G. A. SMITH.

AUTOMATIC STOKER.

APPLICATION FILED FEB. 14, 1918.

1,325,589.

Patented Dec. 23, 1919.

3 SHEETS—SHEET 1.

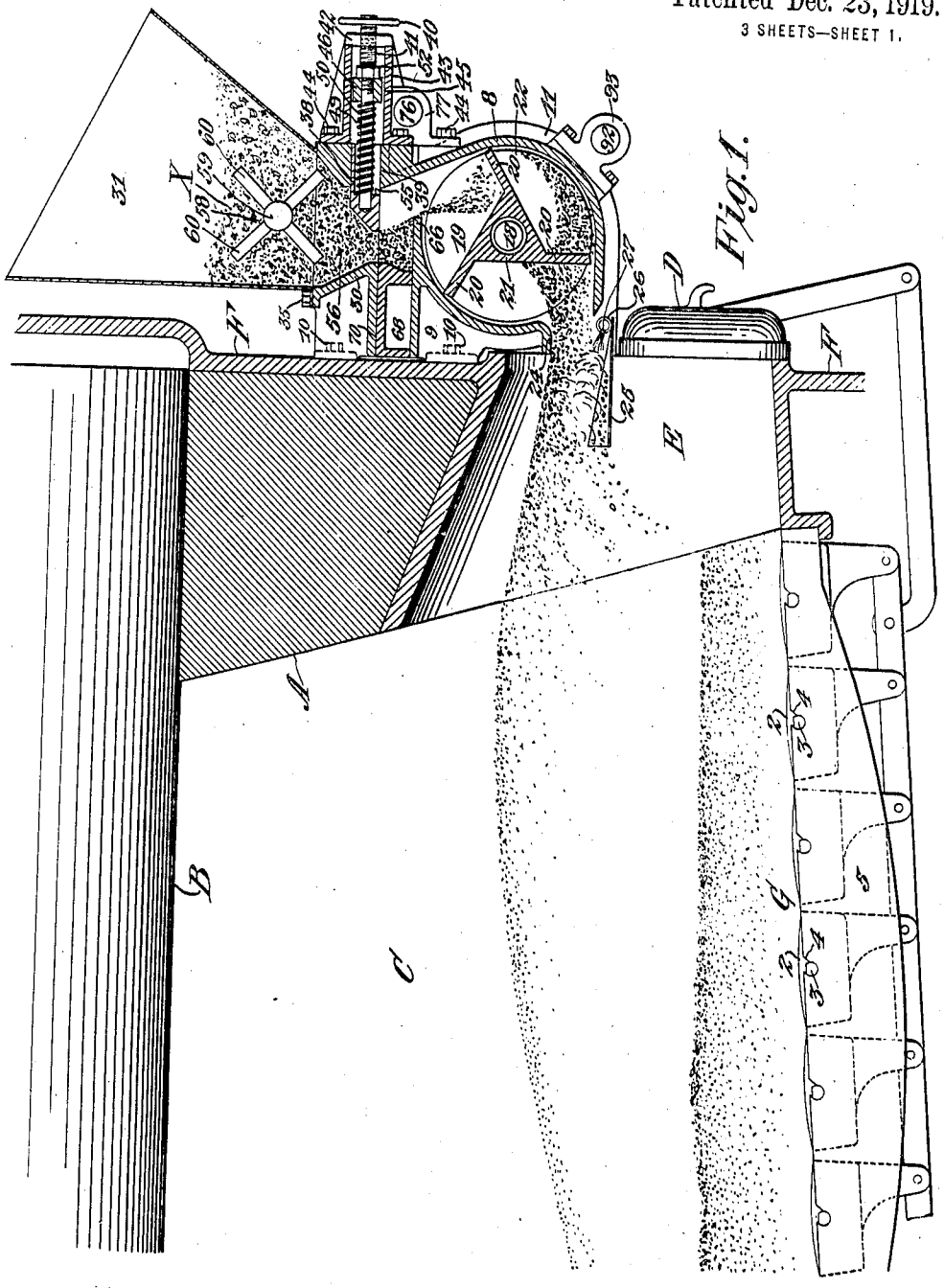


Fig. 1.

