

Nov. 24, 1936.

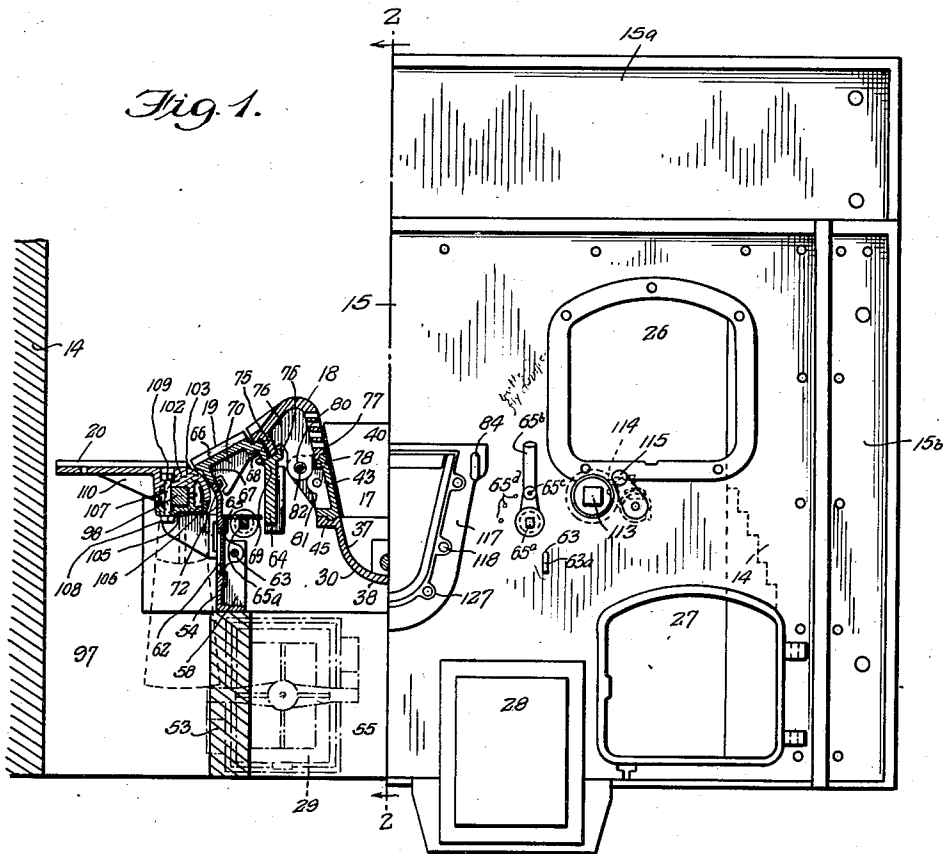
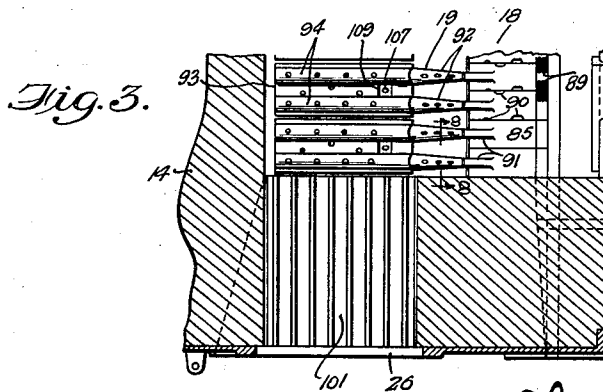
C. A. WARG

2,062,076

UNDERFEED STOKER

Filed Oct. 24, 1930

4 Sheets-Sheet 1



Inventor

Charles A. Warg
H. H. Snelling
Atto

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At Snelling

Attorney

Nov. 24, 1936.

C. A. WARG

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4 Sheets-Sheet 2

Fig. 19.

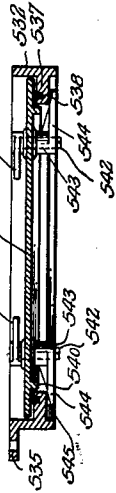


Fig. 18.

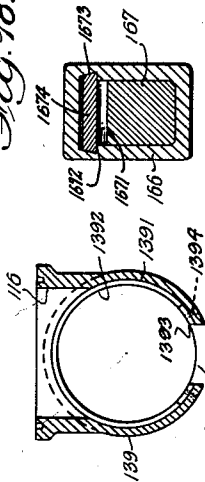
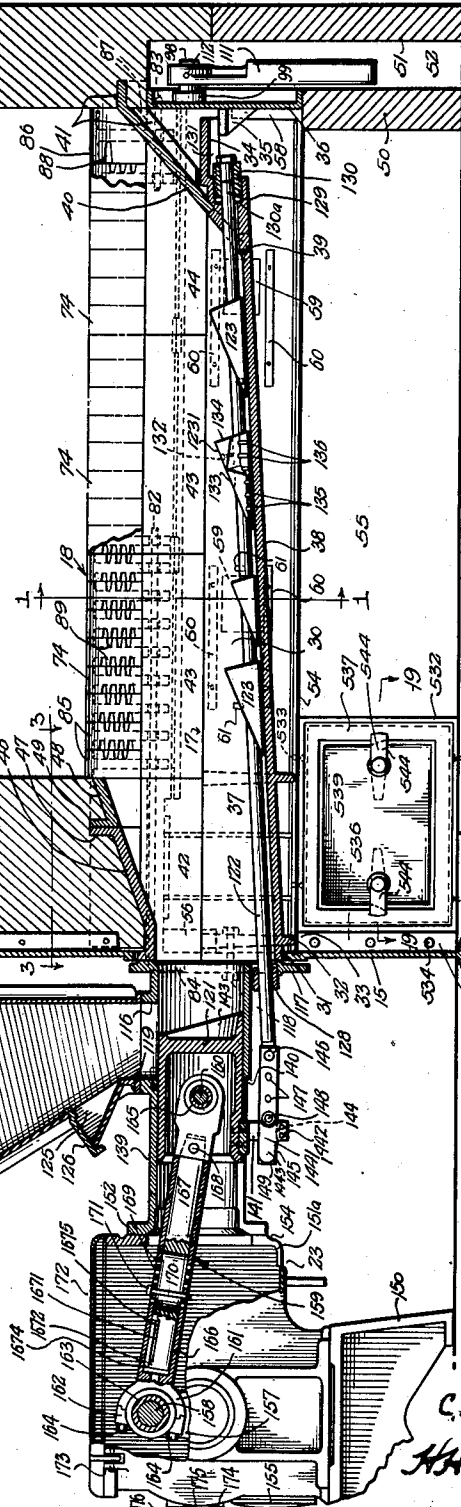


Fig. 17.



