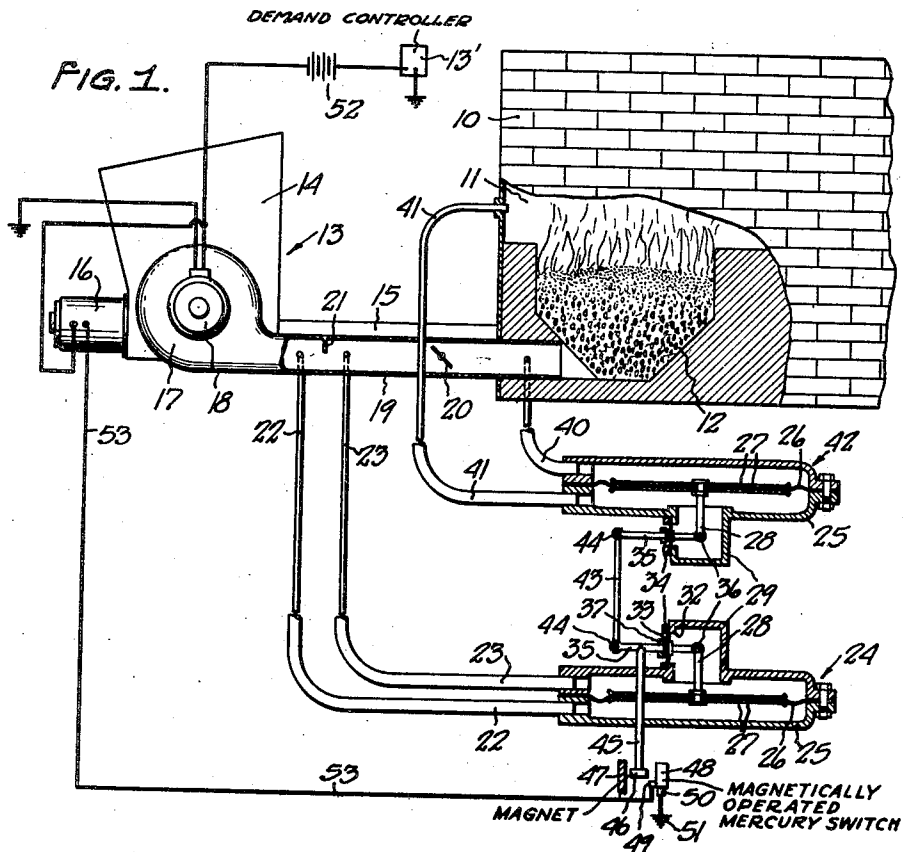


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F. D. BURNS
STOKER AND AIR CONTROL, INCLUDING DIFFERENTIAL
PRESSURE MEASURING MEANS
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INVENTOR.

FRANK DONALD BURNS.

BY

Oltsch & Knoblock
Attorneys.

UNITED STATES PATENT OFFICE

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STOKER AND AIR CONTROL, INCLUDING
DIFFERENTIAL PRESSURE MEASURING
MEANS

Frank Donald Burns, Long Beach, Ind., assignor
to The Hays Corporation, Michigan City, Ind.,
a corporation of Indiana

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This invention relates to improvements in stoker controls.

One of the problems encountered in the operation of small underfeed stokers is that of maintaining a substantially constant fuel bed, and a substantially constant high efficiency of operation.

In most small underfeed stokers the air supply fan and the fuel feed screw are operated simultaneously, as by a single motor. Also, most small underfeed stokers have certain fuel feed adjustments, as low, intermediate, and high, to be set to provide desired fuel-air ratios. When the device is set at low or intermediate position, and the motor is off, a limited amount of air is continuously supplied to the combustion chamber or fuel retort according to the setting of a damper in the air supply duct and the furnace draft. This air burns the fuel bed down when the stoker is off so that upon starting, the fuel will be thinner in proportion to the off time. This will result, after the stoker has been off for a time, in burning of the fuel bed to a point where fissures or openings occur in the fuel bed, and the CO₂ content of the products of combustion drops when the stoker starts. Then, when the stoker is turned on again, the rate of flow of air is increased because the fissures in the fuel bed have lowered the resistance to air flow therethrough. This tends to aggravate or accelerate the condition of thinning fuel bed and improper fuel air ratio, so that efficiency is low.

If the fuel supply motor speed is then set up one step, i. e. from low to intermediate or from intermediate to high, the condition may be balanced for normal operation. However, if an extreme high load condition is encountered, such as one requiring substantially continuous stoker operation, the new setting may prove to have overbalanced the above described condition. In other words, the fuel may be fed at a rate faster than it burns under the forced air supplied by the fan. This will result in a progressive increase in the depth or thickness of the fuel bed, with resultant progressively increasing resistance to the flow of air therethrough. If this continues, the flow of air to support combustion will be substantially stopped, with the result that the fire may be extinguished. However, even if combustion continues, the restriction to air flow will reduce the load carrying capacity of the stoker.