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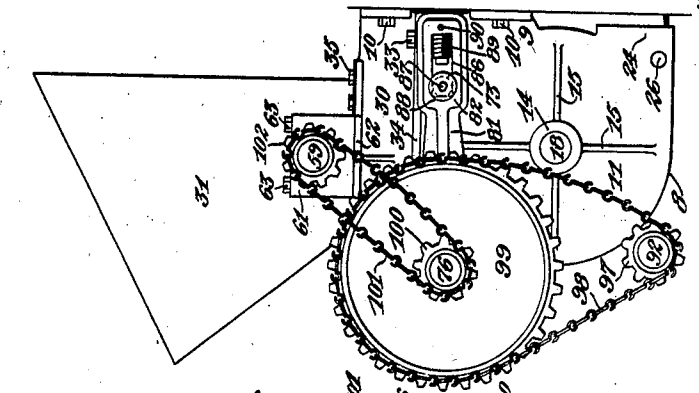


Fig. 4.

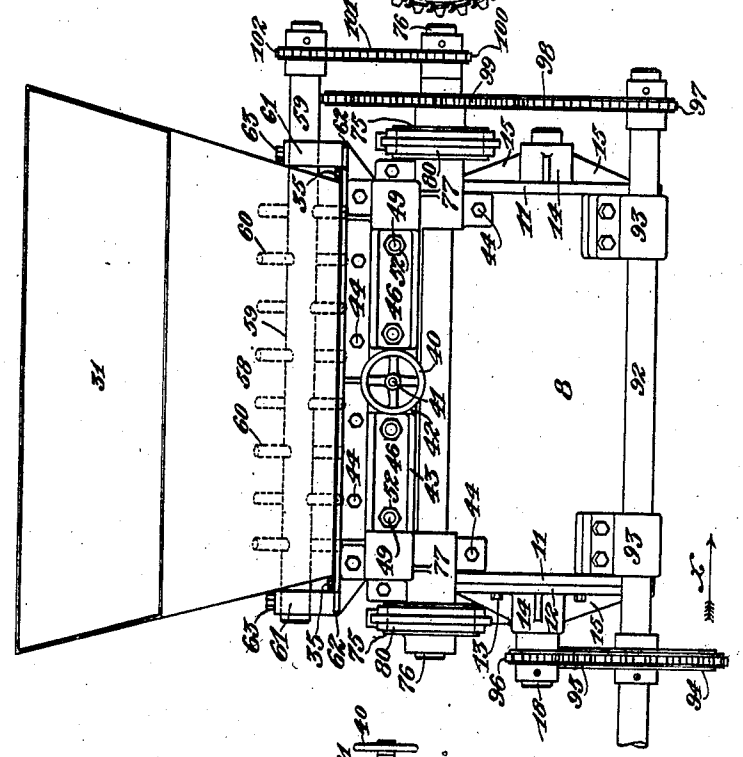


Fig. 2.

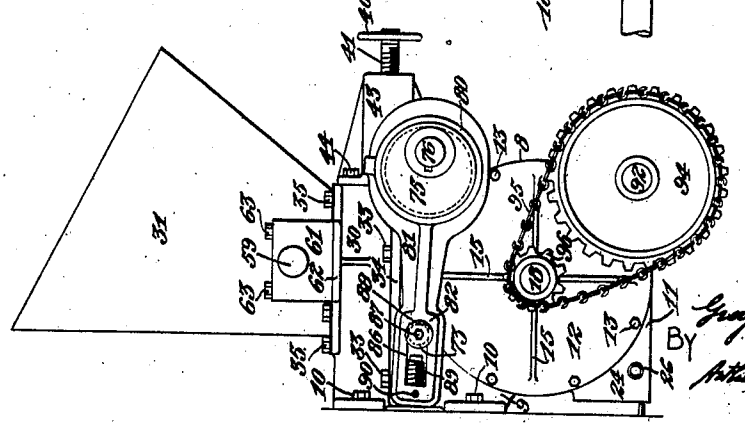


Fig. 3.

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3 SHEETS—SHEET 3.

