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APPARATUS FOR CONTROLLING FUEL SUPPLY TO FURNACES AND THE LIKE

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Fig. 1.

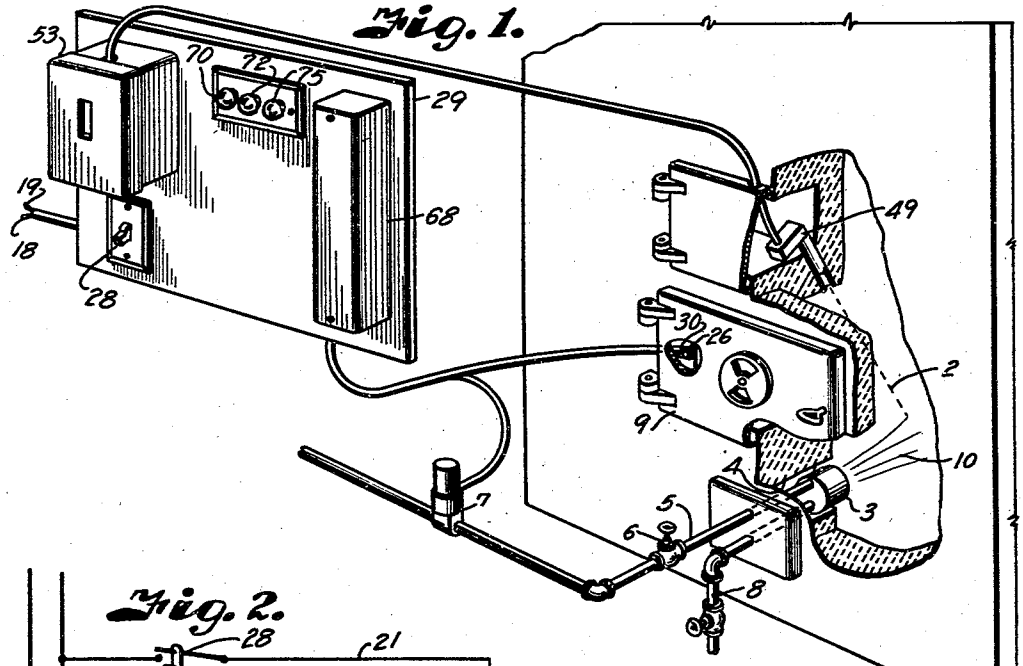
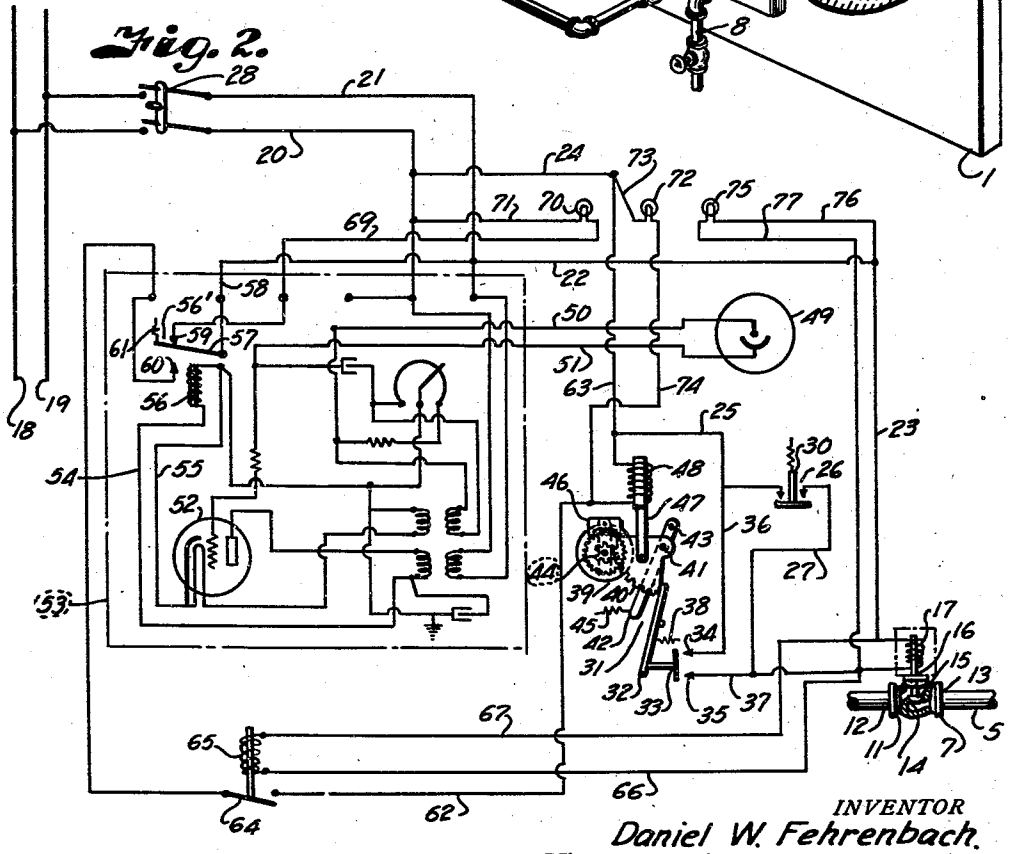


