

Aug. 14, 1934.

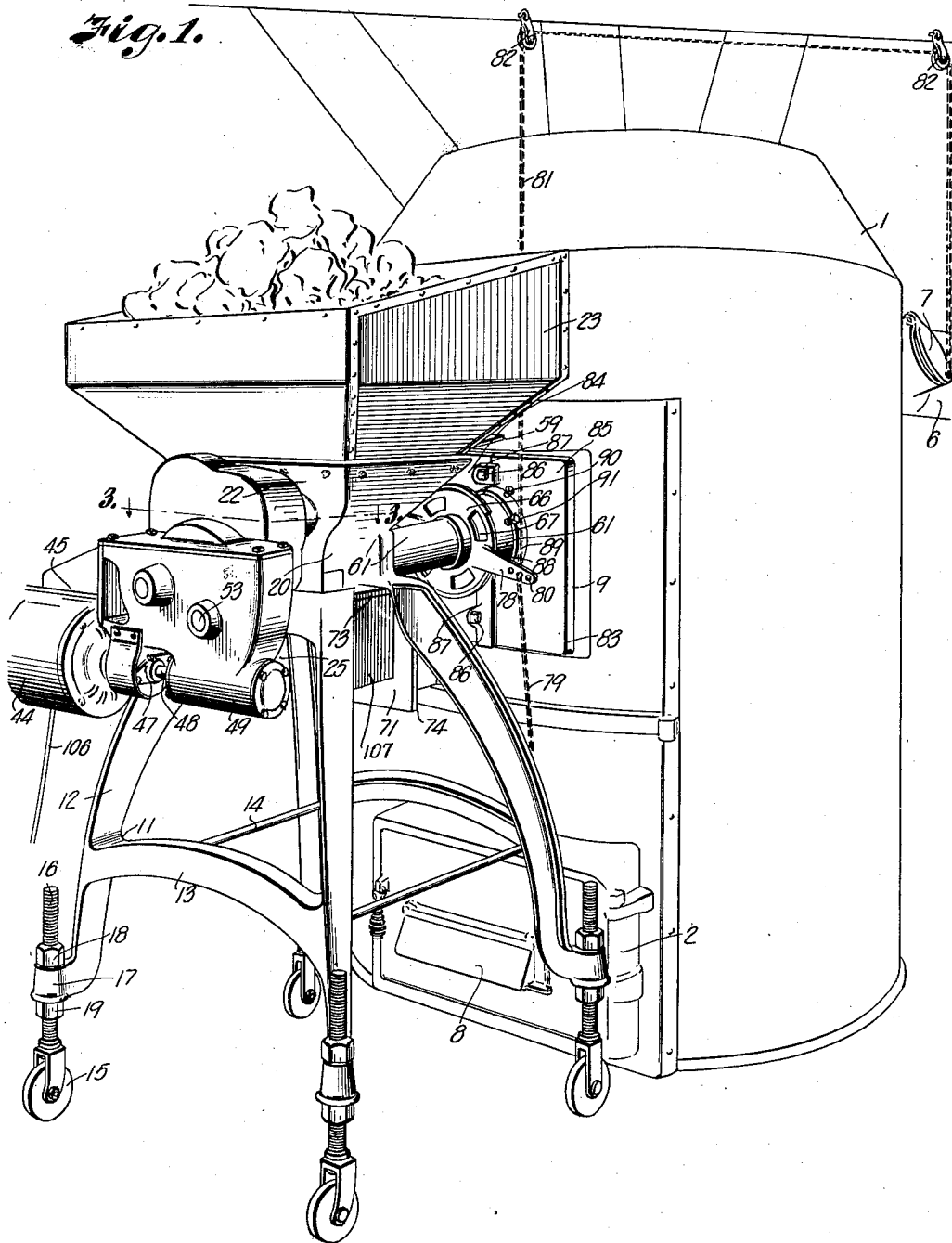
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1,970,523

STOKER

Filed April 1, 1929

3 Sheets-Sheet 1



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Fig. 2.