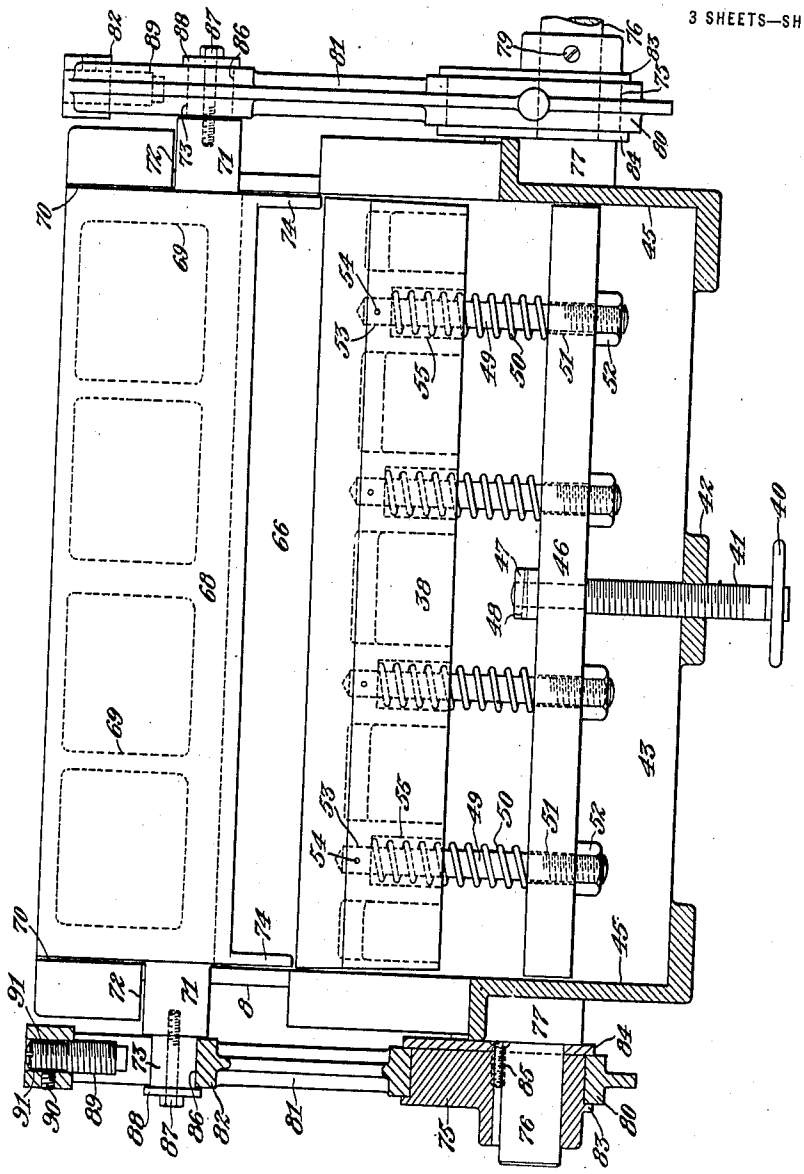


Fig. 5.

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AUTOMATIC STOKER.

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To all whom it may concern:

Be it known that I, GEORGE A. SMITH, a citizen of the United States, residing at Providence, in the county of Providence, State of Rhode Island, have invented certain new and useful Improvements in Automatic Stokers, of which the following is a specification.

My invention relates to improvements in mechanical stokers for feeding fuel to the grates of furnaces, boilers or the like. The object of my improvement is to provide an automatically-operated apparatus for effecting either a continuous or an intermittent feed of the fuel in greater or lesser quantities as required, and in such manner as to distribute it evenly and uniformly over the fire while spreading it to the uttermost limits of the grate. Further objects of the improvement are to provide adjustable devices for regulating the amount of fuel delivered from the magazine or hopper to the distributing-means, with means for positively ejecting it from the hopper in measured quantities and also for preventing it from clogging or choking the outlet passage thereof.

The manner and means for carrying out these improvements are fully described in the following specification, illustrated by the accompanying drawings, in which like reference characters designate like parts. In the drawings:—

Figure 1 is a vertical, cross-sectional view of a steam-boiler, showing my improved stoking-apparatus applied thereto;

Fig. 2, a front elevation of one complete unit of the stoker;

Fig. 3, an end view of the same looking in the direction of the arrow *x*, Fig. 2;

Fig. 4, a view looking in the opposite direction; and

Fig. 5, an enlarged, plan view of the operating-mechanism of the stoker showing the casing partly in section to illustrate the adjustable delivery-regulating devices therein.

