Jan. 25, 1944. G. A. FERRELL 2,339,776

STOKER

Filed Oct. 28, 1940 2 Sheets-Sheet 1

Fig. 1.

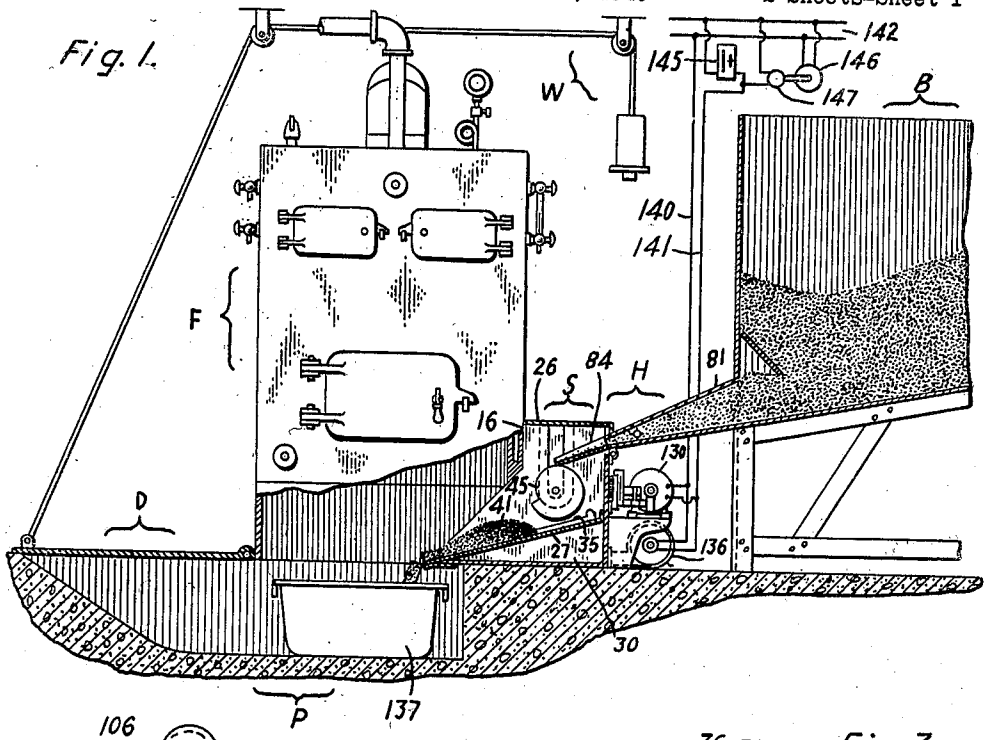


Fig. 2.

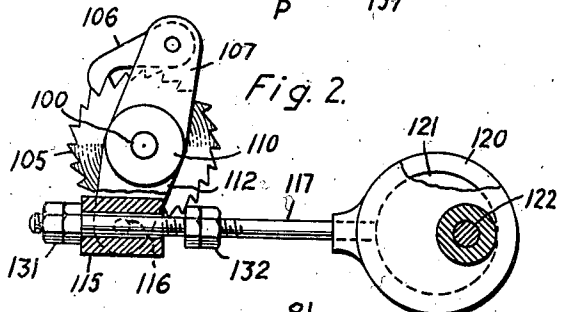


Fig. 3.

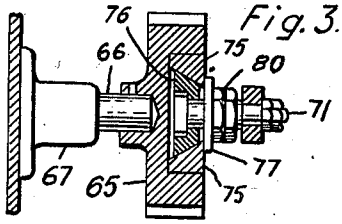


Fig. 4.