Fig. 2.



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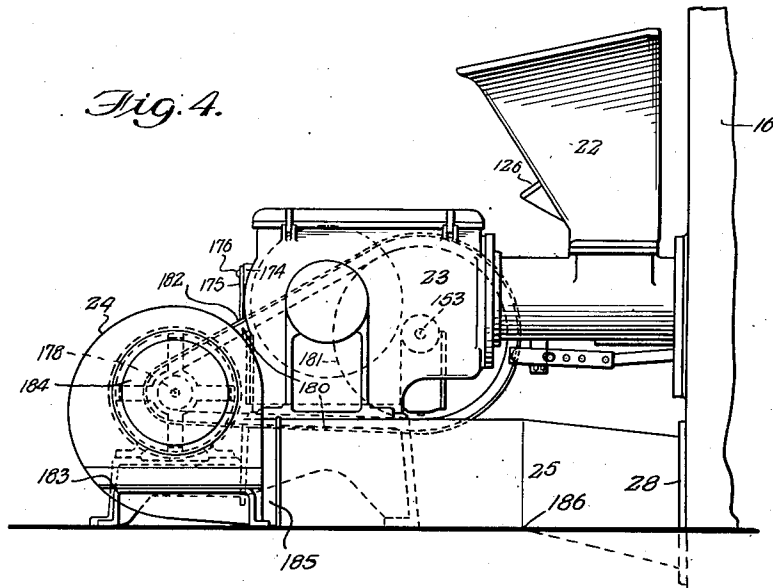
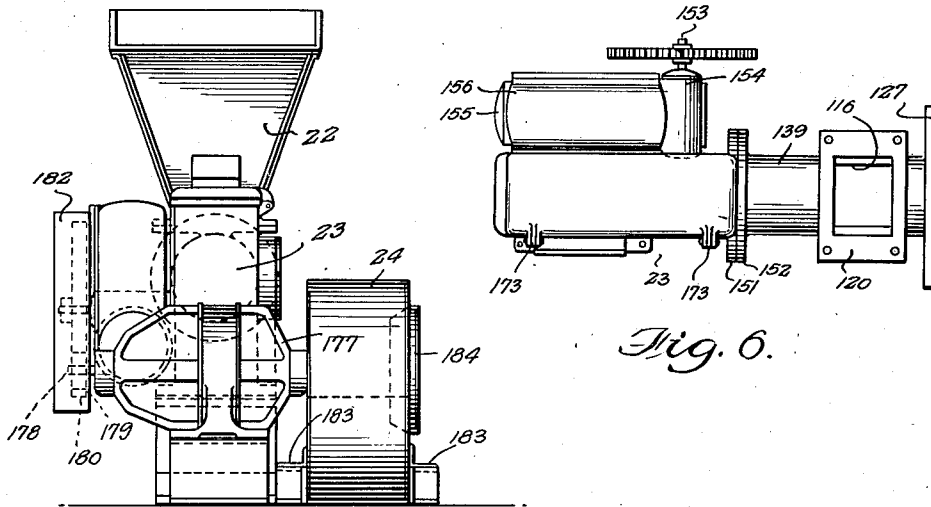


Fig. 5.

Fig. 6.

Inventor

Charles A. Warg

By

H. H. Snelling

Attorney

Nov. 24, 1936.

C. A. WARG

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Fig. 8.

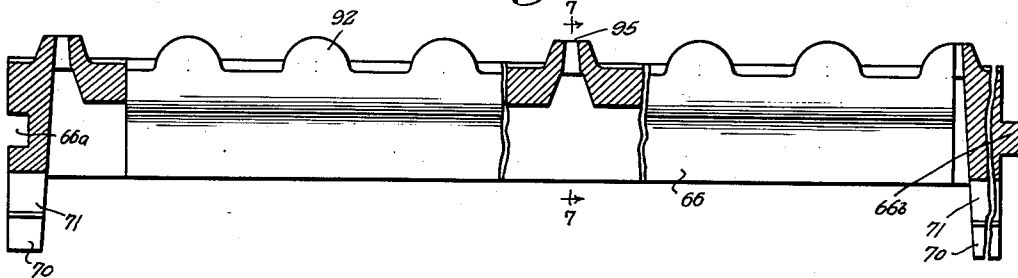


Fig. 7.

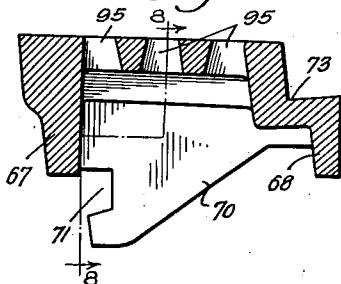


Fig. 10.

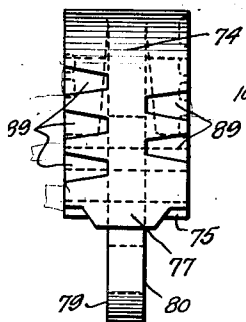


Fig. 11.

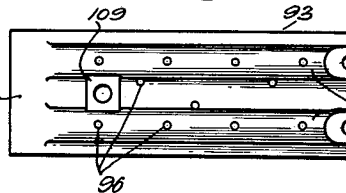


Fig. 12.

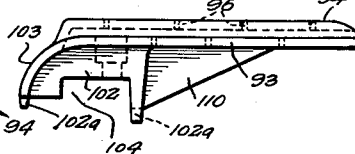
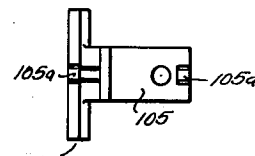


Fig. 13.

