Jan. 25, 1949. E. O. WIRTH ET AL 2,460,207

HEATING SYSTEM

Filed May 15, 1944 2 Sheets-Sheet 1

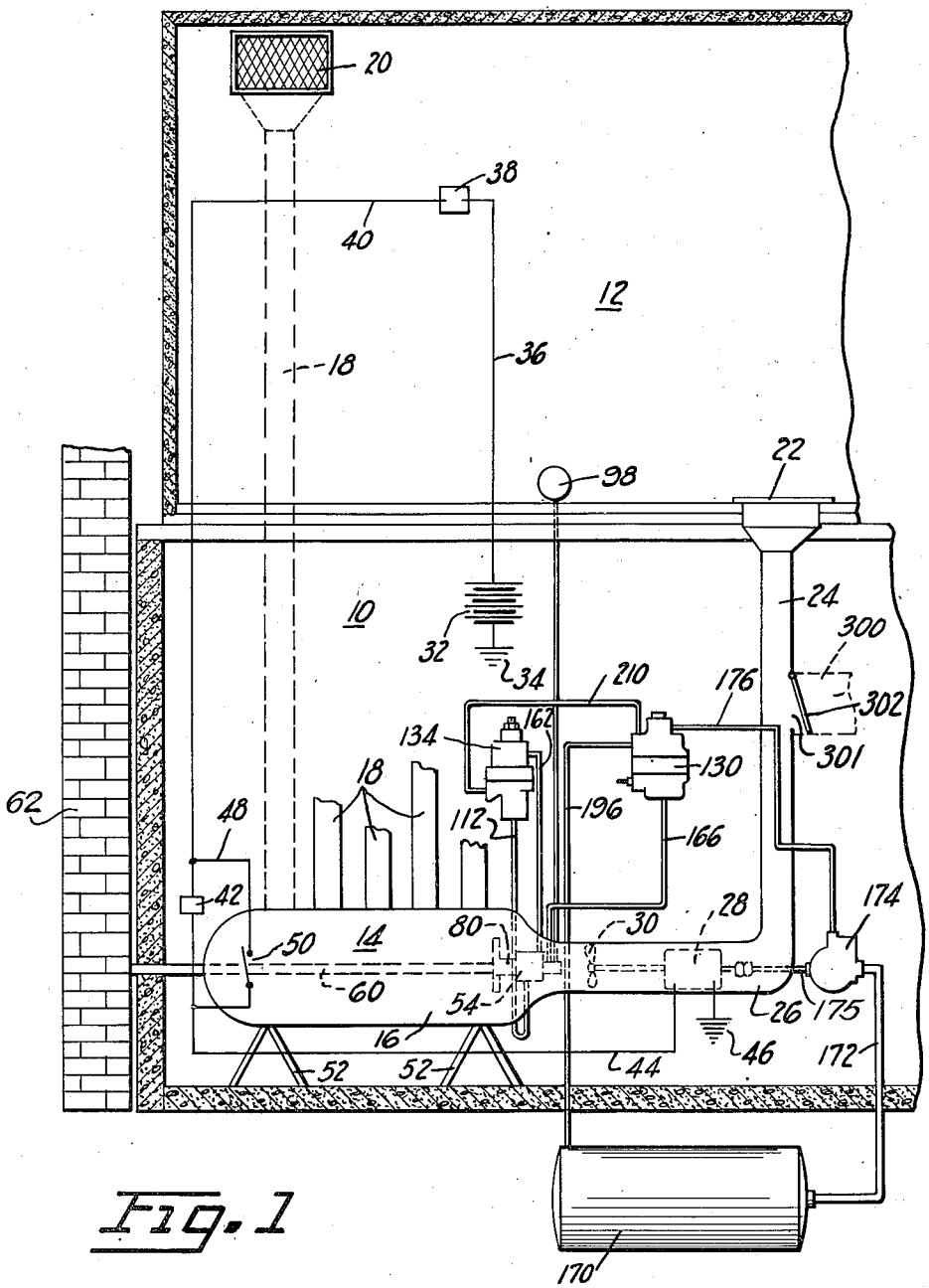


Fig. 1

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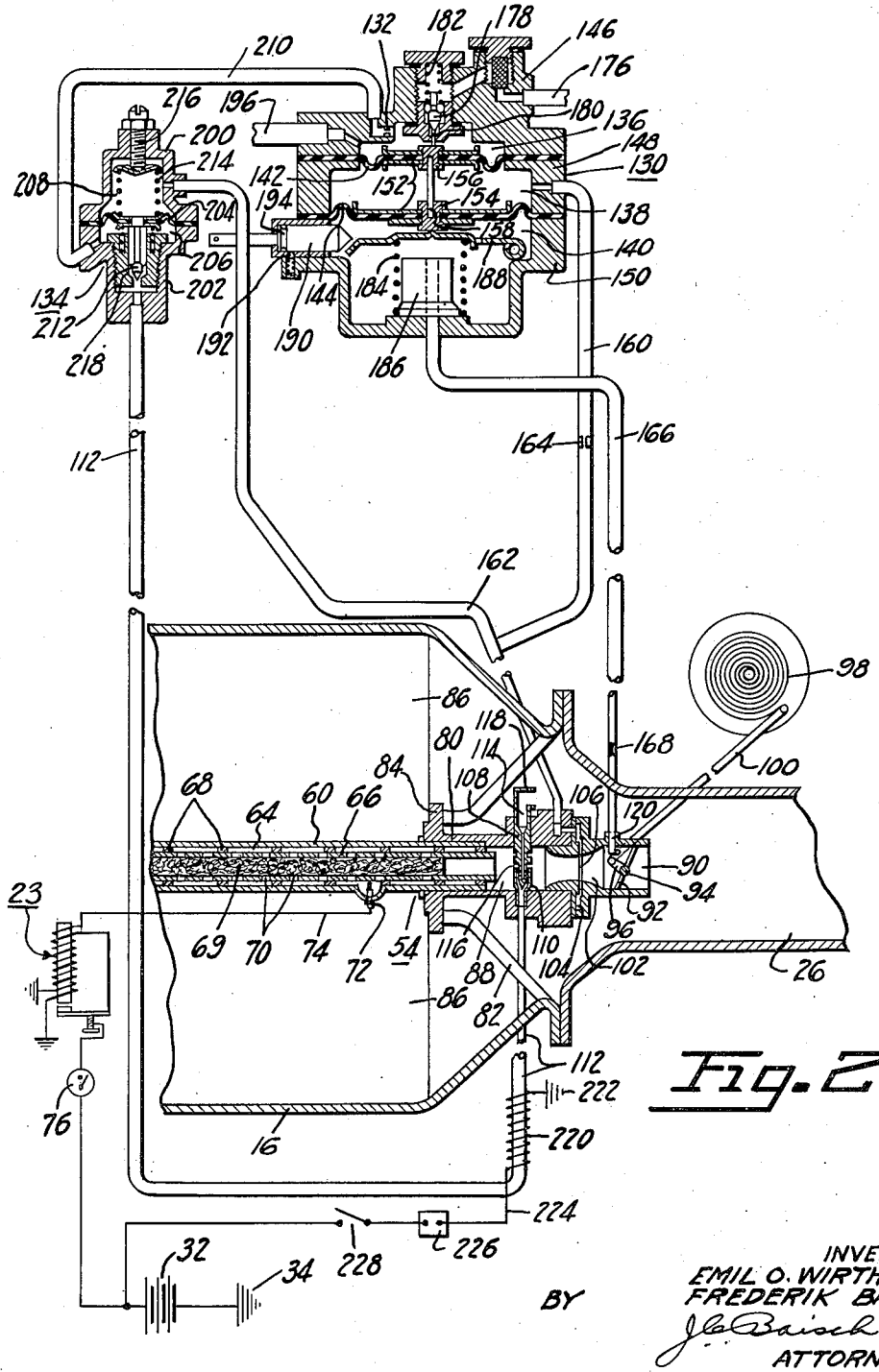


Fig. 2

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Patented Jan. 25, 1949 2,460,207

UNITED STATES PATENT OFFICE

2,460,207

HEATING SYSTEM

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Application May 15, 1944, Serial No. 535,591

4 Claims. (Cl. 236—9)

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This invention relates to heating systems and particularly to automatic heating systems using liquid fuel.

