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METHOD OF AND APPARATUS FOR FEEDING FUEL

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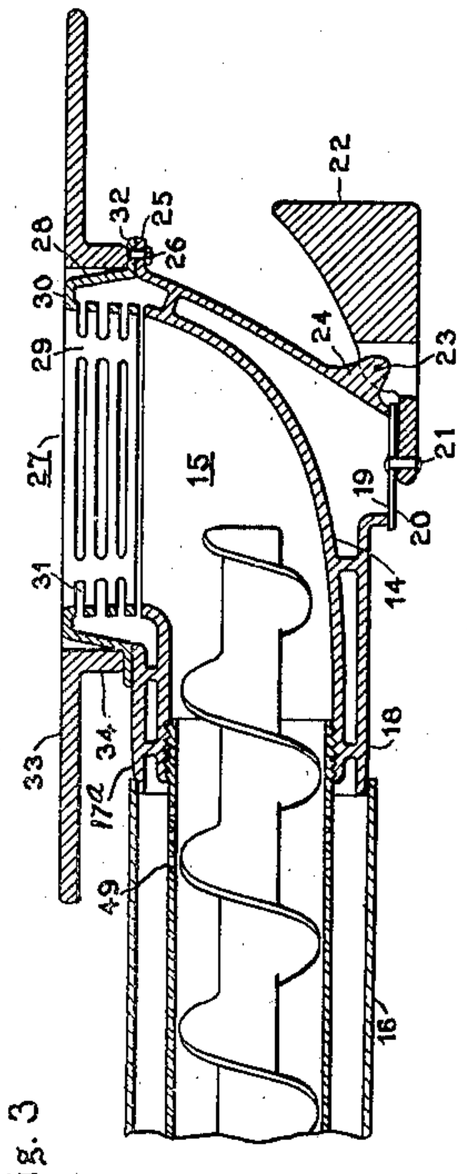