Referring to the drawings, in Fig. 1 B designates a boiler supported on an arch of masonry A above the fire-box or combustion-chamber C, below which is the fuel-grate G. The grate G may be of any preferred type and as here shown comprises a series of rockable bars 2 having trunnions 3 at their ends mounted in suitable openings 4 in the longitudinal supporting members or side-frames 5. The members 5 are supported at their forward ends in sockets in the metal frame F which forms the front plate or casing of the boiler. In the casing F is an opening E for the admission of fuel to the grate G and this may be closed by the usual fire-door D. The flue or chimney is generally arranged at the rear of the fire-box, but is not herein shown, and in some cases a current of air is introduced below the grate G to pass up through the openings in its bars to provide a forced draft for the fire. While I have here illustrated only one conventional form of boiler, it is to be understood that my improved stoker is adapted for practically all types, whether horizontal or vertical, and irrespective of the style of grate or the size of the fire-box.

As shown in Fig. 1 the stoking-apparatus is usually attached to the front of the boiler by bolting it to the plate or frame F, but if preferred it might be supported on stanchions or a framework resting on the floor. As illustrated more particularly in Figs. 2, 3 and 4, the stoker-unit comprises essentially a cylindrical retort or casing 8 having webs or brackets 9 at either end, with lateral flanges for receiving the bolts 10 through which it is fastened to the front plate F of the boiler. The casing 8 is mounted on the frame of the boiler with its lower portion in line with the fuel-opening E, the usual fire-door being removed for this purpose and a narrower door D substituted in its stead. This arrangement provides that the apparatus may be applied to any standard type of boiler without alteration in its structure, the only change required being the cutting away of the upper portion of the fire-door or the substitution of a new door of less height. It will also be understood that when a battery of boilers is employed the stoker-units are installed in series, one at each fire-door.

At one end of the casing 8 is a fixed cylinder-head 11, while at the opposite end is a removable head 12 fastened in place by the bolts 13. At the center of the heads 11, 12 are projecting hubs or bearings 14 stiffened by ribs 15, and bored axially to receive a horizontal shaft 18. The shaft 18 carries a paddle-wheel or rotor 19 keyed thereto and adapted to be rotated thereby

within the cylindrical casing 8, as shown in Fig. 1. As here illustrated the rotor 19 is constructed with three blades or paddles 20, projecting from a triangular hub 21 and reinforced by circular heads or end-flanges 22. When turned to the position shown in Fig. 1, the two upper blades 20 with their end-heads 22 form a hod-like bucket adapted to receive a supply of fuel admitted into the retort 8 from above, while the third blade 20 is in position to act as a pusher or paddle to propel the fuel outwardly from the retort through a lower side-opening 24. The opening 24 takes the form of a flanged spout or discharging chute extending the length of the casing 8 and communicating with the fuel-entrance E in the boiler-plate F above the top of the reduced fire-door D. Projecting from the lower side of the opening or spout 24 is a sheet-metal pan or saddle 25 which is arched or crowned upwardly at its center to adapt it to spread the fuel out laterally as it issues from the retort 8. A steam-pipe 26 extends across the saddle 25 at its rearward end and is perforated with openings 27 through which issue jets of steam to moisten the fuel as it is fed to the fire. The pipe 26 is supported by the end-flanges 11 of the casing 8 and is connected to the boiler with suitable valves, not herein shown, for regulating the pressure of the steam passing therethrough.

On top of the retort 8 is a valve-chamber or casing 30 which, in turn, is surmounted by a magazine or hopper 31 for holding the supply of fuel X. The valve-chamber 30 is preferably made as a separate casting fitted to the top of the cylinder 8 and fastened thereto by suitable bolts 33 extending through the flanges 34 on its sides, see Fig. 3. The open top of the casing or chamber 30 is also flanged at its sides and the fuel magazine or hopper 31 sets thereon and is fastened thereto by means of the bolts 35. Preferably, the hopper 31 is constructed of sheet-metal with sloping front and sides, and flanges at its bottom for receiving the bolts 35.