It is an object of the present invention to provide an efficient and effective heating system adapted to maintain room temperatures substantially uniform.

It is another object of the invention to provide a device of this character wherein gasoline or another liquid fuel may be used and supplied under pressure and metered while being maintained under pressure.

Further objects of the invention are: to provide a device of this character wherein the danger of fire is reduced to a minimum; to provide a device of this character wherein a mixture of fuel and air is delivered to the burner of the heater and is capable of being readily ignited and burned; to provide a device of this character adapted to maintain the fuel and air differential pressures in a substantially constant proportion so that a substantially constant fuel to air ratio is obtained; to provide a device of this character that may be arranged in a compact unit; to provide a device of this character wherein the fuel may be at least partially warmed before being mixed with air in the proportioning device, an arrangement particularly valuable in starting the heater when cold; to provide a device of this character for controlling the fuel warming means; to provide a device of this character wherein the throttle may be controlled by thermostatic means; and to provide means for controlling the motor of the system which circulates air therethrough, said means including a room thermostat and a thermostat adjacent the heater together with means for by-passing one of the thermostats.

Still further objects of the invention are to provide a device of this character which may be built at reasonable cost and which is relatively simple in construction, operation and maintenance.

Other objects and advantages of the invention will be readily apparent to those skilled in the art from the following description taken in connection with the accompanying drawings which represent a preferred embodiment of the invention. After considering this embodiment skilled persons will understand that many changes may be made without departing from the principles disclosed; and the use of any structures, arrangements, or modes of operation that are properly within the scope of the appended claims is contemplated.

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In the drawings:

Figure 1 is a diagrammatic or schematic view of a building embodying the present invention; and

Figure 2 is an enlarged diagrammatic view of the heater and fuel supply control means.

Throughout the drawings similar reference characters represent similar parts although where such parts are modified in structure and operation, they are given a further differing reference character.

Referring first to Figure 1, there is shown a building having a lower room 10, which may be in the basement, and an upper room 12. The heating device is indicated generally at 14 and comprises a casing 16 having hot air discharge ducts 18, there being shown a plurality of such ducts which may lead to various rooms to convey heated air thereto. One of the ducts 18 is shown extending upwardly to a hot air register 20 adapted to discharge heated air into the room 12. Cold air is adapted to be taken from the room 12 through a register 22 in the floor thereof and conducted by a duct 24 to a horizontal duct 26 which is connected with the casing 16. An electric motor 28 is provided for operating a fan 30 in the duct 26 to effect circulation of air through the casing and ducts. The electrical system for the motor comprises a source of power which, as shown, is a battery 32, although any other suitable source of electric power may be used. The battery is grounded at 34 and a wire 36, leads to a thermostat 38 from which a wire 40 leads to a thermostat 42. From the latter thermostat a wire 44 leads to the motor which is grounded at 46. With this arrangement the thermostats are in series. A by-pass 48 is provided about the thermostat 42 and is controlled by a switch 50. The casing 16 is mounted on supports 52 and is provided with a heating unit indicated generally at 54 which is disposed within the casing.

Referring to Figure 2 the heater unit includes a tube 60 axially disposed in the casing 16 and which discharges into a chimney 62, Figure 1. The tube 60 defines a combustion chamber 64 within which is axially arranged a heating tube or burner 66 spaced from the inner wall of the tube 60 by lugs 68 which are spaced longitudinally and circumferentially relative to the tube 60 and are adapted to permit flow of air through said tube. The tube 66 is preferably loosely packed with fine metal shavings 69 of suitable character, such, for example, as steel wool, and is provided with a plurality of discharge orifices

70. The ignition mechanism may be of any well known type and as shown includes a grounded spark plug 72 and a coil and interrupter, shown generally at numeral 73, connected by a wire 74 with any suitable source of electric power such as the battery 32, a switch 76 being interposed in the wire 74 for controlling the electric current to the spark plug 72.