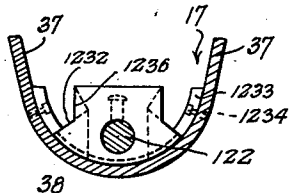


Fig. 14.

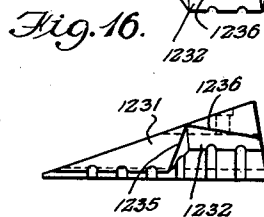


Fig. 16.

Fig. 15.

Inventor

Charles A. Warg

H. H. Snelling
Attorney

UNITED STATES PATENT OFFICE

2,062,076

UNDERFEED STOKER

Charles A. Warg, Scranton, Pa., assignor to
McClave-Brooks Company, Scranton, Pa., a
corporation of Pennsylvania

Application October 24, 1930, Serial No. 491,025

10 Claims. (Cl. 110—47)

This invention relates to underfeed stokers and primarily to equipment of a character which may be installed in either new boiler plant installations or which may be used to replace stoker equipment in boiler plants which have already been installed and in use.

The stoker equipment in accordance with this invention comprises a front plate to be positioned over the outer face of the front wall of the fire chamber of the plant with the lower portion of the wall cut away to accommodate a central fuel retort extending rearwardly from said front plate to the rear fire chamber wall which is formed with a chamber for counterbalance weights for dump grates adjacent the side walls of the fire chamber. Between the retort and the dump grates are arranged tuyères extending to a crest over the retort and intermediate grates slope away from the outer ends of the tuyères beyond the crest to the dump grates. Outside of the fire chamber usually to the front is an individual adjustable stoker feed driving unit and preferably near it is an individual blast fan unit for supplying draft to the tuyères, and means are provided for driving these units either together or independently.

The retort is formed of an integral bottom section supporting a series of top sections on each side; it has a two-sectioned front deflecting plate, the inner section of which is replaceable by breaking away the front portion only of the front wall without interfering with the outer section or that portion of the wall which is above such outer section of the plate. The retort also has a rear deflecting plate which rises from the bottom wall of the retort to the rear fire wall above the top retort sections, and is supported so as to allow for expansion without stress on the fixed parts.

The tuyères form a continuation of the side walls of the retort to the crest and then slope downwardly, grate sections and dump grates beyond forming a continuation of the outer walls of the tuyères. The tuyère blocks have staggered air openings arranged so that openings of adjacent blocks do not coincide, the arrangement being such as to afford a large draft space with relatively small openings well distributed over the tuyères. The intermediate grates and dump grates are also provided with draft openings and dampers control the drafts to these grates thus providing for increased efficiency of combustion. The outer portions of the tuyères and the grates are formed with outwardly directed ribs continuous from the tuyère blocks along the sections of the grates

for distributing and guiding the fuel over the grates and effecting a raising of the burning fuel from the corrugations formed by the ribs thereby cutting down the area of contact of the fuel with the grates so that they will not burn out as fast as they would if their surfaces were flat.

The stoker driving unit as illustrated is arranged to vary the rate of fuel feeding into the retort and also has adjustable means for the pusher rod for distributing the fuel in the retort, and the pusher rod shoes on said rod are also adjustable within limits and are guided so as to prevent bowing of the rod. In many installations the fuel feed mechanism and the blower are driven by a single steam or electric motor but where the blower is located at the side of the furnace it almost invariably is driven by its independent motor often of a different type from the fuel feed motor.

The stoker parts are generally formed in removable sections to provide for variations in temperature of the parts in different positions with respect to the burning fuel and also for the easy replacement of parts which have to be renewed, for example, while the ram case is bolted directly and securely to the retort neither is fastened to the stoker front, but on the contrary the junction rests slidingly on a ledge of the front and space is allowed for expansion without placing any lateral stress on the stoker front. The top retort sections are bolted to the bottom section, the intermediate grate bars resting on the side walls of the draft chamber and side supporting frames between said wall and the retort and the blocks of the tuyères are supported on said side supporting frames and the top retort sections. Access to the plenum chamber is permitted by a readily removable closure in the ash pit wall. A tuyère rod engages each block to retain the tuyères in place and also the intermediate grate sections which have interlocking engagements with the tuyère blocks. The dump grate parts are also removably mounted in the stoker and the parts of the feed driving unit and draft fan are likewise replaceable, and means are provided to prevent improper assembly of the adjustable sections. Special provisions are also made to prevent loss of air pressure and at the same time to avoid any sifting of the fine fuel from either the hopper or the retort to lose fuel or to soil the surroundings.

Further features and objects of the invention will appear from the following specification, accompanying drawings and as pointed out in the claims.

In the drawings in which like characters of reference designate corresponding parts throughout the several views,—

Figure 1 is an elevation of one side of a stoker front and a sectional view of the other side of the stoker, this section being taken on line 1—1 of Figure 2.

Figure 2 is a longitudinal vertical section on the center line of the stoker, line 2—2 of Figure 1, also showing the stoker fuel hopper and stoker feed driving unit in front of the stoker in section and partly in elevation.

Figure 3 is a fragmentary sectional view taken on line 3—3 of Figure 2 showing a portion of the stoker grates in plan.

Figure 4 is a side elevation of the stoker feed driving unit, fan and fuel hopper.

Figure 5 is a front elevation thereof.

Figure 6 is a plan view of the stoker feed driving unit.

Figure 7 is a sectional view of a grate section, taken on line 7—7 of Figure 8.

Figure 8 is an enlarged end elevation of the grate section shown in Figure 7, parts being broken away and shown in section on line 8—8 of Figure 7.

Figure 9 is an enlarged side elevation of a tuyère block.

Figure 10 is an end elevation of the tuyère block shown in Figure 9.

Figure 11 is an enlarged plan view of a dump grate section.

Figure 12 is a side elevation of the dump grate section shown in Figure 11.

Figure 13 is a plan view of a clamp member for the dump grate section shown in Figures 11 and 12.