In the valve-chamber 30 is a slidable closure or gate 38 for regulating the size of the opening between the hopper 31 and retort 8 to control the amount of fuel admitted therethrough. As shown in Figs. 1 and 5, the valve or gate 38 is constructed in the form of a plate or flat bar, beveled on its forward side, and arranged to slide in a slot or opening 39 on the front of the casing 30. The gate 38 is adjustable manually from the front of the apparatus by means of a hand-wheel 40 at the end of a screw-shaft 41. The shaft 41 is threaded through a bearing 42 on the front of a bracket or casing 43 which forms an extension of the valve-chamber 30, being fastened thereto by the bolts 44, see Fig. 1. The casing 43 is formed with a guide-way 45 for a sliding bar 46 which extends horizontally thereacross in parallel relation with the gate 38. At its inner end the adjusting screw 41 is reduced in diameter and inserted through an opening in the bar 46 with its shouldered portion abutting the front side thereof. Abutting the opposite side of the bar 46 is a collar 47 secured to the end of the screw 41 by means of a pin 48. The bar 46 is connected to slide the gate 38 by a series of rods 49 carrying compression-springs 50, see Fig. 5. The outer ends of the rods 49 are fitted loosely to openings 51 in the bar 46 and are threaded to receive nuts 52 which abut the front side of the bar. At their inner ends the rods 49 are inserted in suitable bores 53 in the gate 38 and secured in place by pins 54. The springs 50 are coiled around the rods 49 with their outer ends abutting the side of the bar 46 and their inner extremities seated in pockets 55 on the front of the gate 38. The function of the springs 50 is to maintain the gate 38 in spaced relation with the bar 46 so that when the latter is slid back and forth in its guideway 45 the valve will be adjusted across the throat or opening 56 which leads from the hopper 31 down into the retort 8. As before indicated the bar 46 is moved by turning the hand-wheel 40 to screw the shaft 41 through its bearing 42. The movement of the bar 46 serves to slide the gate 38 across the opening 56, and should the valve meet with obstruction from lumps of coal or other hard substances the springs 50 will contract to prevent undue strain on the parts, which might cause injury or breakage of the mechanism. As soon as the obstruction is removed, however, through the normal operation of the feed, the springs 50 will expand to force the gate 38 into its proper position as determined by the adjustment of the hand-wheel 40. To prevent the fuel from clogging or choking the outlet passage 56 between the hopper 31 and retort 8, I employ an agitator or breaker 58. As shown in Figs. 1 and 2, this comprises a rotary shaft 59 provided with a series of teeth or prongs 60 projecting radially therefrom in spaced relation across the width of the hopper. The shaft 59 is journaled in bearings 61 bolted to the side-flanges 62 on the top of the valve-chamber 30 at 63 and is driven through suitable connections as later described.

Beneath the throat 56 in the valve-chamber 30 is a flat shelf or ledge 66 projecting horizontally across the top of the retort 8 to reduce the width of its inlet-opening. The ledge 66 catches a portion of the fuel X as it feeds down from the hopper 31 through the throat 56 and it is then positively projected off from the shelf into the buckets on the rotor 19 by means of a reciprocating pusher 68. The pusher 68 is preferably of hollow, box-like structure, reinforced by ribs 69, and

is fitted to slide in a slot or guideway 70 at the rear of the shelf 66, see Figs. 1 and 5. For reciprocating the pusher 68, I employ a pair of eccentrics 75 operated from a shaft 76. As shown in Figs. 1 and 2 the shaft 76 is journaled in bearings 77 projecting from the bottom of the casing 43. Referring to Fig. 5, the eccentrics 75 are keyed to the ends of the shaft 76 and secured in place thereon by the set-screws 79. The eccentric-straps 80 are preferably constructed in one piece, integral with their arms or rods 81 which extend radially therefrom, and are formed with slotted bearing-boxes 82 at their ends. The straps 80 are bored to fit the peripheries of the eccentrics 75 and are held in place by the raised flanges 83 on one side and the plates or disks 84 on the other, the latter being fastened to the eccentrics by screws 85.

Projecting from the ends of the slide or pusher 68 are two arms or studs 71 which reach through suitable slots 72 in the sides of the casing 8. At the front of the pusher are two side-flanges 74, see Fig. 5, which act as guards to close the opposite openings 72 in the casing 8 when the pusher is in its rearward position. The studs 71 have cylindrical extensions 73 engaging the slots 86 in the end-boxes 82 of the eccentric-rods 81, see Figs. 3 and 5. Fastened to the ends of the studs 73 by screws 87 are washers 88 which serve to hold the parts in proper relation. Threaded through the ends of the boxes 82 are screws 89 which project into the slots 86 to adapt their extremities to contact with the studs 73. The screws 89 are adjustable to regulate the timing and extent of movement of the pusher 68 under the action of the eccentric-rods 81 by allowing for lost-motion therebetween through the sliding action of the boxes 82 on the studs 73. As shown in Fig. 5, the screws 89 may be locked in their adjusted position by means of the set-screws 90 which reach through the sides of the boxes 82 with their ends adapted to impinge against the flatted sides 91 of the screws.