The carbureting device

The carbureting device comprises a body 80 which is supported within the casing 16 by means of arms 82, said body 80 being provided with a flange 84 adjacent the inner end, as viewed in the drawings, which support radial vanes 86 which extend longitudinally within the casing 16 for radiating heat from the burner and heating the air passing through the casing. The body 80 includes an induction passage 88 having an air inlet 90 receiving air from the duct 26, and an air outlet in which the adjacent end of the tube 60 is received tightly enough to prevent leakage between said tube and the body 80. If desired, a suitable gasket or the like may be provided between said tube 60 and body 80. The air inlet 90 is controlled by a throttle valve 92 mounted on a throttle shaft 94 having a lever 96 fixed thereto which may be manually actuated or adjusted, or if desired, may be connected with a temperature-responsive device or thermostat 98 by means of a rod 100. The thermostat 98 may, if desired, be positioned adjacent the heater, or it may be located in the room to be heated such as room 12. If located in room 12 the thermostat may be positioned in any convenient part of the room, although as shown in the drawing, it is located adjacent the floor of said room 12. It is also preferable that the opening through the duct 26 through which the rod 100 passes be snug enough to prevent appreciable leakage of air through said opening. A Venturi 102 is positioned in the induction passage posterior to the throttle valve 92, this arrangement being found to improve the mixing of fuel and air. The Venturi comprises separable inlet and outlet sections and is formed on an annular chamber 104 which communicates with the interior of the Venturi through an annular slot 106 so as to be subjected to Venturi depression.

A fuel nozzle is provided in the induction passage posterior to the Venturi and may be of any suitable type such, for example, any of the nozzles shown in the Barfod and Wirth Patent 2,445,846, granted July 27, 1948. The type shown in here is that illustrated in Figures 1 and 2 of said application and inasmuch as said nozzle is fully described therein it will be described but briefly herein as including a member 108 mounted in the wall of the body 80 and which extends transversely of the induction passage 88 and is provided with a reduced diameter end portion which projects into an enlarged portion of a member 110 receiving fuel from a fuel conduit 112. Air from the casing 16 is bled into the fuel nozzle through a bore 114 in member 108 and mixes with the fuel in said nozzle to form an emulsion which is discharged into the induction passage from annular groove 116. If desired, the free end of member 108 may be turned at 118 in a direction to receive the impact of air flowing through the casing. An alternative arrangement is to connect the bore 114 with an impact tube 120 which also serves another purpose to be described hereinafter, said impact tube 120 being disposed in the induction passage between the throttle valve and Venturi.

Fuel flow control

The flow of fuel to the heater is regulated or controlled by an unmetered fuel pressure control or regulator unit indicated generally at 130, which registers or determines the fuel pressure on the upstream side of a fuel metering orifice 132, and a discharge control unit, indicated generally at 134, which registers or determines the pressure of fuel on the downstream side of said metering orifice 132. The units 130 and 134 are of a character similar to those disclosed in the above noted Barfod and Wirth application with such modifications thereof as are necessary to adapt same for use in connection with the present heating system.

As shown, the regulator unit 130 is positioned outside the casing 16 and may be located either adjacent to the heater or, preferably, at a point remote enough therefrom to prevent overheating, thereby minimizing the danger of fire from this cause. The unit 130 is divided into three chambers 136, 138 and 140 by preformed flexible diaphragms 142 and 144 which are marginally clamped between respective housing members 146, 148 and 150. As shown, the diaphragms 142 and 144 have an area ratio of one-half although any other desired ratio may be used as fully explained in said Barfod and Wirth application and as will be briefly pointed out hereinafter. The center portions of the diaphragms are supported by plates 152 having the edges turned outwardly relative to the diaphragms to prevent cutting of same and between which said diaphragms are clamped by centrally disposed cylindrically recessed rivets 154 and 156. The ends of a pin or rod 158 are received in the recess of the rivets and said ends are preferably rounded to provide angularly adjustable one-way connections between the diaphragms whereby slight misalignments may be accommodated without binding.

The chamber 138 of the regulator unit 130 is connected to the Venturi annulus 104 by means of a conduit or passage 160 and a conduit 162 and is therefore subjected to a pressure primarily derived from the throat of the Venturi 102. A restriction 164 may be provided in the passage 160 if desired, which alternately may be located in passage 162 between the junction of passages 160 and 162 and the Venturi annulus. Chamber 140 is connected to the Venturi entrance by conduit 166 which may be provided with a restriction 168. If desired, the end of the conduit 166 may be connected with the impact tube 120 opening toward the air stream and adapted to receive the impact of air flowing through the induction passage from the duct 26 so that said chamber 140 is subjected to a pressure primarily derived from the source of air or the duct 26 by way of the impact tube 120.