Fig. 2.



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APPARATUS FOR CONTROLLING FUEL SUPPLY TO FURNACES AND THE LIKE

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6 Claims. (Cl. 158—28)

This invention relates to an apparatus for controlling the fuel supply to a furnace or like appliance particularly operating on liquid or gaseous fuels.

In furnaces of this type the flame, for various reasons, often becomes extinguished with the result the fuel continues to flow and soon fills the combustion chamber with a highly explosive mixture that may cause a serious explosion. Besides the explosive hazard in the combustion chamber the fuel is wasted, and in the case of liquid fuels, the fire hazard is extended beyond the confines of the furnace.

It is, therefore, the principal object of the present invention to provide a control apparatus for shutting off the fuel supply should the flame be extinguished.

Other objects of the invention are to provide an apparatus of this character arranged to automatically shut off the fuel when the burner is operating improperly; to provide an automatic control which is not affected by momentary smoking or flickering of the flame; and to provide a control apparatus of relatively simple construction and which is positive in operation.

It is also a further object of the invention to provide a control apparatus with signals to remotely indicate functioning thereof.

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

Fig. 1 is a perspective view of a portion of a furnace equipped with a control apparatus embodying the features of the present invention, parts of the furnace being broken away to better illustrate mounting of the photoelectric cell with respect to the burner, and the door switch for automatically establishing fuel supply when the door is opened to light the burner.

Fig. 2 is a wiring diagram of the control apparatus.

Referring more in detail to the drawing:

1 designates a conventional furnace having a combustion chamber 2 equipped with a burner 3 adapted for burning a liquid or gaseous fuel. The burner 3 is mounted within an opening 4 in the front wall of the furnace and is supplied with fuel through a pipe line 5 having a manually operated valve 6 and a magnetically operated valve 7 connected therein. In case of a liquid fuel such as heavy oils, the burner is provided with a steam connection 8 for effecting vaporization of the fuel, as in conventional practice. Located in the front wall of the furnace is the usual fire-door 9 through which access is had to the burner for inspection and lighting purposes.

The construction thus far described is conventional to fuel burning apparatus of this character and specifically forms no part of the present invention which provides means for automatically interrupting the fuel supply in case the flame indicated at 10 should become extinguished.

In carrying out the present invention the magnet valve 7 includes a valve body 11, having a fuel inlet and outlet 12 and 13 interconnected by a valve port 14. The valve port constitutes a seat for a valve 15 that is normally seated by gravity to close flow through the line 5. The valve 15 includes a stem 16 having operable connection with a solenoid coil 17 which is adapted to be supplied with an energizing current from service line wires 18 and 19 through conductors 20 and 21. The conductor 21 is directly connected with one of the terminals of the solenoid through interconnecting wires 22 and 23, but the other conductor 20 is connected by wires 24 and 25 with a switch 26, which in turn is connected with the other lead of the solenoid winding by a conductor 27. The circuit through the conductors 20 and 21 is manually operated by a main switch 28 that is mounted on a switch panel 29.