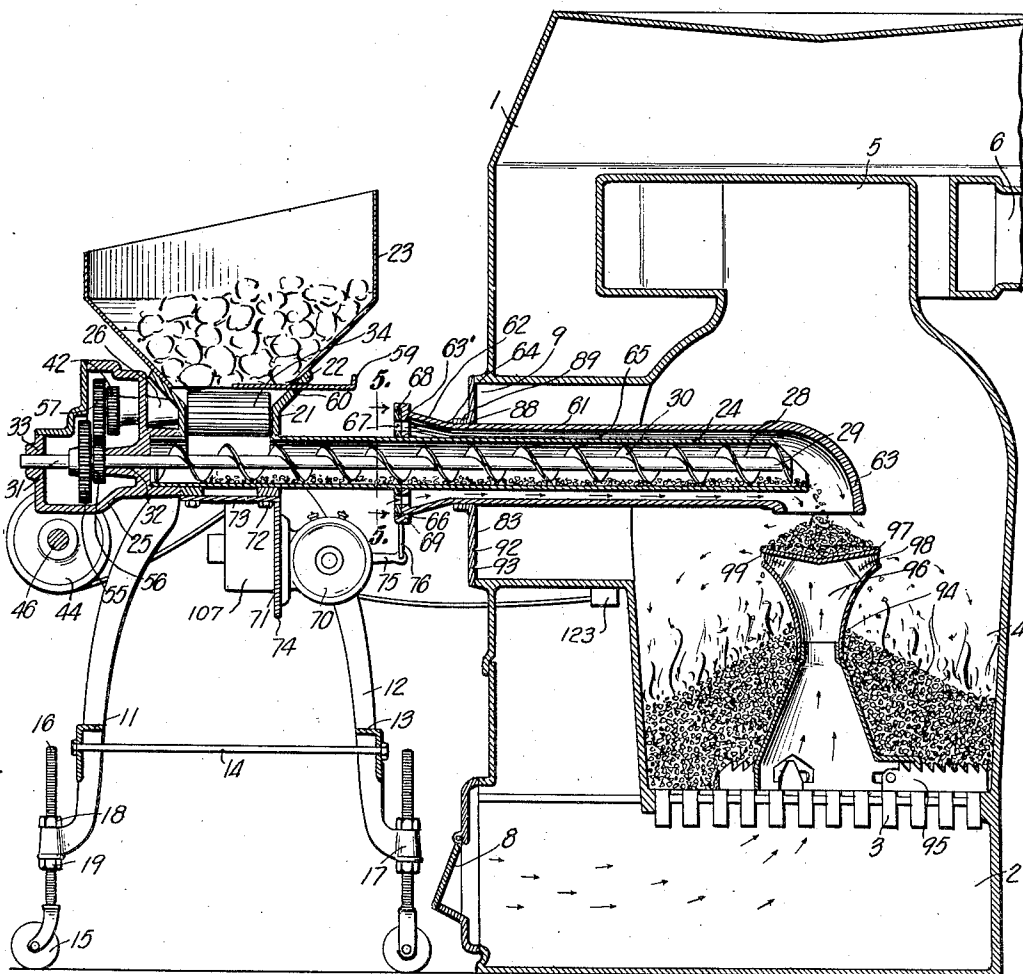
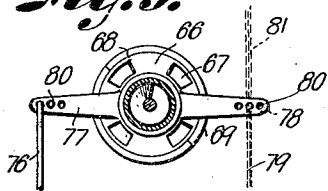


Fig. 5.



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Fig. 3.

