F. W. HEDDEN.

TRAVELING STOKER GRATE.

APPLICATION FILED SEPT. 21, 1909. RENEWED MAY 4, 1911.

1,010,758. Patented Dec. 5, 1911.

2 SHEETS—SHEET 1.

FIG. 1.

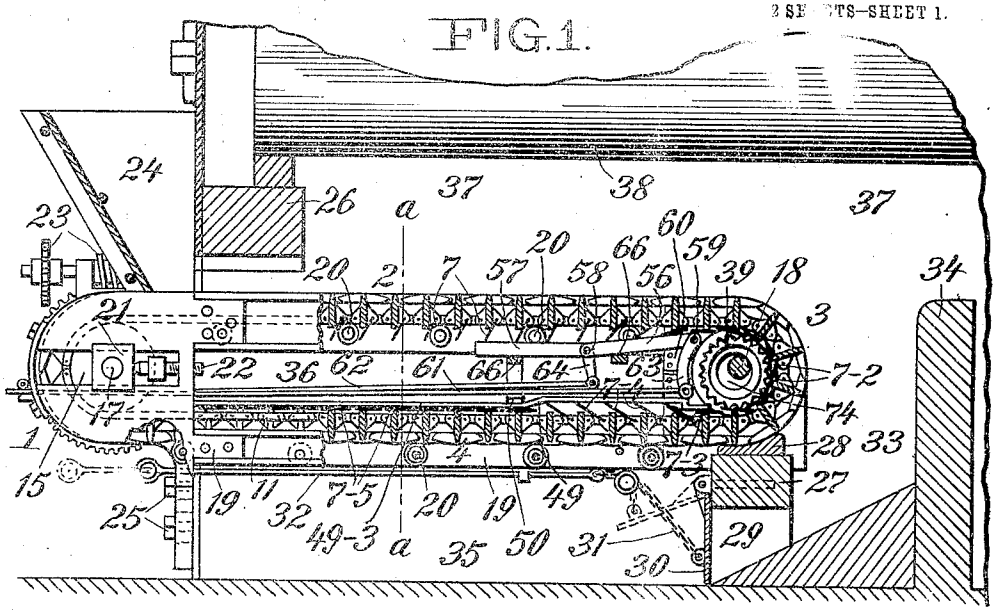


FIG. 2.

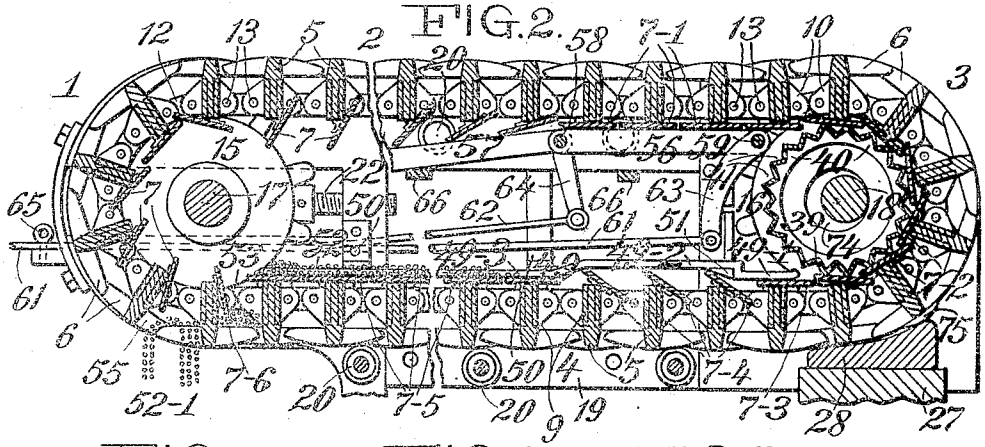


FIG. 3.

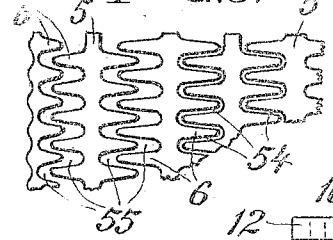


FIG. 4.

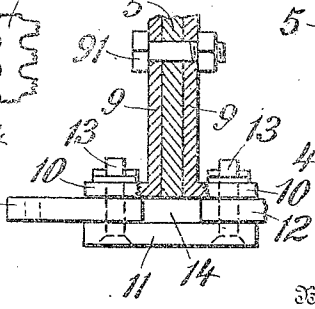


FIG. 5.

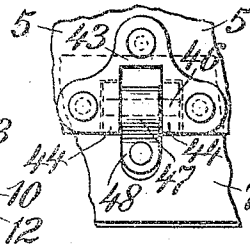
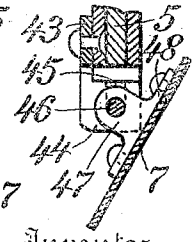


FIG. 6.



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2 SHEETS—SHEET 2.

FIG. 7.

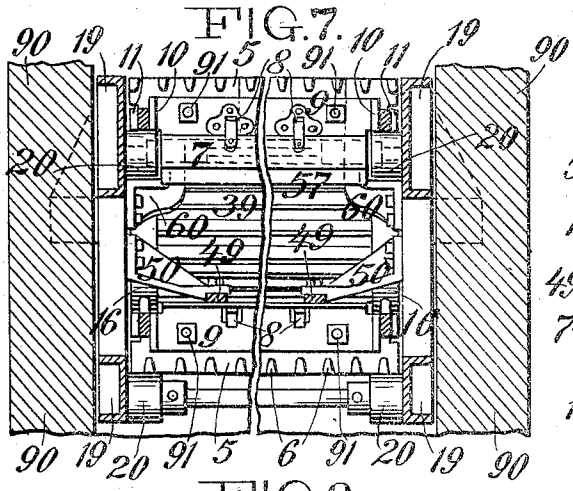


FIG. 8.

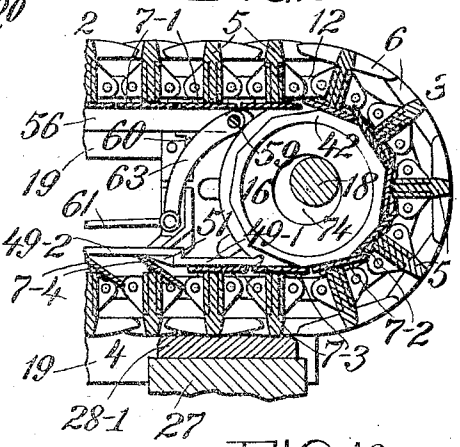


FIG. 9.

