

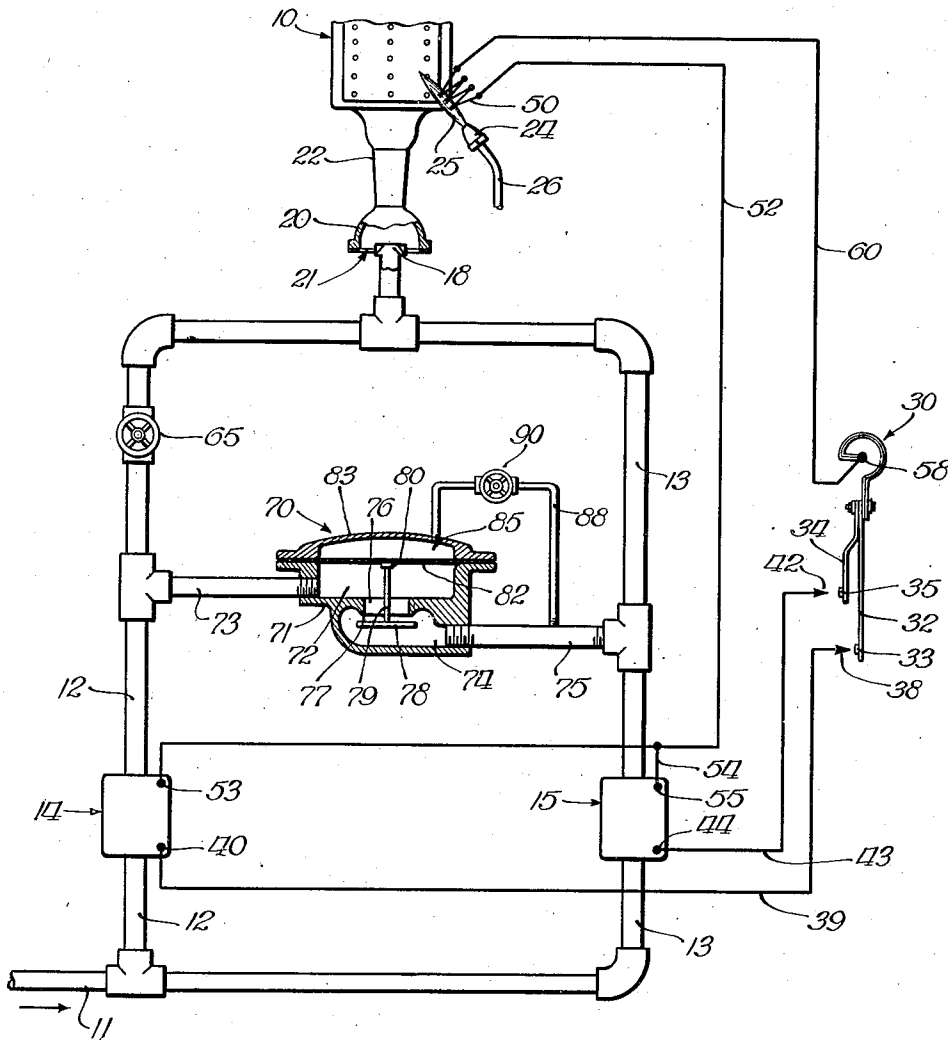
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H. F. ALFERY

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BURNER CONTROL APPARATUS

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INVENTOR.
Henry F. Alfery
BY
Brown, Jackson, Battelle & Quinn
Attys.

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BURNER CONTROL APPARATUS

Henry F. Alfery, Milwaukee, Wis., assignor to
Milwaukee Gas Specialty Company, Milwaukee,
Wis., a corporation of Wisconsin

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9 Claims. (Cl. 236—1)

This invention relates to burner control apparatus and the like.

While I shall make particular reference as this description proceeds to burner control apparatus for room or space heaters, it is to be understood that the invention is not limited to this particular use, but may be employed with any other burners as suitable and desired.

