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DAMPER OPERATED SWITCHES FOR AUTOMATIC HEAT CONTROL OF GAS FIRED UNIT VENTILATOR

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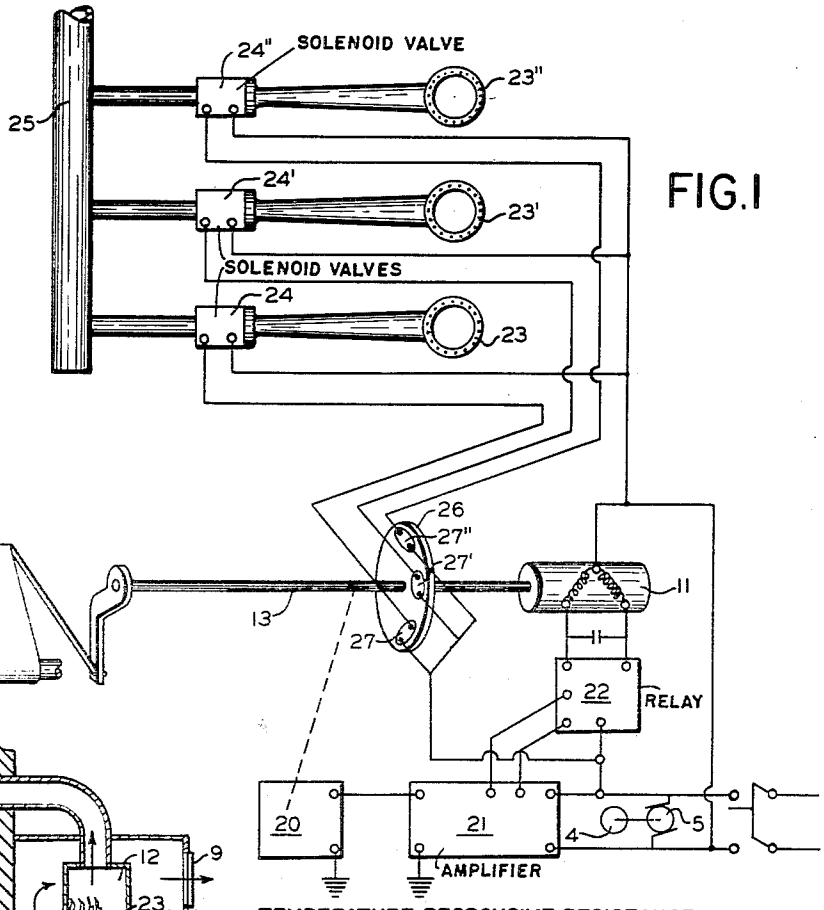


FIG.1

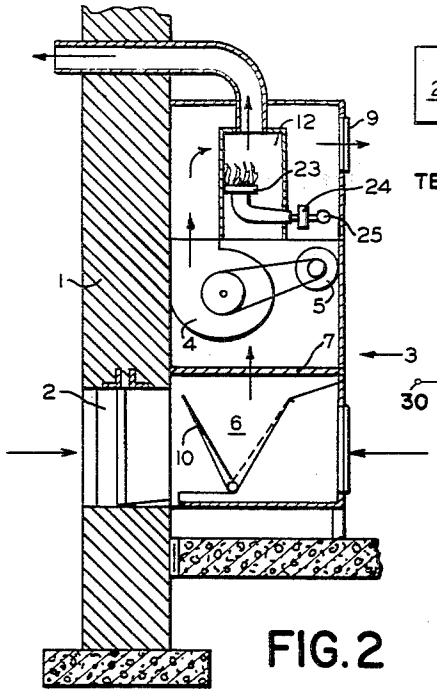


FIG.2

TEMPERATURE RESPONSIVE RESISTANCE

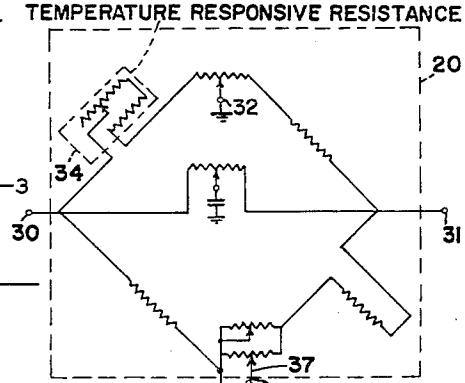


FIG.3

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DAMPER OPERATED SWITCHES FOR AUTOMATIC HEAT CONTROL OF GAS FIRED UNIT VENTILATOR

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Application September 12, 1956, Serial No. 609,412

2 Claims. (Cl. 236—1)

Gas fired ventilators conventionally comprise: a cabinet having one air inlet for outside air, another air inlet for room air and an outlet for discharging air from either or both inlets into the room; a blower within the cabinet between said inlets and said outlet; a gas burning heater with the cabinet between the air inlets and said outlet; a damper for progressively opening and closing the outside air inlet between minimum and maximum positions; a reversible motor operable in one direction to open the damper and in the opposite direction to close it; and control means normally set for a predetermined room temperature condition and normally operative in response to a room temperature condition which rises above or falls below said predetermined temperature condition, to operate the motor progressively in the damper opening or closing direction as required.

