus prevented from rotating in the forward ends of each pair of links, but the adjoining links, through whose rear openings 8 the pins also extend, are permitted to pivot thereon.

A plurality of the grate bar supports 4 and 5 serves to retain the chains and their strands of links in predetermined spaced parallel relation, thereby completing the belt. The short supports 5 have tubular body portions 10 disposed between and spacing apart the strands of each chain 3 with the pivot pins 7 extending therethrough. The openings 11 through these body portions conform to the cross-sectional contour of the pivot pins to prevent the supports from turning thereon.

The long supports 4 have tubular end portions 12 into which the ends of pins in adjacent chains project. The openings 13 in these supports are shaped like openings 11 in the short supports to likewise prevent them from turning on the pivot pins. One side of the body portion between the tubular ends of each long support is open, as at 14, to give access to the pivot pins projecting into it so that they may be driven out or replaced should the belt require repairing, and also to decrease the weight of the supports.

Each of the grate bar supports is provided with an integral radial rib 16 projecting outward from the belt and having oppositely disposed side flanges 17 extending from its outer edge. The ribs of the short supports project across the ends of the adjoining links to substantially meet the ribs of the long supports and to thereby form a continuous grate bar support transversely of the belt.

The tubular end portion 12 of each long support is provided with a transverse bore 18 extending therethrough and outward through its radial rib. The portions of the pivot pins adjoining these bores are provided with similar bores 19 in axial alignment therewith. The outer ends of the two outside lines of pivot pins are provided with transverse bores 21 adjacent the outermost strands of the belt. A key 22 is inserted in each pair of bores 18—19, and a short key 23 in bore 21, to lock the strands and the grate bar supports together. A washer 24, conforming to the contour of a pivot pin, is placed on each pin between links 6 and key 23 to prevent wear on the key. Each key 22 has an integral elongate head 26 which extends along a long support's radial rib 16 and onto the radial rib of the adjacent short support where it is prevented from turning by means of an integral projection 27 of the short support's rib 16, the projection engaging the end of the head in a notch 28.

A plurality of fuel-supporting grate bars 2 is slidably mounted on each row of grate bar supports, the under side of each bar being provided with an irregular recess 29 for receiving flanges 17 of rib 16, the recess having a central offset portion for permitting the bar to be slid over heads 26 of keys 22. Inwardly projecting lugs 31 engage the under surface of flanges 17 to prevent the grate bar from moving transversely of its support. As the head 26 of each key 22 is covered by several grate bars, the breaking of one or two bars at that point does not permit the key to escape.

A row of grate bars is prevented from sliding off the end of the grate bar support by a beveled top bracket 32 (Fig. 3) engaging a correspondingly beveled lower surface of an outermost wide grate bar 33. The bracket is detachably connected to the rib of the adjoining grate bar support by means of a nut 34 which engages a threaded pin 36 whose inner end projects through an aperture in the bracket and is threaded into an opening in the end of the rib. The lower portion of this bracket is provided with an opening through which the outer end of the adjoining pivot pin projects. A depression 37 is formed in the inner face of the bracket for accomodating short key 23, thereby preventing the short key from coming out of the pivot pin.

As clearly shown in Figs. 4 and 6, the endless grate thus formed is disposed in a furnace in such manner that the upper and lower lengths of the grate lie in vertically spaced substantially horizontal planes or reaches with the connecting curved end portions passing around sprockets 38 and pulley 39 at the front and rear of the furnace, respectively. The path of travel of any given point of the grate when the sprockets are revolving is, therefore, in the upper reach from the front to the rear of the furnace, then downward in a curved path around the pulley, back towards the front of the furnace in the lower reach, and up in a curved path around the sprockets to the upper reach.

To prevent the grate from sagging between the sprockets and pulley, its lower portion is supported on rails 41 along which the grate bars slide, and the upper portion is supported on a plurality of slide plates 42 extending longitudinally of the grate between its ends. The slide plates are connected to the upper flanges of transverse beams 43 fastened at their ends to the vertical side walls 44 which form a housing for the grate. Vertical guide plates 45 are connected to the refractory furnace walls 46 above the housing walls, and extend from the top of the grate substantially to the slide plates below.

The grate bars of each row are so constructed as to closely overlap the fronts of the bars of the following row. The overlapped surface of each bar is formed as an arcuate portion of a cylindrical surface coaxial with the axis of the row of pivot pins on which is rigidly mounted the grate bar support that supports that particular grate bar. That particular row of pivot pins is the same row of pins that connects the links, positioning the overlapped bars, to the links with relation to which the adjacent row of overlapping bars is rigidly positioned. In other words, the outer surfaces 47 (Fig. 4) of the overlapped ends of the bars in each row are formed as an arcuate portion of a cylindrical surface co-axial with the common pivot axis of the row of links positioning that row of bars and the row of links positioning the adjacent overlapping row of bars.