In considering, for example, the heating of a room, space, or building, it may be assumed that the rate of heat loss from the room, space or building is a function of temperature difference between the prevailing outside temperature at any time and the predetermined inside temperature which it is desired to maintain.

Obviously, in the case of a building, the rate of loss varies with the type of building, but after that factor is once determined, it may be assumed to be substantially a constant, and the above principle is varied only by such factors as sun, wind, and the like.

The function of the heating system is to supply heat in just sufficient quantity to make up for the loss so as to maintain the inside temperature at a predetermined value or within a selected range. Efficient use of the fuel is also desired.

If it is sought to accomplish the foregoing results merely by turning on and shutting down a burner adjusted, for example, for average requirements, the system will not follow as closely as desired the conditions as sensed by the thermostat. Overheating and inefficient use of the fuel will frequently occur when the outside temperature rises sufficiently to reduce the temperature difference below the average temperature difference for which the apparatus is set, whereas, underheating will frequently occur when the outside temperature drops sufficiently to increase the temperature difference for which the system is set.

One of the main objects of the present invention, is to provide a high, low fire control which is operative not only to shut off and turn on the burner, but also to regulate the fire to suit the conditions as sensed, for example, by the room thermostat.

Another object of the invention is to provide, in conjunction with the burner control apparatus of the character described, means which is operative to enrich the fuel mixture, and particularly the gas-air mixture for the burner upon ignition of the burner.

Another object of the invention is to provide burner control apparatus of the character de-

scribed which is of simple character and effective in operation.

While the particular features by which I provide a system of the character set forth are important features within the more specific aspects of the invention, it is to be understood that the precise features shown and described may be varied within the broader aspects of the invention.

In order to acquaint those skilled in the art with the manner of constructing and operating burner control apparatus in accordance with the present invention, I will now describe one preferred embodiment of the invention in connection with the accompanying drawing, in which the single figure is a diagrammatic view showing burner control apparatus embodying the invention.

The invention can be embodied in a wide variety of forms for use with a wide variety of systems, but for purposes of illustration the invention has been shown as embodied in a thermoelectric safety shutoff system which is operative for the purposes set forth and which will fail "safe."

Referring to the drawing, the burner 10 is the main burner for a room or space heater, or it may be the burner for a water heater or a floor furnace, an oven burner, or any other burner.

A gas or other fuel supply pipe 11 is adapted for delivering gas or other fuel to the burner 10 through one branch pipe line 12 of the system for low fire at the burner 10 and, as will presently appear, through another branch pipe line 13 of the system simultaneously with the delivery of fuel through the branch 12 for high fire at the burner 10.

The low fire branch pipe line 12 has a low fire valve 14 connected between contiguous sections thereof, and the high fire branch pipe line 13 has a high fire valve 15 connected between contiguous sections thereof. Each of the low and high fire valves 14 and 15 is of any desired type capable not only of being held open, but of being actually actuated to open position by the relatively minute thermoelectric current generated by the heat of a pilot flame on the "hot" junction or junctions of a thermocouple, thermopile, or other thermoelectric generator. The automatic thermoelectric valve more fully disclosed and claimed in the copending application of Lourdes V. McCarty, Serial No. 390,247, filed April 25, 1941, is illustrative of one suitable automatic valve adapted to be employed as the low and high fire valves 14 and 15 of the present invention. The automatic thermoelectric valve of the diaphragm

type more fully disclosed and claimed in the Patent No. 2,291,567, issued July 28, 1942, to Guido Wunsch and Josef Schuppert, is illustrative of another suitable automatic valve adapted to be employed as the low and high fire valves 14 and 15 of the present apparatus.

It is to be understood that any other suitable known forms of valves may be employed as the low and high fire valves 14 and 15 of the present invention.