The several operating parts of my improved apparatus are preferably driven from a counter-shaft 92 which is connected to be rotated from any suitable source of power, such as an electric-motor or a steam- or gas-engine, not herein shown. The shaft 92 is journaled in bearings 93 bolted to the lower part of the cylinder or retort 8, and when a plurality of stoker-units are employed with a battery of boilers the shaft is extended to operate the whole series. Referring to Figs. 2, 3 and 4, the left-hand end of the shaft 92, as viewed in Fig. 2, carries a relatively large sprocket-wheel 94 which is connected by a driving-chain 45 to a smaller sprocket 96 on the end of the rotor-shaft 18. At the opposite end of the countershaft 92 is a small sprocket 97 connected by a chain 98 to a larger sprocket 99 on the eccentric-shaft 76, whereby to communicate a relatively slow rotation thereto. At the outer end of the eccentric-shaft 76 is a sprocket 100 connected by a chain 101 to an equal-sized sprocket 102 on the breaker- or agitator-shaft 59. The ratio of gearing between the countershaft 92 and rotor-shaft 18 is such that the paddle-wheel 19 turns very rapidly, usually several hundred revolutions per minute, while the eccentric-shaft 76 is geared down to rotate very slowly, about one turn per minute. This provides that the rotor 19 will receive fuel in relatively small quantities in all of its buckets while the pusher is being carried forward to project it off from the shelf or ledge 66. The method of operation of the complete apparatus is as follows:

The hopper 31 is filled with fuel, either manually or by mechanical means, in some cases a chute being employed to convey it down from bins or other storage receptacles placed on a higher level. When power is applied to the shaft 92 the shaft 18 will be driven therefrom to turn the rotor 19 at a high velocity, while the eccentric-shaft 76 will also be rotated at a much less speed. As the shaft 76 turns slowly the eccentrics 75 act through their rods 81 to reciprocate the pusher 68 back and forth across the shelf or fuel-rest 66. The extent of this reciprocating motion is regulated by adjusting the screws 89 in the boxes 82 to provide more or less lost-motion between the ends of the screws and the studs 73 on the pusher 68. That is to say, the screws 89 can be set so that the bearing-boxes 82 will slide on the studs 73 to a considerable extent before the screws engage therewith to move the pusher 68, and in this way there will be an interval of dwell or rest at the end of each rearward movement of the pusher. With such adjustment the pusher 68 will have a limited forward traverse so that only a comparatively small quantity of fuel will be projected off from the shelf 66 at relatively long intervals. When a maximum feed is desired the screws 89 are adjusted to engage with the studs 73 without lost-motion during the oscillation of the eccentric-rods 81 and the pusher will then be reciprocated continuously, without dwell at the end of its stroke, and to an increased extent to project all of the fuel held on the shelf 66 down into the retort 8. The feed of the fuel may also be further regulated by adjusting the gate 38 in the valve-chamber 30 through the turning of the hand-wheel 40 as previously explained. By moving the gate 38 back toward the rear wall of the passage or throat 56 the latter may be nearly closed so that only a small quantity of fuel will sift down onto the shelf 66; while by

withdrawing the gate 38 toward the front the throat 56 may be opened to its full width to effect a substantially continuous and rapid feed.