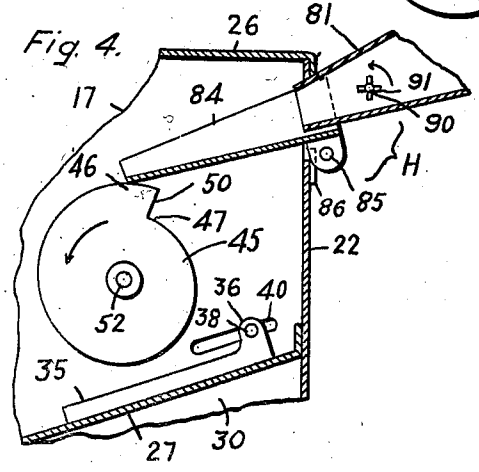
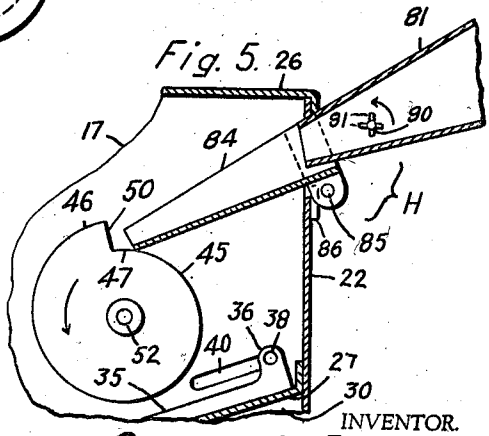


Fig. 5.



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Fig. 6.

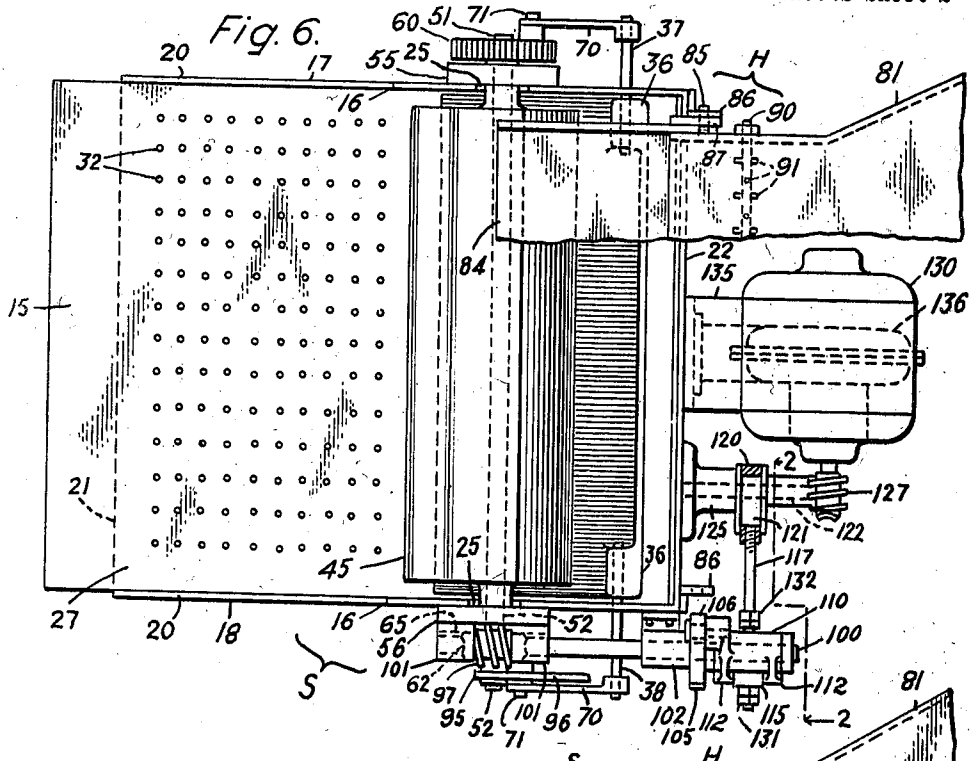
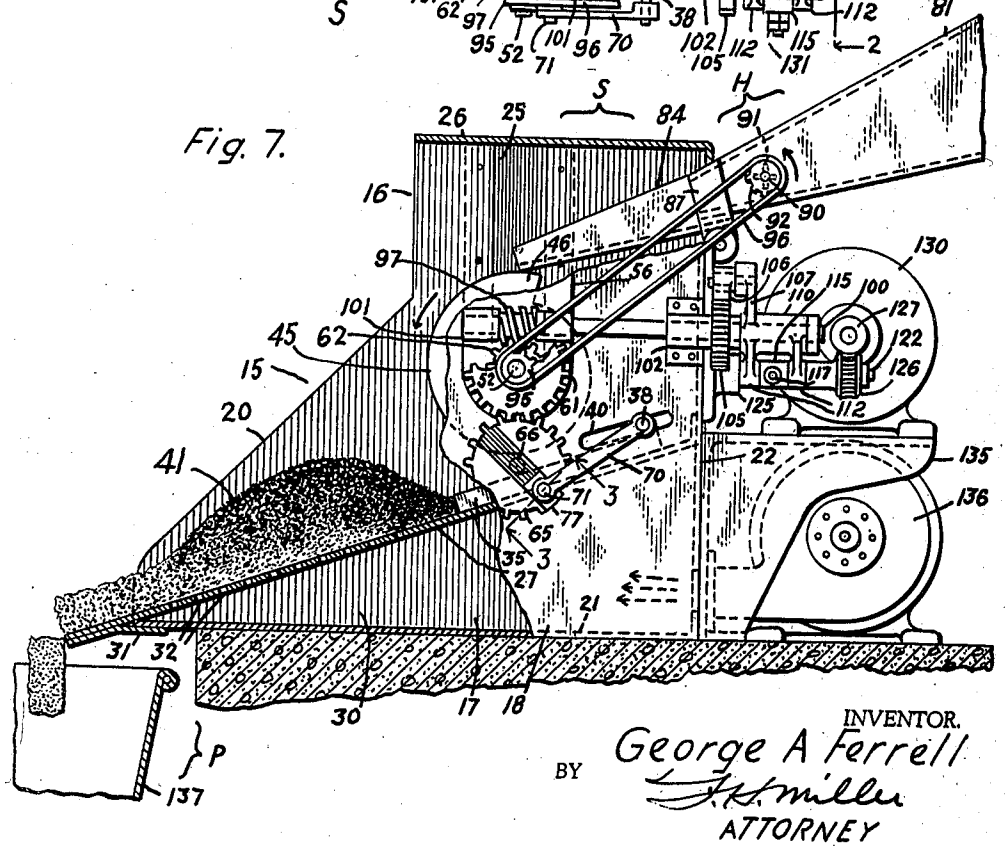


