Jan. 14, 1941. W. R. MITTENDORF 2,228,840

STOKER APPARATUS

Filed May 29, 1937 2 Sheets-Sheet 1

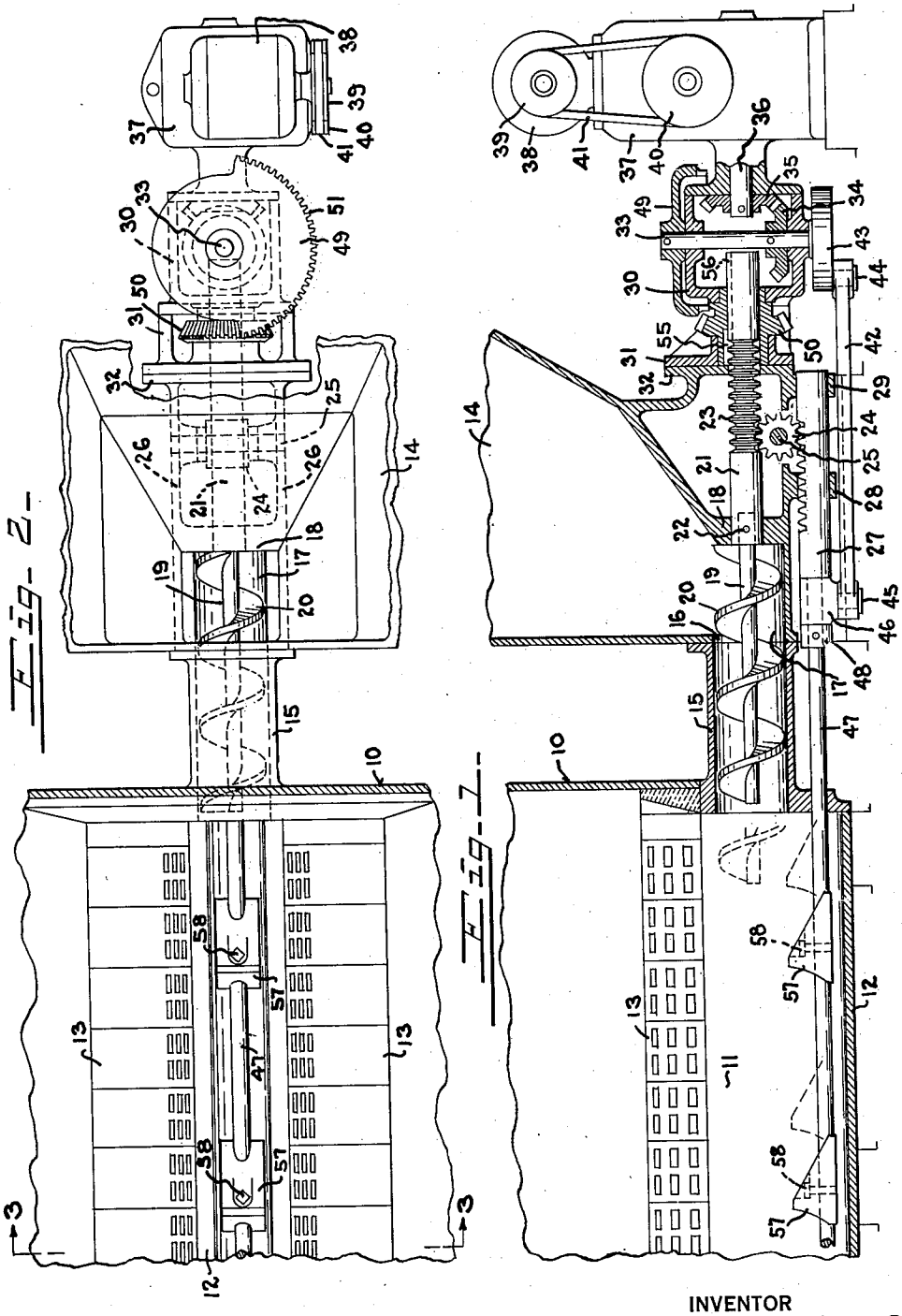

Fig. 2.

Fig. 1.

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Fig. 7.