Fig. 3

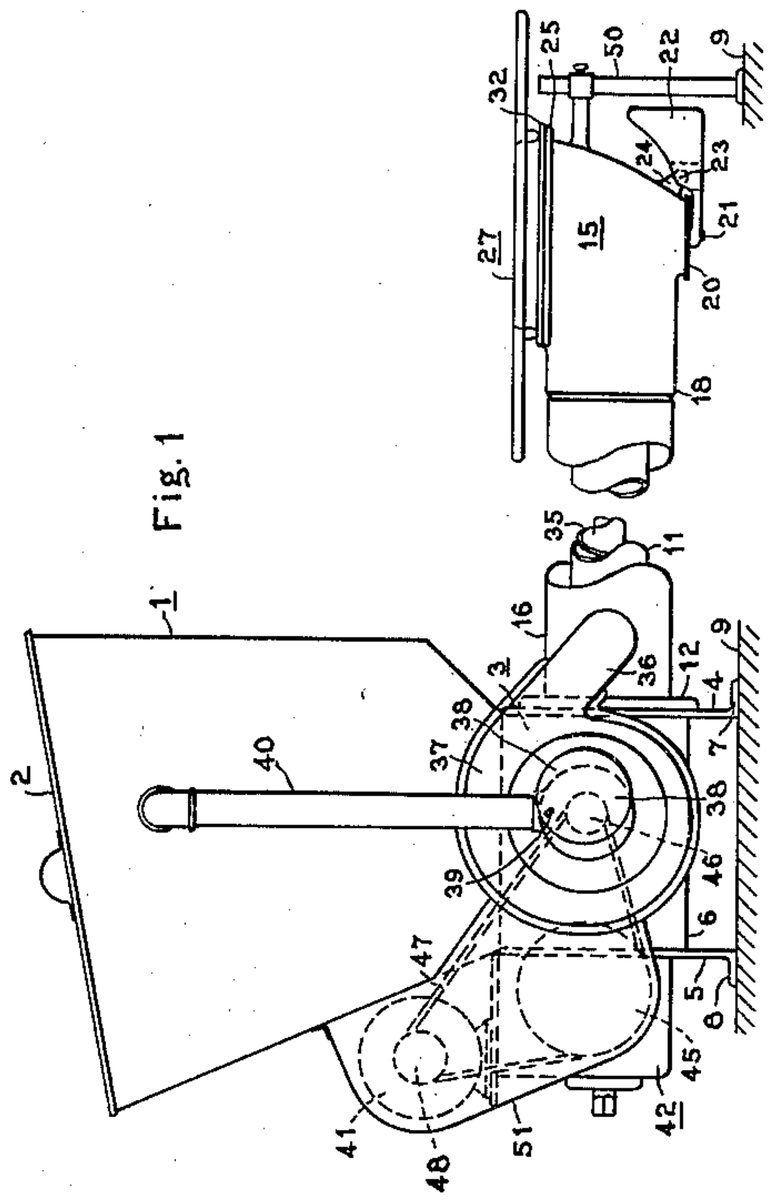
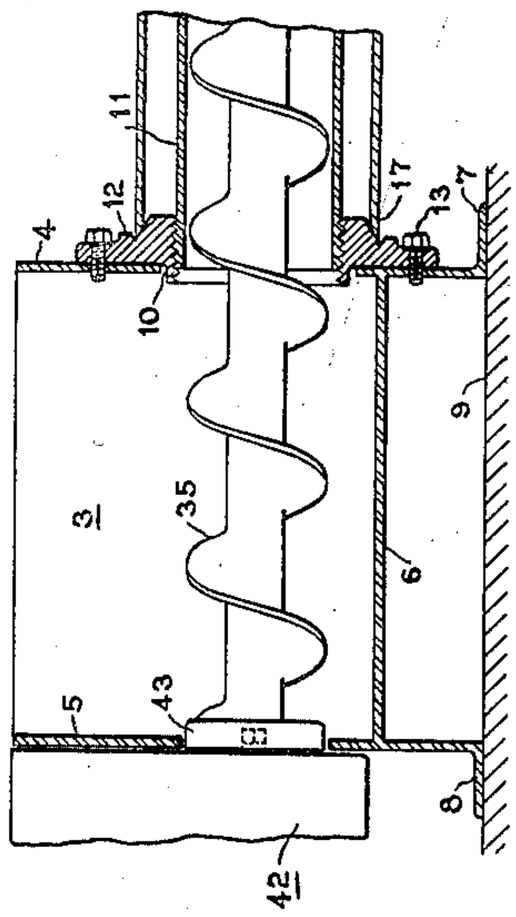


Fig. 1



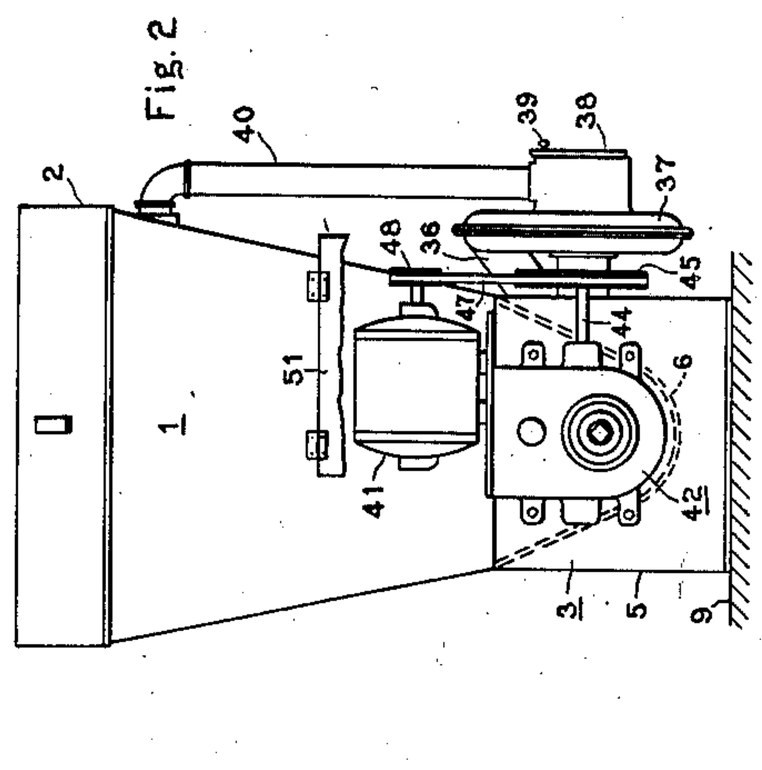


Fig. 2

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METHOD OF AND APPARATUS FOR FEEDING FUEL