Figure 14 is a rear end view of one of the retort fuel pusher shoes showing its relation to the retort, the retort being shown in section.

Figure 15 is a side elevation of the pusher shoe shown in Figure 14.

Figure 16 is a plan view of the same pusher shoe.

Figure 17 is a staggered sectional view through the ram cylinder showing the ram piston engaging ring.

Figure 18 is a transverse sectional view through the ram connecting rod adjacent to the forward end thereof.

Figure 19 is a sectional view taken substantially on line 19—19 of Figure 2.

In general the stoker disclosed, comprises a stoker front 15 which is mounted on the front wall 16 of the fire chamber, retort members 17, tuyères 18, grates 19 and dump grates 20 and other parts hereinafter set forth, extending from stoker front 15 and front wall 16 to the rear fire chamber wall 21; and outside of stoker front 15 are the stoker fuel hopper 22, stoker feed driving unit 23, fan 24 and air duct 25 leading therefrom to the draft chamber.

Stoker front 15 consists of a pair of main plates designated by the same numeral, 15, bolted together and to a top plate 15^a and to two side plates 15^b which in turn are secured to front wall 16 and side walls 14, respectively, of the fire chamber. It is provided with two fire doors (one opening 26 of which is shown in Figure 1) for access to the grates in the fire chamber on either side of retort members 17. There are also a pair of doors (one opening 27 of which is shown in Figure 1) for access to the ash chambers. There is also an opening 28 therein for the air duct 25 from blower fan 24 and a front siftings clean-out door 29, indicated in outline in Figure 1,

providing access to the draft chamber under retort 17, tuyères 18 and grates 19. The stoker front also has control members, other parts and openings referred to hereinafter.

Retort members 17 consists of a lower section 30, the front end of which extends into an opening 31 in stoker front 15 and is provided with a flange 32 which engages interior rest 33 on the stoker front for supporting it with a space between the flanges of the ram case and retort, 117 and 32 respectively, without placing any lateral stress on the stoker front. The retort is thus supported so as to have a clearance in openings 31 and the retort and is secured to the ram case by means of bolts 118 passing through the flanges of these members. These bolts are not in contact with the stoker front which is cut out as indicated at 127 for them so as to permit free movement of this end of the retort in opening 31 of the stoker front to take care of expansion due to variations in temperature as the support for the ram is fixed, the ram being connected to the stoker feed driving unit 23 which is fastened to a concrete foundation, the stoker front is fixed and there must be room for movement due to expansion and contraction. The rear end 34 of this lower section is supported on a pair of spaced brackets 35 on the rear frame plate 36 which is mounted in rear wall 21 of the fire chamber; these brackets also permit longitudinal movement of the end of the retort thereon to take care of the expansion and contraction of the retort since the retort is fastened at its front end as just stated. This retort section 30 has diverging side walls 37 extending upwardly from its bottom wall 38 which slopes upwardly from stoker front 15 towards the rear of the fire chamber to a point 39 where it slopes upwardly at a steeper angle. A rear deflecting plate 40 is a continuation of this bottom wall 38 extending upwardly therefrom to rear wall 21 where it has a laterally extending projection which provides an anchoring means therefor and a pair of flanges 41, the upper ends of which rest on top of rear frame plate 36 to support it in proper position during the assembling of the stoker.

Retort 17 has top members consisting of front sections 42 extending upwardly from side walls 37 of lower section 30 and extending rearwardly from the stoker front opening 31 through fire chamber front wall 16. Rearwardly from these front sections 42 are a plurality of retort top intermediate sections 43 followed by retort top rear sections 44 which extend beyond rear deflecting plate 40 and end adjacent to rear frame plate 36. These top sections have their ends abutting and are assembled on the lower retort section by means of bolts passing through lugs 45 extending laterally outwardly from the sections as shown in the sectional portion of Figure 1.

Above the retort top front sections 42 is a front deflecting plate composed of two sections, a front section 46 extending rearwardly and upwardly from stoker front opening 31 preferably more than half way through wall 16 and ending in an upwardly extending anchoring flange 47. From this section 46 a rear section 48 extends to the inner side of the fire chamber wall 16, this section being anchored in the wall by means of a similar flange 49 which is arranged in substantially abutting relationship with flange 47 but is not fastened thereto. This two section construction of the front deflector plate provides for re-

placement of the rear section 48 by merely breaking a small portion of the fire chamber wall structure from around it for removal and replacement when this section burns out and has to be replaced, without having to replace the entire deflector plate.

In installing the parts in the fire chamber of a plant which has already been in use it is only essential to break away the base of the front wall 16 of the fire chamber to a short distance above the retort 17, likewise the rear wall 21. Walls or masonry partitions, 50 and 51 at the rear for supporting the rear frame plate 36 and providing an enclosed chamber 52, and two side longitudinal walls 53, one at either side of retort 17, are erected. These walls in conjunction with a portion of the lower part of stoker front 15, rear frame plate 36, and damper partition 54 mounted on the two side walls 53 provide a retort or plenum chamber 55 of the stoker.

The front siftings clean-out door 29 at the side of the ram is too small for a man to get into the retort or plenum chamber so provisions are made for him to enter through one of the ash doors, 27, as shown the left hand one, and to enter this chamber through a doorway 531 in the longitudinal wall 53, as it would be impossible also for him to climb over this wall because of the iron partition and other structure above it. This wall 53 therefore terminates a distance from stoker front 15 and an access door frame 532 is fastened in the space provided therebetween, the frame being secured by bolts 533 to the bottom flange of the damper partition 54 above it and by bolts 534 extending through a flange 535 of the frame and a flange 536 on stoker front 15. The base and other end of the frame may also be suitably secured to the floor and end of wall 53 in an air tight manner. Frame 532 has an inwardly extending flange 537 surrounding the opening therethru and in its outer face has a groove 538 which contains packing for engagement with the access door 539 to provide an air tight closure. Door 539 is a little smaller than the inner sides of frame 532 so as to engage flanges 537 thereof and the packing in groove 538. On the inner face of this door is a flange 540 which fits inside of flanges 537 of frame 532 insuring proper closure of the doorway. To secure door 539 in place and provide means for handling it, the door has a pair of handles 541, each provided with a shaft 542 which extends through apertures in door 539 adjacent to the ends thereof, and on the inner side of the door these shafts are squared to receive latch members 543 which are keyed thereon. The extending ends 544 of these latch members are provided with cam faces 545 for engagement with the inner faces of flange 537 at the ends of the door frame. The door is readily secured in the frame by turning handles 541 so that cams 545 will draw the door tightly against the packing in groove 538 and is as readily removed by turning these handles in the opposite direction freeing latches 543 of flanges 537.