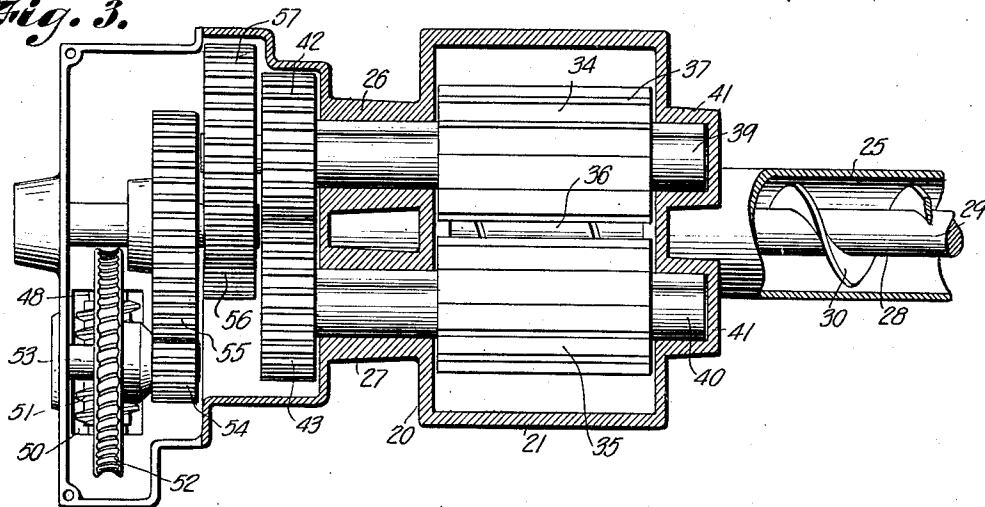
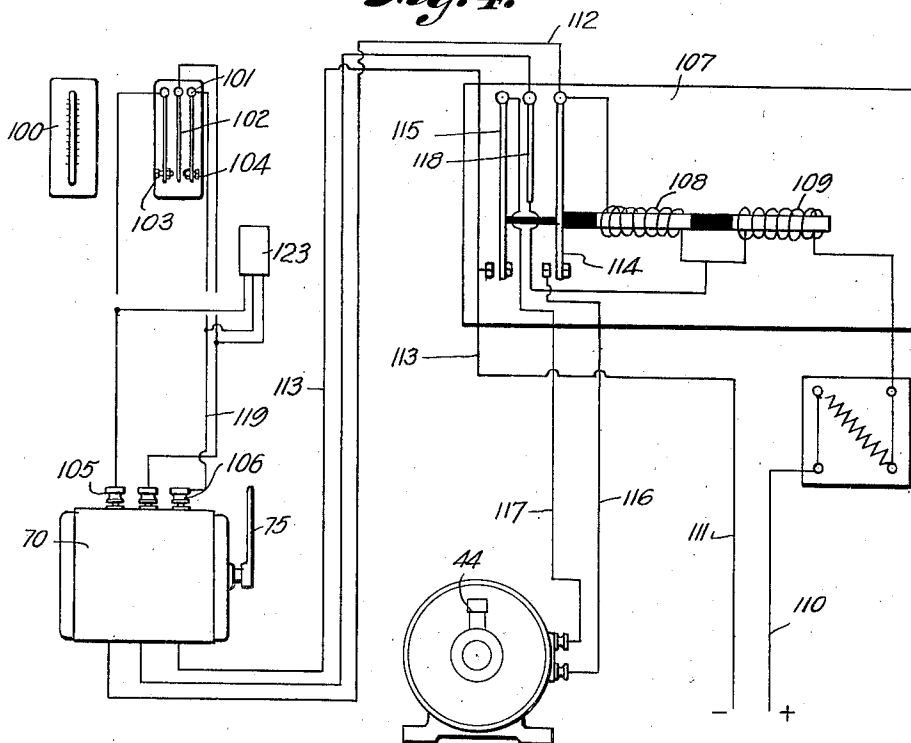


Fig. 4.



UNITED STATES PATENT OFFICE

1,970,523

STOKER

Fred D. Hoffman, St. Louis, Mo., assignor to
Richard F. Kehr, St. Louis, Mo., as trustee

Application April 1, 1929, Serial No. 351,564

2 Claims. (Cl. 110—101)

This invention relates to fueling apparatus and more particularly to mechanical stokers adapted for fueling domestic furnaces and the like.

The principal object of the invention is to provide for automatically feeding fuel in governed quantities proportionate to the temperature of the rooms to be heated, whereby a steady, even fire may be provided to maintain the rooms at a set temperature.

It is also an object of the invention to automatically control the furnace dampers simultaneously with the functioning of the stoker to provide for economic operation and to minimize the formation of smoke and other waste products of combustion.

A further object of the invention is to provide novel and improved means for admitting combustion supporting air into the furnace so that the cheapest grades of fuel can be used, such as coal screenings and the like, or ordinary lump fuel may be used since I equip the stoker with crushing rolls for pulverizing the fuel.

