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CONTROL MECHANISM FOR FURNACES

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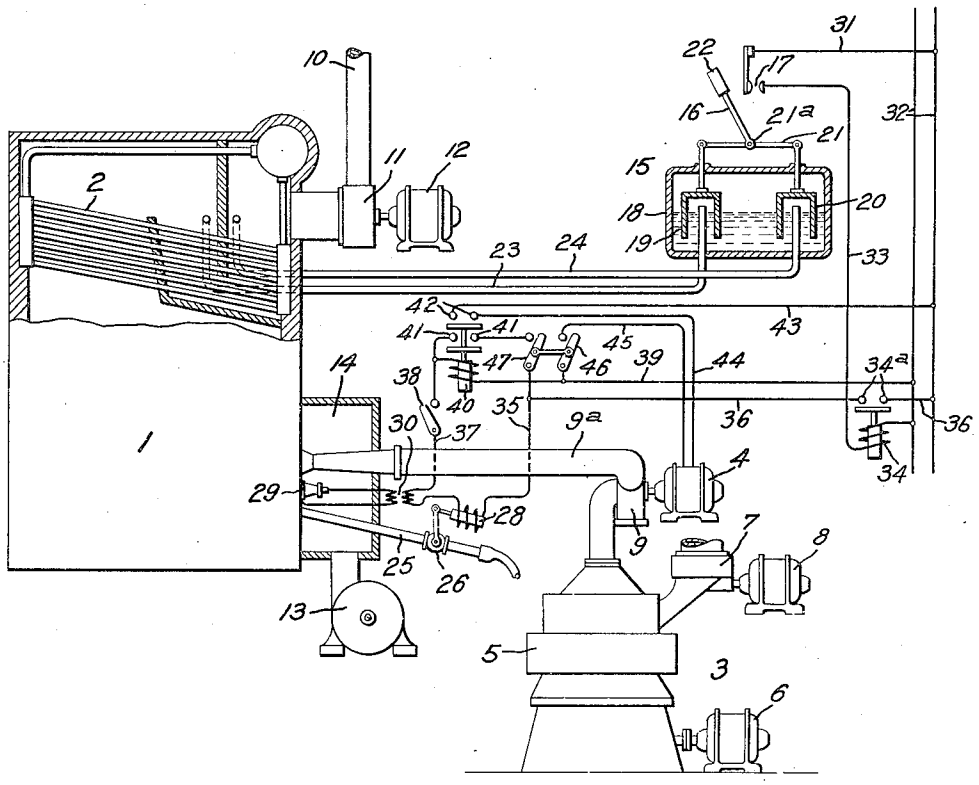

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CONTROL MECHANISM FOR FURNACES

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In connection with the operation of furnaces, and especially furnaces utilizing fuels burned in suspension, such as oil, gas or pulverized fuel, the danger exists that in kindling a fire an explosion may occur if at the time of starting an explosive mixture of fuel and air is in the furnace. To avoid this it is the practice, in kindling a fire in a furnace, to first thoroughly purge or scavenge the furnace by effecting a flow of air through it. This may be done by natural draft or by starting up one of the draft fans, usually the induced draft fan, and operating it for a length of time sufficiently to thoroughly purge or scavenge the furnace, after which the fan may or may not be stopped as found desirable and the fire started.

One object of my invention is to provide an improved construction and arrangement of control mechanism for a furnace whereby it is not possible for an operative to supply fuel to a furnace to kindle a fire therein without having first scavenged the furnace, and whereby if, having scavenged the furnace, he delays kindling the fire until the air flow through the furnace decreases below a certain value then he must again scavenge the furnace in order that he may supply fuel thereto. By this arrangement there is avoided the possibility that the operative may scavenge the furnace, delay kindling the fire until the scavenging may have become ineffective, and then kindle the fire without again scavenging the furnace.

A further object of my invention is to provide a control mechanism actuated by rate of flow of air through the furnace whereby a flow which thoroughly scavenges the furnace must be established before the fuel feeding means can be put into operation.

