Oct. 6, 1936. J. B. MILLER 2,056,478

METHOD AND APPARATUS FOR STOKING FURNACES

Filed June 24, 1931 2 Sheets-Sheet 1

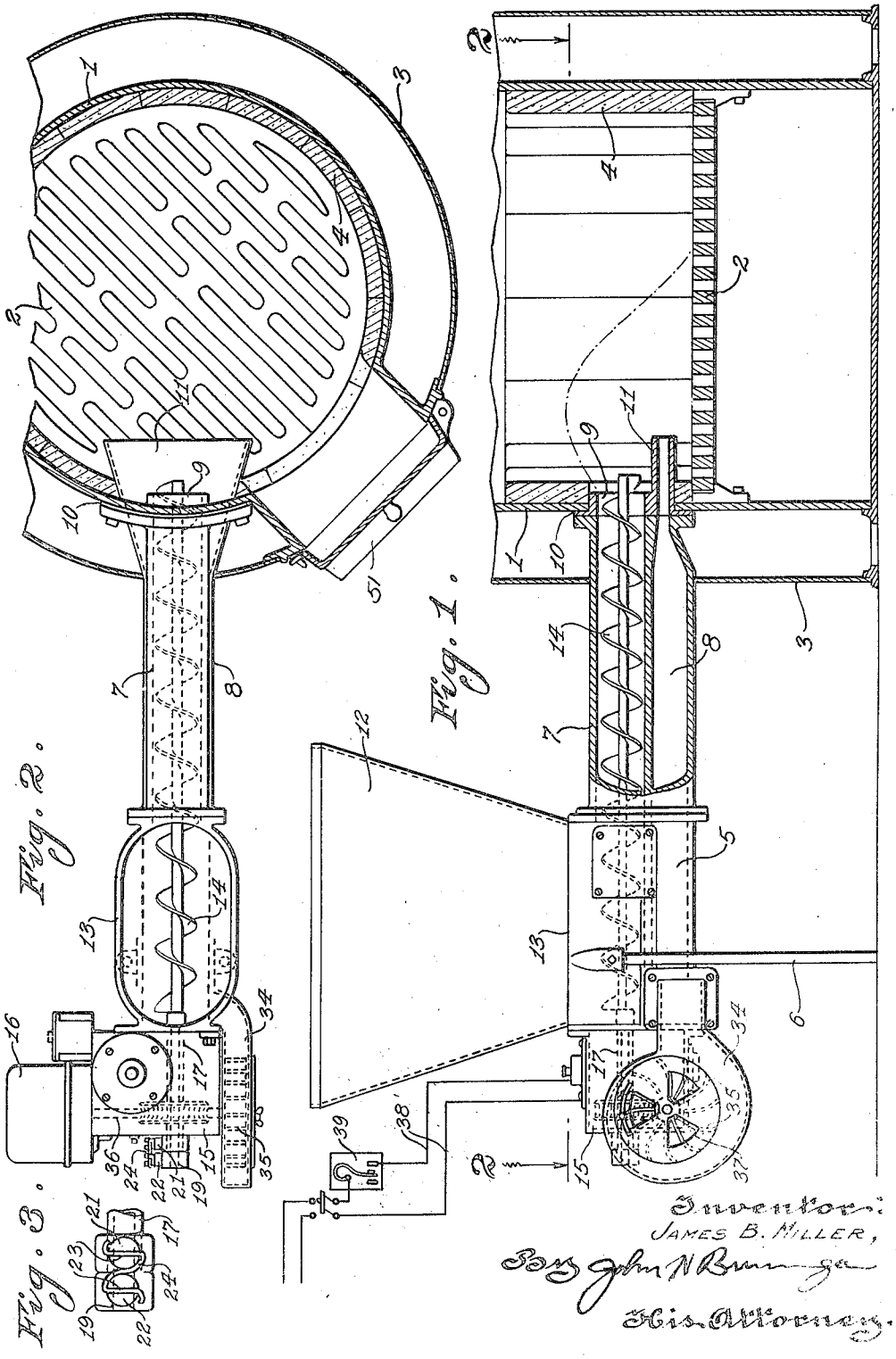


Fig. 1.

Fig. 2.

Fig. 3.

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Fig. 5.

