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HEATER CONTROL

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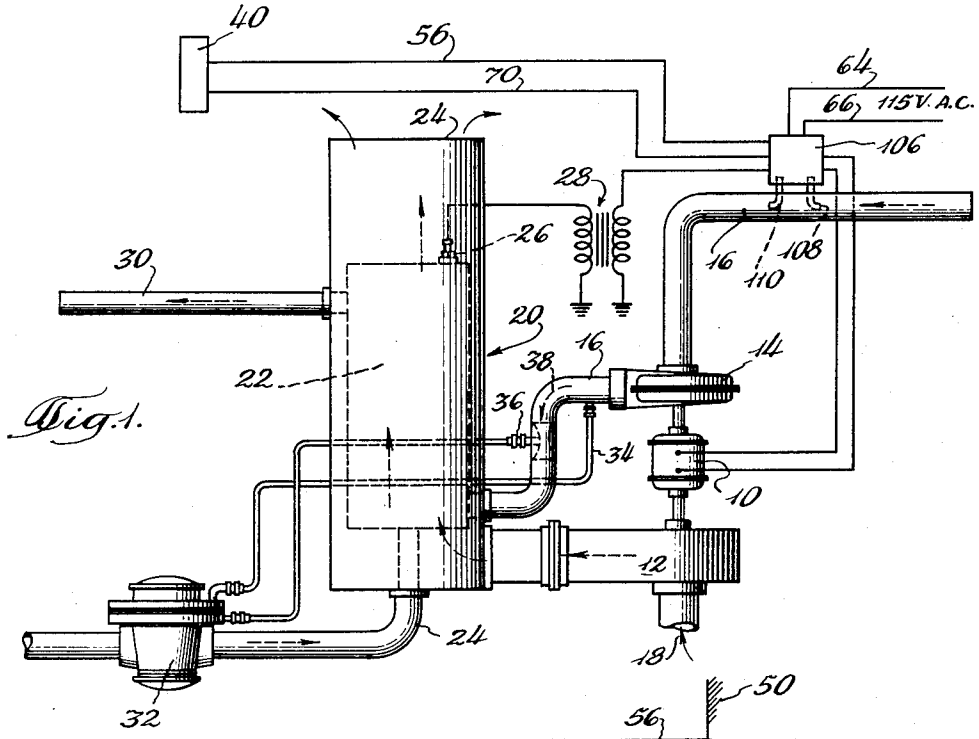


Fig. 1.

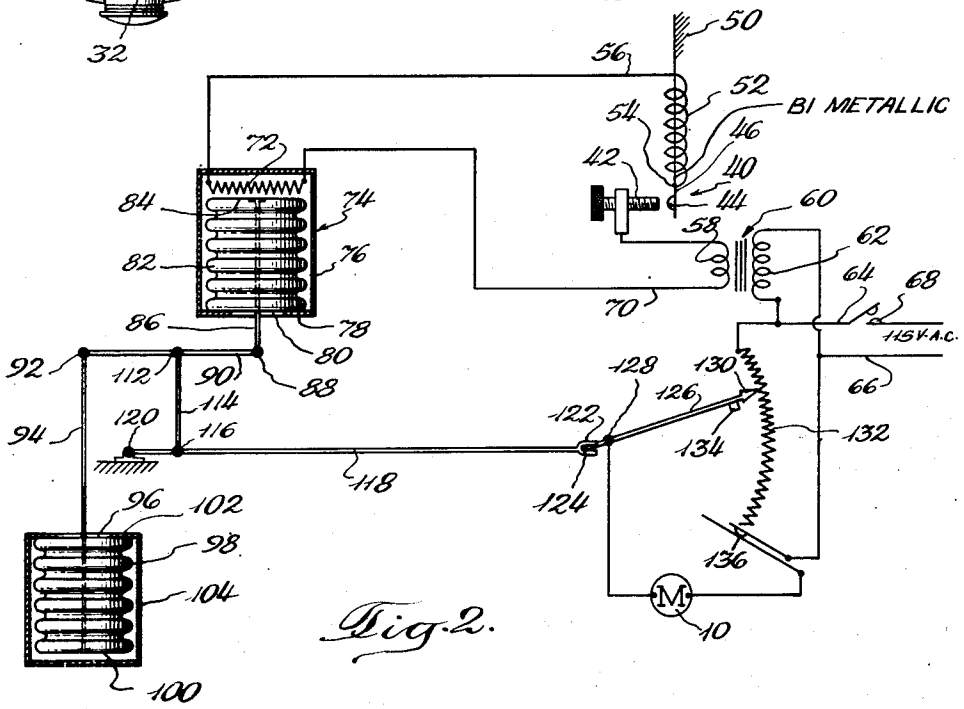


Fig. 2.