Fig. 7.



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2,339,776

STOKER

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Application October 28, 1940, Serial No. 363,069

4 Claims. (Cl. 110—101)

My invention relates to stoker devices, and has reference, more particularly to a furnace stoker including novel feeding and ash removal means severally and in combination.

Heretofore, many furnace stokers have been suggested and employed, including those which merely feed, and those which feed fuel to and discharge ash from the fire beds.

Such prior stokers have had many disadvantages, such as excess cost, undue complication and number of parts, breaking of shear pins and other parts from clogging of fuel and the presence of foreign bodies, such as nuts and bolts in the fuel which cause fly ash; other devices include fuel feed and ash removal means as separate apparatus, such apparatus usually necessitating the use of expensive fuel, while adapted only to furnaces of limited variety, and further being difficult to install, inefficient in burning the fuel, and confined to furnaces of particular style.

A furnace stoker which merely automatically feeds, irrespective of its many advantages, such as smaller cost, and availability to a larger class of usage in certain instances, still leaves substantially as great a problem as it solves, and as much trouble as it avoids, in the necessity for the manual discharge or removal of the ash from the grate or fire bed.

Certain of the former stokers do not burn all of the fuel, but leave unburned portions of it in the ash. Others operate against gravity in feeding the fuel and removing the ash, have parts maintained in position as in burners or stokers of the older less efficient types, are easily deranged, stopped or injured so as to disrupt service causing inconvenience and expense, and readily clog and pack the fuel.

Among the objects of my invention are to overcome all of the above noted disadvantages of former stokers, both as to feeding the fuel and to removing the ash from the fire bed.

Another object of the invention is to feed fuel to a fire bed from the top, and remove the ash at a rate substantially in accordance with the consumption of the fuel at any selected temperature or heat.

Another object of the invention is to take novel advantage of gravity in feeding a furnace charge, maintaining the charge while burning, and removing the ash from said charge.