The primary object of this invention is to overcome the above described deficiencies and difficulties by providing means for maintaining a fuel bed of substantially constant thickness under all operating conditions.

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A further object is to provide a device of this character which will so control a stoker as to insure maintenance of the fuel-air ratio and the CO₂ content of the products of combustion in a combustion unit fed by the stoker substantially constant and at a value insuring high operating efficiency.

A further object is to provide a control for a stoker having independently operated air supply and fuel feeding means wherein the operation of the fuel feeding means is caused to respond to variation of a condition in the air supply means.

A further object is to provide a control for a stoker having independently operated air supply and fuel feeding means, wherein the operation of the fuel feeding means is controlled from variation in air flow or in the difference in air pressure in the air supply means from a predetermined flow or pressure differential range.

A further object is to provide a control for a stoker having independently operated air supply and fuel feeding means, which includes a ratio controller tapped at predetermined points in the air supply means and in the combustion chamber of the furnace associated with the stoker.

Other objects will be apparent from the description, drawing and appended claims.

In the drawing the single figure is a side view of one embodiment of the invention, with parts shown in section and certain parts shown on an enlarged scale.

Referring to the drawing which illustrates one embodiment of the invention, the numeral 10 designates a furnace or boiler having a combustion chamber 11 and a retort 12. A stoker 13 is adapted to supply fuel and air to the retort 12. The stoker is provided with a hopper 14 and a tube or conduit 15 communicating with the bottom of the hopper and the bottom of the retort and houses a feed screw (not shown) which is driven by an electric motor 16. The air supply means of the stoker comprises a fan 17 driven by an electric motor 18 and having an air supply or outlet conduit 19 communicating with the bottom of the retort 12 and provided with a damper 20 therein. The construction of the stoker may be standard throughout, with the exception of the provision of the separate motors 16 and 18. Each of these motors will preferably be the single speed type. The fan motor 18 will be controlled by a conventional stoker control 13', such as a room thermostat, a switch responsive to steam pressure in a boiler, or the like; and motor 16 is connected at one terminal with said control 13'.

A plate 21 or other restriction is positioned in

the air supply conduit 19 between the fan 17 and the damper 20, thereby providing an orifice in said conduit. A tube 22 communicates with conduit 19 and the side of plate 21 adjacent the fan, and a tube 23 communicates with conduit 19 at the opposite side of said plate 21. Tubes 22 and 23 are connected to a conventional differential pressure measuring diaphragm unit 24. As here illustrated diaphragm unit 24 comprises a two-part chambered housing 25 having a slack diaphragm 26 clamped marginally between the housing parts. Rigid plates 27 of a size smaller than the housing chamber are secured together to clamp the central portion of the diaphragm therebetween, and a stud 28 is carried centrally by said plates and extends perpendicularly therefrom. One of the housing parts has a central chambered projection 29. Stud 28 projects into and terminates centrally in projection 29. An opening 32 is provided in one wall of projection 29 and is sealed by a diaphragm 33 held by a marginal clamping ring 34 secured to said projection. A lever 35 is pivoted at 36 to the free end of stud 28 and extends through diaphragm 33 centrally with a sealed fit. A pivot bracket 37 preferably supports the lever 35 adjacent the diaphragm 33 to sustain the weight or stress which otherwise would be exerted by the lever on the diaphragm. Conduits 22 and 23 are connected with the diaphragm unit in communication with the chambers on opposite sides of the diaphragm 26.

A tube 40 communicates with the air supply conduit 19 between damper 20 and retort 12, and a tube 41 communicates with the combustion chamber 11. The opposite ends of tubes 40 and 41 are connected to a second differential pressure measuring diaphragm unit 42 of a construction similar to that of diaphragm unit 24, whose parts are identified by the same reference numerals. The two differential pressure measuring diaphragm units are arranged in stationary close spaced relation facing each other, preferably with their projections 29 innermost. A link 43 is pivoted at 44 to the outer ends of the levers 35 of the two diaphragm units. This arrangement and connection constitutes the two diaphragm units a ratio meter. A rigid arm 45 depends from one of the levers 35, being fixedly secured thereto, and mounts a permanent magnet 46 at its lower end. In its normal vertical position, the arm 45 is positioned in spaced relation to and between a fixed stop 47 and a fixedly mounted magnetically operated mercury switch 48. Terminals 49 and 50 are provided in switch 48, terminal 49 being located at the side of the switch envelope at a level above the level of the mercury (not shown) in the switch, whereby the switch is normally open when its armature is not subjected to a magnetic influence. Terminal 50 may be grounded at 51. Terminal 49 is connected in a circuit with the motor 16 and a source of current 52, as by means of lead 53. The circuit to motor 16 is thus controlled jointly by switch 48 and demand controller 13'.