The low fire branch pipe line 12 leads to the burner 10 for the delivery of the gas or other fuel thereto—for example, through an outlet or delivery orifice 18 into a mixing chamber 20 in which the fuel is mixed with air which enters the mixing chamber 20 through one or more ports usually provided at the outer end 21 of the mixing chamber 20, as well understood in the art. The combustible mixture of gas and air passes out from the mixing chamber 20 through a conduit 22 to the burner 10 where it is delivered through the ports of the burner and ignited by a pilot burner 24.

The high fire branch pipe line 13 also leads to the burner 10 for the delivery of gas or other fuel thereto through the outlet or delivery orifice 18 into the mixing chamber 20 in which this fuel, with the fuel supplied through the branch pipe line 12, is mixed with air which enters the mixing chamber through the port or ports previously referred to, the mixture passing out from the mixing chamber 20 through the conduit 22 to the burner.

The pilot burner 24, which is located in juxtaposition to the main burner 10 to maintain a pilot flame 25 for igniting the main burner, is supplied with gaseous fuel by a pilot supply pipe 26 shown fragmentarily and more or less diagrammatically. The pilot burner 24 may be a continuously burning pilot burner, or the system may be arranged to shut off the supply of fuel to the pilot burner upon extinguishment of the pilot light, within the scope of the present invention.

In the case of a room, space, or building heater, the thermostat indicated in its entirety at 30 may be in the form of a room thermostat mounted in appropriate position within the room or other space heated by the main burner, or it may be subject to the temperature of any other medium, the temperature of which it is desired to control.

The thermostat 30 is shown as comprising a bimetallic spiral having a resilient arm 32 carrying a contact 33, and a second arm 34 carrying a contact 35. Instead of being in the form shown, the room thermostat 30 may consist of two separate thermostats with individual adjustments.

The contact 33 on the resilient arm 32 cooperates with a relatively fixed contact 38 which is connected by a conductor 39 to one terminal 40 for the coil of the electromagnet (not shown) within the body of the low fire valve 14. The contact 35 on the second arm 34 of the thermostat 30 cooperates with a relatively fixed contact 42 which is connected by a conductor 43 with one terminal 44 for the coil of the electromagnet (not shown) within the body of the high fire valve 15.

For purposes of illustration, the thermoelectric generator which is energized by the heat of the pilot flame 25 for supplying thermoelectric current for energizing the electromagnet of the low fire and high fire valves 14 and 15, is shown more or less diagrammatically as a thermopile 50 comprising a plurality of thermocouples connected in series. This, of course, may vary within the scope of the present invention, a thermocouple or any

other form of thermoelectric generator which will generate the required thermoelectric current being contemplated within the scope of the appended claims.

One terminal of the thermoelectric generator 50 is connected by a conductor 52 to the other terminal 53 for the coil of the electromagnet for the low fire valve 14. The conductor 52 is connected by a conductor 54 to the other terminal 55 for the coil of the electromagnet for the high flame valve 15. The inner end of the bimetallic spiral of the thermostat 30 is supported by a member 58, and a conductor 60 connected between this member 58 and the other terminal of the thermoelectric generator 50 connects the contacts 33 and 35 in circuit with the thermoelectric generator through the arms 32 and 34, respectively, and the bimetallic spiral.

The operation of the device, as thus far described, is as follows:

As the room or space, for example, cools, the thermostat first closes its contact 33 into contact with the contact 38. This closes the thermoelectric circuit for the electromagnet of the low fire valve 14, and, assuming that the pilot burner 24 is ignited and that the flame thereof is heating the hot junction or junctions of the thermoelectric generator 50, the resulting energization of the electromagnet for the low fire valve 14 actuates this valve to open position and maintains the same in open position as long as the contacts 33, 38 are closed and the pilot flame is ignited. Fuel then flows through the branch pipe line 12 to the mixing chamber 20 where it is mixed with air for supporting combustion, and the combustible mixture passes to the burner 10 where it is ignited by the pilot burner 24 to provide the low fire main burner flame.