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1 Claim. (Cl. 110—45)

Our invention relates to means for feeding fuel to the firebox of a furnace, boiler or the like, and to a method of promoting combustion of the fuel within the firebox. More particularly our invention relates to a motor driven means of the type commonly referred to in the art as a mechanical stoker, which may be thermostatically controlled, and which is adapted to feed a solid fuel such as coal to the firebox of a domestic furnace or the like, and to a method of supplying combustion air thereto by a combination of forced and natural draft.

In devices of this nature heretofore put forward it is a known expedient to employ a motor driven screw acting within a pipe of relatively large diameter for transferring a solid fuel from a suitable hopper or bin to the firebox of the furnace. It has also been the practice to supply combustion air under pressure from a suitable motor driven fan or blower to the bottom of the firebox in order to promote combustion of the fuel within the furnace. So far as we are aware, in installations where combustion air is forced through the firebox from the section of the furnace immediately thereunder (hereinafter termed the ashpit) it has heretofore been necessary to seal this section of the furnace to prevent the escape of air under pressure from the ashpit other than through the firebox. The necessity of a sealed ashpit is a factor in determining the cost of a mechanical stoker installation and presents other disadvantages as well; leaks inevitably develop, which not only allow the escape of air from the ashpit, but also allow the escape of dust, which in the case of domestic installations is particularly objectionable; the sealed ashpit involves the elimination of the ashpit door from which it follows that ash other than in the form of clinkers may not readily be removed; the sealed ashpit further involves an entire dependence for combustion air on the forced draft provided by the fan or blower, an interruption in the power supplied to the fan or blower consequently placing the user in the position of having no fire; and the sealed ashpit still further involves the entire elimination of natural draft for supplying combustion air to the fire and consequently necessitates a greater number of rates of fuel feed to meet varying weather conditions.

In certain installations, and particularly in domestic installations used for house heating purposes, a mechanical stoker must be adapted to supply fuel and combustion air to the firebox of the furnace, boiler or the like at widely varying rates in order to take care of widely varying weather conditions. For example in the type of mechanical stoker relying entirely on forced draft and wherein a single motor serves to drive both the screw and the fan it has been shown that the fuel feeding means operates under thermostatic control more often and for longer periods than is necessary to maintain the desired temperature during mild weather conditions. This is due in part at least to the fact that during the idle periods of the fan or blower, the fire dies very rapidly owing to the lack of combustion air. In order to overcome this difficulty in devices of the prior art it has been proposed to provide a multi-speed gear reduction between the driving motor and the fuel feeding means in order to provide a number of varying rates of fuel feed to meet varying weather conditions, at the same time allowing for longer periods of operation of the fan or blower. The provision of a multi-speed gear reduction not only adds complexity to the operation of the stoker as a whole but also tends to increase the cost of the unit and consequently is decidedly objectionable.

It is an object of our invention to provide a mechanical stoker particularly designed for domestic installation which will overcome all of the above referred to objectionable features of similar devices of the prior art.

It is a further object of our invention to provide a mechanical stoker for a furnace, boiler or the like fired with solid fuel which will employ a combination of natural and forced draft for supporting combustion within the firebox.

A further object of our invention is to provide a mechanical stoker for solid fuels, which, when added to furnaces, boilers or the like already installed, will necessitate a minimum of disturbance to the existing installation.

A still further object of our invention is to provide a device of the character hereinbefore referred to wherein the escape of dust and combustion air from the hopper and ashpit is substantially prevented, without the necessity of sealing the ashpit against air leaks.

We accomplish the above and other objects in accordance with our invention, by supplying fuel and combustion air under pressure through concentrically located passages to a double walled retort having tuyères in its inner wall, and located centrally of the bottom of the firebox of the furnace, the remainder of the bottom of the firebox being closed by a suitable grate. The retort and grate are supported within the furnace by a double walled elbow casting to the central passage of which fuel is fed by a motor driven screw

from a suitable hopper or bin and to the outer passage of which air under pressure is supplied from a suitable fan or blower.