In accomplishing these and other objects of the invention, I have provided improved details of structure, the preferred form of which is shown in the accompanying drawings, wherein:

Fig. 1 is a perspective view of an ordinary hot air furnace equipped with a stoking apparatus constructed in accordance with my invention.

Fig. 2 is a vertical sectional view through the furnace and stoking apparatus, particularly illustrating discharge of fuel into the furnace, and circulation of combustion supporting air.

Fig. 3 is a sectional view through the grinding rolls on a line 3—3 of Fig. 1, the cover of the transmission case being removed to illustrate the driving gears for the crushing rolls and conveyor screw.

Fig. 4 is a diagrammatic view of the electrical system controlling the motors for driving the stoker and manipulating the dampers.

Fig. 5 is a sectional view through the fuel conduit on the line 5—5, Fig. 2.

Referring in detail to the drawings:

1 designates a furnace which may be any type, but is here illustrated as an ordinary warm air heating furnace including an ash pit 2, grates 3, and fire bowl 4 provided at its upper end with the usual radiator 5 for passage of products of combustion, the outlet 6 of the radiator being controlled by the usual check draft 7.

The ash pit 2 is provided with the usual draft

door 8 admitting air into the ash pit and through the grates into the fire bowl for supporting combustion of the fuel as in ordinary practice.

Positioned in front of the furnace in alignment with the fuel door opening 9 of the furnace is a preferably portable stoker and fuel conditioning apparatus embodying my invention, which includes a frame 11, comprising legs 12 spaced apart by braces 13 and rods 14 to provide a stable structure.

The frame is adjustably mounted on rollers 15 having threaded shanks 16 received in tubular bosses 17 that are formed on the lower ends of the legs 12, and are retained in fixed adjusted relation therewith by nuts 18 and 19 threaded on the shanks and engaging the opposite ends of the bosses to retain the frame at proper elevation with relation to the furnace door opening 9.

The rollers 15 on the rear legs are preferably swiveled on their shanks and the front rollers are fixed with relation to their mounting so that the device may be trundled over the floor, as later described.

Mounted on the upper ends of the legs is a body casting 20, including a rectangular crushing roll housing 21 having an inclined upwardly extending peripheral flange 22 for securing a fuel hopper 23, and extending through the body casting below the housing 21 is a fuel delivery conduit 24, extending forwardly into the furnace and terminating adjacent the vertical center of the fire bowl. The casting 20 includes a gear case 25 which is attached to the crushing roll housing 21 by horizontally spaced tubular bosses 26 and 27.

Rotatably mounted in the conduit 25 and extending longitudinally thereof is a conveyor screw 28 for feeding fuel from the hopper into the furnace, as later described, comprising a shaft 29 on which is wound a spiral flight element 30 slidably received in the conduit 24 so that the flights of the screw form a bearing for the conveyor throughout its length.

The front end 31 of the shaft projects through a bearing 32 formed inwardly of the gear case 25, and through a complementary bearing 33 formed in the front wall of the gear case.

Rotatably mounted in the housing 21 and extending parallel with the spiral screw 28 is a pair of crushing rolls 34 and 35 spaced apart to produce a fuel passageway 36 therebetween. The crushing rolls are preferably provided on their peripheries with longitudinally extending triangular-shaped teeth 37 for crushing the coal

received from the hopper and feeding it into the conduit 24, as later described.

The rolls 34 and 35 are mounted on shafts 39 and 40, the rearward ends of which are mounted in bosses 41 extending rearwardly of the casting 20, and the opposite ends of the shafts are mounted in the bosses 26 and 27, connecting the housing 21 with the transmission case. The shafts extend into the transmission case and carry meshing gears 42 and 43 so that when the gear 42 is rotated, the crushing rolls will rotate toward each other for feeding fuel into the conveyor conduit.

The conveyor spiral is actuated by a motor 44 which is mounted on a bracket 45 extending laterally of the gear case. Connected with the motor shaft 46 by a flexible coupling 47 is a shaft 48 extending through a tubular extension 49 formed on the bottom of the gear case.