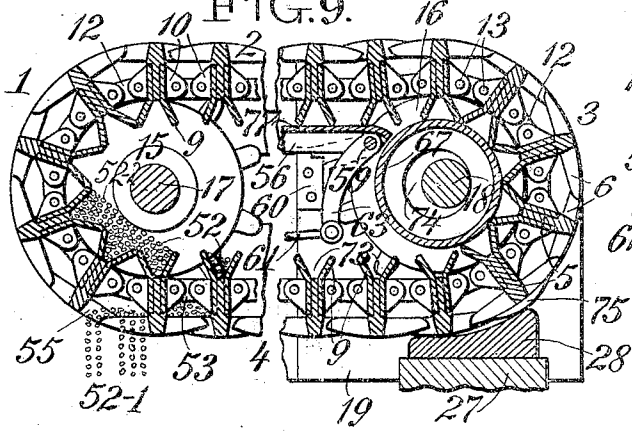


FIG. 10.

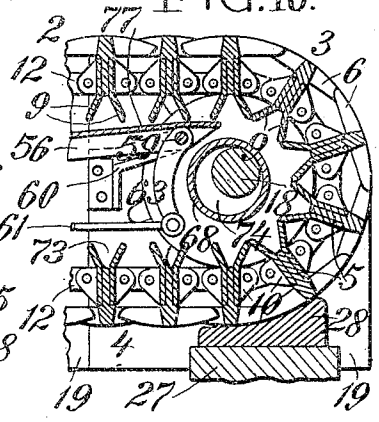


FIG. 11.

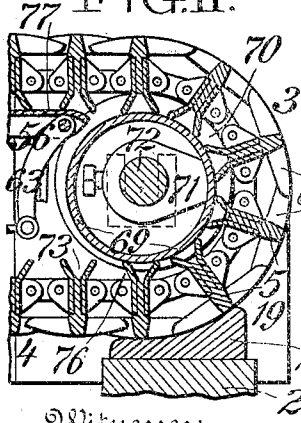


FIG. 12.

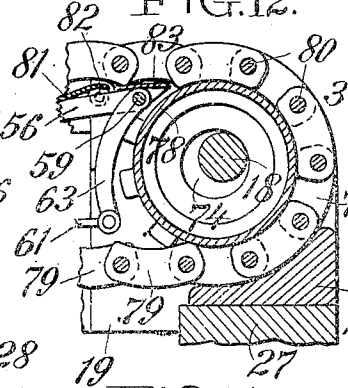


FIG. 13.

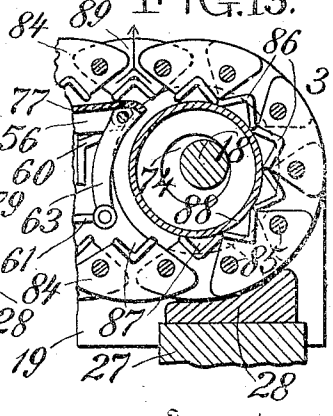
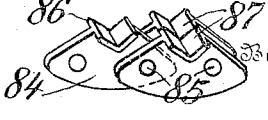


FIG. 14.



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UNITED STATES PATENT OFFICE.

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TRAVELING STOKER-GRATE.

1,010,758. Specification of Letters Patent. Patented Dec. 5, 1911.

Application filed September 21, 1909. Serial No. 518,761. Renewed May 4, 1911. Serial No. 625,084.

To all whom it may concern:

Be it known that I, FRANK WILMARTH HEDDEN, a citizen of the United States of America, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Traveling Stoker-Grates, of which the following is a specification.

This invention relates to mechanical stokers for automatically firing steam boiler or other furnaces.

The invention has for its object to provide improved air-seals at rear portions of the traveling grate without using parts liable to quickly burn out and without employing ashes or other unreliable friable material as an air-sealing medium; and to provide for grinding soft clinkers from the fuel-carriers and prevent clogging or jamming of the grate by hard clinkers on said carriers; and to catch and convey to and discharge at the furnace front the fine good fuel which sifts through draft openings of the grate; and to provide a simple and efficient system of draft regulating dampers at the grate ash-zone.

The invention will first be described and then will be specified in the appended claims.

In the accompanying drawings forming part of this specification, Figure 1 is a partly broken out longitudinal section of a preferred type of stoker grate arranged within a stationary steam boiler furnace. Fig. 2 is an enlarged sectional side view of the grate with central portions broken out. Fig. 3 is a bottom plan view of parts of a few front grate bars. Fig. 4 is an enlarged sectional plan view showing the driving chain connections of transverse grate bars. Figs. 5 and 6 are detailed face and side views showing a preferred hinge connection for the independently movable inner part of the grate bar web. Fig. 7 is an enlarged centrally broken-out transverse vertical section on the line *a*—*a* in Fig. 1. Fig. 8 is a sectional side view of the rear grate turn omitting the inner drum and with a forwardly arranged flat outer abutment. Fig. 9 is a centrally broken-out sectional side view showing front and rear turns of a modified grate. Fig. 10 shows the rear grate turn of Fig. 9, without an inner air-sealing drum. Fig. 11 shows how an independently movable air-sealing drum may be used between disk wheels supporting the rear grate turn. Fig. 12 shows a modified longitudinal link-grate and ash-zone dampers. Fig. 13 shows a link-grate having inner fuel-sifting conveyers, and Fig. 14 is a perspective view of a few assembled links used in Fig. 13.

Referring now more especially to Figs. 1 to 6 of the drawings, the numeral 1 indicates the front turn of the endless grate, 2 is the upper grate run, 3 is the rear grate turn, and 4 is the lower grate run. It now is preferred to use fuel-carriers formed as transverse grate bars having a main imperforate or air-excluding web portion 5 provided with outer longitudinally projecting teeth or fingers 6 which loosely intermesh with teeth of adjoining bars to form a draft-providing fuel bed at the upper grate run. Each grate bar web comprises the part 5, and an inner imperforate movable part which is preferably made as a plate 7 coupled by hinges 8 to the main web portion 5.

The transverse grate bars are preferably coupled together. This is done by forming or providing a fixed longitudinal lug 10 on each end of two steel plates 9, 9 which form front and rear portions of the inner part of the main bar web 5. The two lugs 10, 10 at each end of the web oppose an outer link 11, and between the parts 10, 11, are placed the ends of links 12, 12. All parts 10, 11, 12, are pivoted together by removable bolts or pins 13, as shown in Fig. 4. The spaces 14, between the ends of the links 12, receive the teeth of front and rear sprocket wheels 15, 16, respectively mounted on transverse shafts 17, 18, supported in the stoker side frames 19, 19. These frames carry rollers 20, sustaining the upper and lower grate runs 2, 4. The front shaft 17 is journaled in movable boxes 21, operated by screws 22, for taking up undue slackness of the endless grate. The grate may be operated by ordinary worm-wheel and ratchet gearing 23, or by any other mechanism.