A better understanding of our invention will be obtained from a consideration of the following particular description of a specific embodiment thereof and by reference to the drawing attached thereto, and the scope of our invention will be pointed out in the claim appended thereto.

In the drawing:

Fig. 1 is a side elevation of a device of our invention with certain portions broken away to show members otherwise hidden;

Fig. 2 is a rear elevation; and

Fig. 3 is a longitudinal section of a portion of the device of our invention. Throughout all figures of the drawing like reference numerals refer to the same members.

In the drawing we have illustrated at 1 a hopper or bin provided with a cover 2 and mounted on a base indicated generally at 3. The hopper is made of sheet metal and is generally of rectangular horizontal section decreasing in area from top to bottom. The base 3 comprises front and rear plates 4 and 5 respectively and a bottom plate 6. The front and rear plates 4 and 5 extend downwardly below the lowest portion of the bottom plate 6 and are turned outwardly to form feet 7 and 8 which serve to support the hopper assembly on the floor 9. The bottom plate 6 is bent into a V-shape with a rounded apex as shown by the dotted lines in Fig. 2 and forms the bottom of the hopper 1. The front wall 4 of the hopper base is apertured at 10 and an end of the fuel pipe 11 is secured within the opening 10 by screw threaded engagement with a ring member 12 supported by bolts 13 on the plate 4. The other end of the fuel pipe 11 is in screw threaded engagement with the inner wall 14 of a double walled elbow casting 15. A second pipe 16 is located concentrically with respect to first pipe 11 and is substantially coextensive therewith, forming at one end a tight sliding fit over a conical surface 17 provided on the ring member 12 and at the other end forming a second sliding fit with the outer wall 18 of the elbow casting 15, which is preferably also formed into a conical surface 17*a*.

The casting 15, of metal such as cast iron, is formed with the two walls 14 and 18 defining inner and outer passages. The inner passage as defined by the inner wall 14 makes a bend through substantially 90° and forms in general a bent funnel through which the fuel is adapted to be fed in an upward direction. The passage defined by the walls 14 and 18 is substantially annular in cross section and is adapted to convey combustion air under pressure to the retort described hereinafter. For purposes of removing dust from the outer passage defined by the walls 14 and 18, this passage is somewhat enlarged below the bend in the casting 15 and the wall 18 has a large opening therethrough at 19, closed by the dust flap 20. The dust flap 20 is self aligning, being tiltably mounted on the central support 21 in the end of a weighted lever 22 pivoted at 23 to a lug 24 on the outer surface of the casting 15. The weighted lever 22 is so adjusted that the dust flap is maintained closed against the air pressure within the outer passage of casting 15, but permits ready removal of any dust that gathers therein.

The outer wall 18 of the casting is further provided with a flange 25 about the upwardly extending opening. Mounted on the flange 25 and secured thereto by suitable means such as the bolts 26 is a retort 27 which is preferably made of metal such as cast iron. The retort 27 comprises outer and inner, concentric, substantially cylindrical walls 28 and 29 respectively, forming therebetween an annular passage which is closed at its upper end by the end wall 30. The inner wall 29 of the retort is provided with a plurality of tuyères or openings 31 through which air may pass and the outer wall 28 is provided with a suitable outwardly turned portion 32 adapted to cooperate with the flange 25 on casting 15. Thus the retort 27 is mounted on and is secured to the casting 15 and the inner and outer passages defined by the walls of the retort 27 register with the inner and outer passages respectively of the casting 15.

It will be understood from what has been said hereinbefore that the diameter of the retort 27 is substantially less than the diameter of the furnace or boiler in which it is used. In the space between the retort and the furnace walls there is provided the natural draft grates 33 having a down turned rim or flange 34 which rests on the flange 32 of the retort 27. Thus the space within the furnace above the retort 27 and grates 33 constitutes the firebox and the space below the grates 33 constitutes the ashpit, and in order to adjust the grates 33 and retort 27 to the proper level within the furnace there is provided the adjustable leg 50 mounted on the casting 15.