The branch pipe line 12 is preferably provided with a low fire adjusting valve 55 for adjusting the low fire fuel supply to provide, for example, the desired relation between the pressure of the fuel and the orifice 18 to maintain a satisfactory low fire flame.

If the room continues to cool, or if the cooling is greater than that which will be taken care of by the low fire valve, the further cooling of the thermostat 30 closes the contact 35 into contact with the contact 42. The resilient character of the arm 32 permits this action while maintaining the contact between contacts 33 and 38. The closing of the contacts 35, 42 closes the thermoelectric circuit for the electromagnet of the high fire valve 15, and assuming that the pilot burner is ignited and heating the hot junction or junctions of the thermoelectric generator 50, the resulting energization of the electromagnet for the high fire valve 15 actuates this valve to open position and maintains the same in open position as long as the contacts 35, 42 are closed and the pilot burner is ignited. Fuel then flows through the branch pipe line 13 to the mixing chamber 20 where it is mixed with the fuel supplied by the branch pipe line 12 and with the air for supporting combustion, and this combustible mixture passes to the burner 10 to provide the high fire burner flame at said burner.

Heating of the room to the temperature at which the contacts 35, 42 open, causes these contacts to separate, thereby opening the thermoelectric circuit for the high fire control valve 15 and causing this valve to close. Further heating of the room, or a sufficient rise in temperature to cause separation of the contact 33 from the contact 38, opens the thermoelectric circuit for

the low fire control valve 14, whereupon this valve closes to shut off the fuel supply to the main burner through the branch pipe line 12.

In order to overcome any possibility of ignition failure when the low fire control valve 14 opens first, I provide, in conjunction with the apparatus of the present invention, means for supplying excess gas to enrich the gas-air mixture upon starting or ignition with the low fire valve 14 opening first.

This excess gas supply or enriching means for operation where the low fire valve opens first comprises a diaphragm valve indicated in its entirety at 70. This valve 70 has a valve body 71 having its inlet chamber 72 connected by a pipe 73 to the branch pipe line 12 ahead of the low fire adjustment valve 65, and an outlet chamber 74 connected by a pipe 75 to the branch pipe line 13.

Communication between the inlet and outlet chambers 72 and 74 is effected through a passage 76 having at one end a valve seat 77 for a valve disc member 78. The valve disc member 78 is carried by a stem 79 connected at 80 to a flexible diaphragm 82. The periphery of the diaphragm 82 is clamped between the valve body part 71 and a hood or cover 83 which may be secured in place to the valve body part 71 by screws or other suitable means. A diaphragm chamber 85 is provided between the hood or cover 83 and the diaphragm 82.

For the purpose of bleeding the head pressure gradually from the chamber 85 as the pressure of the gas ahead of the diaphragm acts on the diaphragm, a bleed tube connection 88 is provided between the chamber 85 and the low pressure pipe 75. A bleed tube adjustment may be provided at 90 for adjusting the action of the valve disc member 78 into closed position engaging the valve seat 77.

As the low fire valve 14 opens—assuming that the high fire control valve 15 remains closed—gas flows through the low fire adjustment to the burner as previously described. Gas is by-passed at this time from the branch pipe line 12 through the diaphragm valve to the burner orifice 18 to provide a full or enriched gas supply on starting or ignition. As the pressure ahead of the diaphragm 82 acts on the diaphragm, the gas in the head chamber 85 of the valve is bled off through the bleed tube 88 to the low pressure side of the valve, and the valve disc member 78 gradually closes into engagement with the valve seat 77 to shut off the by-pass supply of fuel so that the proportioning of the fuel and air will thereafter be such as to give satisfactory results during continuous low fire operation of the burner.

It will be understood that the low fire control valve 14 is preferably of sufficient size to provide excess gas on the initial opening of the valve 14, as described. It will also be understood that the gas or fuel supply line 11 supplies sufficient gas to provide an increased amount of fuel to the burner when the high fire control valve 15 is opened.