Damper partitions 54 extend from the stoker front 15 where their ends are bolted to a flange 56 and the lower edges thereof rest on extensions 536 on the stoker front to the rear frame plate 36 where the ends are bolted to similar flanges and the ends of the partition are also provided with end flanges 58 which are fastened to the rear frame plate. These partitions have a plurality of slide damper openings 59, two being shown, each having upper and lower slide

damper guides 60 and front and rear stops 61 which limit the movement of the slide dampers 62. Dampers 62 are provided with apertured lugs which are connected with rods 63 extending through stoker front 15 and having handles 63^a for controlling them to regulate the draft from chamber 55 to dump grates 20 at the outer sides of the draft chamber 55 of the stoker.

There are also two side frames 64 which extend from stoker front 15 to rear frame plate 36 and these frames are fastened at their ends in a similar manner, in intermediate positions between damper partitions 54 and the sides of retort 17 as shown in the sectional portion of Figure 1. Between damper partitions 54 and side frames 64 are arranged butterfly dampers 65, one of which is shown in closed position with its side engaging the upper slide damper guides 60 as stops therefor. Dampers 65 are mounted on shafts 65^a journaled in rear frame plate 36 at one end and in stoker front 15 through which its other end extends and upon which is mounted an operating handle 65^b. The draft to grates 19 from draft chamber 55 is regulated by means of this damper, handle 65^b being provided with an engagement member 65^c adapted to yieldingly engage any one of a series of stops or apertures 65^d on the stoker front, whereby the butterfly damper 65 may be held in various positions.

The upper edges of damper partitions 54, side frames 64 and the retort top sections 43 and 44 provide supports for the sections of grates 19 and tuyères 18. The sections 66 of grates 19 are wide in comparison with their length and have downwardly extending end flanges 67 and 68 which rest on the upper edges of damper partitions 54 and side frame 64 respectively, the latter being channeled in their top edges having side members 69 thereof which engage the inner sides of flanges 68 and prevent the sections from sliding downwardly. As shown in Figures 1, 7 and 8 each section 66 has a pair of side flanges 70 which are slotted at 71 so as to receive a side flange 72 on the damper partition 54. One side of each section is slotted at 66^a and the other side provided with a tenon 66^b, this arrangement providing a snug connection between the sides of the assembled sections which will not permit ashes to sift through nor a leakage of air. With this construction it is essential that the sections of grates 19 be assembled before the tuyère blocks 18, or that tuyères 18 be removed before sections of grates 19 can be removed as each of the sections 66 is slotted at its upper end at 73 for the reception of the end of a number of tuyère blocks 74 of tuyères 18.

Tuyère blocks 74 as shown in Figures 1, 9 and 10 have flanges 75 which engage the channels of side frames 64 and side members 76 thereof and end flanges 77 on these blocks extending below the upper edge of retort sections 43 and 44 and engage lateral flanges 78 thereon. Each tuyère block 74 is provided with a web 79 which extends downwardly and is apertured at 80. Top retort sections 43 and 44 have flanges 81 which extend between a number of the tuyère block webs 79 and have similar apertures in alignment with apertures 80 of webs 79. Tuyère rods 82 extend through these apertures, into apertures in rear frame plates 36 as shown at 83, and through stoker front 15 ending in handles 84 by which these rods may be withdrawn when it is desired to remove any of the tuyère blocks 74 or grate sections 66.

Tuyère blocks 74, as shown in Figures 1, 2, 3, 9 75

and 10 are provided with air openings, except two front end blocks 85 which are blank and the rear side of rear blocks 86 which are substantially double the width of the other blocks and cut away at their outer sides and inwardly flanged at 87 to engage the upper end of rear deflecting plate 40. The rear or outer side of these blocks 86 are blank and inner sides of each have an opening 88. Blocks 74 are each provided with two series of openings, one series on each side of the crest of the bars. The series facing the retort consists of an even number of openings on one side of the block and an odd number of openings on the other side as indicated at 89 and the other series at the end of the block extending beyond the crest and facing away from the retort likewise consists of even and odd numbers of openings on the sides of the block as indicated at 90. These air openings are so arranged that openings of one block will not coincide with openings of an adjacent block and they afford a maximum draft from plenum chamber 55 for the fuel coming over the tuyères 18 directly from retort 17, no damper being positioned in the passageway between side frames 64 and the sides of retort 17, the draft being regulated by the supply of air from fan 24 to draft chamber 55.

Tuyère blocks 74, 85 and 86 are also provided with ribs 91 which when the grates are assembled are arranged in two equally spaced series either side of the retort 17, the ends of the blocks sloping away from the retort toward the side walls of the fire chamber. Sections 66 of grates 19 have ribs 92 which form continuations of ribs 91 and increase in size in the direction of progress of the burning fire, that is as they extend away from retort 17, and likewise sections 93 of grates 20 are each provided with two ribs 94 which are coextensive with ribs 91 and 92 of tuyères 18 and grates 19. This arrangement of the ribs on the grates effects a guide for the fuel and an even distribution thereof over the grates and as its burning progresses as it moves along the grates the increasing of the size of the ribs effects a lateral movement or turning of the burning fuel affording a more even combustion thereof. The ribs also prevent fuel from lying flat on the metal of the grate bars effecting a raising of the fuel from the grooves thereby decreasing the area of contact therewith and consequently increasing the life of the grates in comparison with flat grates which soon burn out due to more uniform contact with the burning fuel.