Fixed on the shaft 48 and extending through an opening 50 in the gear case is a worm 51 meshing with a worm gear 52 which is mounted on a shaft 53 journaled in the sides of the gear case. Also fixed on the shaft 53 is a pinion 54 meshing with a gear 55 fixed on the conveyor shaft whereby the conveyor is operated at a considerably reduced speed relative to that of the motor.

The crushing rolls are driven from the conveyor shaft by a pinion 56 fixed thereon adjacent the gear 55 and meshing with a gear 57 fixed on the rear end of the roller shaft 39. Thus the crushing rollers are operated at a reduced speed relative to that of the conveyor so that the coal will be fed very slowly through the port 36, for I have found it desirable to limit the feed of the crushing rolls so that the conveyor never becomes completely filled with fuel, as otherwise the coal may swell in its passage through the conduit and seriously interfere with smooth operation of the machine.

I also find it desirable to control the amount of fuel received by the crushing rolls from the hopper, and I therefore provide a plate 59 slidable through a slot 60 formed in the lower end of the hopper directly above the crushing rolls, whereby the amount of fuel received by the crushing rolls may be governed by adjustment of the plate.

Sleeved on the rearward end of the fuel conduit is a tubular air conduit 61 of larger diameter than the fuel conduit and having a bell-shaped inlet 62 at its forward end, and a downwardly extending hood 63 at its rear end enclosing the end of the fuel conduit. The bell-shaped inlet 62 is provided with an internal flange 63' encircling the conveyor conduit and provided with air inlet openings 64 communicating with the annular space 65 between the conduits. The openings 64 are closed by a circular plate 66 having openings 67 adapted for registering with the openings 64. This plate is preferably seated for rotation in an annular recess 68 formed in a flange 69 provided on the conduit, and is actuated by a conventional type reversible motor 70, now to be described.

The motor 70 is mounted on an L-shaped bracket 71 secured to the underside of the body casting by bolts 72 extending through the horizontal flange 73 of the bracket, and into threaded openings in the casting, the motor 70 being mounted on the vertical flange 74 of the bracket directly below the fuel conduit 24. The motor is provided with a lever arm 75 adapted to be moved in either direction and which is con-

nected by a link 76 with an arm 77 projecting laterally of the plate 66 so that when the motor 70 is energized to actuate the arm 75 in one direction the plate 66 is rotated to move the openings 67 into registry with the openings 64 in the air conduit and when the arm is actuated in the opposite direction, the openings are moved out of registry.

Projecting laterally from the plate 66 diametrically opposite to the arm 77 is a similar arm 78 connected to the draft door 8 by a chain 79. The arms 77 and 78 are preferably provided with a plurality of openings 80 so that the connections for the link 76 and chain 79 may be adjusted to vary the rotative movement of the plate 69 and draft door 8 with relation to the movement of the arm 75. Thus, it is apparent that when the motor 70 is actuated to move the plate 66 for registering the openings 64 and 67 to admit air into the air conduit, the draft door 8 will be moved to closed position, and when the plate 66 is moved in the opposite direction to partly close off the openings and limit admission of air into the air conduit, the draft door 8 is opened to admit air into the ash pit for discharge into the fire bowl.

The arm 78 is also connected to the check draft 7 by a chain 81 running over pulleys 82 attached to a support adjacent the furnace so that when the draft door is moved to open position the check draft is closed and vice versa, as later described.

In order to close the door opening about the air conduit, I provide a special door plate 83 comprising mated halves 84 and 85 secured together by bolts 86 passing through ears 87 formed on the half 85 and extending into threaded openings formed in the half 84.

The door plate 83 is provided on its median line with a circular opening 88 of sufficient diameter to snugly receive the air conduit, and is provided with a peripheral collar 89 carrying set screws 90 for engaging the air conduit to retain the door plate in fixed relation to the conduit. The air conduit is also retained in fixed relation to the fuel conduit by set screws 91 which are threaded through the air conduit and bear against the fuel conduit, as best shown in Fig. 1.

The door plate 83 is provided of sufficient area to cover the door opening of the largest furnace and is adapted to be fitted to the smaller size furnaces by fracturing the plate along suitable V-shaped grooves 92 and 93 formed on the inner and bottom edges of the plate.