Another object of the invention is to move a burning fuel charge bodily in such relation to its feed and consumption as to maintain the charge substantially constant.

Another object of the invention is to more thoroughly and effectively consume a furnace fuel charge.

Another object of the invention is to provide a stoker, and a device for removing ash from the charge, severally and in combination, which is simpler and less costly in construction, assembly and installation, than heretofore while being more economical and effective in operation, as well as adapted to the use of less expensive fuel.

Another object of the invention is to produce a combined fire stoker and ash remover which is less expensive than former structures having both of said features, and that is more comparable in cost to devices heretofore comprising only the stoking feature.

Another object of the invention is to provide a furnace stoker which is more rugged and durable, that will not pack the fuel or require shear pins to guard against damage from such packing, or from the presence of foreign bodies, will maintain a solid-particle fuel in an effective fluent state, and withal requires the minimum of attention.

Another object of the invention is to provide a stoker of the above-indicated character which is readily applicable to conventional, or special, furnaces, for various uses, such as in shops, schools, factories and stores; or, as in the example hereinafter disclosed, furnaces for heating dwellings.

With the stated objects in view, as well as advantages which may be incident to a utilization of the improvements, this invention comprises the elements and combinations thereof hereinafter described, illustrated in the drawings, and more particularly defined by the concluding claims; it being understood, however, that the several necessary elements constituting the same may be varied in proportion, arrangement, and operation, without departing from the nature and scope of said invention.

In the drawings:

Figure 1 is an outline or general view, partly in front elevation and partly in section, of a heater furnace, a main fuel supply bin, and a stoker constructed and arranged according to this invention, together with a convenient electric control means.

Fig. 2 is an enlarged detail view, partly in side elevation and partly in section, taken substantially along the line 2—2 of Fig. 6, of an adjustable pawl-and-ratchet drive connecting mechanism.

Fig. 3 is an enlarged detail view, partly in

elevation, and partly in section along the line 3—3 of Fig. 7, of an adjustable drive connector for a fuel displacing element of the invention.

Fig. 4 is a view of a portion of the device illustrating the relation between a fuel feeder and a movable hopper element in one phase of operation of the device.

Fig. 5 is a view similar to the preceding but showing the parts in a different position.

Fig. 6 is a top plan view, on an enlarged scale, with parts broken away, of the stoker structure; said view being taken at about the lower central portion of Fig. 1; and,

Fig. 7 is a view to the same scale, taken at right angles to Fig. 6, but showing the structure thereof partly in side elevation and partly in section, some parts being broken away and other parts of Fig. 1 being included.

Referring to Fig. 1, the apparatus therein shown comprises, in general, a domestic heating furnace F, a main fuel supply bin B, a door D of an ash pit P, a balance weight W for the door D, a stoker including a box-like structure S and a hopper H constituting the main parts of this invention, as well as circuit control elements later on set forth.

The set up illustrated in this example, so far as the furnace F is concerned, is a conversion installation, with said furnace being one of known or standard type having an aperture cut in its right hand side, as viewed in Fig. 1, for reception of the box structure S.

Also, the balance weight W is an expedient known, while the pit P is similar to other pits, and an incident of one form of the invention only in its novel shape, location and relation to other parts, but which may be varied and replaced by other means.

The bin B is also, in general, similar to known fuel supply chambers, being novel only in its particular relation to other features of the invention, such as having its floor a continuation of, or cooperating with, the floor of the hopper H.

Referring to Figs. 6 and 7, in which the main features of the invention are better shown, the stoker S is of box-like formation, as above mentioned, constructed of cast or sheet metal such as iron, having an open end 15 for insertion into the furnace F, as through the above-mentioned right side opening, as far as an upper vertical edge 16 on each of the side walls 17 and 18, each said wall including a forward portion having a top edge sloping to the open end of the box, and joined to the other by a bottom 21, and the box being closed at its rear end outside the furnace F by a wall 22.

Vertical slots 25 are provided in the side walls 17 and 18, and a cover 26 closes the top of that portion of the box structure S outside the furnace F.