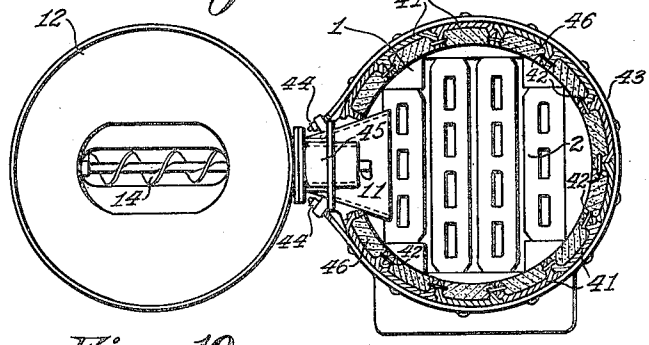


Fig. 8.

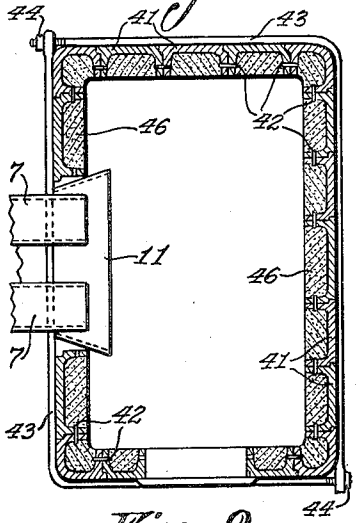


Fig. 10.

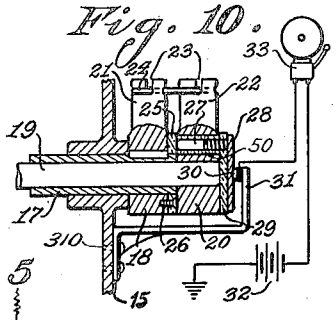


Fig. 4.

Fig. 9.

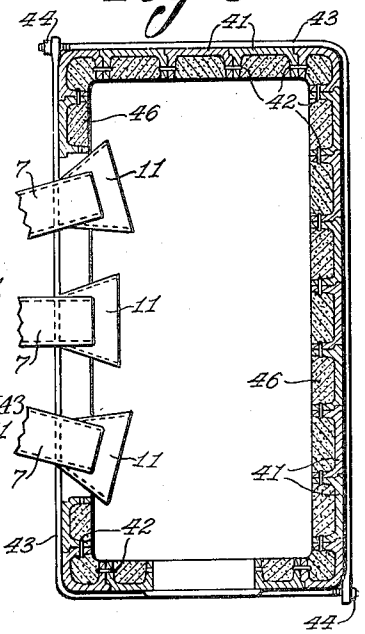


Fig. 6.

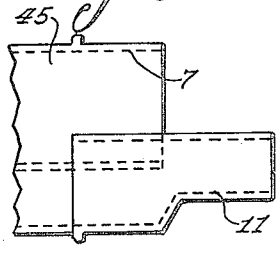
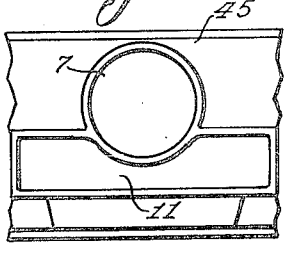


Fig. 7.



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UNITED STATES PATENT OFFICE

2,056,478

METHOD AND APPARATUS FOR STOKING FURNACES

James B. Miller, Webster Groves, Mo.

Application June 24, 1931, Serial No. 546,474

2 Claims. (Cl. 110—101)

This invention pertains to automatic stokers, and more particularly to stokers designed for use in domestic furnaces.

One of the objects of this invention is to provide an automatic stoker of simple construction which is capable of burning low grade fuel at a high efficiency.

Another object is to provide a stoker which will feed fuel on to a grate and means for delivering air to support combustion of the fuel at such a point as to promote efficient combustion of the entire mass of fuel.

Another object is to provide such a stoker which is wholly automatic in its operation so that it may be operated by thermostatic control devices.

Another object is to provide a stoker construction such that it will not interfere with hand firing of the furnace in case of failure of the stoker.

Another object is to provide such a stoker which may easily be installed on existing furnaces with a minimum of alteration in the furnace.

Another object is to provide a construction by which the stoker may be applied in a simple manner to furnaces of different sizes.

Another object is to provide means whereby the driving connections for the fuel feeding devices may be interrupted automatically in case of foreign matter becoming lodged in the feeding device, and whereby an alarm signal may be operated upon such failure.

Further objects will appear from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a side view partly in section of an automatic stoker embodying this invention as applied to a domestic hot air furnace.