Fuel is transferred from the hopper 1 to the casting 15 and retort 27 through the fuel pipe 11 by means of the screw or worm 35 which extends through the hopper base 3 from the rear wall 5 thereof through the aperture 10 in the front wall 4 thereof, and through pipe 11 into the inner passage of casting 15. The screw 35 is given a small clearance within the pipe 11 and, when rotated in one direction serves to drive the fuel forwardly through pipe 11 toward casting 15, as is well known in the art.

Combustion air under pressure is delivered through the pipe connection 36 to the air pipe 16 which connects with the outer passages in casting 15 and retort 27, by a fan or blower 37 of the well known centrifugal type mounted by means of a suitable bracket (not shown) adjacent the side of the hopper base 3. The intake to the fan may be controlled by means of the swinging disk 38 mounted on the set screw 39. During operation of the screw 35 driving fuel into and through the pipe 11 a certain amount of dust is created within the hopper 1 and hopper base 3. In order to prevent the escape of this dust from the hopper 1 there is provided an additional intake conduit to the fan 37 in the form of the pipe connection 40 through which air is delivered from within the hopper 1 to the intake of the fan.

A single electric motor 41 serves to drive both the blower 37 and the fuel screw 35. A gear reduction mechanism 42 is mounted on the rear wall 4 of hopper base 3 and has a projection on its output shaft extending through a suitable aperture in the wall 4 and engaging in a socket in a boss 43 on the end of the screw 35, as is shown in Fig. 3. The gear reduction mechanism shown generally at 42 may be of any suitable type, but we prefer to use a ratchet gear mechanism such as is shown and claimed in a copending application of D. D. Panabaker, now Patent No. 2,121,405, dated June 21, 1938. The gear reduction unit disclosed in the above identified copending application comprises a pair of ratchet discs alternately operating upon a ratchet

wheel to impart thereto and to the output shaft of the unit an intermittent rotary motion. Not only does the unit of the above identified application form a simple and economical means for driving the fuel screw **35** but by reason of intermittent motion transferred to the fuel screw, it has certain advantageous features to be more fully disclosed hereinafter. The input shaft **44** of the gear reduction mechanism is provided with a suitable pulley **45**, and the drive shaft of the blower **37** is provided with a suitable pulley **46**, each of which is engaged by a belt **47** driven by a suitable pulley **48** mounted on the shaft of motor **41**. It will be understood of course that motor **41** may be controlled in any manner, either manually or by any of the well known thermostatic control systems.

In describing the installation of the mechanical stoker of our invention it will be assumed that the furnace or boiler construction is already installed except for the grates defining the bottom of the firebox. The hopper end of the unit of our invention will first be assembled, that is, the hopper **1** will be mounted on the base **3** and the blower **37** will be secured thereto, with the auxiliary pipe connection **40** made between the hopper **1** and intake of blower **37**. An aperture will then be cut in the wall of the ashpit of the furnace, and the casting **15** will be mounted at the proper height within the ashpit and one end of the fuel pipe **11** will be screw threaded therein. One end of the air pipe **16** will also be placed in position on the conical surface **17***a* on the outer wall of casting **15** and the two pipes will be secured in concentric relation by screwing the ring member **12** on the other end of fuel pipe **11**, the other end of pipe **16** making a tight fit over the conical surface **17**. The hopper assembly and pipe assembly will be connected together merely by securing the ring member **12** to the front wall **4** of the hopper base by means of the bolts **14**. The fuel screw **35** may then be inserted through the opening in the rear wall **5** of hopper base **3**, the opening being closed and the screw **35** being supported by the gear reduction unit **42** which is then mounted on the outside of the wall **5**. Motor **41** may then be mounted on the top of the gear reduction unit **42** and the belt connection **47** made to drive blower **37** and unit **42**. The retort **27** and natural draft grates **33** will then be mounted within the furnace on the casting **15** and will be secured thereto by the bolts **26**. Thus the complete assembly is made with the minimum disturbance to the furnace construction. The ashpit need not be sealed against air leaks for the reason that air under pressure is conveyed directly to the fire by means of the pipe **16** and the outer passages in casting **15** and retort **27**. Furthermore a natural draft through the ashpit is desirable for reasons which will be explained hereinafter. Attention is also directed to the fact that the stoker may be installed from any side of the furnace, as desired, by reason of its unitary means for conveying fuel and air under pressure to the firebox.