The stoker front is adjustable vertically with a hopper 24, and may be supported by bolts 25, or otherwise, to regulate the depth of fuel fed from the hopper upon the upper grate run 2, under the ignition arch 26. The rear portion of the grate is supported by the sprocket wheels 16, and also by an outer air-sealing and clinker-grinding abutment which may be the top of a low wall 27, built across the furnace but is preferably a metal block or cap 28, fixed to said wall. This wall may have an opening 29, which

is normally closed by a door 30. A chain 31, is coupled to the door and to a rod 32. By pulling this rod the door may at times be opened to allow ashes which had fallen from the rear grate turn 3, to flow from a rear ash-pit 33, formed between the wall 27, and a higher wall 34, into the front ash-pit 35. This pit 35, and the space or chamber 36, between the upper and lower grate runs 2, 4, form the air-intake, and the hot products pass through the main combustion chamber 37, and around or through a steam boiler 38, or other structure set above or near the grate.

To prevent passage of air from the air-intake 35—36, into the combustion chamber 37, except as needed for maintaining proper combustion of fuel on the upper grate run 2, it is necessary to provide both inner and outer air-sealing means or devices at rear parts of the traveling grate. The improved air-sealing means constitute important features of this invention and are adapted to grates having fuel carriers made with either movable or immovable inner portions. The air sealing means as applied to an endless grate having transverse fuel carriers formed with inner movable web parts 7, will first be described. With these fuel carriers 5—6—7, there is preferably used within the rear grate turn 3, a transverse drum 39, shown corrugated and fastened to flanges 40 on the inner faces of the opposite sprocket wheels 16, 16. As the grate bars form the rear grate turn 3, the drum 39, acting as a guide, folds the movable web parts 7 on their hinges 8, as at 7—2, in Figs. 1 and 2, and edge portions of the parts 7—2 then abut or closely approach each other, and said parts 7—2 also abut the inner edges of the web parts 5. The grate turn 3 thus is air-sealed from within or at the inside by edgewise contact of inner parts 7—2 of adjoining grate bars. Each web part 7—2 also has two lines of air-sealing contact with two parallel ridges of the corrugated drum 39, thus further assuring an effective air-seal at the inside of the grate turn 3. Each grate bar 5—6—7, thus preferably has four air-sealing places, two with adjoining bars and two with the drum. The drum corrugations also provide pockets 41 receiving fine ashes which thus cannot prevent effective air-sealing adjustment at 7—2, of the movable web parts 7. Should the drum 39 be omitted the inner air-seal at the grate turn 3 would be made by the grate bar parts 7 when adjusted as at 7—2, by inner flange guides 42 on the sprocket wheels 16, as shown in Fig. 8 of the drawings. The outer abutment 28 spans the space between the main imperforate web parts 5 of any two adjoining grate bars and thus coacts with said parts 5 and the inner imperforate grate bar web parts 7, when closed at 7—2, to completely air-seal the inside and outside of rear parts of the grate.

The web hinges 8 are specially designed to allow the web part 7 to turn the angular corner of the main web part 5, or its plate 9, and to later fold closely against the inner edge of the part 5 to then prevent passage of air between said parts 5, 7. The hinges 8 comprise one member 43 fixed to the part 5 or its plate 9, and having lugs 44 provided with vertical slots 45. These slots receive the ends of a pin 46 which is fixed in a lug 47 on the other hinge member 48 fastened to the web part 7. The main web part 5, or 5—9, is notched to receive the hinge lugs and to permit rising of the pin-carrying lug 47 as the folding web part 7 settles snugly against the inner edge of the main web part 5 while the pin ends rise in the lug slots 45.

The hinged web parts 7 preferably have sufficient width when folded to fully close edge-to-edge at the upper and lower grate runs 2, 4, to there form the most effective draft dampers and fuel siftings conveyers hereinafter described. This causes the edge portion of one web part 7 to slightly overlap the edge of the adjoining part 7 while they at 7—2, travel together around the rear grate turn 3 to internally air-seal it by edgewise contact as above described. This phrase "edgewise contact" includes this slight preferred edge overlapping of the web parts 7 at the rear grate turn, as well as a true edge-to-edge contact which there would occur if the parts 7 were made narrower and then would not tightly close edgewise at the upper and lower grate runs.

The outer abutment 28 may be located directly under the rear grate turn 3, as shown in Figs. 1 and 2, and 9 to 13, and then has a concave face fitting a portion of said turn 3. The outer abutment also may have a flat top and then would be located forward of the grate turn 3, as shown at 28—1, in Fig. 8. When the concave abutment 28 is used it is desirable, and when the flat abutment 28—1 is used it is necessary, to continue closure of one or more of the bar web parts 7 at the lower grate run directly in front of the rear grate turn to there form an inner air-seal or barrier.

Lower guides coact with the grate bar web parts 7 for various purposes. These guides preferably comprise two or more longitudinal bars 49 fixed at their longer front portions 49—3, to overlying brackets 50 which are fastened to the opposite side frames 19. The upwardly yielding rear parts of the bars 49 comprise intermediate higher-level portions 49—2, and extreme rear portions 49—1, which are at the same lower level as the front guide parts 49—3. Brackets 51 fixed to the frames 19, have ends which underlie the guide bars 49 at the points of

junction of their parts 49—1, 49—2. The guide bars normally rest upon said brackets 51, and may rise therefrom.