A metal fuel bed-plate or grate 27, forming substantially a partition intermediate the top and bottom of the box structure S, also constitutes the top of an air chamber 30 completed by the side walls 17, 18, bottom 21 and outside wall 22 of box structure S.

The grate 27 is secured to the outside and side walls 22, 17, 18 of the box structure S in which it slopes downwardly from the rear wall to a position beyond the front edge of the bottom 21 over the pit P, at which point it is reinforced, as by an angle plate 31. Perforations 32 through the grate 27 are of such diameter, number and distribution relative to the particular fuel intended, in this instance barley coal, as to provide proper support for said fuel, without having it pass through said grate into the air chamber 30, and to ensure a proper flow of combustion air from said chamber.

The angle or slope of the grate 27 is also such, in consideration of the fuel employed, as to maintain the latter in such stable equilibrium, or repose, when not disturbed beyond a certain point, thus permitting the fuel charge to be gradually or intermittently urged bodily downward on the grate 27 at a rate substantially in proportion to the formation of ash at a selected heat.

Thus, there is never any excess fuel on the grate 27 for the required heat, and the operations of adding the fuel and discharging the ash are substantially such as to render the burning of flash character.

A plate-like member 35, which operates as a fuel pusher, is disposed on, and across, an imperforate portion of the bed 27, at a position on the slope thereof above the perforations 32, and has lugs 36 at each upper rear corner thereof, from which rods 37 and 38 project through slots 40, parallel to the slope of the grate 27, in the side walls 17 and 18, respectively, at the rear side of the fuel charge 41 on said grate.

A fuel feeder or delivery element 45 is, in this instance, formed as a drum of substantially cam-shape in cross-section, see particularly Figs. 4 and 5, having one so-called high point 46 leading gradually around the drum axis to a low point 47 precipitately under the high point to form a radial fuel-receiving shoulder 50 between said points. The drum 45 is mounted on short and long trunnions or shaft ends 51 and 52 that extend through the slots 25, and are journaled in bearings 55 and 56 on the side walls 17 and 18, respectively.

A gear wheel 60 is fixed to the short trunnion 51 outside the box at the side wall 17, and a duplicate gear wheel 61 is fixed to the longer trunnion 52 adjacent to the outer end thereof to provide space on the latter for a worm drive 62, fixed in position relative to the trunnion 52, between the bearing 56 and the gear wheel 61.

Gear wheels 65, under the gear wheels 60 and 61, with which they mesh, are fixed to trunnions 66 journaled in bearings 67, Fig. 3, on the side walls 17 and 18, respectively. Only one of each of the gear wheels 65, the trunnions 66, and the bearings 67 is shown in the drawings, see particularly Figs. 3 and 7.

A link or pitman 70 is pivoted, at one end, to a headed pin 71 on each gear wheel 65 eccentric to the corresponding trunnion 66, and, at the other end, to the rod 37 or 38. This arrangement is such as to provide reciprocation of the fuel pusher 35 upwardly and downwardly on the slope of the fire grate 27 while maintaining its forward or active edge parallel to the feeder drum 45.

As seen in Figs. 3 and 7, each gear wheel 65 has a radial outer-face groove rendered undercut, or of dovetail section, by members 75 fixed to said wheel. A wedge like block 76, in the radial groove defined by the members 75, has a recess and an aperture for receiving the head of the pin 71, and a plate washer 77, around the pin 71, spans the groove against the members 75.

By releasing lock nuts 80 binding the block 76 to the gear wheel 65, said block and the pin 71 may be moved radially across the wheel 65, between a neutral or concentric position with its axis coincident with the axis of the trunnion 66 and a position of maximum eccentricity, and fixed in any position within these limits by tightening

the nuts 80. Thus, the reciprocatory stroke of the pitman 70 and the fuel pusher 35 may be adjusted according to temperature and other conditions of any particular service or installation.

The hopper H illustrated, comprising a stationary body portion 81 of flat sided taper-section converging vertically and horizontally from an aperture in the bin B, to a position just inside the stoker structure S. This hopper body portion 81 is thereby entirely enclosed about its length from the bin B to the stoker structure S.