The operation of the device of our invention will now be briefly described. A supply of fuel is placed in hopper **1** sufficient, for example, to last for one day's firing. It will be assumed that initially the control for the driving motor is such that the motor operates to drive the screw **35** and the blower **37**. Under these conditions fuel will be slowly fed from the hopper base **3** through the pipe **11** to casting **15** and from thence to the firebox through the retort **27**, and at the same time air under pressure will be supplied by the blower **37** to the pipe **16** and through the outer passage in casting **15** to the firebox through the tuyères in the inner wall of retort **27**. As the screw **35** continues to force fuel through the casting **15** the fire will gradually spread throughout the whole of the bottom of the firebox and will cover the natural draft grates **33**. The forced draft through the retort **27** creates therein a brilliant fire which rapidly generates heat to be absorbed in the heating system.

When the control for the motor **41** changes to interrupt the power supply thereto the screw **35** will no longer feed fuel to the firebox and no further air under pressure is supplied to the retort **27** by the blower **37**. However, in contradistinction to devices of this type known in the prior art, the fire does not die to a very low minimum as soon as the blower **37** shuts off, but is maintained at an intermediate rate of combustion by reason of the natural draft through the grates **33** from the unsealed ashpit. This feature is a very advantageous one particularly in mild weather operation of domestic installations for house heating purposes. The presence of a natural draft through the firebox assures substantially complete combustion of the fuel fed thereto by the screw **35** without continued operation of the blower **37**, and contributes to the economy of operation of the installation in that less frequent operation of the blower **37** and feed screw **35** is required to maintain a desired temperature.

Under certain conditions of operation it has been found that the gaseous products of combustion have tended to flow from the retort **27** back through the fuel pipe **11**. Heretofore this objectionable tendency has been overcome by supplying air under a relatively low pressure to the interior of the fuel pipe at a point adjacent its entrance into the furnace, by means of a special air conduit running from the blower. In the device of our invention this tendency to "smoke back" is readily and economically overcome by drilling a few holes through pipe **11** adjacent its juncture with the casting **15**.

During operation of the stoker a certain amount of fuel is unavoidably pulverized to dust by the action of the screw **35** within pipe **11**. Some of the "fines" thus created falls through the tuyères **31** in retort **27** into the outer passage of casting **15** and lodges in the bend of the casting, thereby restricting this passage and reducing the rate of air feed from blower **37**. The opening **19** which is normally closed by the dust flap **20** provides a convenient means for periodically removing the dust or "fines" accumulated within the casting **15**.

The dust created by the action of screw **35** and which remains in the hopper **1**, and any gaseous products of combustion which find their way back to hopper **1** from the firebox are quickly removed from the hopper by means of the pipe connection **40** to the blower **37**. By the suitable adjustment of the intake valve on blower **37** comprising the disk **38**, a sufficiently lowered pressure is generated within the hopper **1** to prevent the escape of dust or gaseous products of combustion therefrom to the outside atmosphere.

The use of the ratchet gear reduction unit of the aforementioned Panabaker application is particularly advantageous in that the intermittent rotary motion imparted to screw **35** provides a small amount of agitation to the fuel within the hopper **1** and pipe **11**. It has been found that this agitation settles the fuel around the screw

35 in a very solid mass, reduces the grinding noise arising from the fuel being forced into pipe 11 from hopper 1, and further reduces the amount of "fines" created by the action of screw 35.

While we have disclosed herein, in accordance with the patent statutes, a specific embodiment of our invention, we do not wish to be limited thereto and aim, in the appended claim to cover all such modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States, is:

In a device of the character described, a hopper having a base with an aperture therein, a pipe communicating with said aperture, a second pipe located concentrically with respect to said first pipe, and a ring member in screw threaded engagement with said first pipe and adapted to be secured to said base to close said aperture, said ring member being provided with a conical surface to engage an end of said second pipe to form therewith a substantially airtight seal and to support said second pipe in concentric relation with respect to said first pipe.

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