As the closed grate bar web parts 7—2, pass forward from the air-sealed rear grate turn 3, they run under the guide bar ends 49—1, which hold them closed edgewise as at 7—3, to convey ashes falling from the drum at the turn 3, until said closed parts 7—3, pass along under the higher guide bar parts 49—2, which permit said closed parts 7—3, to tilt open as at 7—4, and discharge the ashes into the front ash-pit 35. As the opened web parts 7—4, move forward under the guide bar parts 49—3, they are again automatically closed edgewise as at 7—5, and then serve as conveyers which carry toward the furnace front practically all of the fine good fuel 52 which sifts through draft openings of the front portion of the upper grate run 2. These fuel siftings 52 thus are conveyed forward until the closed web parts 7—5, pass the front ends of the guide-bars 49, when said web parts successively and fully tilt open downward as at 7—6, and discharge the fuel siftings into a chamber 53, formed between the teeth 6 and web parts 5—7, of two adjoining grate bars. As these bars begin their front turn at 1 around the sprocket wheels 15, the narrow sinuous openings 54 which appeared at the lower grate run 4, between the teeth 6 of adjoining bars become much larger openings 55 around the diverging bar teeth, as shown in Figs. 2 and 3, and the fuel siftings 52 in the chamber 53, gravitally escape through said enlarged openings 55, as shown at 52—1, in Fig. 2, and fall outside the furnace front and later will be re-charged into the fuel feeding hopper 24. Any desired number of the movable grate bar web parts 7, may be permitted to open at 7—4, five being so shown in Fig. 1, three in Fig. 2, and two in Fig. 8.

In view of varying depths of fuel on the upper grate run 2, and of varying speeds of travel of the grate, and of varying draft pressures maintaining combustion of fuel on the grate, it is desirable and sometimes necessary to provide adjustable air-barriers or dampers at or below the rear part or ash-zone of said upper grate run. Mechanical stokers have hertofore had various types of ash-zone dampers. It is new to use inner movable grate bar web parts 7 as such dampers and to close them by subjacent pivoted frames two or more of which may be used. Two frames 56, 57, are shown and they are pivoted together by the shaft 58 on the front frame 57, while the rear frame 56 is pivoted by its shaft 59 to brackets 60, fixed to the stoker side frames 19. Any approved mechanism may be used to successively raise the pivoted frames 56, 57, such as rods 61, 62, coupled to crank-arms 63, 64, fixed to the frame pivot shafts 59, 58. When the rear frame 56 is raised about level by pulling the rod 61, said frame will be locked suitably, say by a pin 65, passed through the rod into a side frame 19. All grate bar web parts 7, passing over said raised frame 56, will be closed edge-to-edge as at 7—1, in Figs. 2 and 8, to serve as dampers cutting off air draft through all that portion of the grate ash-zone overlying said parts 7—1, while web parts 7 overlying the front still lowered frame 57, will remain open, as in Fig. 2. Should larger closed damper area be required this may be obtained by pulling the rod 62, thereby turning the shaft 58 and raising the front frame 57 which then will be locked to cause closure as at 7—1, of all pivoted web parts 7 moving over said frame. By unlocking and retracting the rods 62, 61, the pivoted frames 57, 56 will successively swing downward to allow superposed closed web damper plates 7—1, to again gravitally open, as shown in Fig. 1. The lowered frames rest upon cross-bars or other stops 66, which are fixed to the stoker side frames 19, and hold the lowered frames clear above the moving lower grate run 4. The swinging damper-plates actuated by the pivoted frames thus cut off passage of air through any desired definite area of the grate ash-zone and thereby avoid the bad effects of open blow-holes at thinner rear portions of the fire on the grate. Should three frames be used to assure still larger ash-zone damper area, the third frame would be pivoted to the front end of the frame 57, and would have its own pull-rod connections for raising it after the two frames 56, 57 were raised, thus closing more web parts 7 at 7—1, substantially as above described.

From the above description it will be obvious that inner movable or hinged grate bar parts or plates 7, are automatically closed at 7—1, for any desired grate ash-zone area by the pivotally connected frames 56, 57, one of which also is pivoted to relatively fixed supports, and said parts 7 are closed at 7—2, by the drum 39, or by the equivalent sprocket wheel flanges 42, to internally air-seal the rear grate turn 3, and said parts 7, are closed at 7—3, by the guides 49, to make an inner air-seal and to convey ashes forward, and these guides also permit the parts 7, to open at 7—4, to dump said ashes and then close them at 7—5, to catch and convey forward the good fuel siftings, and the guides also permit tilting of the parts 7, at 7—6, for dumping the recovered siftings prior to their final discharge at 52—1, at the furnace front.

Figs. 9 and 10 of the drawings show that the inner air-seal of the rear grate turn 3, and the fuel siftings conveyers, may be formed by transverse grate bars having outer parts 5—6, like the bars shown in

Figs. 1 and 2, but having inner unhinged or rigid web portions preferably formed by inner parts of the bar side plates 9, 9, which are diverged sufficiently to cause them to abut or quite closely approach each other edgewise to make the air-seal at the grate turn 3. With this type of grate bar may be used an inner cylindrical drum 67, fixed to the sprocket wheels 16, as in Fig. 9. With this drum the diverged inner parts of each grate bar have two air-sealing places or lines of contact. In Fig. 10, where the drum 68 is too small to allow the grate bars to touch it, each grate bar has but two air-sealing places or lines of contact at its plates 9, 9, with the adjoining bars, substantially as have the movable grate bar parts 7, when adjusted at 7—2, in Fig. 8. In Fig. 9, each grate bar has four air-sealing places or lines of contact, or two with adjoining bars and two with a drum, substantially as have the movable grate bar parts 7, when adjusted at 7—2, in Figs. 1 and 2.

Fig. 11 sufficiently shows that an inner air-sealing drum 69 may be placed loosely within the rear grate turn 3, between opposite disk-wheels 70, and may bear upon thrust blocks 71, which are fixed or bolted to a non-revoluble shaft 72. This permits upward yielding of the drum 69, with the lower part of the rear grate turn 3, without lifting the heavy wheels 70, which may turn upon the shaft 72. Fig. 11 also shows that the diverged inner parts of transverse grate bar webs need not touch each other when they make radial contact with an inner drum of any kind at the rear grate turn 3, if a solid air-sealing and clinker-grinding abutment 28 be used at the outer face of the grate.

The diverged inner web parts of the grate bars shown in Figs. 9, 10 and 11, form cups 73, which at the lower grate run 4, catch good fuel siftings 52, which fall through the upper grate run 2, and convey them forward, and Fig. 9 shows how said siftings may pile upward more or less within the closed front grate turn at 52—2, and roll backward into the grate chamber 53, at the junction of the lower grate run 4 and front grate turn 1. As the grate continues its movement its bar fingers diverge to produce around them the larger openings 55, through which the recovered siftings fall from the chamber 53, as shown at 52—1, in Fig. 9, and substantially as when the hinged web conveyers 7 of Figs. 1 and 2 are used. Ashes may lodge in the cup conveyers 73 at rear portions of the grate, and these separated cups will not catch at the lower grate run 4, all the good fuel which sifts through the upper grate run, and the siftings prior to their final discharge are piled up at 52—2, inside the abutting cups 73 at the closed front grate turn. These objections do not apply to the grate having inner movable web portions 7, which open at 7—4, to prevent mixing of ashes with the recovered fuel siftings, and all of these siftings lodge on the lower closed web parts 7—5, which when opened at 7—6, permit the siftings to fall directly into the chamber 53, whence they finally escape at 52—1, without having been piled up within the front grate turn.