The grates 19 and 20 are also provided with air openings for the draft controlled by butterfly dampers 65 and slide dampers 59 respectively. Openings 95 in grates 19 are arranged to extend upwardly through the ribs 91, and openings 96 in grates 20 extend through ribs 94 and through intermediate portions in the staggered relationship.

The arrangement of the grate surfaces and draft openings afford efficient combustion of the fuel as it passes outwardly from the retort so that as the fuel progresses to the outer ends of grates 20 it is reduced to ashes before dropping into the ash chambers 97 at the outer sides of walls 55.

As the spent fuel accumulates on grates 20 it is occasionally necessary to dump these grates and to provide for this the section 93 thereof at each side of retort 17 are mounted on dump grate shafts 98. These shafts are square in cross section and provided with bushings which are

journalled in bosses in stoker front 15 and rear frame plate 36 through which they extend as indicated at 99 in the rear frame plate end.

On these shafts 98 between the dead plates 101, just inside of doors 26, and the rear wall 21 of the fire chamber are mounted the grate sections 93, shown in detail in Figures 11 and 12, of the dump grates 20. The mounting of these sections consists in integral hub portions 102 which have cylindrical surfaces 103 to close as far as possible the space between the sloping grates 19, as best shown in the sectional portion of Figure 1.

Hub portions 102 have rectangular slots 104 to receive the upper half of the dump grate shafts 98 and lower cooperating caps 105 shown in Figures 1 and 13, are similarly slotted and have cooperating cylindrical surfaces 106. Caps 105 have V projections 105^a which extend upwardly and cooperate with notches 102^a in hub portions 102. Bolts 107 pass through aligned openings in sections 93 and the bottom caps and receive nuts 108 for securing the sections assembled on shafts 98; the heads of these bolts are positioned in deep pockets 109 which afterwards become filled with ashes and protect the bolt heads from the effects of the heat and also prevent leakage of air.

Extending forwardly from these hub portions 102, under each of the grate sections 93, and integral with these parts are vertical triangular reinforcing webs 110 extending from the lower portions of the sections between the ribs. It will be noted that the holes 96 in these portions of the grate sections are staggered on either side of these web members and as close thereto as possible.

On the rear end of each dump grate shaft 98 within the chamber 52 formed in the lower portion of the rear fire chamber wall 21 is a counterbalancing weight 111 secured to the shaft by means of a set screw 112. Chamber 52 is large enough to permit the counter-weights to swing upwardly to a horizontal position in the direction of the retort when the grates are to be dumped. The weights are of such proportion as to overbalance all the dump grate bars but are overbalanced by the weight of the grates when they are loaded with the ashes that accumulate thereon between dumpings.

These weights on shafts 98 thus facilitate the operation of the dump grates by means of a handle which is applied to the front ends 113 of shafts extending through the stoker front 15 when it is essential to dump the grates. In order to prevent the grates from swinging freely a latch 114 is provided inside retort front 15 having means for engaging shafts 98 from turning. When it is desired to dump these grates a handle 115 on the outside of the stoker front is operable to disengage latch 114.

In order to feed the fuel from stoker hopper 22 to retort 17 a ram case 116 is mounted in an intermediate position to the front of stoker front 15, flange 117 of the ram case being secured by bolts 118 to the retort as hereinbefore set forth. Hopper 22 is mounted over ram case 116 by bolting flanges 119 on hopper 22 to flange 120 surrounding an upper opening in the ram case. The ram case thus affords a direct passageway for fuel from the hopper to the retort, and a ram 121 therein operates to feed the fuel to the retort in conjunction with a pusher rod 122 and a plurality of pusher rod shoes 123 adjustably mounted thereon along the bottom wall 38 of the retort

which shoes operate to distribute the fuel in the retort.

Hopper 22 is shown composed of sections having flanges 124 secured together as indicated.

5 It is provided with a bar hole 125 affording access to the passageway to retort 17 and a bar hole cover 126 normally closes this hole.

Pusher rod 122 passes through a bushing 128 secured in an aperture through the downwardly extending portion of flange 117 on ram case 116. The pusher rod extends adjacent to the bottom wall 38 of the retort and its rear end 129 extends through a similar bushing 130 mounted in an enlarged portion of opening 130^a in the portion 15 of this wall sloping upwardly beyond point 39. Bushings 128 and 130 are each provided with a pair of laterally extending apertured flanges and stud bolts extend therethru for securing the bushings in their respective positions. These 20 pusher rod bushings prevent loss of fuel at the front which would mean dirt sifting through onto the floor outside the stoker front and air at the rear from the plenum chamber. The rear end 34 of the lower retort section is recessed as shown 25 at 131 so that end 129 of rod 122 is free to move therein to a point between brackets 35 as it does when the ram and rod are set to operate to a maximum rearward stroke.

Pusher rod shoes 123 as shown may vary in 30 size, and are secured to pusher rod 122 by means of set screws 132 preferably with their heads entering sockets in the upper inclined faces 133 thereof; the relative positions of the shoes may be changed on rod 123, their distance apart, and 35 also arrangement of different sizes shoes.

It will be seen that inclined faces 134 of these shoes are at such an angle that when the shoes are pushed rearwardly the fuel will be moved in that direction and on the return stroke the fuel 40 will not follow the shoes but will slide up over faces 133 thereof, the fuel coming down from hopper 22 into ram case 116 preventing any movement in that direction. The lower faces 135 of these shoes are grooved at 136 to grind any siftings which may get under the shoes and otherwise 45 might obstruct the free movement of the shoes.

In order to prevent the pusher rod from bending in retort 17 which may be of considerable length one or more of the pusher rod shoes, one 50 shoe 123¹ as shown in Figures 2, 14, 15 and 16, may be provided with lateral extensions 1232 and pusher shoe guides 1233 are secured to the retort by countersunk head bolts 1234 so as to engage these lateral extensions at each side to prevent 55 the rod from bending. These extensions have forward sloping faces 1235 and rearward diverging walls 1236 which also assist in raising the fuel in the retort on their forward stroke.