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HEATER CONTROL

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2 Claims. (Cl. 236—68)

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The present invention relates to heater controls and is, more particularly, directed to a control system adapted for use with a heater of the general type disclosed in the copending applications of Theodore Y. Korsgren, Serial No. 626,837, filed November 5, 1945, for "Gas heaters," now Patent No. 2,482,552, issued September 20, 1949, and Frank A. Ryder, Serial No. 622,429, filed October 15, 1945, for "Heaters," now Patent No. 2,502,345, issued March 28, 1950. It will be appreciated, however, that although the control system of the present invention is particularly adapted for use with heaters of this type, it is not limited to such use but is of more general application.

It is an object of the present invention to provide a control system for a heater which will modulate the output of the heater according to demand conditions.

An additional object of the present invention is to provide a novel heater control circuit and mechanism which operates the heater at a low rate of heat output unless greater heat output is necessary to satisfy the prevailing conditions.

Yet another object of the present invention is to provide an improved heater control arrangement which prevents the heater from cycling on and off excepting under extremely mild weather conditions.

Still another object of the present invention is to accomplish all of the above with a mechanism of low cost and which is safe and reliable in operation.

Other objects and advantages will become apparent from the following description of a preferred embodiment of our invention which is illustrated in the accompanying drawings.

In the drawings, in which similar characters of reference are used to indicate similar parts in both the figures:

Fig. 1 is a diagrammatic representation of a heater of the type disclosed in the previously referred to copending applications while;

Fig. 2 is a diagrammatic representation of the control system for use therewith which illustrates the present invention, including both mechanical and electrical components.

As explained in the previously referred to copending applications, the heating system with which the control arrangement of the present invention is particularly adapted for use is comprised of a variable speed electric motor 10 which drives a ventilating air blower 12 and a combustion air blower 14. The combustion air blower receives its air through a duct 16 which leads preferably to the outside of the building to be

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heated. The ventilating air blower 12 receives its air through an opening 18 which may be in the space to be heated. Air from these two sources, that is, the ventilating air blower 12 and the combustion air blower 14, is passed into the heater proper 20 where the ventilating air circulates over a heat exchanger 22 and leaves the heater at an appropriate opening 24 so as to pass into the space to be heated. Within the heater, the combustion air is mixed with gaseous fuel delivered through a pipe 24 and this mixture is ignited by a spark plug 26 which receives its energy from an ignition transformer 28. Products of combustion, after passing through the heat exchanger 22, are exhausted to the atmosphere remote from the space to be heated through the exhaust pipe 30.

By means of a modulating control valve 32, the pressure on the fuel passing through the pipe 24 to the heater varies depending upon the rate of combustion air flow from the blower 14. This is accomplished by means of a static pressure tap 34 connected to the combustion air conduit and a low pressure tap 36 connected to the throat of a venturi 38 located in the same conduit. It is apparent that these connections are such that the greater the rate of flow of combustion air, the greater the pressure differential existing between the taps 34 and 36. This pressure difference is communicated to the valve 32 and as is explained in the previously referred to copending application of Frank A. Ryder, this pressure acts to vary the pressure upon the fuel supplied to the heater, such that the mixture ratio in the heater is kept comparatively constant regardless of the rate of flow of combustion air. Thus, the heat output of the heater depends upon the voltage across the variable speed motor 10. The higher this voltage, the higher the speed of rotation of the motor and blowers, and thus the greater the heat output. The converse is, of course, also true.

The control system illustrated and intended primarily for, but not limited to, use with this type heater includes an electric impulse sending unit 40 comprised of a stationary contact 42 and a movable contact 44 mounted at the free end of a bimetallic blade 46, the opposite end of which is fixed as at 50 so as to be immovable with respect to the fixed contact 42. The bimetal blade is equipped with an electric heating element 52, one end of which is grounded as at 54 to the strip 46 while the other end is connected to a wire 56 which forms a portion of an electric circuit to be described presently.