The important upward yielding of the rear grate turn 3, will now be fully explained. The object of this yielding is to allow clinker-holding or warped fuel carriers to easily pass over any outer support for rear portions of the grate without jamming or stopping the grate. In Figs. 1, 2, 8, 9, 10, 12 and 13, the rear grate turn supporting wheels 16 are bored larger than the shaft 18 to provide next the shaft a clearance space 74, permitting the wheels to swing upward and forward eccentrically. The outer abutment 28, or 28—1, is so located that most of the weight of the wheels 16, the grate turn 3, and the inner drum when used, will fall upon the shaft while allowing said grate turn to bear heavily enough upon the outer abutment to cause said abutment to grind all soft hot clinkers from the fuel-carrying faces of the grate and without lifting said grate turn 3. Should a hard clinker 75 on the fuel carrier pass unground over the abutment it will, as shown in Figs. 2 and 9, simply raise one end of the grate turn 3, and the inner drum when used and one sprocket wheel 16, until the clinker passes forward off the abutment and the parts again resume normal positions shown in Figs. 1 and 10. Passage of an edgewise warped grate bar over the outer abutment would in like manner temporarily raise the grate turn 3. With the loose drum 69, of Fig. 11, a hard clinker or warped grate bar would lift the drum as it turns slightly upon the fixed thrust-blocks 71, there being sufficient lower clearance space at 76 between the wheels 70, and the sagged grate bar couplings to permit this independent drum movement. With the grate bars having inner movable web portions 7, and lower guides 49 operating them, the rear guide parts 49—1, and 49—2, are temporarily lifted from the brackets 51, when the rear grate turn is lifted at one end by a hard clinker 75 riding over either outer abutment 28 or 28—1, and whether the inner air-sealing drum be used or omitted.

Figs. 9, 10 and 11, show that with grate bars having air-sealing parts or cups 73, later forming fuel siftings conveyers, the swinging ash-zone dampers are to be thin plates 77, fixed one to the top of each of the swinging pivoted frames 56, 57. When these frames are successively raised and lowered by operating their pull-rods as

above described, the plates 77, swing with the frames and thus are made to close and open the spaces between said cups 73, to control the draft through the grate ash-zone.

Fig. 12 shows an inner yielding air-sealing drum 78 and an outer concaved air-sealing and clinker-grinding abutment 28, with an endless grate formed of series of longitudinal links 79, hung at their side-lapped ends upon transverse pivot rods 80. These side-lapped link ends together form transversely ranging air-excluding grate portions the longitudinal space between any two of which is spanned or closed by the inner drum 78, and the outer abutment 28, to form inner and outer air-seals at the grate turn 3. Fig. 12 also shows one of a series of short swinging damper-plates 81, which are pivoted at 82, to the opposite fixed side frames 19. Underlying pivoted frames 56, 57, are to be adjusted to close and open said damper-plates 81, at the grate ash-zone. A space-bridging damper-plate 83, is fixed to the frame 56, between the rearmost swinging plate 81, and the drum 78.

Figs. 13 and 14, show that longitudinal links 84, which are pivoted at their thinner side-lapped ends upon transverse rods 85, have angular flanges 86, which abut transversely and thus form a continuous transverse fuel siftings conveyer 87. These conveyers 87, act like the above named grate bar cups 73, in abutting each other to form an inner air-seal at the rear grate turn 3, whether the inner drum 88, be used or omitted. Air supporting combustion passes upward between adjoining conveyers 87, and through small openings 89, between the link ends, as indicated by the arrow, and the good fuel siftings are finally discharged through these openings when enlarged at the front grate turn 1. Damper-plates 77, may be fixed to swinging frames 56, 57, to control the draft through the ash-zone of this link grate. Grates made with either links 79 or 84, also may rest upon a forwardly located flat abutment 28—1, if an air-barrier plate be fitted inside the lower grate run 4, between the grate turn 3 and said flat abutment.

In all the above described forms of the invention the opposite ends of the rear grate turn are air-sealed by opposite sides 19, 19 of the stoker frame, or by opposite furnace side walls 90, 90, should said parts 19, be omitted. Whether the transverse grate bars have movable inner parts 7, or have rigid inner air-sealing parts, it is preferred to make their fuel-carrying portions 5—6, in two or three or more transversely alined cast-iron sections held to and between the steel side plates 9, 9, by bolts 91, as shown in Figs. 4 and 7, to permit easy renewal of any injured fuel-carrying part without stopping the grate.

There are special advantages in using fuel carriers formed as transverse grate bars having either movable or rigid inner air-sealing portions which may also recover the fuel siftings, as compared with longitudinal link grates such as shown in Figs. 12 and 13. All such link grates have many joints through which objectionable air leakage may occur at rear parts of the grate. Transverse grate bars avoid this air leakage and their outer fuel-carrying parts also may be easily renewed without stopping the grate while link-grates usually are stopped to renew worn-out links.

When the outer air-sealing abutment 28, is used under the internally air-sealed grate turn 3, and when ash-zone dampers at the grate run 2, may not be required, air-sealing of the interior of the grate to prevent passage of excessive volume of air from the intake 35—36, into the combustion chamber 37, is effected by the inner air-seals at the rear grate turn 3. Should this abutment 28, be used with the grate turn inner air-seals and with required ash-zone dampers, said dampers then would complete necessary air-sealing of the interior of the grate. Should the flat forward outer abutment 28—1, be used with inner air-seals at the grate turn 3, and should ash-zone dampers be omitted, necessary air-sealing of the interior of the grate would be completed by the web plates 7, when closed at 7—3, in Fig. 8. Should this abutment 28—1, be used with the grate turn inner air-seals and with ash-zone dampers, these dampers and the closed web plates 7—3, or an equivalent air-barrier plate, then would complete necessary air-sealing of the interior of the grate.

The terms "imperforate" and "air-excluding" and "abut" or "abutting" used in this specification are to be construed as including substantially imperforate air-excluding parts of the fuel carriers which either touch or quite closely approach each other or the inner drum or the outer fixed abutment to air-seal rear portions of the grate in manner substantially as above described.