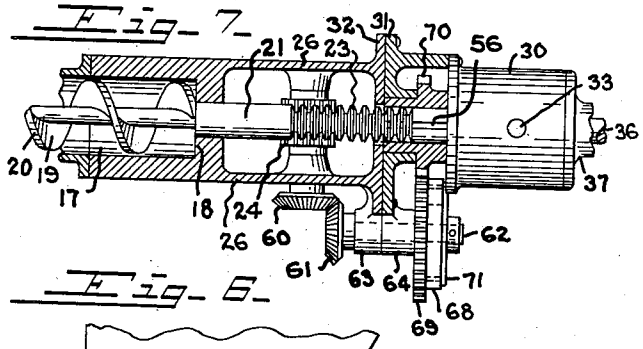


Fig. 6.

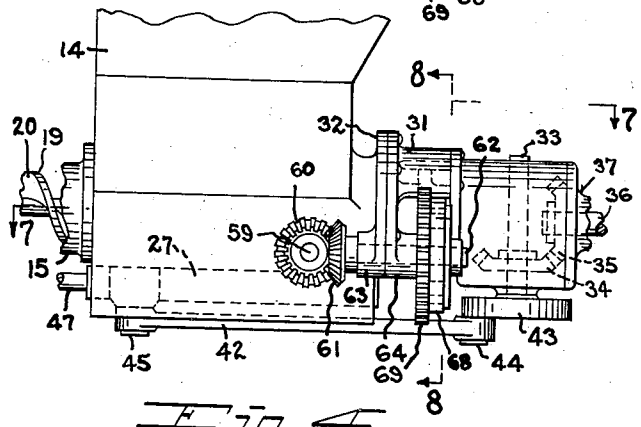


Fig. 8.

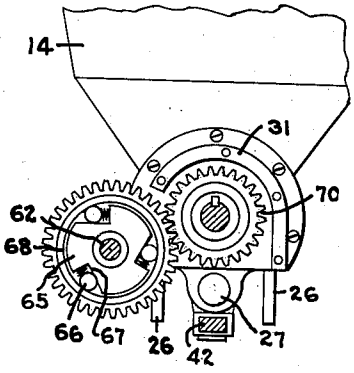


Fig. 4.

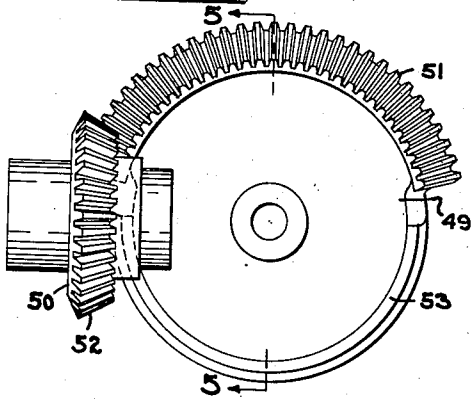


Fig. 5.

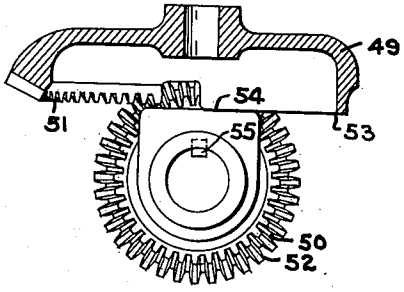
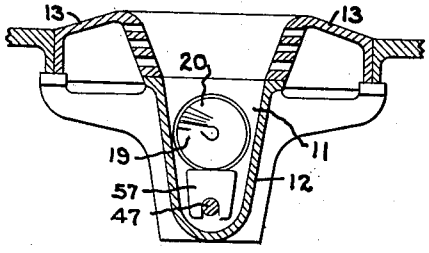


Fig. 3.



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2,228,840

STOKER APPARATUS

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Application May 29, 1937, Serial No. 145,610

9 Claims. (Cl. 110—44)

This invention relates to stoking apparatus whereby coal, or other solid fuel, is transported from a source of fuel-supply, such as a hopper or bin, and delivered to the retort or firebowl of a furnace and therein subsequently distributed to the fire-bed.