Thus, when the grate rounds a curved end of its path, any given row of links, with the grate bars rigidly positioned by it, pivots at its rear end on the axis which is also the axis of a cylindrical surface in which lie the overlapped ends of the immediately following row of bars. Consequently, the rear or overlapping ends of the bars of the first row turn in an arc concentric with the curve of the overlapped surfaces of the forward ends of the bars of the following row. The grate bars are of such length relative to the diameters of the sprockets and pulley that the overlapping bars never move far enough away

from the bars they overlap to leave a gap that would permit ash to lodge between the ends of the bars. In actual practice it is preferred that the bars always overlap to some extent, as shown in Fig. 4. In one sense, therefore, the outer surface of the grate is continuous throughout its length; that is, the rows of bars never completely separate from one another. See Fig. 4.

It is desirable that a portion 48 of the lower surface of the overlapping end of each bar be curved to conform to the arc in which it turns in order to prevent a gap from being formed between the end of adjacent bars in case the tip of an overlapping end is burned away by the intense heat from the overlying fuel.

Referring particularly to Fig. 6, where the grate is shown diagrammatically in a furnace, fuel 49 is fed to the front portion of the upper reach of the grate by which it is carried while burning to the rear of the furnace. By the time the fuel reaches the rear of the furnace it has been reduced to ash. As the grate rounds the curved rear end of its path, this ash 51 is dumped between the grate and the back wall 52 of the furnace and is spread over the furnace floor from there to the front of the grate. After the ash has become banked up this manner to form a hard wall adjoining the outer surface of the rear end and lower reach of the grate, the grate removes substantially all additional ash from the furnace and discharges it into a pit 53 at the front where it is conveniently accessible from outside the furnace through a trap door 54 in the floor.

Although the endless grate has been described as it is shown in the drawings, it is not, of course, necessary that it be constructed in precisely this manner. The essence of the invention lies principally in the shape of the grate bars which are designed to overcome the defects inherent in prior traveling grates of the general type referred to herein, namely, the stalling or breaking of a grate by clinkers or foreign matter which becomes lodged between the rows of grate bars at the ends of the grate and prevents the rows from closing up.

To this end the overlapped or front end of each grate bar is in the form of a narrow vertical rib. In the embodiment illustrated in the first five figures of the drawings, an integral flange 56 extends laterally from the edges of the vertical rib 57, except along its upper edge. Thus, as shown in Figs. 1 and 5, when the bars are mounted side by side on a grate bar support a plurality of pockets or recesses 58 is formed between the vertical ribs. The recesses disposed in the upper and lower reaches of the grate are covered by the overlapping ends of the grate bars in the row ahead of them, the upper reach thereby having a continuous unbroken fuel-supporting surface. At the ends of the grate, however, where the overlapping ends of the bars move away from the overlapped bars somewhat, recesses 58 are uncovered, as is clearly shown in Figs. 4 and 5.

As the grate passes from its upper to its lower reach at the back of the furnace, the recesses are opened and ash falls and is pushed into them. But as the size of these recesses is comparatively small, clinkers and large pieces of other material, such as bricks and stones, are not admitted to the grate through them. In other words, the vertical ribs 57 serve to screen out the large pieces and prevent them from entering the recesses and jamming the grate. Ash is prevented from falling out of the recesses, when the rows of bars start to enter the lower reach of the grate, by the wall or bank of ash 51 disposed between the grate and the furnace.

The closed recesses in the lower reach of the grate transport their loads of ash from the rear of the furnace to the front where they again open in passing around the sprockets to the upper reach. When the recesses open, the ash pours out of them and into ash pit 53 because there is no wall of ash at the front of the grate to hold it in the recesses. To prevent ash from working out of the recesses and between the bars ahead from whence it could not readily escape to the ash pit, a deflecting flange 59 is formed across the inner rear end of each bar. However, as some ash might sift behind the flange, the flange is provided with a notch 61 on each side of the body of the grate bar. Imprisoned ash can escape through these notches. Discharge of ash from the recesses is facilitated by tapering the vertical ribs 57 outward, and by converging the end portion of flanges 56 toward the bases of the recesses.

The grate bars are provided with projections or lugs 62 integral with their fuel-supporting surfaces. These lugs serve to feed ash into the open recesses 58 at the rear end of the grate, and to sweep or push along to the ash pit 53 the small amount of ash which is not transported by the grate. However, the main purpose of the lugs is to aid in breaking or grinding up clinkers so that they too can enter the recesses. The lugs force clinkers into the highly restricted area between the end of the grate and the substantially unyielding wall of ash 51 where the clinkers are mashed and broken into smaller particles which then enter the open recesses and are carried away. Stones, bricks and other foreign matter, which can not be ground up, are forced by the lugs to cut a path through the backing wall of compacted ash.