Thermostatic impulse senders of this type act

in the following manner whenever electric energy is impressed across the unit, that is, when connections are made to the contact 42 and the wire 56. The flow of electric energy through the heater 52 causes the temperature thereof and the blade 46 to rise, thereby bending the blade away from the contact 42 so as to separate the contacts 44 and 42. As soon as this happens, the circuit through the heating element 52 is interrupted, thereby permitting the heater and the bimetal strip to cool until the circuit is re-established when the contacts 42 and 44 are brought together. An impulse sender of this type, if not compensated, is influenced by the temperature of the surrounding atmosphere, since the time required to heat the element 52 and blade 46 sufficiently to interrupt the circuit increases as the temperature of the surrounding air decreases. Similarly, a decrease in the temperature of the surrounding air will cause the strip 46 and heater 52 to cool faster and therefore will reclose the circuit sooner. It is apparent, therefore, that the cooler the surrounding atmosphere, the greater the amount of electric power flowing through the circuit during any certain time interval.

The impulse sending unit just described is located within the space to be heated and is therefore sensitive to the temperature of the air therein.

The sending unit just described has one terminal thereof, for instance, the contact 42, connected to one side of the secondary 58 of a control transformer 60, the primary 62 of which is connected across the heater main line represented by the wires 64 and 66, one side of this line being controlled by a master heater switch 68. The other end of the secondary is connected by means of a wire 70 to one end of a heating element 72 which forms a portion of a heat motor 74, the other end of the heater 72 being connected to the wire 56.

The heat motor 74 comprises a can or other container 76 having an in-turned flange 78 at its open end secured in liquid-tight relationship to the open end 80 of a corrugated metal bellows 82. The heating element 72 is located within the container 76 and is spaced from the bellows 82. The can 76 is filled with a suitable liquid, such as acetone, for instance, which surrounds the bellows 82 and which has the property of expanding when heated so as to urge the closed end 84 of the bellows downwardly. Since the lower the temperature prevailing in the space to be heated, the greater the total electric energy flowing through the circuit including the heating element 72, and therefore the greater the heating effect of this element upon the liquid filling of the container 76, and the more the bellows 82 will be collapsed.

The closed end 74 of the bellows 82 is connected to a link 86 which extends out of the open end 80 and is connected by means of a suitable pivot 88 to one end of a floating lever 90. The opposite end of this lever is similarly pivoted, as at 92, to a link 94 which extends into the open mouth 96 of a second bellows 98, this link being secured to the latter bellows at the closed end 100 thereof. The links 94 and 86 are generally parallel and extend in opposite directions from the lever 90. As in the previous case, the bellows 98 is secured at its open end to an in-turned annular flange 102 of a cylindrical container 104 which closely embraces the bellows and is filled with a suitable liquid, such as acetone, for instance. The container 104 is not provided with an electric heating element as is the receiving unit 74, but is located within a box 106 having two air circulating tubes connected thereto, one of which, indicated by the numeral 108, has its open end facing upstream within the duct 16, while the other tube 110 has its open end similarly located within the conduit 16, but facing downstream. Whenever cold air from outside the building flows through the combustion air duct 16, the dynamic effect at the openings 108 and 110 will cause a portion of the cold air to be diverted into the box 106 where it flows around the container 104 so as to cause this container, the bellows 98, and the liquid filling between these elements to assume the temperature of the outside air.

At a mid point, the floating link 90 is connected by means of a pivot 112 to a link 114, the opposite end of which is connected by a pivot pin 116 to a control arm 118 near one end thereof. The end of the arm 118 adjacent the pivot point 116 is pivoted, as at 120, to a stationary portion of the structure so that the opposite end of the arm swings upwardly and downwardly in the same direction as the link 114 is moved, but to a greater extent.