Fuel is supplied to the chamber 136 from a source of fuel which is shown herein as a tank 170, Figure 1, which may be underground and/or remote from the heating unit, said fuel being taken from the tank by a pipe 172 connected with a pump 174, driven through a shaft 175 from the motor 28, and which is adapted to deliver fuel to the pressure regulator 130, by means of the pipe 176, at a substantially constant pressure. The pipe 176 is connected with a fuel inlet port in the regulator unit 130 which is controlled by a valve 178 and which has a pin-like projection 180 into the chamber 136 in a position to be engaged by the head of rivet 156 whereby upward movement of the diaphragms, as viewed in the drawings, opens the valve 178, a light spring 182

being provided to urge the valve 178 toward its closed position. A spring 184 is mounted in chamber 140 on a boss 186 and its free end is received in a spring retainer portion of a pivoted lever 188 having a crimped central portion normally engaging the head of rivet 154 and urging the diaphragm upwardly in a direction to open the valve 178. If desired, the fuel supply to the piston may be cut off by closing valve 178 and, as shown, this may be effected by a plunger 190 which upon inward movement thereof engages the free end of lever 188 and moves the lever downwardly against the force of spring 184. The lever is thus moved out of engagement with rivet 154 whereby the light spring 182 may close the valve 178 and thereby stop the flow of fuel to the carburetor. A spring urged ball 192 may be provided for engagement with an annular groove 194 in the plunger 190 for releasably retaining said plunger in its inward position and if desired the plunger may be remotely controlled by any suitable mechanism. A pipe 196 having restricted communication with the top of the fuel chamber 136 may be provided for leading back to the fuel supply tank 170, vapors which may accumulate in the chamber 136.

The discharge control unit 134 which regulates the metered fuel pressure, comprises a pair of casing members 200 and 202 between which is clamped a preformed annularly grooved flexible diaphragm 204 dividing the interior of the unit to chambers 206 and 208, chamber 206 being connected with chamber 136 of the regulator unit 130 by means of a conduit 210 in which the metering orifice or jet 132 is located, and chamber 208 is connected with the Venturi annulus 104 by the passage 162. The diaphragm 204 is connected to a fuel outlet valve 212 urged downwardly, in a direction to close said valve, by a spring 214 arranged to be variably loaded by an adjustment screw 216, the stem of valve 212 being preferably of triangular cross-section or otherwise relieved to permit fuel flow therepast and is slidably disposed within a guide 218. The outlet of the discharge control unit is connected with the fuel pipe 112 leading to the fuel nozzle in the induction passage, and if desired, the pipe may include a portion adjacent the heater unit about which is disposed an electrical heating coil 220, one end of which may be grounded at 222 and the other end connected to a source of power or battery 32 by a wire 224. If desired, a thermostatic switch 226 may be interposed in the wire 224 and also a manually operated switch 228 may be interposed in said wire.

Operation of heating unit

Assuming the carburetor has not been filled with fuel and the plunger 190 is in its outer position as shown, the spring 184 will urge the diaphragms upwardly and open valve 178. Fuel under the pressure of pump 174, is delivered through pipe 176, and enters and fills chamber 136 from which it flows through the metering orifice 132 and pipe 210 to the chamber 206 of the discharge control unit 134, thence to the fuel nozzle in the induction passage by way of conduit 112. As the pressure in chamber 136 increases it acts against diaphragm 142 and tends to compress spring 184 whereby the valve 178 tends to close while fuel under pressure supplied to chamber 206 acts on diaphragm 204 and tends to open valve 212. The screw 216 is normally adjusted to compress spring 214 to such a point that a slightly lower pressure is required in chamber 206 to open valve 212 than is required in chamber 136 for sufficiently compressing spring 184 to permit valve 178 to close. Once the carburetor has been filled with fuel, fuel will thereafter slowly spill from the nozzle unless plunger 190 is moved inwardly to compress spring 184 and allow valve 178 to close. Although the screw 216 has been described as being adjusted to permit valve 212 to open at a pressure somewhat less than the closing pressure of valve 178, it will be apparent that by screwing the adjustment screw 216 in or out, the pressure in chamber 206 required to open valve 212 may, if desired, be made greater than, equal to or less than the pressure required in chamber 136 to permit valve 178 to close. It will also be apparent that the actual value or degree of the fuel pressures will be determined by the strength of springs 184 and 214, the pressures required being greater as the strength of the spring is increased, and conversely the pressures required will be less as the strength of the springs is decreased.