A further object of my invention is to provide in connection with a fuel supplying means, a fuel igniting means and a control means therefor whereby the fuel supplying means cannot be put into initial operation until the fuel igniting means is rendered operative.

A further object of my invention is to provide in connection with a furnace a fuel supplying means, a fuel igniting means, and a control means whereby the fuel supplying means and the fuel igniting means cannot be rendered operative until a predetermined flow of air obtains in the furnace, the arrangement being such, preferably, that the fuel supplying means cannot be operated until after the fuel igniting means has been started.

For a consideration of what I believe to be novel and my invention, attention is directed to the following specification and the claims appended thereto.

In the drawing, the figure is a diagrammatic view of a furnace provided with control mechanism embodying my invention.

Referring to the drawing, 1 indicates a furnace which may be of any suitable type. It is shown in the present instance as being a furnace for heating a boiler, 2 indicating the boiler tubes of the boiler.

3 indicates a means for supplying fuel to the furnace, and 4 indicates electrically operated means for controlling the fuel supplying means, it being shown in the present instance as being in the form of an electric motor. The device 3 is to be taken as typical of any suitable means for supplying fuel to a furnace, and may represent, for example, a means for supplying oil, gas, pulverized fuel or the like. In the present instance a pulverized fuel feeding means is illustrated, 5 indicating the mill which is driven by an electric motor 6, 7 indicating the feeder which is driven by an electric motor 8, and 9 indicating the exhauster which is driven by motor 4 and supplies fuel to the furnace through a pipe 9^a. 10 indicates the stack of the furnace and 11 indicates an induced draft fan driven by an electric motor 12. 13 indicates a motor driven blower for supplying forced draft to the furnace, 14 being the wind box.

The furnace construction so far described is illustrated only diagrammatically and by way of example and is to be taken as representing any suitable furnace provided with a fuel feeding means and a means for effecting flow of air through the furnace.

According to the embodiment of my invention illustrated in the drawing, I provide a mechanism 15 which is responsive to the

rate of flow of air through the furnace, and I provide such device with a contact closing arm 16 which, when the flow of air through the furnace reaches or exceeds a predetermined value, effects the closing of a pair of contacts 17. Contacts 17 are biased toward open position so that they are open except when held closed by the flow responsive mechanism.

In the present instance the flow responsive device is shown as comprising a casing 18 in which is a sealing liquid, such as oil, for sealing two inverted bells 19 and 20 connected to opposite ends of a lever arm 21 pivoted centrally at point 21a. Contact arm 16 is connected to lever arm 21 and forms a part of it. The arm 16 extends at an angle to lever arm 21 and is weighted by means of a suitable weight 22 which biases the bell structure to a position as shown in the drawing, which position it occupies at no flow. When arm 16 is moved into engagement with contacts 17, it moves toward vertical position but does not move beyond the vertical, i. e., beyond dead center. It tends always, therefore, to move toward the position shown in the drawing wherein contacts 17 are open. Bells 19 and 20 are connected by pipes 23 and 24 to points of differential pressure in the furnace whereby the bells are subjected to a differential pressure which bears a definite relation to the rate of flow of air through the furnace. In the present instance the connections are shown as being made across the second and third passes of the furnace. It will be understood, however, that this is only by way of example and that the connections may be made to any two suitable points, the essential thing being that the bells be subjected to a differential pressure of sufficient value to effect the operation of the flow responsive device.

25 indicates a torch, such as an oil torch, for use in kindling the furnace. Flow of fuel through it is controlled by a valve 26 adapted to be opened by a solenoid 28 and closed by hand. At 29 is an igniting means for the torch such as a spark plug. It is connected to the secondary winding of a transformer 30.

The movable element of contacts 17 is connected by a conductor 31 to one side of electrical supply lines 32 and the stationary element is connected by a conductor 33 to the other side, such conductor including the winding of a solenoid 34. Solenoid 34 has a pair of contacts 34a which are bridged whenever solenoid 34 is energized.