Due to the sliding action of one row of bars over the other when closing up, the ash in the recesses is not compressed therein, and there is no opportunity for ash to pack between the rows and prevent their coming together. Ash not actually inside the recesses is forced away from them, while medium size particles of ash which are partially lodged in the recesses are either knocked out or sliced off by the closing overlapping bars.

The modified form of grate shown in Figs. 7 and 8 is for the most part the same as that just described. The only structural differences are that the innermost edges and the tips of the overlapped vertical ribs 67 of the grate bars are not provided with lateral flanges, and the inner rear ends of the bars have no deflecting flanges. Consequently, ash enters recesses 68 and accumulates in the spaces 69 between the grate bar supports. In order to prevent any possible interference with the sprockets at the front of the furnace, a plurality of sprockets 70 is substituted for the pulley at the rear of the furnace. The teeth of these sprockets 70 take up substantially all of the space between the strands of each chain at the curved end of the grate, thereby preventing ash from becoming packed in that space. Between the sprockets 70 it is immaterial how the ash arranges itself.

When the rows of grate bars start to close up in entering the lower reach of the grate, vertical ribs 67 cut through the ash disposed in spaces

69. The innermost edges of the vertical ribs are preferably sharply tapered to aid in their cutting action. As the combined capacity of recesses 68 and spaces 69 is large in comparison with the amount of ash to be transported, there is substantially no compression of ash when the rows of bars close up. Furthermore, the ash is free to be lifted up between the chains by the vertical ribs of the bars.

The form of grate illustrated in Figs. 9 and 10 is also similar to the two previously described grates. In this form the inner rear portion of each grate bar is cut away and provided with a backwardly projecting integral flange 81, thereby forming an ash-receiving pocket 82 in the back of the bar. The innermost edges 86 of the vertical ribs 87 of these grate bars are sharply tapered to facilitate their cutting through ash in pockets 82 when the rows close up. These edges are also concave longitudinally to further decrease the possibility of the ribs compressing ash against flanges 86.

The general type of grate bar shown in Fig. 11 may be used in place of any of the bars discussed herein. In this modification grate bars 92, instead of being mounted on grate bar supports which are mounted on links of a chain are made integral with chain links 93. This form eliminates grate bar supports entirely, but, of course, requires a chain link for every bar.

According to the provisions of the patent statutes, I have explained the principle and mode of operation of my invention. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

1. An endless traveling grate extending from front to rear of a furnace in upper and lower reaches connected by curved ends and comprising a plurality of grate bars disposed in transverse rows and having overlapping ends, substantially all of the overlapped end of each of said bars being formed as a vertical rib extending longitudinally of the grate whereby a plurality of normally closed ash-receiving recesses is provided between the ribs in each of said rows for transportation of ash by the grate along its lower reach from the rear to the front of the furnace, and means for pivotally connecting said rows of bars to permit them to pass around said curved ends, said overlapping ends of the bars in each row thereby being moved in a direction away from the bars they overlap as they pass around said curved ends whereby said recesses are opened for receiving ash at one end of the grate and for discharging it at the opposite end.

2. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches connected by curved ends and comprising a plurality of grate bars disposed in transverse rows and having overlapping ends, substantially all of the overlapped portion of each of said bars being formed as a vertical rib provided with a flange extending laterally from all its edges except the one adjacent the bar overlapping the rib whereby a plurality of normally covered ash-receiving and transporting recesses is provided in each of said rows, and means for pivotally connecting said rows of bars to permit them to pass around said curved ends, said overlapping ends of the bars in each row thereby being moved in a direction away from the bars they overlap as they pass around said curved ends whereby said recesses are opened for receiving ash at one end of the grate and for discharging it at the opposite end.

3. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches connected by curved ends and comprising a plurality of grate bars disposed in transverse rows and having overlapping ends, the overlapped portion of each of said bars being formed as a vertical rib, whereby a plurality of normally covered ash-receiving and transporting recesses is provided in each of said rows, each bar being provided with a flange projecting longitudinally thereof between the vertical rib of the bar it overlaps and the inner surface of the grate, and means for pivotally connecting said rows of bars to permit them to pass around said curved ends, said overlapping ends of the bars in each row thereby being moved in a direction away from the bars they overlap as they pass around said curved ends whereby said recesses are opened for receiving ash at one end of the grate and for discharging it at the opposite end.