During operation, the air flow through the Venturi 102 creates a differential between the impact pressure in the impact tube 120 and the pressure in the Venturi chamber 104 which varies as a function of the rate of air flow through the induction passage varies. The pressures in the Venturi chamber 104 and in the impact tube 120 are respectively transmitted to the chambers 138 and 208, and chamber 140, and control the opening of the valves 178 and 212 so as to regulate the flow of fuel to maintain a differential between unmetered and metered fuel pressure which is in fixed proportion to Venturi to impact differential air pressure. The diaphragms 142 and 144 are shown as of unequal size, and assuming that the area ratio thereof is equal to 2, the regulator unit 130 functions to maintain a differential fuel pressure across the metering jet 132 which is equal to twice the differential air pressure. For example, a given decrease in the pressure at the Venturi chamber 104 is transmitted to chamber 138, where it results in an equal increment increase in the unmetered fuel pressure in chamber 136, and is also transmitted to chamber 208, where it results in an equal increment decrease in the metered fuel pressure. Consequently, the fuel metering differential pressure is increased an amount double the increase in the air differential. Similarly, a given increase in the pressure of the air entering the Venturi is transmitted from the impact tube 120 to chamber 140 and since it is applied to the diaphragm 144 having twice the area of diaphragm 132, the unmetered fuel pressure in chamber 136 is increased an increment double the increase in entering air pressure.

Although the diaphragms 142 and 144 are shown as having a 2–1 area relationship, they may be of any other desired area ratio in which case the fuel metering differential pressure will be maintained at some multiple, other than 2, of the air pressure differential. For example, if the area of diaphragm 144 is three times the area of diaphragms 142, the fuel differential will be maintained equal to three times the air metering differential. In any case, however, the fuel and air differential pressures are maintained in constant proportions and therefore constant fuel to air proportioning is obtained.

From the foregoing it will be apparent that the control of unmetered and metered fuel on the upstream and downstream sides respectively of the metering orifice 132 are separately con-

trolled, the valve 178 controlling only the pressure of the unmetered fuel and the valve 212 controlling the pressure only of the metered fuel.

The fuel discharged from the annular groove 116 of the fuel nozzle is mixed with the air from the air inlet 90 of the induction passage and the mixture thus formed enters the burner tube 66, passing through said tube. When the tube is cold as during the starting period the fuel mixture is discharged from the orifices 70 into a combustion chamber 64 and tube 60. Ignition of the fuel mixture is effected by the spark plug 72 and after the device has been in operation a short time the burner tube 66 together with the metal shavings of steel wool 69 becomes heated sufficiently so as to more completely vaporize the fuel mixture therein, said vaporized fuel mixture being discharged into the combustion chamber 64. It is to be noted that the end of tube 66 adjacent the fuel nozzle is disposed close to said nozzle and in line with the discharge groove 116 of said nozzle so that the fuel mixture will enter the burner tube 66 for vaporization of said mixture by the heated steel wool and burner tube.

The thermostat 98 is adapted to control the throttle valve 92 in such a manner that as the temperature of the thermostat drops the throttle valve is opened thereby supplying the burner with a larger volume of fuel mixture to increase the heat thereof and increase the temperature of the air passing through the heater.