An inventor should disclose and have patent protection for the best or more complete devices and their combinations which may be used most advantageously, and he should also clearly specify and have patent protection for all novel sub-combinations of parts which may be used with perhaps less advantage but with good practical results. It is believed that all such combinations and sub-combinations of parts contributing more or less to the advantageous use of this invention and specified in the appended claims, will be clearly understood without further detailed description.

I claim as my invention:—

1. A traveling stoker grate movable be-

tween an air-intake and a combustion chamber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel-combustion zone of the grate and including said grate bar webs which abut each other edgewise at the grate turn and thereby form an inside air-seal at said turn, and a barrier opposing said webs and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

2. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel-combustion zone of the grate and including said grate bar webs which abut each other edgewise at the grate turn and also radially abut a portion of said grate turn supports and thereby form an inside air-seal at the grate turn, and a barrier opposing said webs and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

3. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers having transversely ranging air-excluding parts, supports sustaining the fuel-carriers at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said transversely ranging parts of the fuel-carriers which abut each other edgewise at the grate turn and thereby form an inside air-seal at said turn, and a non-friable clinker-grinding abutment opposing said transversely ranging parts of the fuel-carriers and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

4. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said grate bar webs which abut each other edgewise at the grate turn and thereby form an inside air-seal at said turn, and a non-friable clinker-grinding abutment opposing said webs and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

5. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers having transversely ranging air-excluding parts, supports sustaining the fuel-carriers at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said transversely ranging parts of the fuel-carriers which radially abut a portion of said grate turn supports and thereby form an inside air-seal at the grate turn, and an immovable non-friable clinker-grinding abutment opposing said transversely ranging parts of the fuel-carriers and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

6. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said grate bar webs which radially abut a portion of said grate turn supports and thereby form an inside air-seal at the grate turn, and an immovable non-friable clinker-grinding abutment opposing said webs and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

7. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers having transversely ranging air-excluding parts, supports sustaining the fuel-carriers at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said transversely ranging parts of the fuel-carriers which abut each other edgewise at the grate turn and also radially abut a portion of said grate turn supports and thereby form an inside air-seal at the grate turn, and a non-friable clinker-grinding abutment opposing said transversely ranging parts of the fuel-carriers and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

8. A traveling stoker grate movable between an air-intake and a combustion cham-

ber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said grate bar webs which abut each other edgewise at the grate turn and also radially abut a portion of said grate turn supports and thereby form an inside air-seal at the grate turn, and a non-friable clinker-grinding abutment opposing said webs and air-sealing the outside of rear portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

9. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers having transversely ranging air-excluding parts, supports sustaining the fuel-carriers at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said transversely ranging parts of the fuel-carriers which abut each other edgewise at the grate turn and thereby form an inside air-seal at said turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between any two adjacent transversely ranging air-sealing portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

10. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said grate bar webs which abut each other edgewise at the grate turn and thereby form an inside air-seal at said turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between the webs of any two adjoining grate bars, and necessary barriers completing air-sealing of the interior of the grate.

11. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers having transversely ranging air-excluding parts, supports sustaining the fuel-carriers at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said transversely ranging parts of the fuel-carriers which radially abut a portion of said grate-turn supports and thereby form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between any two adjacent transversely ranging air-sealing portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

12. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said grate bar webs which radially abut a portion of said grate turn supports and thereby form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between the webs of any two adjoining grate bars, and necessary barriers completing air-sealing of the interior of the grate.

13. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers having transversely ranging air-excluding parts, supports sustaining the fuel-carriers at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said transversely ranging parts of the fuel-carriers which abut each other edgewise at the grate turn and also abut a portion of said grate turn supports and thereby form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between any two adjacent transversely ranging air-sealing portions of the grate, and necessary barriers completing air-sealing of the interior of the grate.

14. A traveling stoker grate movable between an air-intake and a combustion chamber and comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports sustaining said grate bars at the rear grate turn, and a system of air-sealing barriers coacting to cut off the combustion chamber from the air-intake except at the fuel combustion zone of the grate and including said grate bar webs which abut each other edgewise at the grate turn and also radially abut a portion of said

grate turn supports and thereby form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between the webs of any two adjoining grate bars, and necessary barriers completing air-sealing of the interior of the grate.

15. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, devices flexibly coupling the fuel-carriers together, supports sustaining the coupled fuel-carriers at the rear grate turn, said fuel-carriers and their coupling devices and supports coacting to form an inside air-seal at the grate turn, and an immovable non-friable clinker-grinding abutment opposing said transversely ranging parts of the coupled fuel-carriers and air-sealing the outside of rear portions of the grate.

16. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, devices flexibly coupling the grate bars together, supports sustaining the coupled grate bars at the rear grate turn, said grate bars and their coupling devices and supports coacting to form an inside air-seal at the grate turn, and an immovable non-friable clinker-grinding abutment opposing the webs of the coupled grate bars and air-sealing the outside of rear portions of the grate.

17. A traveling stoker grate comprising fuel-carriers having inner conveyers adapted at the lower grate run to catch unconsumed fuel siftings dropped from the upper grate run and to carry said siftings to and discharge them at the front or outer portion of the grate.

18. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having inner conveyers adapted at the lower grate run to catch unconsumed fuel siftings dropped from the upper grate run and to carry said siftings to and discharge them at the front or outer portion of the grate.

19. A traveling stoker grate comprising fuel-carriers having outer portions forming a fuel bed at the upper grate run and having inner fuel siftings conveyers at the lower grate run, said outer portions of the fuel-carriers separating farther at the front grate turn to there permit final discharge of recovered fuel siftings.

20. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having outer portions forming a fuel bed at the upper grate run and having inner fuel siftings conveyers at the lower grate run, said outer portions of the grate bars separating farther at the front grate turn to there permit final discharge of recovered fuel siftings.

21. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having webs provided at outer parts with teeth or fingers which intermesh at the upper grate run to there form a fuel bed, said webs having inner fuel siftings conveyers at the lower grate run, the web teeth separating farther at the front grate turn to there permit final discharge of recovered fuel siftings.

22. A traveling stoker grate comprising a series of fuel-carriers having inner fuel siftings conveyers which by edgewise contact with each other at the rear grate turn form an inside air-seal at said turn.

23. A traveling stoker grate comprising a series of fuel-carriers formed as transverse grate bars having inner fuel siftings conveyers which by edgewise contact with each other at the rear grate turn form an inside air-seal at said turn.