Early forms of stoking devices heretofore used for this purpose, employed a cylindric ram or piston element for transporting the fuel from the hopper and discharging the same into the retort, the said ram being reciprocably operated within a cylindric conduit, the receiving end of which had communication with the hopper and the delivery end with the retort. This ram method of feeding coal was decidedly advantageous in respect to efficiency in that it accomplished the delivery to the retort of a large volume of fuel in a short space of time and with the consumption of a comparatively small amount of power. Also in the case of underfed retorts, the ram method, giving intermittent delivery, was particularly desirable because the sudden push of the coal into the retort underneath the fire acted to disrupt the mass of burning fuel, leveling it off and closing up the large air holes therethrough. This is of great importance in the case of coking and caking coals which do not burn readily and which form large coke trees allowing free passage of air. However, there was a disadvantage attending this method due to the fact that the stroke of the ram was necessarily limited to a comparatively short movement and thus it was essential that the hopper be located close to the retort and at a distance somewhat less than the length of the ram stroke, or auxiliary feeding means be employed to carry the coal from a distant hopper to the ram chamber. This physical limitation precluded the use of the ram method of feeding coal in the vast majority of cases. Furthermore, as one of the objects of stocking apparatus is to accomplish the efficient burning of the cheaper grades of coal, such as slack, the ram method of feeding the coal to the hopper also had the serious disadvantage that it caused coherence or packing of the fuel particles of such grades of coal, particularly if the same was wet or even moist and this condition entailed the employment of agitating means within the retort to disintegrate the coherent mass of fuel and effect distribution of the loosened fuel particles throughout the retort and delivery thereof to the fire-bed. In this matter, the reciprocating pusher-block type of agitator operating in the bottom of the retort in timed relation with the ram impulses, has been generally employed, particularly in the case of long and narrow retorts.

In order to avoid the disadvantages of the ram method of delivering coal to the retort, later types of stoking devices employed a rotating conveyor of the screw or spiral vane type disposed within a cylindric conduit extending from the hopper to the retort, the movement of the coal through the conduit resulting from the urge set up by the rotary movement of the spiral vane of the conveyor. This enabled the hopper to be remotely spaced from the retort and substantially reduced the tendency of the coal to pack during transit but the low delivering efficiency of a rotating conveyor and its excessive waste of power due to unavoidable friction were serious disadvantages of this method. Also the delivery of coal by a rotating conveyor is substantially continuous and therefore there was no sudden impulse in the retort to disrupt the mass of burning fuel. In the early forms of such stokers, the conveyor screw was employed not only to transport the coal from the hopper to the retort but the screw was arranged so as to extend a substantial distance into the retort, even the full length thereof, in order that it may also function therein as a distributor element. This latter feature however had certain disadvantages of a particularly harmful nature—the distribution of the coal to the fire-bed was uneven, a preponderance of the fuel being delivered to that side of the retort toward which the screw rotated; also the section of the screw within the retort would deteriorate rapidly due to its proximity to the fire. Consequently, later designs of stokers employing rotating conveyors are usually arranged with the conveyor terminating at the entrance to the retort and a separate agitating and distributing device operating in the bottom of the retort.

Therefore, a principal object of this invention is to provide a stoker apparatus having the efficiency of the conventional ram method of delivery together with the advantages of the rotating conveyor and without the inherent disadvantages of either.

Another object is to provide means for transporting coal from a hopper or bin to the retort by a method which is positive in delivery and definite as to volume.

Another object is to provide transporting means of this character which will effect delivery of coal into the retort by a direct longitudinal thrust at intermittent time intervals.

Another object is to provide means of this

character which will minimize the tendency of the fuel particles to become packed during transit.

Another object is to provide means of this character which will permit locating the fuel hopper or bin at a substantially remote distance from the retort.

Another object is to provide a stoker apparatus comprising such transporting means in cooperative combination with agitating and distributing means within the retort.

Another object is to provide such a stoker apparatus which will be economical in operation in respect to power and fuel consumption, easy to manufacture at low cost and require a minimum of expenditure for service and upkeep.

Other objects will be apparent from the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a longitudinal vertical elevation, mostly in section, of a stoker apparatus and retort arranged and constructed so as to embody this invention.

Fig. 2 is a plan view of the apparatus shown in Fig. 1.

Fig. 3 is a sectional end elevation of the retort, taken on the line 3—3 of Fig. 2.

Fig. 4 is an underneath view of the intermittent gears forming part of the manipulating mechanism for the fuel transporting means.