Figure 2 is a section on line 2—2 of Figure 1.

Figure 3 is a detail illustrating the breakable link in driving connections for the feed.

Figure 4 is a view similar to Figure 1, on a somewhat reduced scale, illustrating the application of the stoker to a hot water or a steam boiler.

Figure 5 is a section on line 5—5 of Figure 4.

Figure 6 is an enlarged detail of the terminal arrangement of the feed tube shown in Figure 4.

Figure 7 is a right-hand end view of Figure 6.

Figure 8 is a sectional view of a furnace similar to the furnace part of Figure 5, but showing the application to a furnace of rectangular cross section.

Figure 9 is a view similar to Figure 8, illustrating the application to a larger furnace.

Figure 10 is a longitudinal vertical section showing the release mechanism.

In accordance with this invention the stoker may be applied to an existing furnace of practically any type and is so positioned as to enter the fire box at one side of the ordinary fire door. This places the stoker in such a position that in case of failure, the furnace may be fired by hand through the fire door. The stoker operates to feed fuel, such as slack coal, continuously on to the furnace grate. Upon being delivered to the grate, the fuel stacks up in a pile at the end of the feed screw. As the feed continues the pile moves progressively across the grate. A blower provides air which is delivered to a point underneath the pile of fuel on the grate below the feed screw, but spaced above the grate bars. This air draft is delivered at a relatively low pressure. The pile having been ignited, the air draft is delivered mostly to a point near the middle of the bottom of the pile and is directed toward the side distant from the entering feed. The fuel burns progressively from the outer side towards the feed as the pile is pushed across the grate. Upon the fuel first entering the furnace, the volatile elements in the fuel are driven off and ignited and the remaining portion reduced to a coke. This is then fed forward by the feeding of new fuel and enters the zone to which the draft is supplied. By this time the coke has become incandescent and the ample supply of air provides for complete smokeless combustion. The fuel is finally reduced to ash which settles down upon the grate. An occasional shaking of the grate deposits the ash in the ash pit. During the operation, a thin layer of ash is preferably maintained over the grate surface.

Referring now to the drawings, 1 designates the fire box of the furnace, having a grate 2 and a jacket 3, the furnace illustrated in Figures 1 and 2, being of the hot air type. The fire box 1, may if desired be lined with refractory material 4.

The stoker itself, comprises a body 5, supported by one or more legs 6. Extending forwardly, (or in the direction of feed) from the body 5, is a casting comprising a fuel feed tube 7, and an air duct 8. The duct 8 is located below the tube 7 and extends parallel thereto. Where the feed tube enters the fire box 1, it is provided with a tip 9, which may be a separate casting provided with a flange 10 for securing it to the furnace. Below the end of the feed tube 7, the tip 9 is provided with a laterally flared terminal 11 for the air duct 8. It will be noted that the vertical dimension of the terminal 11 is relatively

small while its lateral dimension is comparatively large. It is thus adapted to deliver to the fire a relatively concentrated draft which is confined in its vertical extent but spreads out laterally. The terminal 11 is spaced above the grate 2, so as to provide room for a layer of ash to be maintained on the grate.

Surmounting the body 5, is a hopper 12. This is preferably constructed with a circular top opening as shown in Figure 5 and rests in an oval receiving opening 13 in the body 5. This construction has advantages over a rectangular type of hopper as it has no corners in which the fuel tends to bridge. Consequently, no stirring or loosening devices are necessary in this hopper.

Mounted for rotation in the tube 7 is a feed screw 14, which traverses the body 5, so as to receive fuel from the hopper 12. The shaft of the screw 14 extends rearwardly through a gear box 15 mounted on the rear of the body 5. Associated with the gear box 15 is a driving motor 16, of any suitable type and connected in any suitable manner to drive the gear mechanism in the box 15 and through it the feed screw 14. The motor 16 may be connected to any suitable source of electric power, not shown. Connections from the gear mechanism to the feed screw are made in the following manner: The gear mechanism, indicated in Figure 2 as a worm gear drives a sleeve 17 surrounding the shaft of the feed screw 14 and journaled in any suitable manner in the gear box. The sleeve extends through the wall of the gear box and has secured thereto outside of the gear box a collar 18 (see Figure 10). The shaft of the screw 14, which is indicated by the numeral 19 in Figure 10, after traversing the sleeve 17 extends therebeyond and has secured thereto a collar 20, similar to the collar 18. The collars 18 and 20 are equipped with laterally extending lugs 21 and 22 respectively. These lugs are slotted, as indicated at 23, to receive a wire 24 a strand of which is threaded in an S form through the slots as shown in Figure 3. The wire 24 provides a driving link between the sleeve 17 and the shaft 19. This link is the weakest part of the driving connection so that in case foreign matter, such as stones or metal should become lodged in the screw 14, this link will break, releasing the screw 14 from its driving connection before any damage is done to those connections.