The primary winding of transformer 30 and the winding of solenoid 28 are connected in series to one of the supply lines 32 by conductors 35 and 36, the conductor 36 including the contacts 34a of solenoid 34. The other side of the primary transformer winding is connected to the other supply line 32 by a conductor 37, hand switch 38, and conductor 39, conductor 39 including the winding of a solenoid 40 having two sets of contacts 41 and 42 which are closed whenever the solenoid is energized. Contacts 42 control the circuit of motor 4 which may be traced as follows: right hand supply line 32, conductor 43, contacts 42, conductor 44, motor 4, conductor 45, switch blade 46 and conductor 39 to the other supply line 32. Contacts 41 control a holding circuit for solenoid 40 which may be traced as follows: right hand supply line 32, conductor 36, switch blade 47, contacts 41, winding of solenoid 40 and conductor 39 to the left hand supply line 32. Switch blades 46 and 47 are connected together so that they are operated simultaneously.

The operation is as follows: Assume that the furnace is shut down and that it is desired to kindle the same. The flow responsive device 15 will occupy the position shown in the drawing, contacts 17 being open. The operative first effects a flow of air through the furnace to scavenge it. This may be done by natural draft or by means of the induced draft blower, the forced draft blower or both, the means by which the flow of air is established depending upon the nature of the particular furnace installation to which the invention is applied. The essential thing is that a flow of air be established through the furnace to scavenge it. As the flow of air through the furnace increases, a differential pressure is applied to the flow responsive device 15 which differential increases with the rate of flow. As soon as a predetermined rate of flow is reached, the differential pressure applied to bells 19 and 20 will be sufficient to turn lever arm 21 on its pivot and move contact arm 16 to a position wherein it closes contacts 17. The arrangement is such that a predetermined flow of air through the furnace is required before this operation takes place. The closing of contacts 17 closes the circuit through the winding of solenoid 34 thereby energizing the winding and causing the solenoid to bridge its contacts 34a. The operative now closes hand switch 38 thereby closing the circuit through the primary of transformer 30 and the winding of solenoid 28. The energizing of solenoid 28 opens the valve 26 of torch 25 and the energizing of the primary winding of transformer 30 effects the operation of spark plug 29 whereby the torch is ignited. Also, when switch 38 is closed the winding of solenoid 40 is energized so that pairs of contacts 41 and 42 are bridged. The operative now closes the switch comprising switch blades 46 and 47, the closing of switch blade 46 serving to start fuel supplying motor 4 and the closing of switch blade 47 serving to close the holding circuit for the winding of solenoid 40, and short-circuit the solenoid 28 and transformer 30,

which it is now unnecessary to keep energized as the torch has been lit and valve 26 remains open until closed by hand. The fuel now supplied to the furnace is then ignited by the torch whereby the furnace is kindled. The operative may now open switch 38 and close valve 26 by hand, thereby discontinuing operation of the torch which, if desired, may be removed. The opening of switch 38 will not affect the solenoid 40 as it is now held closed by the holding circuit.

It will be noted that the holding circuit for solenoid 40 includes the contacts 34ª of solenoid 34 so that if at any time, the flow of air through the furnace decreases to an extent such that arm 16 moves away from contact 17, permitting the contacts to open, thereby opening the circuit on the winding of solenoid 34, the holding circuit for the winding of solenoid 40 will be opened whereupon the winding of solenoid 40 will be deenergized and contacts 41 and 42 opened. The opening of contacts 42 will open the circuit of the fuel supplying motor 4. Thus it will be seen that if at any time the flow of air through the furnace decreases below a predetermined value the supply of fuel to the furnace will be cut off automatically. In this connection, it is pointed out that it is the customary practice to interlock the exhauster, the mill and the fuel feeder so that they must be started up in the order named and therefore failure of the exhauster trips out the mill and the feeder. The circuit arrangement for this is a known one and since it forms no part of the present invention it is not illustrated in the drawing.