In order to control air passing through the grates and preheat the air, and to provide free passage for a portion of the air through the burning fuel, I provide an air preheating and discharge device 94 comprising a Venturi-shaped casting supported concentrically in the furnace and over the grate by a suitable spider 95. The upper bell 96 of the Venturi member is positioned below the fuel discharge of the stoker and is provided with a tuyere plate 97 spaced from the periphery of the bell by a plurality of curved vanes 98 cast integrally with the cover plate and bearing on the upper edge of the bell to provide air discharge outlets 99 between the blades.

Thus when the upwardly traveling air is gathered by the lower bell and passes through the venturi, the air expands with substantial velocity into the upper bell and against the tuyere plate where it is directed outwardly and in a curved path by the curved vanes.

In order to maintain a steady, even fire in proportion to the temperature of the rooms to be heated, I provide for automatic control of the stoker feed governed by temperature of the rooms heated, so that when the temperatures of the rooms are lowered below a set temperature, the stoker motor is automatically started to feed additional fuel into the furnace for predetermined periods at predetermined intervals until the temperature of the room has again reached the proper degree, at which time the motor is automatically shut off to stop the fuel feed.

The draft door 8, control plate 66 and check draft 7 also function automatically whenever the stoker motor functions by actuation of the motor 70, as now described.

Located in a room heated by the furnace is a thermometer 100 and associated therewith is a thermostatic switch 101 for controlling actuation of the reversible motor 70. The thermostat switch 101 includes a thermostat blade 102 which is responsive to changes in temperature of the room. The thermostat blade 102 moves between the contacts 103 and 104 which are connected to the reverse terminals 105 and 106 of the motor 70 so that when the temperature in the room drops below a predetermined degree the thermostat blade 102 will engage the contact 103 to establish a secondary circuit to effect operation of the motor 70 in one direction for moving the arm 75 of the motor 70 in a clockwise direction, Fig. 2, thereby opening the draft door 8 and closing the damper 66 to supply combustion supporting air through the draft door 8.

Simultaneously with actuation of the motor 70, the motor 44 is energized to start operation of the crushing rolls in the conveyor to feed pulverized fuel to the furnace by means of a control mechanism which is mounted in the housing 107 supported on the front of the bracket 71. The energizing circuit for the motor 70 is connected with opposed solenoids 108 and 109 forming a part of the control mechanism and to line wires 110 and 111 through conductors 112 and 113, respectively.

The control mechanism also includes switches 114 and 115 for connecting conductors 116 and 117 leading to the motor 44 with the solenoid 108 and to the wire 113 respectively. The solenoid 109 normally preponderates over the solenoid 108 so that when they are energized by current flowing to the motor 70, the switches are closed to effect operation of the motor 44. Connected in shunt with the solenoid 108 is a heating element 118 also included in the control mechanism and which, upon heating offers resistance to the current flowing therethrough to cause more current to flow through the solenoid 108 to effect opening of the switches 114 and 115 to stop operation of the motor 44.

When the heating element 118 cools, it will again cause closing of the motor circuit to again start feed of fuel to the furnace. Intermittent operation of the motor 44 will thus continue as long as the thermostatic switch 102 engages the contact 103, but after temperature of the room heated by the furnace reaches a predetermined degree then circuit through the contact 103 will be broken by the thermostat blade 102 which will then engage the contact 104 to establish circuit through the conductor 119 connected with the terminal 106 of the motor 70 to move the arm 75 in the opposite direction for closing the draft door 8 and opening the damper 66.

The installation and operation of the stoker

constructed and assembled as described is as follows:

The threaded shanks carrying the rollers 15 are adjusted to elevate the fuel delivery conduit into proper relation with the furnace. The door plate 83 is then adjusted and sized to suit the particular door opening and the chains 79 and 81 controlling the check draft, and the draft door, are connected to the arm 78. The line wires 106 are then connected to a suitable electric service line and a fire is kindled in the furnace.