Fig. 5 is a sectional elevation of said intermittent gears, taken on the line 5—5 of Fig. 4.

Fig. 6 is a side elevation of a modified form of manipulating mechanism for the fuel transporting means.

Fig. 7 is a longitudinal plan view in section, taken on the line 7—7 of Fig. 6, and;

Fig. 8 is an end elevation, partly in section, taken on the line 8—8 of Fig. 6.

Referring to the drawings, 10 designates generally a furnace having a retort 11 comprising a trough portion 12 and tuyères 13. A fuel-supply hopper or bin 14 may be located at any desired distance from the furnace and connected to the trough portion 12 of the retort 11 by means of a cylindric conduit 15 which may be constructed as a unitary element, as shown, or of as many sections as desired. In any case, the conduit 15 is preferably united rigidly to the trough portion 12 at one end and similarly united to the hopper 14 at the other end, the said hopper having an opening 16 in the forward wall which coincides with the duct of the conduit 15. Thus the chamber within the hopper 14 is connected to the retort 11.

The forward bottom portion of the hopper 14 is formed internally with a semi-cylindric recess 17 having a rear wall 18, said recess being in axial alignment with the opening 16 and conduit 15. Disposed within the conduit 15 and extending into the recess 17 is a cylindric element 19 which may be termed "a retrohelically loaded ram" and which, when arranged and manipulated as hereinafter described, serves to take fuel from the hopper 14, transport it through conduit 15 and positively thrust the fuel into the retort in definite volume at intermittent time intervals.

The element 19, which comprises a vane 20 formed as a helix around the axis of said element, is caused to move reciprocally forward toward the retort 11 and backward toward the hopper 14. The forward movement of said element is non-rotatory but during the backward or return movement the element is given a rotary motion in such timed relation with its longitudinal movement and in such direction that the spiral vane will not change longitudinally from the spiral path in which it moves.

The manipulation of the element 19 in this manner may be accomplished in various ways but I have herein shown, in Figs. 1, 2, 4 and 5, one form of operating mechanism which comprises a cylindric rack bar 21 suitably supported at one end for sliding and rotary movement in the rear wall 18 of the hopper 14 and thereat having driving connection with the element 19, as by means of a pin 22.

The rack bar 21 has a series of rack teeth 23 formed circumferentially thereof and said teeth are in operative engagement with a toothed pinion 24 which is journaled on a shaft 25 supported at each end in webs 26 extending from and below the hopper structure. A second rack bar 27 is slidably supported in brackets 28 and 29 also extending from the under side of the hopper structure and this second rack bar also has toothed engagement with the pinion 24 diametrically opposite that of the rack bar 21.

Rotatably supported in a housing 30, which is preferably secured to a bracket 31 attached to a flanged extension 32 on the hopper 14, is a crankshaft 33 which may be driven in any suitable manner but I have herein provided a bevel gear 34 mounted on said crankshaft, within the housing 30, and drivingly connected thereto, the said gear meshing with a similar gear 35 secured to a drive shaft 36 forming part of a speed reducing device 37 which may be of any suitable character and attached to the housing 30 as shown.

Any form of power device, such as an electric motor 38, may be employed to operate the said speed reducing device either directly or otherwise, as by means of pulleys 39 and 40 and belt 41.

In order that reciprocatory movement may be imparted to the rack bar 27 and through it and pinion 24 impart similar movement to rack bar 21 and element 19 I prefer to operatively connect the said bar 27 to the crankshaft 33 by means of a link 42 pivotally connected at one end to crank arm or head 43 of the crankshaft 33 by means of a stud 44 anchored in said head, the said link being similarly connected at its other end, by means of a stud 45, to member 46 attached to an extension 47 of the rack bar 27 and held in fixed longitudinal relation thereon by means of a collar 48 anchored to the said extension.