The control arm 118 operates a variable resistor by means of a yoke 122 at the end thereof which embraces a pin 124 secured to the overhanging end of a resistor slider arm 126. The arm 126 is pivoted at 128 and is connected at its free end to a slider 130 which is in contact with a resistance element 132, the upper end of which is connected to one side 64 of the power supply line. As the slider 130 reaches the high resistance end of the resistor 132, that is, the lower end, a projection 134 secured to the slider operates to open a switch 136, this switch being connected in series with the slider arm 126 and the electric motor 18, the other side of the motor being connected to the power supply line 66.

The device operates in the following manner. Assuming for the purpose of description that the pivot point 92 is stationary, then any decrease in temperature within the space to be heated will cause the impulse sending unit 40 to send a greater quantity of electric energy during any particular time interval through the resistance element 72. This raises the temperature of the liquid filling within the container 76 and forces the upper end 84 of the bellows downwardly. This downward movement is communicated by means of the link 86 to the end of the lever 90, thereby causing this lever to pivot about the point 92. The link 114 is therefore urged downwardly and since the pivot point 120 is fixed, the yoke 122 of the control arm 118 is forced downwardly. This causes the slider arm 126 to be rotated about the pivot point 128 so as to move the slider 130 upwardly, thereby decreasing the resistance in the circuit of the motor 18. The voltage across the motor is therefore greater and the motor runs at a higher speed, thereby increasing the heat output of the heating unit.

Now, if it is assumed that the pivot point 88 is fixed, it will be apparent that a decrease in the temperature of the outside air flowing through the duct 116 to the combustion side of the heater will cause colder air to flow inwardly at the opening 108 and outwardly at the opening 110, thereby lowering the temperature within the box 106 which in turn lowers the temperature of the case 104 and the liquid filling therein. The liquid therefore contracts and urges the lower end 100 of the bellows 98 downwardly. This causes the link 94 and the pivot point 92 to be moved down-

wardly and since it has been assumed that the point 88 is fixed, it will be seen that the link 114 will be moved downwardly, thereby causing the yoke 122 also to move downwardly. This in turn rotates the slider arm 126 so as to move the slider 130 upwardly, thus increasing the heat output.

Of course, the pivot points 88 and 92 are not fixed, each moving independently of the other depending upon the particular temperature conditions each is intended to measure. It is apparent, therefore, that the point 112 as well as the subsequent points in the linkage mechanism, including the slider 130, is a differential and depends upon the temperature prevailing in the room to be heated as well as the outside temperature. Thus, the system described modulates the heat output of the heater to maintain a constant temperature level within the room according to the setting of the contact 42 which may be manually moved to the desired position. In addition, any sudden change in the outside temperature is anticipated by the system so as to increase or decrease the heat output even before any temperature change has taken place in the room. If it is desired that the temperature within the room have more influence upon the heat output than the outside air temperature, this can be accomplished simply by moving the pivot point 112 closer to the pivot point 88. Also, it will be appreciated that, if desired, the variable resistor may be replaced by a variable reactance of the inductive type or by a variable transformer without departing from the scope of the present invention.

Having described our invention, what we claim as new and useful and desire to secure by Letters Patent of the United States is:

1. In combination with a space heater including means for supplying combustion air, means responsive to the flow rate of the combustion air for admitting fuel to said heater at a substantially constant ratio with the rate of admission of the combustion air such that a single motor will suffice to control the heat output of said heater and maintain a combustible mixture, and a variable speed motor for driving said combustion air supply means, a heater motor speed modulating device comprising an electric impulse sending device responsive to the temperature of the space to be heated, thermostatic means responsive to the temperature of the ambient air, a thermostatic heat motor, electric heating means for said heat motor, said sending device being electrically coupled to and energizing said heating means, differential linkage mechanism coupling said thermostatic means and said heat motor, and heater motor speed control means connected for operation by said linkage mechanism.

2. In combination with a compartment heater having an air intake exterior of the compartment, a heater motor speed modulating device comprising an electric impulse sending device responsive to the temperature of the space to be heated, thermostatic means responsive to and situated in the flow of combustion air, a thermostatic heat motor, electric heating means for said heat motor, said sending device being electrically coupled to and energizing said heating means, differential linkage mechanism coupling said thermostatic means and said heat motor, and heater motor speed control means connected for operation by said linkage mechanism whereby the heat demand of the electric impulse sending device is modulated by said thermostatic means.

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FRANK A. RYDER.

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