The switch 26 is located adjacent the fire-door 9 and has a plunger 30 arranged to be engaged by the fire-door. When the door is closed the circuit is open, and when the door is open the circuit is closed, as later described.

Also connected in the circuit parallel with the switch 26 is a delay or timing switch 31 including a pivoted lever 32 carrying a contact 33 adapted to bridge contacts 34 and 35 that are connected with the wires 25 and 27 by wires 36 and 37 respectively. The lever is moved to circuit closing position by a spring 38 and away from circuit closing position by a time actuated trip mechanism 39.

The trip mechanism 39 includes a gear segment 40 pivotally mounted as at 41 on a lever 42 which has a fixed pivot 43. The teeth on the segment 40 are retained in engagement with the teeth of a pinion 44 by a spring 45 connected with the lever 42. The rotational speed of the pinion 44 is regulated by an escapement 46. Connected with the segment 40 is an armature 47 of an electromagnet 48 which is energized responsive to activation of a photoelectric cell 49. The photoelectric cell 49 is located so that it is

directed into the combustion chamber and exposed to the light of the flame when in propagation, whereupon a circuit is established from the photoelectric cell through conductors 50 and 51 to an amplifying tube 52 that is located within a housing 53 on the switchboard to generate an amplified current in the plate circuit thereof which acts through conductors 54 and 55 to energize an electromagnet 56 which operates a switch 56'.

The switch 56' includes an armature 57, having connection by a conductor 58 with the conductor 21 previously described. The switch also includes spaced contacts 59 and 60 adapted to be alternately engaged by the armature. The armature is normally retained in circuit closing position with the contact 59 by a spring 61, and upon energization of the electromagnet 56, the armature is moved into engagement with the contact 60 to close circuit through the magnet 48 by way of a wire 62 that is connected with one of the leads of the electromagnet 48. The other lead of the electromagnet 56 is connected by a conductor 63 with the wires 24 and 25. Thus when the electromagnet 56 is energized the magnet 48 is also energized through the armature and switch contact 60, raising the segment 40 to allow closing of the contacts 34 and 35 and establish a second circuit through the magnet 17 of the valve 7, whereby the valve is retained in open position when the door is reclosed and as long as a flame is burning in the combustion chamber. In case the flame should become extinguished the current ceases to flow through the photoelectric cell thereby interrupting the plate circuit so that the magnet 56 is deenergized and the spring 61 is free to break circuit of the armature 57 with the contact 60.

The circuit to the magnet 48 is controlled by a relay switch 64 located in the conductor 62 and actuated by an electromagnet 65 having connection with the conductors 27 and 23 through wires 66 and 67 respectively.

The timing switch 31, including the actuating mechanism therefor and relay switch 64 are mounted within a suitable housing 68 on the panel 29, as shown in Fig. 1.

In order to visibly indicate when the fuel is cut off to the burner, the contact 59 is connected by a conductor 69 with a preferably red signal light 70 through which circuit is completed by a wire 71. A similar signal light 72 of different color may be connected with the conductor 24 by a wire 73 and with the conductor 62 by a wire 74, which light is energized when current is flowing through the magnet of the delayed action switch 31, thereby indicating that the burner is in operation. Another signal 75 of still different color may be connected to the conductors 23 and 37 by wires 76 and 77 respectively to indicate when the magnet actuated valve 7 is opened.

In using a control apparatus constructed and assembled as described, the operation thereof is as follows:

Assuming that the burner is to be lighted, the main switch 28 is closed. Immediately upon closing the circuit the red signal is lighted to indicate the circuit is closed and that the burner is not operating. The fire-door 9 is then opened to permit access to the burner. Incidental to opening of the door 9, the switch 26 automatically closes so that a current flows through the conductors 21, 22 and 23 to the magnet 17, conductor 27, switch 26, conductors 25, 24 and 20, to the line conductor 18, thereby energizing the magnet and effecting opening of the fuel valve 7 so that the burner may be lighted upon opening of the hand valve 6. At the time of opening of the valve 7, a current flows through the signal light 75 to show that the fuel valve is opened.