The embodiment of the invention shown in the drawing is for illustrative purposes only, and it is to be expressly understood that said drawing and the accompanying specification are not to be construed as a definition of the limits or scope of the invention, reference being had to the appended claims for that purpose.

I claim:

1. A burner control apparatus comprising, in combination, a main burner, a pilot burner in juxtaposition to said main burner, a fuel supply

pipe for supplying fuel to maintain a relatively low fire at the main burner, an electroresponsive low fire control valve in said pipe, a fuel supply pipe for supplying fuel to maintain a relatively high fire at the main burner, an electroresponsive high fire control valve in said last mentioned pipe, a condition responsive circuit having contact means for the low fire control valve and contact means for the high fire control valve, thermostat means in said condition responsive circuit and having a pair of contacts one cooperable with the contact means for the low fire control valve and the other cooperable with the contact means for the high fire control valve, a thermoelectric generator responsive to the heat of the pilot burner and connected into said condition responsive circuit, a low fire adjustment means in said low fire fuel supply pipe, and a fuel supply pipe connected between said low fire fuel supply pipe and said high fire fuel supply pipe ahead of said low fire adjustment means and beyond said high fire valve for supplying excess fuel to enrich the fuel-air mixture for the burner upon starting the burner with the low fire supply of fuel supplied by said low fire control valve.

2. A burner control apparatus comprising, in combination, a main burner, a pilot burner in juxtaposition to said main burner, a fuel supply pipe for supplying fuel to maintain a relatively low fire at the main burner, an electroresponsive low fire control valve in said pipe, a fuel supply pipe for supplying fuel to maintain a relatively high fire at the main burner, an electroresponsive high fire control valve in said last mentioned pipe, a condition responsive circuit having contact means for the low fire control valve and contact means for the high fire control valve, thermostat means in said condition responsive circuit and having a pair of contacts one cooperable with the contact means for the low fire control valve and the other cooperable with the contact means for the high fire control valve, a thermoelectric generator responsive to the heat of the pilot burner and connected into said condition responsive circuit, a low fire adjustment means in said low fire fuel supply pipe, a fuel supply pipe connected between said low fire fuel supply pipe and said high fire fuel supply pipe ahead of said low fire adjustment means and beyond said high fire valve for supplying excess fuel to enrich the fuel-air mixture for the burner upon starting the burner with the low fire supply of fuel supplied by said low fire control valve, and a valve in said last mentioned pipe having a valve member which is open when said burner is started with the low fire fuel supply and operative to closed position by the pressure of the fuel in said low fire fuel supply pipe.

3. A burner control apparatus comprising, in combination, a main burner, a pilot burner in juxtaposition to said main burner, a fuel supply pipe for supplying fuel to maintain a relatively low fire at the main burner, an electroresponsive low fire control valve in said pipe, a fuel supply pipe for supplying fuel to maintain a relatively high fire at the main burner, an electroresponsive high fire control valve in said last mentioned pipe, a condition responsive circuit having contact means for the low fire control valve and contact means for the high fire control valve, thermostat means in said condition responsive circuit and having a pair of contacts one cooperable with the contact means for the low fire control valve and the other cooperable with the contact means for the high fire control valve, a thermoelectric

generator responsive to the heat of the pilot burner and connected into said condition responsive circuit, a low fire adjustment means in said low fire fuel supply pipe, a fuel supply pipe connected between said low fire fuel supply pipe and said high fire fuel supply pipe ahead of said low fire adjustment means and beyond said high fire valve for supplying excess fuel to enrich the fuel-air mixture for the burner upon starting the burner with the low fire supply of fuel supplied by said low fire control valve, a valve in said last mentioned pipe having a valve member which is open when said burner is started with the low fire fuel supply and operative to closed position by the pressure of the fuel in said low fire fuel supply pipe, said last mentioned valve having a head pressure chamber, and means for bleeding the head pressure from said chamber to the low pressure side of the system.