As before explained, the shaft 59 is rotated continuously from the shaft 76 during the operation of the apparatus, and the agitator 58 is thus turned slowly to cause its teeth 60 to stir and churn the fuel to break up the lumps and prevent it from clogging or chocking in the outlet-passage 56. Meanwhile, as the fuel feeds down into the buckets on the rotor 19 it is whirled rapidly around within the cylinder 8 and ejected forcibly therefrom through the lower side-opening or spout 24. The rapid rotation of the rotor 19 causes its blades to act more or less as sweeps or propellers to throw the coal out through the spout with considerable energy, the effect of centrifugal force also assisting materially in this action. The fuel is thus projected into the fire-box C in a relatively thin spray, somewhat as it is delivered from the edge of a shovel wielded with a swinging stroke under energetic action. This spray or sheet of fine particles, under the impulse of its ejection from the retort, and assisted by the draft toward the flue, is carried clear back to the furthermost ends of the grate and also scattered laterally with a substantially uniform distribution to all parts of the fire. In this way the fire is fed with fresh fuel in such small volume that it cannot become smothered or its draft choked, and consequently the combustion will be maintained constantly at the maximum. As the coal is spread out across the fire-box at a distance above the grate it becomes coked so that when it drops down onto the fire the combustion will be much more complete, thereby increasing the intensity of the heat produced. Furthermore, the present method of feeding the fuel in a sheet-like spray causes it to be spread uniformly over the whole fire, thus obviating the necessity of leveling it at frequent intervals and also providing for a more complete combustion in all of its parts. For this reason the use of my improved apparatus effects a very considerable saving of fuel, at least twenty-five per cent. over hand-feeding methods, besides doing away with the necessity for opening the fire-door and cooling off the fire. As before explained the apparatus may be easily adjusted to feed the fuel in greater or less quantities in accordance with any and all requirements.

It will also be observed that my new form of apparatus is extremely simple and compact in structure and arrangement, and easy to install and operate. It may be employed in single units for small boilers or extended in series for larger batteries and requires very little power to operate. It is also adaptable to practically all types of boilers and can be installed without material fitting or alteration thereof.

Various modifications might be made in the structure and arrangement of the parts of the apparatus without departing from the spirit or scope of the invention; therefore, without limiting myself to the exact embodiment herein shown and described, what I claim is:—

1. In an automatic stoker for feeding fuel to boilers, the combination with a cylindrical retort having an inlet-opening at its top and a discharge-opening on its side, of a rotor rotatable within the retort, said rotor formed with cylindrical ends and substantially radial blades dividing it into V-shaped buckets adapted to receive fuel from the inlet-opening, and means to rotate the rotor to carry measured quantities of fuel downwardly from the inlet-opening to the discharge-opening whereby the blades will project it out therethrough at a high velocity.

2. In an automatic stoker for feeding fuel to boilers, the combination with a cylindrical retort having an inlet-opening at its top and a discharge-opening on its side, of an adjustable valve for regulating the size of the inlet-opening, a rotor journaled axially within the retort and provided with cylindrical ends and substantially radial blades dividing it into a plurality of V-shaped buckets, and means to rotate the rotor to adapt it to receive the fuel from the inlet-opening in measured quantities whereby to carry it downwardly to the discharge-opening and project it out therefrom under the propulsion of the blades.

3. In an automatic stoker for feeding fuel to fires, the combination with a cylindrical retort having an inlet-opening at its top and a discharge-opening on its side, of an adjustable valve for regulating the size of the inlet-opening, a shelf projecting beneath the inlet-opening part way across the top of the retort, a pusher reciprocable on said shelf, means to operate the pusher to push the fuel off from the shelf, a rotor journaled axially within the retort and formed with cylindrical heads at its ends and substantially radial blades dividing it into V-shaped buckets, and means to rotate the rotor to adapt it to carry the fuel downwardly from the shelf in measured quantities and project it out through the discharge-opening at a high velocity.

4. In an automatic stoker, the combination with a fuel-retort having an inlet-opening at its top and a discharge-opening on its side, of a hopper communicating with the retort through the inlet-opening, an adjustable valve for regulating the size of the inlet-opening, a shelf projecting across the interior of the retort to receive the fuel from the inlet-opening, a reciprocable pusher for pushing the fuel off from the shelf to feed

it to the retort in measured quantities, means for adjusting the range of action of the pusher, and a rotor rotatable within the retort and formed with end-flanges and a plurality of substantially radial blades dividing it into hod-shaped buckets adapted to receive the fuel to carry it downwardly to the discharge-opening and project it outwardly therefrom.

5. In an automatic stoker, the combination with a fuel-retort having an inlet-opening at its top, of a fuel-receiving shelf projecting across said opening, a pusher reciprocable across the shelf to push the fuel off therefrom, studs projecting from the ends of the pusher, a pair of rotatable eccentrics, pitmen oscillated from the eccentrics and formed with slotted bearing-boxes for engaging the pusher-studs, and screws adjustable in said bearing-boxes to regulate the extent of movement of the pusher under the action of the pitmen.

In testimony whereof I affix my signature.

GEORGE A. SMITH.