The sliding plate may then be adjusted in the hopper for regulating the amount of fuel fed, depending upon the weather, or the type of fuel used, and the hopper is filled with fuel. If the rooms are below the temperature set by the wall thermostat 101, the stoker motor will automatically start feeding fuel into the furnace, and under control of the heating element 118, will continue feeding fuel into the furnace at intervals until the room temperature has been raised to the desired degree.

The amount of fuel fed by the stoker and the intervals between operations of the stoker may be varied according to the outside temperature by adjusting the heating element 118. However, I find it desirable to set the stoker to feed for one and a half minutes and at ten minute intervals. Intermittent feed to the furnace will continue until the rooms have been brought to the proper temperature, at which time the motor will cease functioning.

When the room temperature drops, the motor will again start feeding the fuel at intervals as before. Should the outdoor temperature be such that the rooms will not cool off for a considerable period, the furnace fire may become so low that when the stoker is again operated, the admission of fresh fuel may smother the fire, or the fire may have become entirely extinguished, and to prevent the fire from becoming too low, I provide a thermostatic switch 123 located in proximity to the fire bowl of the burner for functioning of the stoker when the temperature of the fire bowl has dropped below a certain temperature, so that the stoker will operate for a period to keep the fire going.

When the stoker starts feeding the furnace the draft door is automatically opened by the motor 70 and the plate 66 is moved to partly close the ports in the air conduit. The air then enters the ash pit and follows the course of least resistance through the grate which will be through the Venturi member. The Venturi member being covered with hot coals will preheat the air as it rises through the venturi, and the air will expand into the upper bell at a high rate of flow.

The air coming in contact with the fins of the tuyere plate will be deflected thereby to produce a turbulent whirling effect above the hot coals. The whirling air comes into contact with gases distilled from the coals, and with the gases volatilized from the fuel being fed into the furnace before the same is ignited to contact the products of combustion as well as the volatile, to cause burning of said gases and volatile before they can pass from the furnace.

I have also determined that air admitted through the partly opened air ports in the fuel conduit is also preheated, but at a lower temperature than the air passing through the venturi, and the cooler air contacting with the hotter air causing a more violent turbulent

effect, assuring a better mixing of the air and gases with the volatile.

I have also found that by admitting the major portion of air through the venturi instead of through the coal bed, the distillation of gases is retarded, and the more slowly distilled gases can be consumed before they can pass from the furnace.

When the stoker is shut down the draft door will automatically close and the air conduit inlets will be opened to admit air through the conduit to mix with the air discharged from the venturi which has been drawn through leaks around the ash pit doors.

What I claim and desire to secure by Letters Patent is:

1. In combination with a furnace, a self contained fuel stoking apparatus including a mobile frame, a housing carried by the frame, fuel crushing rolls operable in the housing, a fuel hopper supported by the frame and arranged to discharge fuel into the crushing rolls to be pulverized thereby, a fuel conduit arranged to receive the pulverized fuel from the crushing rolls, a conveyor in the conduit for moving the pulverized fuel therethrough to the furnace, means associated with the conduit for admitting air to the furnace, a damper supported on the conduit controlling said air, a motor on the frame operably connected with the crushing rolls and the stoker, a reversible motor on the frame arranged for operating said damper, a control

mechanism supported on the frame to control operation of the first named motor for actuating the fuel crushing rolls and the conveyor to pulverize and feed the fuel into the furnace, and thermostatic means for simultaneously rendering said reversible motor and the control mechanism effective.

2. In combination with a furnace, a self contained fuel stoking apparatus including a mobile frame, fuel crushing means on the frame, a fuel hopper supported by the frame and arranged to discharge fuel into the fuel crushing means to be pulverized thereby, a fuel conduit arranged to receive the pulverized fuel from the crushing means, a conveyor in the conduit for moving the pulverized fuel therethrough to the furnace, means associated with the conduit for admitting air to the furnace, a damper supported on the conduit controlling said air, a motor on the frame operably connected with the fuel crushing means and the stoker, a reversible motor on the frame arranged for operating said damper, a control mechanism supported on the frame to control operation of the first named motor for actuating the fuel crushing means and the conveyor to pulverize and feed the fuel into the furnace, and thermostatic means for simultaneously rendering said reversible motor and the control mechanism effective.

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