Inside the stoker structure S, the hopper body portion 81 communicates into a chute 84, open at the top, which is pivoted to the structure S by pins 85 engaged in lugs 86 on said structure, and in end bearing portions 87 at opposite sides of the chute 84.

The forward extremity of the chute 84 is supported by the feeder drum 45 so that, as the latter rotates, counterclockwise, as indicated by arrows in Figs. 4 and 5, the chute 84 is gradually raised to the high point 46, as indicated in Fig. 4, and suddenly dropped therefrom to the low point 47, as indicated in Fig. 5.

The cross-section of the feeder-drum 45 may, of course, be varied to alter the shape and dimensions of the shoulder 50, to provide more than one such shoulder, or shoulders of different shapes and spacings from each other, in order to vary the time of raising and lowering of the movable chute 84, and equivalent results obtained in other ways, each of which forms may have advantages over the others depending upon various conditions of installation, such as costs, capacity and other factors.

During rotation of the feeder drum 45, with the chute 84 supported thereby between the points 46 and 47, the fuel is not delivered to said drum, but upon dropping from the high point 46, fuel at the mouth of the hopper stationary part 81 is jarred and deposited on the shoulder 50 and on the adjoining cam surface of the feeder drum 45 for a predetermined extent from said shoulder. Upon continued rotation of the feeder drum 45, the shoulder 50 attains an angle at which the deposit is released to the charge 41 on the grate 27.

To provide even flow of the fuel, and ensure against stoppage thereof in the hopper stationary part 81, agitator means is provided, in this instance, in the form of a shaft 90 having staggered radial prongs or pins 91 thereon, and rotating counterclockwise, as indicated by the arrows in Figs. 4, 5 and 7.

The shaft 90 is journaled in the sides of the body part 81 and protrudes a sufficient distance, from one side, to support a sprocket wheel 92, shown only in Fig. 7, between which and a sprocket wheel 95 on the trunnion 52 extends a chain drive 98.

As seen in Figs. 6 and 7, a worm-screw 97, meshing with the worm wheel 62, is fixed to a shaft 100 that is journaled in lateral extensions 101 of the bearing block 56, and in a bearing 102 on the side wall 18.

Referring also to Fig. 2, a ratchet wheel 105, fixed to the shaft 100, cooperates with a pawl 106 pivoted to one arm 107 of a rock lever 110 fixed to the shaft 100, and having a fork extension 112 between which is pivotally mounted a block 115, as by trunnions or stub shafts 116, only one of which is indicated, see dotted circle in Fig. 2.

Slidably engaged through the bore of the block 115, is a rod 117 which extends to a follower 120 about a circular cam disk 121, said disk being eccentrically fixed to a shaft 122, journaled in a bearing 125 on the rear wall 22 of the stoker structure S, and having secured thereon a worm wheel 126 in mesh with an endless screw 127 on the drive shaft of a suitable motor 130.

Two sets of lock nuts 131 and 132 are carried by the rod 117 at opposite sides, respectively, of the block 115, for adjusting the rotary steps of the ratchet wheel 105 relative to the constant throw of the slide rod 117 effected by the cam disk 121. By adjusting the nuts 132, the throw of the rock lever 110, and consequently that of the pawl 106, may be varied to turn the ratchet wheel 105 to the extent of one, or more, teeth for each reciprocation of the rod 117, whereby the rate of operation of the pusher 35, the fuel-feeder drum 45 and the agitator 90 are variable.

The main motor 130 is mounted on a bearing bracket 135, and under it is disposed a motor-operated blower 136 for impelling air, through an opening in the rear wall 22 of the stoker structure S, into the air chamber 30 beneath the fire grate 27, as indicated by the dotted-line arrows in Fig. 7, for projection through the perforations 32 in said grate.

As typically indicated in Fig. 1, the main motor 130, as well as the motor for the blower 136, are connected by circuit conductors 140 and 141 in parallel to conventional service lines 142, through an adjustable thermostat 145, conveniently in series with the conductor 141.

By adjusting the thermostat 145, the stoker S of this invention may be caused to operate, as above set forth, to maintain any desired temperature in a building irrespective of the outside temperature.