After the burner is lighted and the flame is in operation, the light of the flame causes a current to be generated by the photoelectric cell, which current flowing through wires 50—51 to the amplifying tube effects energization of the plate circuit thereof and causes the magnet to move the armature 57 into engagement with the contact 60. When the magnet 56 is energized the circuit to the signal 70 is broken and current is established through the relay switch 64. Simultaneously with energization of the magnet winding 17, the magnet 65 is also energized through the conductors 66 and 67 to close the switch 64. Current is now flowing through the conductors 21, armature 57, contacts 60, conductor 62, switch 64, magnet winding 48, conductor 24 and conductor 20 to the line 18, thereby energizing the magnet 48 to effect release of the lever 32 so that the spring 38 closes the contacts 34 and 35. When the fire-door is closed the switch 26 is, of course, opened, but circuit is maintained through the valve coil 17 incidental to closing of the contacts 34 and 35. As long as the magnet 48 is in circuit, the signal light 72 will be energized indicating that the burner is in operation. The signal 75 will also be energized indicating that the fuel valve is open.

Now, assuming that for some reason the flame of the burner should become extinguished, when this occurs current ceases to flow through the photoelectric cell controlled relay portion of the circuit with the result that current is broken through the coil 56. The spring 61 then comes into play to move the armature into engagement with the contact 59 energizing the signal 70 to indicate that the burner is out of operation. Upon breaking of the contact 60 current is again interrupted to the magnet 48, whereupon the armature is adapted to drop by gravity to again move the gear segment, under control of the escapement, into engagement with the lever 32 so that the contacts 34 and 35 are broken. Upon breaking of the contacts 34 and 35 current is interrupted to the magnet 17 of the fuel control valve 7 and the valve is caused to seat, shutting off the fuel supply. Simultaneously circuit is broken in the magnet winding 65 to effect opening of the switch 64.

Downward movement of the armature 47 is controlled by the escapement so that opening of the contacts 34 and 35 is delayed. This is an important feature for the reason that the flame may momentarily smoke or flicker so that the photoelectric cell would tend to break circuit to the fuel valve, but if the smoke or flickering clears up before the armature 47 has reached the bottom of its stroke, the contacts 34 and 35 remain closed and maintain the fuel valve open since the cell is still responsive to the light of the flame, and after the difficulty has cleared the current through the magnet 48 which has momentarily interrupted, is again effective to return the armature and segment to their original positions. However, if the fire continues to flicker, the segment 40 will have reached its lowermost position to engage the lever 32 which causes opening of the contacts 34 and 35. Opening of these contacts breaks circuit to the valve magnet 17, and the valve seats to stop flow of

fuel to the burner and thereby shut down operation of the furnace. It is then necessary for the operator to relight the burner as above described, and unless the burner is adjusted so that it will operate efficiently, the smoking and flickering condition will again cause closure of the fuel valve.

From the foregoing it is obvious that I have provided a simple and efficient control mechanism for automatically operating the fuel valve to establish fuel supply to a burner and which, as long as the flame is being propagated, will retain the fuel valve open and continue operation of the burner.

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

1. An apparatus of the character described including, a furnace having a fire-door, a burner, a fuel supply pipe connected with the burner, an electromagnetic valve in said fuel supply pipe, a circuit connected with the electromagnetic valve, a source of electric current, a switch having connection with said fire-door for closing said circuit when the fire-door is open, a photoelectric cell supported in the light zone of a flame from said burner, a normally opened switch in said electromagnetic valve circuit, an electromagnet for effecting closure of the normally open switch, and a relay circuit connected with said electromagnet and with the photoelectric cell for energizing the electromagnet to effect closure of said normally open switch when the photoelectric cell is activated by the flame from said burner to maintain the electromagnetic valve circuit in operation after opening of said door switch upon closure of the fire-door.