24. A traveling stoker grate comprising fuel-carriers having inner fuel siftings conveyers, and a drum or abutment arranged within the rear grate turn and with which said conveyers are in contact thereby forming an inside air-seal at said turn, and means air-sealing the outer face of the grate.

25. A traveling stoker grate comprising fuel-carriers having inner fuel siftings conveyers, and a drum or abutment arranged within the rear grate turn and with which the conveyer of each fuel-carrier has two air-sealing contacts thereby forming an inside air-seal at said turn, and means air-sealing the outer face of the grate.

26. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having inner fuel siftings conveyers, and a drum or abutment arranged within the rear grate turn and with which said conveyers are in contact thereby forming an inside air-seal at said turn, and means air-sealing the outer face of the grate.

27. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having inner fuel siftings conveyers, and a drum or abutment arranged within the rear grate turn and with which the conveyer of each grate bar has two air-sealing contacts thereby forming an inside air-seal at said turn, and means air-sealing the outer face of the grate.

28. An endless traveling stoker grate comprising fuel-carriers formed as transverse grate bars having an air-excluding main web portion provided with outer fuel sustaining parts, and an air-excluding inner auxiliary web plate or part hinged to said main web portion and coacting therewith in air-sealing functions.

29. An endless traveling stoker grate comprising fuel-carriers each including an air-excluding main web portion having outer longitudinal fuel-sustaining teeth or fingers, and an air-excluding inner auxiliary web

plate or part hinged to said toothed main web portion and coacting therewith in air-sealing functions.

30. A traveling stoker grate comprising fuel-carriers having an air-excluding main web portion provided with outer fuel-sustaining parts, and an air-excluding inner auxiliary web plate or part hinged to said main web portion and coacting therewith in air-sealing functions; the auxiliary web plate hinges comprising one member having vertical slots and another member having pins movable in said slots and permitting the auxiliary web plate to turn the angular corner of the main web part and to later fold closely to the inner edge of said main web.

31. An endless traveling stoker grate comprising fuel-carriers each including an air-excluding main web portion having outer fuel-sustaining parts, and an air-excluding inner auxiliary web plate or part hinged to said main web portion and coacting therewith in air-sealing functions, and guides closing and permitting opening of said hinged inner web plates at different places along the course of travel of the grate.

32. An endless traveling stoker grate comprising fuel-carriers each including an air-excluding main web portion having outer fuel-sustaining parts, and an air-excluding inner auxiliary web plate or part hinged to said main web portion and coacting therewith in air-sealing functions, and guides operative beneath the upper grate run in front of the rear grate turn and there closing and permitting opening of said inner hinged web plates for regulating the draft through the grate ash-zone.

33. A traveling stoker grate comprising fuel-carriers having inner movable or hinged plates or parts, and guides around the rear grate turn closing said movable plates edgewise to make an inside air-seal at said grate turn.

34. A traveling stoker grate comprising fuel-carriers having inner movable or hinged plates or parts, and a corrugated drum within the rear grate turn closing said movable plates edgewise to make an inside air-seal at said grate turn and providing ash-receiving pockets between the drum and the closed plates.

35. A traveling stoker grate comprising fuel-carriers having inner movable or hinged plates or parts, and guides arranged next the internally air-sealed grate turn at the lower grate run and closing one or more of said inner movable plates edgewise directly in front of said grate turn at the lower grate run.

36. A traveling stoker grate comprising fuel-carriers having inner movable or hinged plates or parts, and yielding guides next the rear grate turn at the lower grate run closing one or more of said inner movable plates directly in front of said grate turn and permitting inward yielding of clinker-holding or warped fuel-carriers.

37. A traveling stoker grate comprising fuel-carriers having inner movable or hinged plates or parts, and guides closing said movable plates at the grate turn and permitting opening of said plates at the lower grate run in front of said grate turn for dumping ashes.

38. A traveling stoker grate comprising fuel-carriers having inner movable or hinged plates or parts, and guides automatically closing said movable plates at the lower grate run to cause said closed plates to receive and carry to the outer part of the grate unconsumed coal dropped from the fuel bed at the upper grate run.

39. A traveling stoker grate comprising fuel-carriers having inner movable or hinged plates or parts, and guides automatically closing said movable plates at the lower grate run to cause said closed plates to receive and carry to the outer part of the grate unconsumed coal dropped from the fuel bed at the upper grate run, said guides permitting opening of the closed plates at or near the front grate turn for dumping the recovered fuel siftings.

40. A traveling stoker grate comprising fuel-carriers each having a web portion provided at its outer part with longitudinal teeth or fingers which intermesh with the teeth of adjoining fuel-carriers to form a fuel bed at the upper grate run, each fuel-carrier web having an inner movable or hinged plate or part, combined with guides automatically closing said movable plates at the lower grate run to cause said closed plates to receive and convey to the outer part of the grate unconsumed coal dropped from the fuel bed, said guides permitting opening of the closed plates at or near the front grate turn for dumping the recovered fuel siftings into chambers formed between the webs and teeth of adjoining fuel-carriers, said siftings finally discharging from said chambers through enlarging openings around the diverging outer teeth or fingers of the fuel-carriers at said front grate turn.

41. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, an abutment air-sealing the inside of the rear grate turn, and a non-friable clinker-grinding abutment air-sealing the outer face of said grate turn for an arc spanning the space between any two adjacent or following transversely ranging air-excluding portions of the grate, one of said abutments being yielding to permit passage of clinker-holding or warped fuel-carriers between the two air-sealing abutments without jamming the grate.

42. A traveling stoker grate comprising

fuel-carriers formed as transverse grate bars having air-excluding web portions, an abutment air-sealing the inside of the rear grate turn, and a non-friable clinker-grinding abutment air-sealing the outer face of the grate turn for an arc spanning the space between the webs of any two adjacent or following grate bars, one of said abutments being yielding to permit passage of clinker-holding or warped grate bars between the two air-sealing abutments without jamming the grate.

43. A traveling stoker grate having fuel-carriers, and a sectional draft regulator comprising swinging damper-plates at the grate ash-zone, means adapted to actuate said plates including two or more pivotally connected frames or parts one of which also is pivoted to relatively fixed supports, and means adapted to independently and successively operate the pivoted frames for closing and permitting opening of the swinging damper-plates.

44. A traveling stoker grate comprising fuel-carriers having inner movable or hinged damper-plates, means adapted to actuate said plates at the grate ash-zone comprising two or more pivotally connected frames or parts one of which also is pivoted to relatively fixed supports, and devices adapted to independently and successively operate the pivoted frames for closing and permitting opening of said damper-plates.