4. A burner control apparatus comprising in combination, a main burner, a pilot burner in juxtaposition to said main burner, a fuel supply pipe for supplying fuel to maintain a relatively low fire at the main burner, an electroresponsive low fire control valve in said pipe, a fuel supply pipe for supplying fuel to maintain a relatively high fire at the main burner, an electroresponsive high fire control valve in said last mentioned pipe, a condition responsive circuit having contact means for the low fire control valve and contact means for the high fire control valve, thermostat means in said condition responsive circuit and having a pair of contacts one co-operable with the contact means for the low fire control valve and the other co-operable with the contact means for the high fire control valve, a thermoelectric generator responsive to the heat of the pilot burner and connected into said condition responsive circuit, a low fire adjustment means in said low fire fuel supply pipe, a fuel supply pipe connected between said low fire fuel supply pipe and said high fire fuel supply pipe ahead of said low fire adjustment means and beyond said high fire valve for supplying excess fuel to enrich the fuel-air mixture for the burner upon starting the burner with the low fire supply of fuel supplied by said low fire control valve, a valve in said last mentioned pipe having a valve member which is open when said burner is started with the low fire fuel supply and operative to closed position by the pressure of the fuel in said low fire fuel supply pipe, said last mentioned valve having a head pressure chamber, means for bleeding the head pressure from said chamber to the low pressure side of the system, and means for adjusting said bleeding action to control the closing of said last mentioned valve.

5. A burner control apparatus comprising, in combination, a burner, a fuel pipe for supplying fuel to said burner, adjustment means in said pipe capable of restricting the flow of fuel to said burner to an amount less than full flow

through said pipe, an "on" and "off" valve in said pipe ahead of said adjustment means, and means operative only upon starting the burner for supplying excess fuel to the burner from said pipe ahead of said adjustment means and beyond said "on" and "off" valve.

6. A burner control apparatus comprising, in combination, a burner, a fuel pipe for supplying fuel to said burner, adjustment means in said pipe capable of restricting the flow of fuel to said burner to an amount less than full flow through said pipe, an "on" and "off" valve in said pipe ahead of said adjustment means, means operative only upon starting the burner for supplying excess fuel to the burner from said pipe ahead of said adjustment means and beyond said "on" and "off" valve, and means independent of said last means for supplying fuel to the burner in conjunction with the supply through said adjustment means to provide a high fire at the burner.

7. A burner control apparatus comprising, in combination, a burner, a fuel pipe for supplying fuel to said burner, adjustment means in said pipe capable of restricting the flow of fuel to said burner to an amount less than full flow through said pipe, an "on" and "off" valve in said pipe ahead of said adjustment means, and means operative only upon starting the burner for supplying excess fuel to the burner from said pipe ahead of said adjustment means and beyond said "on" and "off" valve, said last means being normally open and operable to closed position by the pressure of the fuel in said fuel supply pipe.

8. A burner control apparatus comprising, in combination, a burner, low fire and high fire pipes for supplying fuel to said burner, a control valve in each of said pipes, condition responsive means controlling said valves, and means actuated by the pressure in said low fire pipe for supplying excess fuel therefrom to said burner independently of said high fire control valve upon starting of said burner and shutting off the supply of excess fuel to said burner after starting thereof.

9. A burner control apparatus comprising, in combination, a burner, low fire and high fire pipes for supplying fuel to said burner, an "on" and "off" control valve in each of said pipes, temperature responsive means effective to open said low fire valve and said high fire valve successively upon successive drops in temperature and to close said high fire valve and said low fire valve successively upon successive increases in temperature, and means connected to said pipes beyond said valves actuated by the pressure in said low fire pipe for supplying excess fuel from the latter to said burner independently of said high fire control valve upon starting of said burner and shutting off the supply of excess fuel to said burner after starting thereof.

HENRY F. ALFERY.