In order to provide an indication that the connections are broken, an alarm device is provided as illustrated in Figure 10. This comprises an insulating washer 25, mounted on the end of the sleeve 17 and secured to the collar 18 by one or more screws 26. Slidably mounted in an insulating sleeve 50 in an axially extending guide hole in the collar 20 is a spring pressed contact 27. This contact bears against the washer 25 when the link 24 is normally connected. Its spring bears against a metal plate 28 insulated from the collar 20 by an insulating disk 29. An insulated contact 30 is pressed by a spring arm 31 against the plate 28, said contact being carried by but insulated from said spring arm. The contact 30 rests in a depression in the plate 28 so that this plate may rotate with the shaft 19 and still be held in place by the spring 31. The spring 31 may be mounted on any convenient portion 310 of the gear box 15.

A circuit is connected from a battery 32 through an alarm device 33 of any suitable type to the contact 30. The other terminal of the battery 32 is grounded. It will be noted that this alarm circuit is open under normal conditions and so long as the link 24 is intact. When the link 24 breaks, however, the shaft 19 stops while the sleeve 17 continues to rotate, carrying with it the washer 25. This rotation causes the screw 26 to make momentary contact with the spring pressed contact 27 at each rotation of the sleeve 17. Each contact with a screw 26 establishes a circuit from the alarm device through the contact 30, plate 28, contact 27, screw 26, collar 18 and the frame of the machine to the ground. Accordingly a complete circuit is established and the alarm is operated. The alarm will be operated intermittently so long as the motor 16 remains in operation. It will be understood, of course, that any kind of an alarm device may be used at 33. A relay may also be included in this circuit to stop the motor.

Mounted on the gear box 15 on the side opposite the motor 16 is a fan housing 34 which has an outlet communicating with the duct 8. The rotor 35 of the fan is mounted on the shaft 36 of the motor 16, said shaft extending through the gear box and into the fan housing 34. An adjustable shutter 37, may be provided for the fan inlet so as to adjust the amount of draft supplied to the fire.

In order to provide for thermostatic control, the motor 16 may be supplied by a circuit 38 passing through a thermostat 39 of any suitable type.

In the operation of this portion of the device fuel is supplied to the hopper 12, which may be filled to the top. The motor is started so as to drive the feed screw 14 through the gear box 15, which contains suitable reduction gearing to drive the screw 14 at a suitable rate of speed. By operation of the screw 14, the fuel is fed from the hopper 12 through the tube 7 and deposited on the grate 2 where it stacks up in a pile as indicated by the broken line in Figure 1. The fuel is ignited in any suitable manner and the fan 35 provides air, which is delivered through the duct 8 and the flared terminal 11 to the interior of the pile of fuel. The air is supplied to the fire at a low pressure. As low as one quarter inch on a water gauge has been found sufficient for perfect combustion. The rate of feed is adjusted to such a value as to provide for a sufficient consumption of fuel to heat the house in the coldest weather. This, of course, will provide too much heat for moderate weather. The thermostat 39, however, which is located in one of the rooms to be heated, operates to open the motor circuit 38 when the temperature reaches the desired value. This causes the motor to stop and accordingly the operation of the screw 14 and the fan 35 ceases. The fuel pile, however, is still burning and continues to burn at a greatly reduced rate of combustion. The forced air draft has been cut off and air for combustion is now supplied by natural suction through the duct 8 and the fan 35 and the opening of the shutter 37. This is sufficient to maintain a low rate of combustion. This rate is low enough, however, that the fire eventually dies down to such a condition as to be inadequate to supply the necessary amount of heat. Accordingly the temperature falls in the room where the thermostat 39 is located. This fall of temperature causes the thermostat to again close the circuit 38 whereupon the motor 16 is started and operation of the stoker is resumed. The fire now increases in rate of combustion and additional heat is supplied until the thermo-

stat again operates to stop the motor. Thus the stoker is operating intermittently in accordance with the heat required and as regulated by the thermostat. During normal operation the draft door 51 below the grate may be kept closed so that all the air for combustion is supplied through the duct 8.