The operation of the device is as follows: Whenever there is a demand for an increased rate of combustion, as at a room thermostat or at a steam pressure controlled switch, the fan motor 18 is operated, thereby increasing the supply of air to the retort 12 and the combustion chamber 11 and accelerating the rate of combustion in the retort. The fuel feed motor 16 is not controlled by demand controller 13' only, and therefore, if switch 48 is open, the motor 18 will operate in-

dependently of motor 16. Operation of fan 17 by motor 18 creates a pressure differential in duct 19 at the orifice or plate 21 which is transmitted by tubes 22 and 23 to act upon diaphragm unit 24 of the ratio controller. Also, it creates a pressure differential between conduit 19 and combustion chamber 11, which is transmitted by tubes 40 and 41 to diaphragm unit 42 of the ratio controller. The differential pressure in tubes 40 and 41 is dependent upon the thickness of the fuel bed in the retort and the resistance of the fuel bed to the passage of the air therethrough. The two diaphragm units supplement each other, and the two differential pressures are resolved in the movement of the levers 35, link 43 and arm 45. If the fuel bed is thin or is fissured so that the rate of flow of air therethrough is excessive, the arm 45 will be swung to the right as viewed in Fig. 1. The magnet 46 will then be positioned close to switch 48 so that the armature therein will be magnetically attracted thereto so as to close the circuit between contacts 49 and 50. In this way the circuit to motor 16 is closed, causing fuel to be fed to the retort. The fuel feed continues only so long as the fuel bed conditions continue of such value as to position arm 45 and magnet 46 to magnetically influence switch 48. In other words, when the fuel bed has thickened to the desired extent or when the fissures therein have been closed, so that the air flow or pressure values in the air supply line change the action of the ratio controller and the position of magnet 46, the fuel feed motor 16 will be deenergized without regard to whether or not the fan motor 18 continues to operate. Under any condition other than that of an excessively thin or fissured fuel bed, starting of the fan motor will not cause operation of the fuel feed motor. Therefore, it is apparent that fuel will be fed only as needed; the fuel bed will be controlled to prevent it from becoming either too thick or too thin; efficiency of the plant as evidenced by the CO₂ content of the products of combustion will be maintained at a high stable level; danger of the fire being extinguished is avoided; and adjustment of motor speed for varying operating conditions is not necessary.

While the embodiment illustrated and described herein includes two separate motors for operating the fuel feed and air supply means, respectively, it is obvious that the device may also be conditioned for operation of both the fuel means and air supply means by a single motor. For example, the fan may have a direct drive connection with the motor and the fuel supply means may be connected with said motor by a mechanical drive which includes a clutch controlled by a solenoid. The arrangement may be such that the solenoid causes the clutch to engage when the controller switch 48 closes the operating circuit, but disengages the clutch or permits disengagement of the clutch under all other conditions. It will be obvious that this single motor type drive will operate in the same manner described above.

I claim:

1. A controller for a heating plant including a combustion chamber, a stoker having air supply means actuated in response to a demand controller and including an air duct, and fuel feed means actuated by a motor, comprising a differential pressure measuring unit connected at opposite sides of an orifice in said air supply means, a second differential pressure measuring unit connected to said air supply means and combus-

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tion chamber, linkage connecting said units to act additively with each other, and means responsive to movement of said linkage for controlling said fuel feed motor.

2. A controller for a heating plant including a combustion chamber, a stoker having air supply means actuated in response to a demand controller and including an air duct, and fuel feed means actuated by a motor, comprising a pair of differential pressure measuring instrumentalities connected additively to form a ratio meter unit, an orifice plate in said air supply means, means connecting one of said instrumentalities with said air supply means at opposite sides of said orifice plate, means connecting the other instrumentality with said air supply means and said combustion chamber, and means responsive to said ratio meter unit for controlling said fuel feed motor.

3. A controller for a heating plant including a combustion chamber, a stoker having air supply means actuated in response to a demand controller and including an air duct, and fuel feed means actuated by a motor, comprising a ratio controller, a plurality of conduits connecting said ratio controller at opposite sides of a flow restriction in said air supply means and at a third point therein, a conduit connecting said ratio controller with said combustion chamber, and means responsive to said ratio controller for controlling said fuel feed motor.

4. A controller for regulating the thickness of a fuel bed in a heating plant fired by a stoker

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having fuel feed means actuated by a motor responsive to a control switch and air supply means responsive to a demand controller, comprising two differential pressure measuring units, means connecting one measuring unit to said air supply means at opposite sides of a restriction therein, means connecting the other measuring unit to said plant above and below said fuel bed respectively, and means connecting said units to supplement each other, said connecting means controlling said switch.

FRANK DONALD BURNS.

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