Pusher rod 122 is moved by ram 121 which is 60 constructed in the form of a piston which is to be reciprocated in the cylinder 139 of the ram case extending forwardly from retort 17. In order to prevent real fine fuel from creeping through at the top of the ram and falling to the floor, cylinder 139 is provided with a groove 139¹ 65 which houses a ram packing ring 1392 formed of a casting cut, expanded and turned so as to spring against the outer cylindrical wall of the ram to prevent the ram from pulling such fine fuel back into the cylinder of the ram case on 70 its outward stroke which would fall through a slot 140 in the bottom portion thereof. This ram packing ring clears slot 140 by about an inch on each side and the two ends of the groove are closed by stop blocks 1393 secured thereon by 75

means of screws 1394. The face of the ram piston is provided with a flange 143 which assists in moving the fuel on the forward stroke and on the reverse stroke covers slot 140 in cylinder 139, the upper portion of this flange extending only slightly 5 beyond the face of the piston permits of a wide range of movement of the piston for varying the amount of fuel to be fed by the ram into the retort on each rearward stroke thereof. Through slot 140 in the lower rear portion of 10 cylinder 139 extends a projection 141 which is fastened to ram piston 121 by tap bolts. This projection 141 has laterally extending projections providing a pusher rod guide 144 for supporting a pusher rod adjusting strap 145, the rear end of 15 which strap is pivoted at 146 to pusher rod 122. This strap is provided with a series of apertures 147 which are adapted to receive a pusher stroke adjusting pin 148, shown in Figure 2 in the first 20 of these apertures.

When ram 121 is moving inward projection 141 20 thereon moves pusher rod 122 and shoes 123 thereon in a feeding direction and on the return stroke the projection moves until it engages the end 149 of the adjusting strap 145 and then moves 25 rod 122 and shoes 123 outwardly with it. The stroke of rod 122 is diminished by changing pin 148 to any of the other holes 147 shown and when in the holes nearest the connection with rod 122 the stroke is a minimum,—when farthest away, 30 as shown, the stroke is a maximum. To the end of the pusher rod guide 144 at the outer side is secured a pusher adjusting pin guard 144¹ by means of a pair of bolts 1442. This guard member has a projecting end 1443 extending outwardly 35 from the retort so that in case it is desired to change the position of the pusher stroke adjusting pin it will be impossible to insert it through any of the apertures 147 on the side of guide 144 occupied by the projecting end 1443 of the guard 40 which covers them.

Driving unit 23 for operating ram 121 and pusher rod 122 consists of an enclosed case protecting the driving mechanism from all dust, breakage, etc. and is mounted on a motor and crank 45 case base 150 which is secured to a concrete foundation in front of ram case 116 in a position for its open flanged rear end 151 to be bolted to an end flange 152 on the ram cylinder 139. The driving mechanism includes a drive shaft 50 153 journaled in a worm housing 154 at right angles to a second worm housing 155 in which are double worm reduction gears driving a worm gear in a third housing 156 of the casing. From the latter worm gear a crank 157 extends carrying 55 a journal 158.

A connecting rod 159 extends between crank journal 158 and a wrist pin 160 in the ram piston 121 which is adapted to impart strokes to the ram of different lengths so that the amount of fuel 60 fed by the ram into the retort by each stroke may be regulated. This connecting rod has a front bearing 161 and bearing cap 162 with brass linings 163 and the cap is secured to the rod by bolts 164. The rear end of the connecting rod 65 is likewise provided with a brass bearing lining 165. The front end of connecting rod 159 has a tubular extension 166 of rectangular cross section into which a rod 167 of similar cross section 70 that is secured in the rear end of the connecting rod by means of a bolt 168, is telescopically engaged so that the free end of the tubular extension 166 can engage the shoulder provided at the junction of rod 167 with the rear end of connect- 75

ing rod 159 to move ram 121 on the feeding stroke in the direction of retort 17. Tubular member 166 of the connecting rod is provided with a series of five apertures 169 extending downwardly therethru and rod 167 has a cooperating downwardly extending slot 170. A ram stroke adjusting pin 171 may be positioned in any desired aperture and extends through slot 170 in rod 167 so that on the outward movement of the connecting rod tubular member 166 the driving unit will withdraw this section of the connecting rod until pin 171 engages the forward end of slot 170 and thereafter rod 167 will be drawn with it for the return stroke of ram 121. In the position shown pin 171 is in the second aperture so that ram 121 will be actuated for a long stroke. When the pin is in the first aperture the stroke of the ram is a maximum, being substantially the full stroke of crank 157 of the driving mechanism and the minimum stroke provided for is the fifth aperture. In order to prevent pin 171 from being positioned through an aperture 169 when the tubular portion of the connecting rod and ram are at the far ends of the crank strokes with respect to each other the end of rod 167 of the connecting rod is recessed at 1671 and provided with an end abutment 1672 which extends upwardly a short distance and tubular member 166 is provided with laterally extending grooves 1673 in the upper portion thereof; in groove 1673 a ram adjusting pin guard 1674 is slidably mounted so as to be received in recess 1671 of rod 167 entirely when the tubular member 166 and rod 167 are telescoped together and to be more or less withdrawn from the recess according to the amount the tubular member is withdrawn. An extension 1675 of the pin guard 1674 engages abutment 1672 so as to prevent this guard from being withdrawn from the end of rod 167 when tubular member 166 is moved outward to its fullest extent by crank 157 with respect to rod 167. This guard extending beyond the end of rod 167 is adapted to cover apertures 169 and prevent the improper insertion of pin 171. It will be noted that opening 151 has a slot 151^a extending therefrom to provide for movement of projection 141 on ram 121 thereinto when the ram is set for a maximum charge stroke.

Access to adjusting pin 171 in the crank case of driving unit 23 is provided for by opening the crank case cover 172 which is hinged to the case as shown at 173. The crank case is also provided with another opening 174 for access to the bearing 161 and cap 162 therefor, this opening being closed by a plate 175 fastened by bolts 176.