By my invention it will be seen that, in starting the furnace, the operative must first effect a flow of air through the furnace so as to thoroughly scavenge or purge it prior to kindling the fire, and that a flow of air sufficient to maintain the flow responsive device in the position wherein it closes contacts 17 must be maintained or the fuel feeding means and the igniting means cannot be put into operation. In this connection, the flow responsive device may be so arranged that, having been moved by a predetermined flow of air through the furnace to effect closing of contacts 17, it will, due to weight 22 having moved to a more nearly vertical position, stay in such position until the flow decreases by a certain amount. By this means the draft through the furnace may be decreased somewhat over that required to close contacts 17 and still the contacts will remain closed which means that, if desired, the arrangement may be such that a stronger draft must be used to scavenge the furnace after which the draft may be shut down somewhat during the kindling operation.

While in carrying out my invention, I prefer to use an arrangement wherein the air supply responsive mechanism is interlocked with both the fuel supplying means and the fuel igniting means it will be understood that my invention in its broader aspects is not limited to such an arrangement as I may utilize an arrangement wherein the air supply responsive means is interlocked only with the fuel supplying means or only with the fuel igniting means.

It is to be understood also, that while I have illustrated my invention in connection with a furnace burning powdered fuel, this is only by way of example, and that the invention may be utilized in connection with furnaces burning other fuels, such as oil or gas, for example.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

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

1. In the operation of a furnace having air supplying means, fuel supplying means and fuel igniting means; the method which comprises effecting a predetermined rate of flow of air through said furnace for scavenging the same, making effective the fuel igniting means when said predermined rate of flow of air is reached and finally effecting a feed of fuel for combustion therein when said fuel igniting means is made effective for igniting said fuel.

2. In the operation of a furnace having air supplying means, fuel supplying means and fuel igniting means; the method which comprises effecting a flow of air through the furnace for scavenging the same, measuring the air flow, making effective the fuel igniting means when a predetermined rate of flow of air is reached, and finally effecting a feed of fuel for combustion in the furnace when said fuel igniting means is made effective for igniting the fuel.

3. The combination with a furnace, of fuel supplying means and fuel igniting means therefor, and control mechanism whereby said means can be operated only when a predetermined or greater flow of air obtains through the furnace.

4. The combination with a furnace, of means for effecting flow of air through the furnace, fuel supplying means for the furnace, fuel igniting means for the furnace, and control mechanism whereby the fuel igniting means can be rendered operative only when there is a predetermined flow of air through the furnace.

5. The combination with a furnace, of means for effecting flow of air through the furnace, means for supplying fuel thereto, means responsive to flow of air through the

furnace, and means under control of said flow responsive means which prevents operation of said fuel supplying means until the rate of flow of air through the furnace reaches a predetermined value.

6. In combination with a furnace, of means for effecting flow of air through the furnace, means for supplying fuel thereto, a flow meter for measuring the flow of air through the furnace, and means under control of said flow meter which prevents operation of said fuel supplying means until the rate of flow of air through the furnace reaches a predetermined value.

7. The combination with a furnace, of means for effecting flow of air through the furnace, means for supplying fuel thereto, a pressure differential responsive means for measuring the flow of air through the furnace, and means under control of said differential pressure responsive means which prevents operation of said fuel supplying means until the rate of flow of air through the furnace reaches a predetermined value.

8. The combination with a furnace, of means for effecting flow of air through the furnace, means for supplying fuel thereto, a measuring device for the air flow, and control mechanism rendered operable by said measuring device whereby the fuel supplying means can be operated only when there is a predetermined measured flow of air through the furnace.

9. The combination with a furnace, of means for effecting flow of air through the furnace, normally inoperative means for supplying fuel thereto, and means responsive to flow of air through the furnace which renders said fuel supplying means operative when the flow reaches a predetermined high value and renders it inoperative again when the flow decreases below such value.

10. The combination with a furnace, of means for effecting flow of air through the furnace, normally inoperative fuel supplying means and fuel igniting means for the furnace, and means responsive to flow of air through the furnace for rendering said fuel supplying means and fuel igniting means operative when the flow reaches a predetermined high value.