4. An endless traveling chain grate extending from front to rear of a furnace in upper end lower reaches connected by curved ends and comprising a plurality of grate bars disposed in transverse rows and having overlapping ends, the overlapped portion of each of said bars being formed as a vertical rib having a concave inner edge, whereby a plurality of normally covered ash-receiving and transporting recesses is provided in each of said rows, each bar being provided with a flange projecting longitudinally thereof between the vertical rib of the bar it overlaps and the inner surface of the grate, and means for pivotally connecting said rows of bars to permit them to pass around said curved ends, said overlapping ends of the bars in each row thereby being moved in a direction away from the bars they overlap as they pass around said curved ends whereby said recesses are opened for receiving ash at one end of the grate and for discharging it at the opposite end.

5. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches and comprising a plurality of transversely extending fuel-supporting sections serially disposed longitudinally of the grate in overlapping relation, the overlapped portion of each of said sections being provided with a plurality of small recesses for receiving only relatively fine ash and small lumps thereof and transporting it along the lower reach of the grate from the rear to the front of the furnace, and means for pivotally connecting said sections together to form an endless chain grate, the overlapping portion of each section thereby being moved in a direction away from the section it overlaps as it passes from one reach to the other whereby said recesses are opened at the rear end of the grate for receiving ash and at the forward end for discharging it.

6. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches and comprising a plurality of grate bars arranged in transverse sections or rows and having overlapping ends, the overlapped portion of each of said rows being provided with a plurality of small recesses for receiving only relatively fine ash and small lumps thereof and transporting it along the lower reach of the grate from the rear to the

front of the furnace, and means for pivotally connecting said rows of bars to form an endless chain grate, the overlapping portion of each row thereby being moved in a direction away from the row it overlaps as it passes from one reach to the other, whereby said recesses are opened at the rear end of the grate for receiving ash and at the forward end for discharging it.

7. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches and comprising a plurality of transversely-extending fuel-supporting sections serially disposed longitudinally of the grate in overlapping relation, the overlapped portion of each of said sections being provided with a plurality of small recesses for receiving only relatively fine ash and small lumps thereof and transporting it along the lower reach of the grate from the rear to the front of the furnace, and means for pivotally connecting said sections together to form an endless chain grate, the overlapping portion of each section thereby being moved in a direction away from the section it overlaps as it passes from one reach to the other whereby said recesses are opened at the rear end of the grate for receiving ash and at the forward end for discharging it, the outer surface of the grate being provided with clinker breakers.

8. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches and comprising a plurality of transversely-extending fuel-supporting sections serially disposed longitudinally of the grate in overlapping and substantially contacting relation, the overlapped portion of each of said sections being provided with a plurality of recesses for transporting ash along the lower reach of the grate, and means for pivotally connecting said sections together to form an endless chain grate, the overlapped surface of each section being formed as an arcuate portion of a cylindrical surface coaxial with the axis on which said section and the adjacent overlapping section pivot relative to each other whereby the cooperating overlapped and overlapping surfaces of each pair of adjacent sections move relative to each other in concentric paths in opposite directions to open said recesses as they pass from one reach to the other at the ends of the grate to receive ash at the rear end of the grate and to discharge it at the forward end.

9. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches connected by curved ends and comprising a plurality of grate bars disposed side by side in transverse rows and having overlapping ends substantially in contact with the bars in the next row in line, the overlapped portion of each of said rows being provided with a plurality of recesses for receiving and transporting ash, means for pivoting each of said rows to the next adjacent row on a single transverse axis, said adjacent rows being movable relative to each other on said axis only, the overlapped surface of each row being formed as an arcuate portion of a cylindrical surface coaxial with the axis on which said row and the adjacent overlapping row pivot relative to each other, whereby all of the rows remain substantially in contact with one another throughout their path of travel and the cooperating overlapped and overlapping surfaces of each pair of adjacent rows move relative to each other in concentric paths in opposite directions to open said recesses at one of said curved ends for receiving ash, to then close them for transporting ash along said lower reach, and to then open them for discharging ash at the opposite curved end.

10. An endless traveling chain grate extending from front to rear of a furnace in upper and lower reaches connected by curved ends and comprising a plurality of grate bars disposed side by side in transverse rows and having overlapping ends substantially in contact with the bars in the next row in line, substantially all of the overlapped end of each of said bars being formed as a vertical rib whereby a plurality of normally covered ash-receiving and transporting recesses is provided between the ribs in each of said rows, means for pivoting each of said rows to the next adjacent row on a single transverse axis, said adjacent rows being movable relative to each other on said axis only, the overlapped surface of each row being formed as an arcuate portion of a cylindrical surface coaxial with the axis on which said row and the adjacent overlapping row pivot relative to each other, whereby all of the rows remain substantially in contact with one another throughout their path of travel and the cooperating overlapped and overlapping surfaces of each pair of adjacent rows move relative to each other in concentric paths in opposite directions to open said recesses at one of said curved ends for receiving ash, to then close them for transporting ash along said lower reach, and to then open them for discharging ash at the opposite curved end.

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