In accordance with this invention, arrangements are made to adapt this stoker to any type of existing furnace. In a hot water or steam boiler, it is not admissible to simply cut through the fire box in order to insert the feed device. This is on account of the fact that such boilers are usually constructed of a series of superimposed sections, which sections are hollow and contain water. In order to meet this situation, arrangements are made to provide an extra fire box section for the boiler as illustrated in Figures 4, 5, 8 and 9.

Figure 5 illustrates a circular boiler and Figures 8 and 9 rectangular boilers. The extra section provided in accordance with this invention is shown in Figure 4 at 40 and is arranged to be inserted between the base and the boiler sections of the furnace. The section 40 is made up of a plurality of short units or sub-sections 41. Each of these units is a separate casting arranged to interlock with adjacent units as shown in the drawings. The abutting flanges of adjacent units may be perforated and locked together by pins 42 which maintain alignment. The units 41 are made of such length, that by inserting one unit of greater or less length, a section whose outer circumferential dimension is greater or less by one inch may be formed accordingly. Any size furnace may be accommodated by inserting the proper number of units to form a circle. These units are then surrounded by a hoop 43 having its ends threaded and secured by nuts 44 to the terminal head casting 45 of the stoker. Said head thus provides a stoking entry as part of the inserted section. By providing shorter units 41 varying in their circumferential dimensions by half an inch, variations in the circumference of the section of half an inch can be accommodated. Accordingly one or two sizes of units 41, may be arranged to accommodate all sizes of boilers. After installation of the section 40, its inner surface may be packed with fire clay or other refractory material as indicated at 46 for which the pins 42 provide anchors. In Figures 8 and 9, the manner in which this unit construction is applied to rectangular furnace sections is shown. In this case, side units and corner units are provided. Side units of two or three different lengths will accommodate practically any size furnace.

In order to take care of additional fuel requirements of larger furnaces and to provide an even distribution thereof over the grate, a plurality of feed tubes may be provided as indicated in Figures 8 and 9. Each of these provides a unit and operates as described above. Terminal castings for the feed and draft duct may be provided to fit the section 40 as illustrated in Figures 6 and 7.

It will be seen, therefore, that this invention provides a stoker which may be applied in a simple manner to any type furnace and particularly to existing domestic furnaces. Its construction is simple and its operation is simple and effective. The draft is delivered by the terminal 11 at such a point in the fuel pile as to permit the most efficient combustion, providing for an incandescent zone at the outer portion of the pile and a coking zone in the region of the point of air delivery so that a progressive action is obtained in which the volatile parts of the fuel are first released and burned, reducing the fuel to coke which is then advanced to the incandescent zone for complete combustion. The operation is entirely automatic and requires only the occasional filling of the hopper 12 and shaking of the excess ash from the grate 2.

While this stoker has been described as a unitary device, it will be understood, of course, that individual features or sub-combinations thereof may be useful in themselves without reference to other portions of the complete device. It is understood, of course, that the employment of such individual features and sub-combinations is contemplated by this invention and is within the scope of the appended claims.

It is further obvious that various changes may be made in the details of construction within the scope of the appended claims, without departing from the spirit of this invention and that the invention is not limited to the specific details shown or described.

Having thus described the invention what is claimed is:

1. In the art of firing furnaces automatically, the method comprising, forming a shallow layer of ashes on a horizontal grate, feeding fuel horizontally onto said layer at a definite rate so as to form a pile of fuel on the grate, delivering air in a concentrated flow at a moderate pressure to a point near the middle of the bottom of the pile, and by progressively feeding new fuel gradually pushing the burning pile of fuel across the grate, whereby to establish a coking zone in the region of the point of air delivery and to gradually push the coked fuel into a combustion zone therebeyond.

2. In a stoker of the character described, a combustion chamber, a horizontal grate therein, an air inlet conduit extending a short distance into the combustion chamber and spaced above said grate sufficiently to permit a layer of ashes on the grate and below said conduit whereby to prevent air passing downwardly thru the grate, said conduit being open for exit of air only at its end and adapted to direct the draft along the layer of ashes on the grate, power-driven fuel feeding means terminating above said air conduit constructed and arranged to deliver fuel to move horizontally over said conduit and onto said grate, and a fan operated in accordance with the operation of said fuel-feeding means and connected to deliver air to said conduit.

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