Operation of complete installation

In the preferred embodiment of the installation, such as shown in Figure 1, the electric circuit for the motor 28 includes the thermostat 38 disposed in the room 12 and the thermostat 42 preferably disposed in the basement room 10 adjacent the heating unit. The thermostat 38 is so constructed and arranged that the switch thereof is opened upon an increase in temperature. The thermostat 38 is adapted to control the motor circuit for maintaining the temperature normally desired in a room, whereas the thermostat 42 is normally adjusted to control the circuit at much lower temperatures and to open upon a decrease in temperature. Thus the thermostat 38 primarily controls the room temperature and the thermostat 42 is provided to cut out the motor only in case the burner fails to function and the temperature adjacent thereto drops a substantial degree. As hereinabove pointed out, the thermostat 98 may be located in the room 12, if desired and thus control the opening and closing of the throttle valve in accordance with room temperature. It is to be understood, of course, that any of the thermostats may be otherwise located than as shown in the drawings, the locations depending upon the installation and type of control desired.

When the system is being used the switch 50 of the bypass 48 is opened. However, should it be desired to render the thermostat 42 inoperative to control the motor circuit, the switch 50 is closed and the motor circuit is then controlled entirely by the thermostat 38. This arrangement may be desirable under some circumstances when the system is functioning to heat the building, although the arrangement may also be useful should the air circulating system be connected with an air conditioning unit which is not shown but which may be of any commercial type, for circulating cooled air throughout the building when the weather is hot. The bypass arrangement 46, 50 may also be useful in starting the heating apparatus when the temperature is sufficiently low to effect opening of the switch of thermostat 42. The switch 50 is then closed so that the system is controlled by thermostat 38 the switch of which is closed at such low temperatures. Thus the electrical control circuit is operable until the temperature in the room reaches the desired value. After the temperature of the heating unit becomes sufficiently warm for the switch of thermostat 42 to close, the switch 50 may be opened. Therefore the thermostat 42 provides a safety factor for shutting off the apparatus in case the burner fails to function and the temperature adjacent thereto drops a substantial amount.

An air conditioning system may, if desired, be connected to the air circulating system of the present invention by means of a conduit 300 delivering conditioned air to conduit 24 through an opening 301, said opening being normally closed by a valve-like door 302, when the air conditioning unit is not connected with said air circulating system.

Although but one modification of the invention has been particularly shown and described, it is believed that it will be obvious that many changes may be made in the form, construction and arrangement of the parts and it is not intended that the scope of the invention should be limited to the embodiment shown and described nor otherwise except by the terms of the appended claims.

We claim:

1. In a heating system for buildings and the like: a heater comprising a casing; a carbureting device disposed within the casing and having an induction passage therein; an air duct for conveying heated air to the room to be heated; electrically operated means for inducing a flow of air through the casing and the induction passage; a source of electric power for the last mentioned means; a temperature responsive device adapted to be disposed in a room to be heated; a second temperature responsive device adjacent the heater and adapted to cut off the source of electric power to the electrically operated means upon a decrease in temperature below a predetermined value; said temperature responsive devices being connected in series; the first mentioned temperature responsive device being located in an upper portion of a room to be heated; a third temperature responsive device adapted to be disposed adjacent the floor of said room; a valve controlling the fluid flow through the induction passage of the charge forming device; and a linkage between the third mentioned temperature responsive device and the valve whereby the latter is temperature controlled.

2. In a heating system for buildings and the like: a heater comprising a casing; a carbureting device disposed within the casing and having an induction passage disposed therein; a duct for conveying heated air to a room to be heated; electrically operated means for inducing a flow of air to the casing and the induction passage; an electric circuit for the last mentioned means; a temperature responsive device adapted to be disposed in the room to be heated; a second temperature responsive device adjacent the heater; said temperature responsive devices being connected in series and adapted to control said electric circuit; a balanced throttle controlling the flow of fuel through the induction passage; and a temperature responsive device linked with the throttle for controlling the position thereof.

3. In a heating system for buildings and the like: a heater comprising a casing; a carbureting device disposed within the casing having an induction passage therein; a throttle valve in said induction passage; electrically operated means for inducing a flow of air through said casing and the induction passage; an electric circuit for the last mentioned means; a temperature responsive device disposed in the room to be heated and adapted to open upon an increase in temperature; a second temperature responsive device adjacent the heater and adapted to open upon a decrease in temperature; said temperature responsive devices being connected in series in the electric circuit; and a third temperature responsive device disposed in the room to be heated and linked with the throttle valve of the induction passage for controlling same.

4. The invention defined by claim 3 wherein the third mentioned temperature responsive device is adapted to move the valve in the opening direction upon a decrease in temperature.

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