Rotary movement may be imparted to the rack bar 21 and element 19, on the backward or return stroke, in any suitable manner but I have herein shown in Figs. 1, 2, 4 and 5 one form of operating mechanism which comprises a pair of intermittent bevel gears 49 and 50. Gear 49 is mounted upon and secured to shaft 33 and is formed as a sector having driving teeth 51 throughout less than half of its circumference whereas the driven gear 50 is provided with teeth 52 throughout its full circumference. As shown more clearly in Figs. 4 and 5, gear 49 is provided with a circular locking face 53 extending substantially 180 degrees and disposed diametrically opposite the teeth 51; said locking face cooperates with another locking face 54 attached to gear 50 and suitably spaced from the axis of said gear so that gear 50 will be held against rotation whenever the teeth 51 are out of engagement with teeth 52. Gear 50 may be supported in any suitable manner but I have herein shown the same as being journaled at one end in the wall of the housing 30 and at its other end in the bracket 31. The rear end of the cylindric rack bar 21 is

slidably supported within the gear 50 and the gear is drivingly connected to the said rack bar by means of a key 55 anchored in said gear and disposed within a spline groove 56 in the rack bar 21.

For certain sizes and proportions of retorts, particularly those which are required to be long and narrow in furnaces of large capacity, it is desirable to provide agitating and distributing means within the retort to cooperate with the fuel feeding means in getting proper distribution of the fuel throughout the extent of the retort. Such agitating and distributing means may be of any suitable character but I prefer to employ a reciprocating device, such as the well known pusher-block type of agitator, which may be provided by extending the member 47 into the trough portion 12 of the retort 11 and mounting thereon one or more agitators or pusher-blocks 57 which may be anchored to the member 47 by any suitable means such as bolts 58.

If desired, the rotary movement as required in the operation of element 19, may be accomplished directly by the reciprocatory movement of rack bar 27 by the driving mechanism shown in Figs. 6, 7 and 8 wherein the pinion 24 is drivingly secured to shaft 59 which is rotatably supported in the webs 26. Secured to shaft 59 is a bevel gear 60 which meshes with a similar gear 61 drivingly secured to a shaft 62 which is rotatably supported in extensions 63 and 64 of flanged extension 32 and bracket 31 respectively. Drivingly secured to shaft 62 is an internal clutch member 65 which, together with suitable rollers 66, roller thrust springs 67 and external clutch member 68, forms a one-way driving clutch whereby rotary motion may be transmitted to cylindric rack bar 21 simultaneously with its backward or return stroke. This may be accomplished by providing the external clutch member 68 with gear teeth 69 which mesh with the teeth of a gear 70 mounted in the same manner and disposed in the same location as gear 50 and drivingly connected to the rack bar 21 in the same way by means of key 55 disposed within groove 56 in the rack bar 21. If desired, a closure plate 71 may be provided to enclose the internal mechanism of the clutch. By means of this device, the element 19 will be subjected to rotary movement during its backward stroke only and not during its forward stroke as the clutch is then inoperative.

While no means is herein shown for supplying and controlling draft air to the retort, nor for controlling the operation of the electric motor or other power device, it will be understood that any suitable equipment may be employed for such purposes.

In operation, coal is removed from the hopper or bin 14, transported through the conduit 15 and thrust into the retort 11 solely by the manipulation of the element 19 in the manner and through the means hereinbefore described. As the coal is being carried into the retort by the forward movement of the element 19, the agitators 57 are moving in relatively reverse direction. Owing to the fact that the delivery of coal into the retort is periodic—that is, periods of delivery (when element 19 moves toward the retort) alternating with periods of non-delivery (when said element is operating on its return stroke away from the retort)—the feature of having the agitators 57 move in timed relation with an in reverse direction to the movement of element 19 is particularly advantageous as the agitators 57 are moving forwardly while element 19 is moving rearwardly on its return stroke or vice versa. Thus during such non-delivery periods, the coal in the retort is subjected solely to the distributive influence of agitators 57 as they move forward and conversely, during periods of delivery when element 19 pushes forwardly into the retort, the raking action of agitators 57 is in opposition thereto and this compound action serves to effectively break up caking of the coal and thereby enables agitators 57 to accomplish better distribution on their subsequent forward movement.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a stoker mechanism, in combination, a hopper for holding a supply of coal, a retort spaced from said hopper and having a receiving opening, a cylindric conduit extending from said hopper to said receiving opening, a cylindric ram freely disposed within said conduit and having a helically formed groove extending throughout its length, said ram having one end disposed in communicative relation with said hopper and its other end disposed in similar relation with said retort, means to cause relatively timed rotary and longitudinal movement of said ram toward said hopper and non-rotary longitudinal movement thereof toward said retort whereby coal may be caused to move from said hopper through the groove in said ram and be thrust into said retort, said means comprising a crank operated device, a pusher-block device disposed within said retort in a plane below said receiving opening and adapted to agitate and distribute the coal within the retort, and a member operatively connecting said pusher-block device with said means so as to cause reciprocatory movement of said pusher-block device simultaneously with the longitudinal movement of said ram in timed relation therewith and in reverse direction thereto.