For a given inside temperature, the stoker S will operate more or less frequently, according to whether the outside temperature is low or high, respectively, relative to the selected inside temperature.

If, as occurs between seasons and at other times, the temperature differential between the interior and exterior of the building maintains the thermostat 145 so that successive feedings by the drum 45 cease, or are so far apart that the combustion of the charge 41 may become extinguished, or too low, and it is desired to maintain the fire, a suitable time control 146 may be provided. This control 146, indicated as of the electric-clock variety energized from the service lines 142, is adjustable so that, irrespective of the thermostat 145, said control may cause actuation of the stoker S at any desired intervals by actuating a switch 147, which closes and opens the circuit represented by the conductors 140 and 141, also controlled by the thermostat 145.

Thus, the feeding of fuel may be gauged so as to merely maintain the fire, until such time as the outside temperature may drop sufficiently to cause automatic resumption of control by the thermostat 145, or until all operation is discontinued.

The ash formed and pushed from the lower end of the grate 27 is, in this instance, of substantially solid or clinker form, which breaks off in sections for deposit in a receptacle 137 in the pit P, or for disposition in other manner, and thereby does not pass through the perforations 32 in the fire grate 27.

It is contemplated that either, or both, the bin B and the ash pit P, or other fuel storage supply and ash disposal means, may be directly accessible from outside the building being heated; that irrespective of location, either may be of suffi-

cient capacity to preclude frequent attention; and that other means may be provided for supplying the fuel and removing the ash from the building, so that, depending upon the conditions, structure, arrangement or other circumstance, the stoker S may be of maximum convenience and minimum trouble for any given installation or service.

By its open, rugged, simple construction, the stoker S may be provided in a wide range of sizes or capacities, all the way from a size suitable to the so-called bucket-a-day hot water stoves for small or ordinary dwellings, to a size suitable for furnaces F of relatively large buildings.

The stoker S may be provided in any size, and arranged in batteries of two or more, in side-by-side or other relation, such as extending into a furnace F from different sides, or at various angles.

By its effective use of barley coal, the stoker S is of such economical operation as to absorb its cost in a relatively short period of time, and is a marked improvement generally, in its field, in the other features set forth.

I claim as my invention:

1. A stoker comprising a grate, a horizontally pivoted chute sloping slightly downward from adjacent the pivot mounting to its delivery end over the grate, aligned means for receiving fuel from the chute for delivery thereby to the grate and cooperatively rocking the chute about its pivot axis, and said means including a shelf-like portion for receiving fuel on downward movement of the chute and being movable between a position for supporting said fuel and a position for discharging said fuel onto the grate.

2. A stoker comprising a grate, a horizontally pivoted chute sloping slightly downward from adjacent its pivot mounting to the delivery end over the grate, and a rotatable drum across and above the grate having a cam-like cross-sectional shape for imparting rocking motion to the chute, said drum having a shelf-like portion for receiving a deposit of fuel on downward rocking of the chute and for delivering said fuel from the shelf to the grate.

3. A stoker comprising a grate, means for feeding fuel to the grate including a drum across and over the grate, said drum being of cam-like section having a high point leading gradually around the drum to a low point precipitately under said high point to provide a shoulder between said points, a chute pivotally mounted parallel to the grate and sloping downwardly from the pivot toward the drum with its delivery end supported by said drum, and means for turning the drum about its axis whereby the delivery end of the chute is gradually raised to, and suddenly dropped from, the drum high point for flow of fuel onto said shoulder for delivery by the latter to the grate.

4. A stoker comprising a box-like structure having an open end for association with the ash receptacle of a furnace and including a bottom air chamber portion, a perforate grate between the side walls of the box structure and sloping downwardly from adjacent a closed end wall of the box structure, outside the furnace, toward the open end in the furnace, a fuel feeder-drum rotatably journaled across the box structure between the side walls over said grate adjacent to the closed end wall, said drum being of cam-like cross-section to provide a fuel receiving shoulder, a hopper for supplying fuel to the feeder-drum shoulder, a movable section pivoted on said box structure parallel to said drum for jolting action over said shoulder, and a fuel pusher disposed on and across the grate parallel to the drum.

GEORGE A. FERRELL.