An electric motor 177 is mounted on the outer portion of base 150. On one end of the motor shaft 178 is mounted a sprocket 179 for driving a chain 180 between this sprocket and a sprocket 181 on shaft 153 of the driving unit 23. This drive between motor 177 and driving unit 23 is enclosed in drive chain guard 182 suitably secured to the driving unit. On the other end of motor shaft 178 are mounted the blades of fan 24 the casing of which has side base members 183 secured to the floor so as to position the fan alongside the motor and driving unit base 150. It will be noted that the intake opening 184 of the fan extends outwardly from the rest of the equipment and the outlet end 185 is arranged to direct the air blast toward the stoker where it communicates with the outer end of air duct 25 positioned alongside the driving unit base 150 then leading downwardly beyond a point 186 below the floor

line and into opening 28 through stoker front 15 to draft chamber 55.

In operation motor 177 drives fan 24 at a speed to furnish the required air blast to tuyères 18 and through the chain drive 180, etc., double worm reduction gears, crank 157 and connecting rod 159 operates to reciprocate ram 121 and pusher rod 122 with shoes 123 thereon for ramming charges of fuel from hopper 22 into retort 17 and feeding same over tuyères 18, grates 19 and dump grates 20. The amount of fuel fed at each stroke is regulated by adjusting the ram stroke adjusting pin 171 in the apertures 169 and 170 of the telescopic connecting rod 159 between crank 157 and wrist pin 160 of ram 121 and the stroke of pusher rod 122 is adjusted by changing the position of pusher stroke adjusting pin 148 in apertures 147 of the pusher rod adjusting strap 145 so as to give the pusher rod shoes 123 the required stroke for distributing the fuel charge in retort 17.

In the normal operation of the stoker the full air blast is directed through tuyères 18 and slide dampers 62 and butterfly damper 65 are closed. But when dump grates 20 become loaded with an accumulation of spent fuel, handles 65^b are turned to open butterfly dampers 65 and handles 63^a are operated to open slide dampers 62 to provide a draft through grates 19 and dump grates 20, respectively, so as to burn the fuel on these grates briskly for a few minutes before grates 20 are released to dump the spent fuel. Latches 114 are then released by handles 115 permitting grates 20 to dump, and dump grates 20 are controlled during the dumping by means of an operating handle applied to the outer ends 113 of dump grate shafts 98 for controlling the dumping of the grates and their return to normal horizontal position which is facilitated by the aid of counterbalance weights 111 on the rear ends of these shafts. Dampers 62 and 65 are then closed and the stoker is again in normal operating condition.

What I claim is:

1. An underfeed stoker including a stoker front, a rear frame plate, a retort extending from the stoker front to said frame plate and supported by said front and rear frame plate, a damper partition secured to said front and rear frame plate at either side of said retort, a side frame secured to said front and rear frame plate at either side of said retort between said damper partitions and said retort, grate sections arranged side by side and having their ends supported by said damper partitions and said side frames, blocks of tuyères arranged side by side and having their ends supported by said side frames and said retort, and dump grates pivotally supported by said stoker front and rear frame plate at either side outside of said damper partitions.

2. An underfeed stoker including a stoker front, a rear frame plate, a retort extending from the stoker front to said frame plate and supported by said stoker front and rear frame plate, a damper partition secured to said front and rear frame plate at either side of said retort, a side frame secured to said front and rear frame plate at either side of said retort between said damper partitions and said retort, tuyère blocks supported by the retort and the side frames and grate sections supported by the side frames and damper partitions.

3. The stoker of claim 2 including a fuel hopper and ram case, the forward end of said case being fixedly mounted in front of said stoker front

and having its rear end connected with said retort to deliver fuel thereto, said retort being freely supported by the front and rear frame plate.

5 4. An underfeed stoker for a fire chamber including front and rear walls, a fuel retort extending from the front of the fire chamber to the rear wall thereof and freely supported by said walls whereby during expansion or contraction the retort may move with respect to said walls, 10 and a rear deflecting plate secured only to the rear wall and resting on the floor of the retort.

5 5. An underfeed stoker including a fuel retort comprising a lower troughlike section and a plurality of top sections resting freely on the lower section and extending upwardly from each side thereof, and a front deflector plate resting on the top sections at the front end of the retort comprising a front section extending from the front thereof inwardly and a rear section extending 20 from the rear end of the front section inwardly, said deflector sections having flanges to engage the front wall of a fire chamber.

25 6. An underfeed stoker including a stoker front having a retort opening therethru, a rear support, a retort having its rear end resting on said rear support and having its front end extending thru said opening and resting on said stoker front, a ram case outside the stoker front and fixedly mounted at one end, said ram case being connected at the other end to the front end of said 30 retort whereby the retort moves with respect to said rear support and stoker front during expansion and contraction due to changing temperatures.

35 7. An underfeed stoker including a stoker front having an opening therein, a rear frame plate, a ledge on said plate, a retort extending thru and resting freely in said opening and also resting on said ledge, a side frame supported by said front

and rear frame plate and tuyères locked to said retort but resting freely on said side frame whereby said retort is entirely freely supported to allow for expansion and contraction.

8. An underfeed stoker including a stoker front 5 having an opening therein for receiving a retort, a rear frame plate, a ledge on said plate, a central retort resting freely in said opening and on said ledge, a rail secured to said front and to said rear plate, a side frame between said rail and said retort and supported by said front and 10 said rear plate, grates transverse of and resting freely on said rail and side frame, tuyères forming continuations of the side walls of said retort, means for locking the tuyères to said walls, said 15 tuyères resting freely on said side frame and each having a ledge overlapping said grates, said grates having downwardly extending webs for interlocking with said rail.

9. The device of claim 8 including dump grates 20 forming continuations of said grates, means cooperating with said rail for providing a partition between the space under the retort and the space under the dump grates, dampers in said partition for controlling the flow of air between 25 said spaces, and damper means between the rail and the side frame for controlling the flow of air from said first mentioned space and said grates.

10. The device of claim 8 in which said side frame consists of a plank-like member mounted 30 with its edges in an upright plane and having a channel along its upper edge, downwardly extending supporting lugs on said tuyères and on said grates resting in said channel whereby said grates and tuyères may have free movement 35 longitudinally of said frame but are prevented from moving laterally thereof.

CHARLES A. WARG.