11. The combination with a furnace, of means for effecting flow of air through the furnace, normally inoperative fuel supplying means and fuel igniting means for the furnace, a flow meter for measuring the flow of air through the furnace, and means under control of said flow meter for rendering said fuel supplying means and fuel igniting means operative when the rate of flow of air through the furnace reaches a predetermined high value.

12. The combination with a furnace, of means for effecting flow of air through the furnace, fuel supplying means for the furnace, fuel igniting means for the furnace, a flow meter for measuring the flow of air through the furnace, and control mechanism adapted to be actuated by the flow meter for rendering the fuel igniting means operative only when there is a predetermined flow of air through the furnace.

13. The combination with a furnace, of means for effecting flow of air through the furnace, fuel supplying means for the furnace, fuel igniting means for the furnace, and control mechanism whereby the fuel igniting means can be rendered operative only when there is a predetermined flow of air through the furnace, and the fuel supplying means can be operated only when there is a predetermined flow of air through the furnace and the fuel igniting means has been rendered operative.

14. The combination with a furnace, of electrically operated means for supplying fuel to the furnace, electric circuit connections for controlling the fuel supplying means, a switch means in said circuit connections, normally open contacts in said circuit connections, and means responsive to flow of air through the furnace which when the air supply exceeds a certain value effects the closing of said normally open contacts.

15. The combination with a furnace, of means responsive to flow of air through the furnace, an electric circuit adapted to be closed by said means, means for supplying fuel to the furnace, an electric circuit for the fuel supplying means, a fuel igniter, an electric circuit for the fuel igniter, a solenoid in the first named circuit for controlling the igniter circuit, and a solenoid in the igniter circuit for controlling the circuit for the fuel supplying means.

16. The combination with a furnace, of means responsive to flow of air through the furnace, an electric circuit adapted to be closed by said means, means for supplying fuel to the furnace, an electric circuit for the fuel supplying means, a fuel igniter, an electric circuit for the fuel igniter, a solenoid in the first named circuit for controlling the igniter circuit, a solenoid in the igniter circuit for controlling the circuit for the fuel supplying means, and a holding circuit for the last named solenoid.

17. The combination with a furnace, of means responsive to flow of air through the furnace, an electric circuit adapted to be closed by said means, means for supplying fuel to the furnace, an electric circuit for the fuel supplying means, and a solenoid in said first named circuit which controls the circuit for the fuel supplying means.

18. The combination with a furnace, of means responsive to flow of air through the furnace, an electric circuit adapted to be closed by said means, means for supplying fuel to the furnace, an electric circuit for the

fuel supplying means, a fuel igniter, an electric circuit for the fuel igniter, and a solenoid in the first named circuit which controls the igniter circuit.

19. The combination with a furnace, of means for effecting flow of air through the furnace, normally inoperative means for supplying fuel thereto, and means responsive to flow of air through the furnace which renders said fuel supplying means operative when the flow reaches a predetermined high value and renders it inoperative again when the flow decreases below a predetermined low value.

20. The combination with a furnace, of electrically operated means for supplying fuel to the furnace, electric circuit connections for controlling the fuel supplying means, a switch means in said circuit connections, normally open contacts in said circuit connections, and means responsive to flow of air through the furnace which when the air supply exceeds a predetermined value effects the closing of said normally open contacts and when the air supply decreases a predetermined amount below said predetermined value effects the opening of said contacts.

21. The combination with a furnace, of electrically operated means for supplying fuel to the furnace, electric circuit connections for controlling the fuel supplying means, a switch means in said circuit connections, normally open contacts in said circuit connections, a flow meter for measuring the flow of air through the furnace, and means under control of said flow meter which when the air flow exceeds a predetermined value effects a closing of said normally open contacts and when the air flow decreases a predetermined amount below said predetermined value effects an opening of said contacts.

In witness whereof, I have hereunto set my hand this 12th day of August, 1929.

RALPH M. HARDGROVE.