2. An apparatus of the character described including, a furnace having a fire-door, a burner, a source of fuel supply connected with the burner, an electromagnetic valve controlling said fuel supply to the burner, an electric circuit connected with the electromagnetic valve, a source of current supply for said circuit, a switch having connection with said fire-door for closing said circuit when the fire-door is open, a photoelectric cell supported in the light zone of a flame issuing from said burner, a normally open switch in said electromagnetic valve circuit, an electromagnet for effecting closure of the switch, a relay circuit connected with said electromagnet and with the photoelectric cell for energizing the electromagnet to effect closure of said switch when the photoelectric cell is activated by the flame from said burner to maintain the electromagnetic valve circuit in operation after opening of said door switch upon closure of the fire-door, and an electromagnetic switch in the photoelectric cell relay circuit and having connection with the electromagnetic valve circuit whereby the photoelectric relay circuit is closed upon energization of the electromagnetic valve.

3. An apparatus of the character described including, a furnace having a fire-door, a burner, a source of fuel supply connected with the burner, an electromagnetic valve controlling said fuel supply to the burner, an electric circuit connected with the electromagnetic valve, a switch having connection with said fire-door for closing said circuit when the fire-door is open, a photoelectric cell supported in the light zone of a flame issuing from said burner, a normally open switch in said electromagnetic valve circuit, an electromagnet for effecting closure of the switch, a relay circuit connected with said electromagnet and with the photoelectric cell for energizing the electromagnet to effect closure of said switch when the photoelectric cell is activated by the flame from said burner to maintain the electromagnetic valve circuit in operation after opening of said door switch upon closure of the fire-door, and timing means having operative connection with the electromagnet to effect delay in opening of the electromagnetic valve circuit upon interruption of said relay circuit.

4. An apparatus of the character described including, a furnace having a fire-door, a burner, a fuel supply line connected with the burner, an electromagnetic valve in said supply line, a circuit connected with the electromagnetic valve, a switch having connection with said fire-door for closing said circuit when the fire-door is open, a photoelectric cell supported in the light zone of a flame issuing from said burner, a normally open switch in said electromagnetic valve circuit, an electromagnet for effecting closure of the switch, a relay circuit connected with said electromagnet and with the photoelectric cell for energizing the electromagnet to effect closure of said switch when the photoelectric cell is activated by the flame from said burner to maintain the electromagnetic valve circuit in operation after opening of said door switch upon closure of the fire-door, an electromagnetic switch in the photoelectric cell relay circuit and having connection with the electromagnetic valve circuit whereby the photoelectric relay circuit is closed upon energization of the electromagnetic valve, and timing means having operative connection with the electromagnet to effect delay in opening of the electromagnetic valve circuit.

5. An apparatus of the character described including, a furnace having a fire-door, a burner, a fuel supply pipe connected with the burner, an electromagnetic valve in said fuel supply pipe, a circuit connected with the electromagnetic valve, a source of electric current, a switch having connection with said fire-door for closing said circuit when the fire-door is open, a photoelectric cell supported in the light zone of a flame from said burner, a normally open switch in said electromagnetic valve circuit, an electromagnet for effecting closure of the normally open switch, a relay circuit connected with said electromagnet and with the photoelectric cell for energizing the electromagnet to effect closure of said normally open switch when the photoelectric cell is activated by the flame from said burner to maintain the electromagnetic valve circuit in operation after opening of said door switch upon closure of the fire-door, and signals connected in said circuits for remotely indicating operating condition of the burner.

6. An apparatus of the character described including, a furnace having a fire-door, a burner, a fuel supply line connected with the burner, a control valve in said line, means having connection with the fire-door and with the control valve for effecting opening of the control valve upon opening the fire-door, means supported in the light zone of a flame issuing from said burner for maintaining said valve open responsive to the light of said flame, and means for delaying closure of said valve.

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