2. In a stoker apparatus comprising a container for holding a supply of coal and a retort in which coal is to be burned, the combination of means for transporting coal from said container to said retort and a reciprocable device in said retort to agitate and distribute the coal therein, said means comprising a cylindric conduit extending from said container to said retort, a cylindric ram movable reciprocally within said conduit and having a helically formed coal-carrying channel extending throughout the length thereof and means comprising a crank-operated device to manipulate said ram so as to cause a portion of the coal in said container to enter said channel at one end and to subsequently cause said portion of coal to move through said conduit and out of the other end of said channel into said retort and said reciprocable device being associated with said crank-operated device so as to be actuated thereby in timed relation with the reciprocal movement of said ram and in reversed direction thereto.

3. In a stoker apparatus, the combination with a container adapted to contain coal and a retort in which coal may be burned; of a cylindric conduit extending from said container to said retort, a coal-feeding element reciprocable longitudinally within said conduit, means comprising a crank-operated device for reciprocating said element, means for rotating said element as it is being moved in one direction, a member reciprocable longitudinally within said retort to distribute and agitate the coal therein, and means operatively connecting said member with said crank-operated device so as to actuate said member in timed relation with the recip-

rocal movement of said element and in reverse direction thereto.

4. In a stoker apparatus, the combination with a hopper, a retort and a conduit extending from said hopper to said retort; of a coal-feeding element reciprocable longitudinally of said conduit, a rotating power device, means comprising gearing operatively connecting said power device to said element for imparting reciprocatory movement thereto, and other means comprising intermittent gearing associated with said power device and said element for rotating said element as it is being moved longitudinally in one direction.

5. In a stoker apparatus, the combination with a hopper, a retort and a conduit extending from said hopper to said retort; of a coal-feeding element slidably and rotatably supported and enclosed within said conduit, means to move said element endwise non-rotatively in one direction and endwise rotatively in the opposite direction, said means comprising rack-and-pinion gearing for accomplishing said endwise movements and intermittent gearing for accomplishing said rotative movement.

6. In a stoker apparatus, the combination with a hopper, a retort and a conduit extending from said hopper to said retort; of a coal feeding element slidably and rotatably supported and enclosed within said conduit, a crank-operated device for imparting longitudinally reciprocatory movement to said element, and means associated with said device for imparting rotary movement to said element during its endwise movement in one direction only, said means comprising a gear drivingly connected to said element.

7. In a stoker apparatus, the combination with a container adapted to contain coal, a retort in which coal may be burned, and a conduit extending from said container to said retort; of a helically grooved cylindric ram for moving coal from the container through the conduit into the retort, a member in the retort adapted to distribute the coal throughout the retort area and to agitate the fire-bed, and means comprising a crank-operated device for imparting longitudinally reciprocatory movement to said ram and said member simultaneously and in reverse direction one with the other, and other means for imparting rotary movement to said ram during its longitudinal movement in one direction only.

8. In a stoker apparatus, the combination with a container adapted to contain coal, a retort in which coal may be burned, and a conduit extending from said container to said retort; of a coal-feeding element slidably and rotatably supported within said conduit and adapted for moving coal from the container through the conduit into the retort, means to move said element endwise non-rotatively in one direction and endwise rotatively in the opposite direction, said means comprising a revolving crank for accomplishing said endwise movements and gearing associated therewith for accomplishing said rotative movement.

9. In a stoker apparatus, the combination with a hopper, a retort and a conduit extending from said hopper to said retort; of a coal-feeding element rotatably and slidably supported and enclosed within the conduit, a rotating power device, means operatively connecting said power device to said element to cause said element to be reciprocated longitudinally of said conduit, said means comprising a revolving crank, and other means operatively connected to said element to cause said element to be rotated simultaneously with its longitudinal movement in one direction only, said other means comprising a gear adapted to be inoperative during the longitudinal movement of said element in the opposite direction.

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