With the room temperature at a desired value and with the damper wide open, the gas flow to the heating element should be at a minimum or entirely cut off. However, as the room temperature drops and the damper progressively closes, the gas flow should be progressively increased. Various controls have been proposed to accomplish this control of the gas flow.

The principal object of the present invention is to provide a simple and inexpensive control for the heat output of the gas heater, one that will increase the gas flow in progressive steps as the damper progressively closes and decrease it in progressive steps as the damper progressively opens.

In accordance with my invention, the principal object may be achieved simply and inexpensively, by providing the gas fired heater with a plurality of burners, each connected to the gas source through a separately electrically actuated valve energized by a respective switch, and by connecting the plurality of switches to the damper operating means in such a manner as to cause such means to open and close the switches in steps to decrease or increase the heat output of the heater progressively as the damper operating means opens or closes the damper.

The present invention is illustrated in the accompanying drawings wherein:

Fig. 1 is a diagrammatic view showing the electrical and mechanical relation between the operating elements forming the invention;

Fig. 2 is a vertical section taken through the unit ventilator and an adjacent building wall; and

Figure 3 is a schematic circuit diagram of the circuit elements forming the Wheatstone bridge.

The structure illustrated in the drawing conventionally comprises: an outside building wall **1**, having an air inlet opening **2**; and a room ventilating unit **3** having a blower **4** operated by a motor **5** for drawing air from its air inlet chamber **6** through an air filter **7** and a blower intake so as to discharge that air into the room through air outlet **9**. The inlet chamber **6** of the ventilating unit **3** contains a damper **10** mounted for movement by a damper operating motor **11** from one extreme damper closed position to another extreme damper open position,

i.e., the dotted line position illustrated within Fig. 2. A gas fired heater **12** is mounted in the cabinet **3** between the blower **4** and the outlet **9**. With the damper **10** closed, the blower **4** operates to recirculate room air successively through the inlet chamber **6**, the air filter **7** and the heater **12**, and to discharge that air through outlet **9** into the room. With the damper fully open, the blower **4** operates to draw only outside air through the outside inlet opening **2**. When the damper **10** is in an intermediate position, the blower **4** will draw both room air and outside air in quantities depending upon the position the damper occupies relatively to the outside air inlet and the recirculating room air inlet.

The damper **10** is connected by a suitable linkage to a shaft **13** of the reversible damper operating motor **11** which is energized by a suitable control system.

The control system preferably is of the character described and illustrated in the copending application of Forrest G. Baker, Serial No. 426,770, now U.S. Pat. No. 2,843,324. This system (Fig. 1) may be energized from a suitable electrical energy source and includes a Wheatstone bridge **20** having temperature responsive resistances and a variable resistance controlled by the movement of the damper operating motor **11**. The bridge **20**, when energized, operates, in response to varying room temperature conditions, to feed varying currents to an amplifier **21** controlling the flow of current through a relay **22**. When the control system is in a balanced condition, the bridge **20** causes the amplifier to feed an intermediate current to the relay **22** which balances the mechanical pull of a spring against the magnetic pull of a coil, energized by the intermediate current, to maintain the damper motor **11** de-energized. As the room temperature drops, the current to relay **22** decreases whereby the mechanical pull of the spring overcomes the magnetic pull of the coil to energize the damper closing circuit of motor **11** causing it to move the damper **10** in the damper closing direction until the control system is again in balance. Conversely, when the temperature rises, the current to the relay **22** increases and the damper opening circuit of motor **11** is energized causing it to move the damper **10** in the damper opening direction until the system is in balance.

The heater **12** includes a plurality of burners **23**, **23'**, **23''**, connected by corresponding conduits containing respective electrically operated solenoid valves **24**, **24'**, **24''** to a header **25**, which in turn is connected to a suitable source of gas supply. The solenoid valves **24**, **24'**, **24''** are closed when de-energized and opened when energized.

A disc **26** is keyed to the shaft **13** of the damper operating motor **11** and carries a plurality of mercury switches **27**, **27'**, **27''**, each mounted concentrically in a separate spaced sector of the disc **26** so that as the shaft **13** rotates, each switch will be closed or opened in succession as it moves through a predetermined angle with respect to horizontal. Normally, this predetermined angle will be the same for all the switches. For example, assuming that shaft **13** moves 180° between the extreme damper open and damper closed positions, the switches would be arranged about disc **26** so that all of them would be open in extreme damper open position and closed in extreme damper closed position.