45. A traveling stoker grate comprising fuel-carriers, supports having vertically yielding parts sustaining the fuel-carriers at the rear grate turn, and means sustaining rear portions of the grate at its outer face, whereby clinker-holding or warped fuel-carriers riding over said outer grate sustaining means may yield with the grate turn supports to prevent jamming of the grate.

46. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars, supports having vertically yielding parts sustaining said grate bars at the rear grate turn, and means sustaining the grate bars at the outer face of rear portions of the grate, whereby clinker-holding or warped grate bars riding over said outer grate sustaining means may yield with the grate turn supports to prevent jamming of the grate.

47. A traveling stoker grate comprising fuel-carriers, devices coupling said fuel-carriers together, supports having vertically yielding parts sustaining the fuel-carriers at the rear grate turn, and means sustaining rear portions of the grate at its outer face, whereby coupled clinker-holding or warped fuel-carriers riding over said outer grate sustaining means may yield with the grate turn supports to prevent jamming of the grate.

48. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars, devices coupling said grate bars together, supports having vertically yielding parts sustaining said grate bars at the rear grate turn, and means sustaining the grate bars at the outer face of rear portions of the grate, whereby coupled clinker-holding or warped grate bars riding over said outer grate sustaining means may yield with the grate turn supports to prevent jamming of the grate.

49. A traveling stoker grate comprising fuel-carriers, supports having vertically yielding parts sustaining the fuel-carriers at the rear grate turn, and a non-friable clinker-grinding abutment sustaining rear portions of the grate at its outer face.

50. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars, supports having vertically yielding parts sustaining said grate bars at the rear grate turn, and a non-friable clinker-grinding abutment sustaining rear portions of the grate at its outer face.

51. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, supports including vertically yielding parts sustaining the fuel-carriers at the rear grate turn, said yielding parts and the transversely ranging parts of the fuel-carriers coacting to form an inside air-seal at the grate turn, and a barrier opposing said transversely ranging parts of the fuel-carriers and air-sealing a portion of the outer face of the grate.

52. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports including vertically yielding parts sustaining said grate bars at the rear grate turn, said yielding parts and the grate bar webs coacting to form an inside air-seal at the grate turn, and a barrier opposing the grate bar webs and air-sealing a portion of the outer face of the grate.

53. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, supports including vertically yielding parts sustaining the fuel-carriers at the rear grate turn, said yielding parts and the transversely ranging parts of the fuel-carriers coacting to form an inside air-seal at the grate turn, and a non-friable clinker-grinding abutment opposing said transversely ranging parts of the fuel-carriers and air-sealing the outer face of rear portions of the grate.

54. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports including vertically yielding parts sustaining said grate bars at the rear grate turn, said yielding parts and the grate bar webs coacting to form an inside air-seal at the grate turn, and a non-friable clinker-grind-

ing abutment opposing the grate bar webs and air-sealing the outer face of rear portions of the grate.

55. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, supports including vertically yielding parts sustaining the fuel-carriers at the rear grate turn, said yielding parts and the transversely ranging parts of the fuel-carriers coacting to form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between any two adjoining transversely ranging air-sealing portions of the grate.

56. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports including vertically yielding parts sustaining said grate bars at the rear grate turn, said yielding parts and the grate bar webs coacting to form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between the webs of any two adjoining grate bars.

57. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, supports including a vertically yielding drum or abutment within the rear grate turn, said abutment and the transversely ranging parts of the fuel-carriers coacting to form an inside air-seal at the grate turn, and a barrier opposing said transversely ranging parts of the fuel-carriers and air-sealing a portion of the outer face of the grate.

58. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports including a vertically yielding drum or abutment within the rear grate turn, said abutment and the grate bar webs coacting to form an inside air-seal at the grate turn, and a barrier opposing the grate bar webs and air-sealing the outer face of rear portions of the grate.

59. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, supports including a vertically yielding drum or abutment within the rear grate turn, said abutment and the transversely ranging parts of the fuel-carriers coacting to form an inside air-seal at the grate turn, and a non-friable clinker-grinding abutment opposing said transversely ranging parts of the fuel-carriers and air-sealing the outer face of rear portions of the grate.

60. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports including a vertically yielding drum or abutment within the rear grate turn, said abutment and the grate bar webs coacting to form an inside air-seal at the grate turn, and a non-friable clinker-grinding abutment opposing said grate bar webs and air-sealing the outer face of rear portions of the grate.

61. A traveling stoker grate comprising fuel-carriers having transversely ranging air-excluding parts, supports including a vertically yielding drum or abutment within the rear grate turn, said abutment and the transversely ranging parts of the fuel-carriers coacting to form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between any two adjoining transversely ranging air-sealing portions of the grate.

62. A traveling stoker grate comprising fuel-carriers formed as transverse grate bars having air-excluding web portions, supports including a vertically yielding drum or abutment within the rear grate turn, said abutment and the grate bar webs coacting to form an inside air-seal at the grate turn, and an air-sealing and clinker-grinding abutment opposing the outer face of the grate turn for an arc as long or longer than the space between the webs of any two adjoining grate bars.

63. A traveling stoker grate comprising a series of fuel-carriers, interior supports for the rear grate turn including a loose drum or abutment held within said turn and vertically movable therewith independently of other parts of said interior supports, and an outside support for the grate at or near said grate turn.

64. A traveling stoker grate comprising a series of fuel-carriers having transversely ranging air-excluding parts, interior supports for the rear grate turn including a loose drum or abutment held within said turn and vertically movable therewith independently of other parts of said interior supports, said drum or abutment coacting with the transversely ranging parts of the fuel-carriers to form an inside air-seal at the grate turn, and an outside air-sealing support for the grate at or near said grate turn.

65. A traveling stoker grate comprising a series of fuel-carriers, chains coupling said fuel-carriers together, interior supports for the rear grate turn including wheels over which run the fuel-carrier chains, and a loose drum or abutment held within the grate turn between the chain wheels and vertically movable independently of the wheels, and an outside support for the grate at or near said grate turn.

66. A traveling stoker grate comprising a series of fuel-carriers having transversely ranging air-excluding parts, chains coupling

said fuel-carriers together, interior supports for the rear grate turn including wheels over which run the fuel-carrier chains, and a loose drum or abutment held within the grate turn between the chain wheels and vertically movable independently of the wheels, said drum or abutment coacting with the fuel-carriers to form an inside air-seal at the grate turn, and an outside air-sealing support for the grate at or near said grate turn.

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Witnesses:
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