One terminal of each of the switches **27**, **27'**, **27''** is commonly wired to one side of a suitable source of electrical energy and the opposite terminal of each is wired to a terminal of one of the corresponding valves **23**, **23'**, **23''**. The opposite terminals of the valves are commonly wired to the opposite side of the source of electrical energy. Figure 3 illustrates the essentials of the circuit elements included in a suitable Wheatstone bridge represented by the box **20** of Figure 1. As indicated earlier, Baker U.S. Patent 2,843,324 discloses the illustrated

structure and explains the operation thereof. In general, the Wheatstone bridge **20** is provided with a pair of power receiving terminals **30** and **31** and a pair of energy delivering terminals **32** and **33**. The power receiving terminals **30** and **31** are connected to a suitable power supply. The energy delivering terminals **32** and **33** are suitably connected to the amplifier **21** as illustrated in Figure 1. One leg of the illustrated bridge contains a temperature responsive resistance such as a room thermostat **34**. As indicated, the rotative displacement of the damper shaft **13** is transmitted through a suitable linkage schematically shown and designated by the reference numeral **36** into concomitant displacement of a potentiometer arm **37** which serves to re-balance the bridge and bring the system again into balance.

Operation

Assuming the damper **10** to be in extreme damper open position, all the valves **24**, **24'**, **24''** will be closed. The room temperature falls and the control system energizes the motor **11** to start moving the damper **10** progressively in the damper closing direction. The movement of the motor **11** will continue until either the control system is balanced by the room temperature which de-energizes the motor or the damper is completely closed and all of the switches **27**, **27'**, **27''** are closed energizing all of the valves **24**, **24'**, **24''** causing them to open and admit gas to the burners **23**, **23'**, **23''**. At this time, the heater **12** will be operating at its maximum heat output and the blower **4** will be drawing all of its air through the recirculating room air inlet.

During the movement of the motor **11** in damper closing direction, the switch **27** will be closed after the shaft **13** has moved a predetermined amount, then switch **27'** will be closed after the shaft **13** has passed through a larger predetermined amount of movement and finally the switch **27''** will be closed after the shaft **13** has moved a still larger predetermined amount. In other words, the switches **27**, **27'**, **27''** will be closed in successive steps in that order during the movement of the shaft **13** in damper closing direction.

Next, assuming that the damper **10** is in extreme damper closed position and the room temperature is rising, the damper operating motor **11** will be energized to move the damper **10** in damper opening direction. As this movement continues, assuming the rise in temperature condition continues to exist, the switches **27''**, **27'**, **27** will be opened in successive steps in that order to progressively reduce the heat output of the heater **12**.

The movement of the damper **10** in either opening or closing directions and the corresponding opening or closing of the switches **27**, **27'**, **27''** will continue until either the damper is in one of its extreme positions or the room temperature balances the control system causing relay **22** to de-energize the motor **11**.

An example of how this system could be adjusted to perform is given in the table below:

Room Temperatures	Valve Positions			Damper Position
	24	24'	24''	
72°	Open	Closed	Closed	66% open.
73°	Closed	do	do	100% open.
72°	Open	do	do	66% open.
71°	do	Open	do	33% open.
70°	do	do	Open	0% open.
71°	do	do	Closed	33% open.
72°	do	Closed	do	66% open.

Although an embodiment of the invention employing mercury switches appears to be preferable, applicant contemplates another embodiment in which the mercury switches are replaced by a series of push button switches operated by a cam driven by the motor **11**.

Furthermore, the switches can be used to individually control two or more valves and burners. In addition, instead of providing a single solenoid valve for each burner, a plural stage valve could be used to feed gas to all of the burners. Such a valve would be opened or closed in progressive steps with each switch controlling one step.

Having described my invention, I claim:

1. In a unit room ventilator having an outside air inlet, a recirculating air inlet, a gas fired heater for heating air introduced through said air inlets, a pivotally mounted damper displaceable between one limiting position closing said outside air inlet and fully opening said recirculating air inlet and a second limiting position fully opening said outside air inlet and closing said recirculating air inlet, a rotatable shaft for displacing said damper and means responsive to a departure of room temperature from a predetermined desired value thereof for selectively displacing said rotatable shaft and pivotally mounted damper intermediate said first and second limiting positions in accordance wtih the direction of said departure from said desired temperature value to reduce the same, the improvement comprising a plurality of burners in said heater, an electrically operable valve for each of said burners to control the admission of gas thereto, a switch for controlling the energization of each of said electrically operable valves and means selectively responsive to the positional disposition of said damper displacing shaft for operating each of said switches in successive predetermined steps in accordance with the position of said damper relative to said outlet air inlet to maintain a predetermined inverse relationship between the amounts of air introduced through said outside air inlet and the number of burners in ignited condition whereby each of said valves is successively opened to admit gas to its respective burner in response to progressive displacement of said damper closing said outside air inlet and each of said valves is successively closed to decrease the heat output of said heater during reverse displacement of said damper.

2. The improvement as specified in claim 1 wherein said switches are mercury switches arranged in circular array around a rotatably displaceable damper operating shaft and are rotatably displaceable in conjunction therewith.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,935,261 May 3, 1960

Herbert G. Smith

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 20, for "with" read -- within --; line 35, for "gas flow" read -- gas flows --; column 4, line 36, for "outlet" read -- outside --.

Signed and sealed this 10th day of January 1961.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents