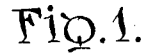


E. C. MILLER
GAS HEATING APPARATUS
Filed March 1, 1941

3 Sheets-Sheet 1



INVENTOR

Erwin C. Miller
By Frank M. Dough, ATTORNEY.

Feb. 20, 1945.

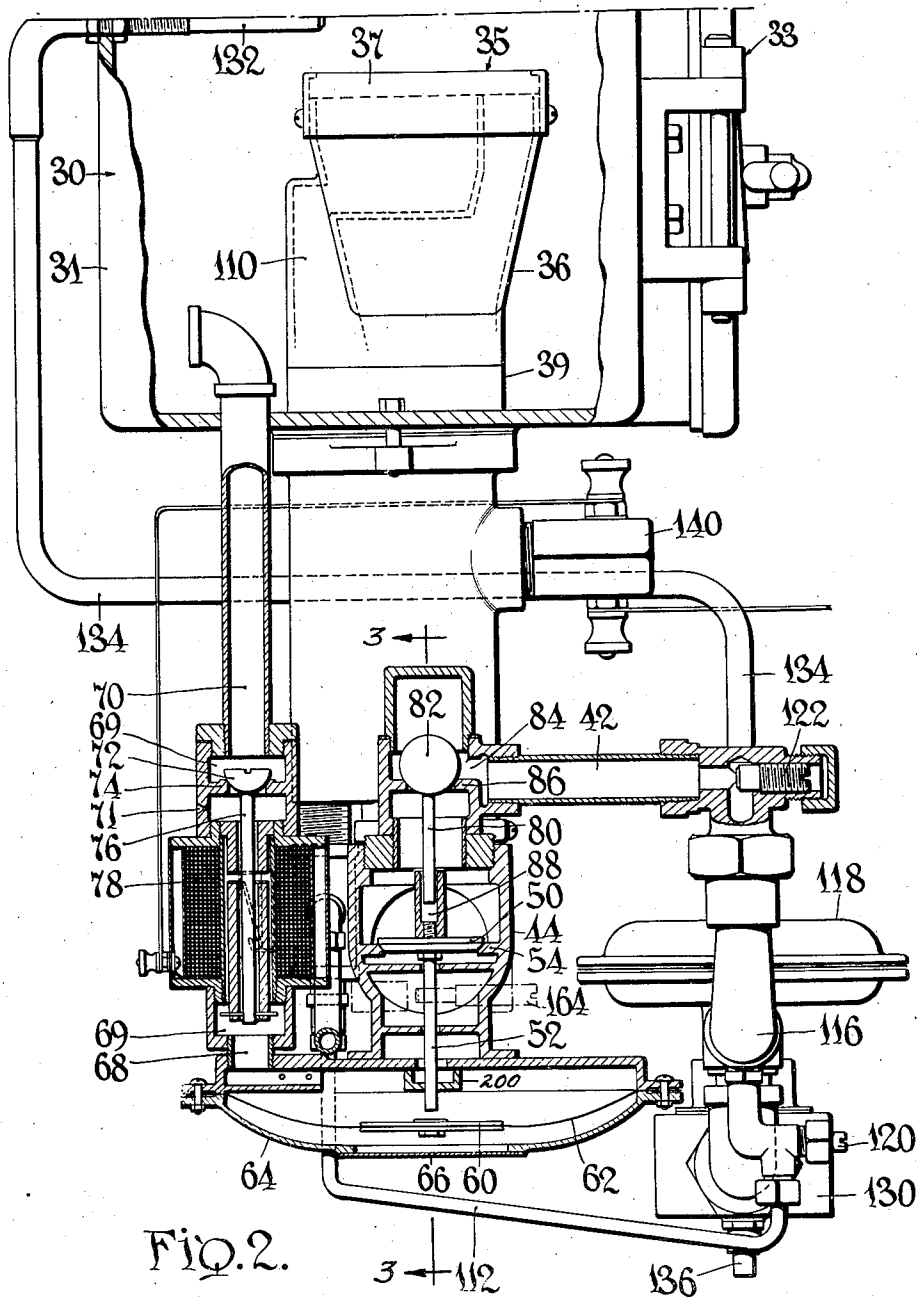
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2,369,746

GAS HEATING APPARATUS

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3 Sheets-Sheet 2



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FIG. 5.

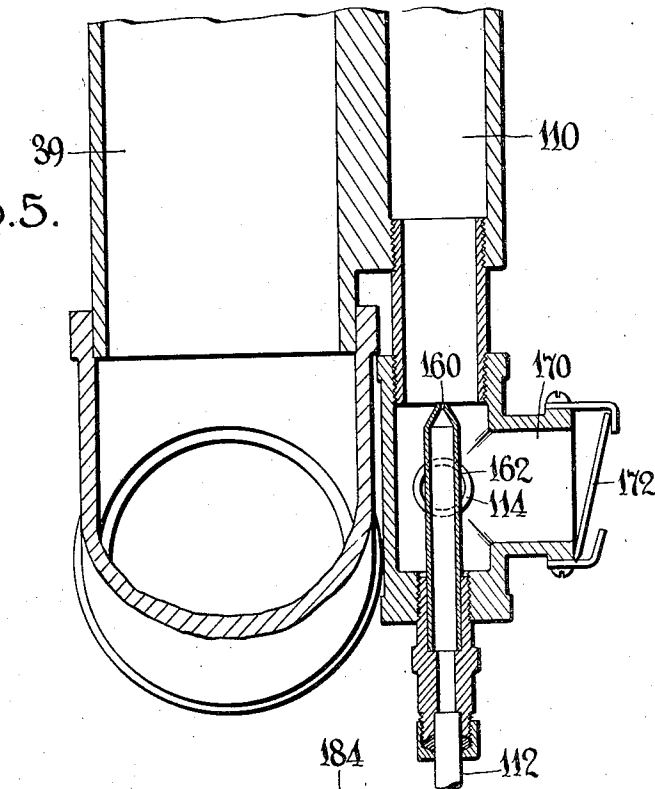
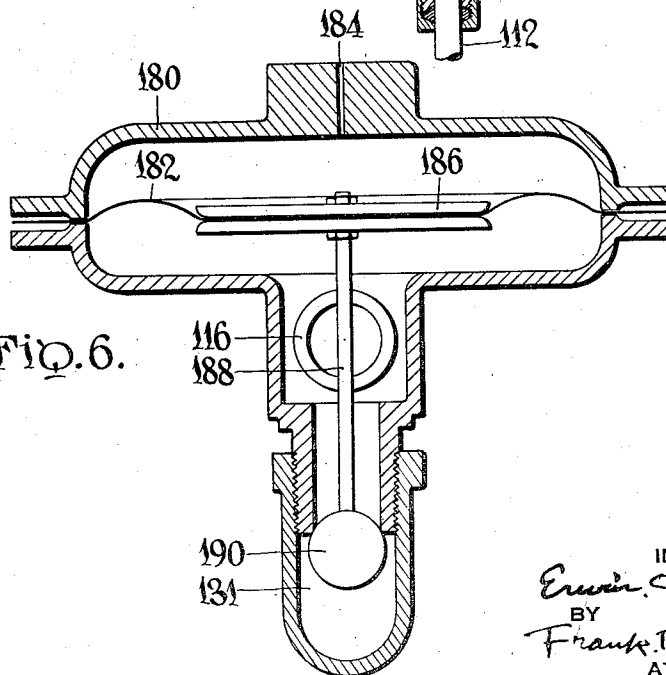


FIG. 6.



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GAS HEATING APPARATUS

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Application March 1, 1941, Serial No. 381,335

4 Claims. (Cl. 126—91)

This invention relates to gas burning heating apparatus of the type to which Patent No. 1,510,475 relates, and the present invention constitutes an improvement thereon.

One of the objects of the invention is to provide an improved form of gas burner device which operates with increased efficiency and safety. Another object of the invention is to provide a control system for gas burner devices of the character described which functions in a novel and improved manner to provide improved starting and stopping performance. Other objects and advantages of the invention will appear from the specification herein.

In the drawings:

Fig. 1 is an elevation of a gas burning heater device of the invention;

Fig. 2 is a fragmentary view on an enlarged scale taken substantially along line II—II of Fig. 1, showing portions of the air-gas mixing device and combustion chamber in elevation and other portions in section;

Fig. 3 is a fragmentary section taken substantially along line III—III of Fig. 2; and

Fig. 4 is a fragmentary section taken substantially along line IV—IV of Fig. 1 and showing the interior of a detail thereof.

Fig. 5 is a fragmentary section of the fuel tube of Fig. 1;

Fig. 6 is a fragmentary section of the pressure regulator device of Figs. 1 and 2.

As illustrated in Fig. 1, the invention is applicable to a gas burning device comprising generally, in combination, a heat transfer radiator 10; a suction fan 20; a combustion chamber 30; an air-gas mixing device 40; and a fuel flow control system as will be described in detail hereinafter.

The combustion chamber and the radiator and the suction fan elements are interconnected to provide for movement of the gaseous products of combustion from the combustion chamber through the radiator and thence through the fan into a discharge conduit. An air-gas fuel mixture is induced to flow into the combustion chamber through an automatic valve mixing device which delivers the fuel to a burner head 35 located in the lower portion of the combustion chamber by the action of the suction fan; the air for the mixture being taken either from the atmosphere in the neighborhood of the heating unit or from some remote point through a suitable inlet conduit 41. The partial vacuum created within the combustion chamber by the action of the fan 20 also operates to induce flow

of an appropriate proportion of gas into the burner head to be mixed with the air therein; and the gaseous products of the combustion process then flow through the radiator 10 and the conduit 15 and thence through the fan 20 to be discharged thereby through a suitable discharge conduit (not shown).

In the drawings the radiator 10 is shown as being of the well known sectional type; but it will be understood that the invention is adapted to use in connection with any other suitable form of hot gas conveying heat exchange device. Ports 11 in lower wall portions of the radiator sections lead into the conduit 15 which leads into the intake opening of the fan 20. The combustion chamber 30 comprises essentially a box-like casing 31 located centrally of and in the upper portion of the radiator unit; and intercommunicating conduits 32 are provided between the interiors of the radiator sections and the combustion chamber. A door 33 is hingedly mounted upon a side wall portion of the combustion chamber casing to provide access into the interior thereof whenever necessary.

The burner head 35 may be of any suitable type and is illustrated as comprising a flaring tube 36 with an end closure plate 37 in which are provided a plurality of jet openings 38 to provide evenly distributed flow of fuel over the area of the burner head. The lower end of the burner head is connected in open communication with the upper end of a fuel tube 39 which extends through the lower wall portion of the combustion chamber casing 31 and into communication with the interior of the air-gas mixing device casing 44 by means of an elbow 45, for transmission of fuel therefrom to the burner head.

The air inlet control device of the invention includes a valve 50 disposed within the casing 44 and adapted to seat upon a partial partition wall portion 54 of the valve casing 44 to regulate flow of air through the casing from an air inlet conduit 41 to the fuel tube 39. The valve 50 is mounted upon a valve stem 52 which is slidably mounted upon the casing 44 by means of suitable slide bearings 57 and 58 (Fig. 3). A fluid pressure responsive diaphragm 62 is mounted within a casing 64 which also encompasses the lower end of the valve stem 52. The casing 64 is open to the atmosphere underneath the diaphragm 62, as at 66, and above the diaphragm is arranged in open communication with a vacuum conduit 68 (Fig. 2) which leads from a vacuum valve chamber 69 which in turn is in open communication

with a conduit 70 leading into the interior of the combustion chamber 30.

The casing 64 above the diaphragm is otherwise closed by the cup shaped sealing element 200 surrounding the valve stem 22 whereby no effective communication of air, from the space 201 of the casing 44 with the space disposed above the diaphragm 62 and in the casing 64, is had. Therefore, the fluid pressure exerted upon the upper side of the diaphragm 62 is always substantially that determined by the fluid pressure communicated thereto through said conduit 70.

A vacuum control valve 72 is disposed within the vacuum chamber 69 and is adapted to seat upon a partial intermediate partition wall 74 thereof. The valve 72 is mounted upon a valve stem 76 which extends into the interior of a solenoid winding 78 and is adapted to function as the armature thereof. The solenoid 78 is so arranged as to be adapted to draw the armature stem 76 upwardly under closed circuit conditions so as to unseat the valve 72, thus permitting flow of air through the conduit tube 70 into the combustion chamber under the suction force of the fan, and the partial vacuum will then be projected into the portion of the casing 64 that is above the diaphragm 62. Consequently, the air under atmospheric pressure admitted through the aperture 66 of the diaphragm casing will exert pressure against the bottom surface of the diaphragm 62 that will overcome the pressure against the top side thereof with the result that the diaphragm will move upwardly and the plate 60 will press against the valve stem 52 to raise the latter vertically so that the valve 50 will be unseated and air will be admitted from the conduit 41 through the valve casing and into the fuel tube 39. Whenever the solenoid 78 is de-energized, however, the force of gravity operates to cause the valve 72 to lower upon its seat thus cutting off the vacuum above the diaphragm 62. A small aperture 71 is formed through a wall portion of the casing of the chamber 69 so as to permit a slight bleeding of air at this time into the vacuum chamber and above the diaphragm 62 so that the atmospheric pressures at opposite sides thereof become equalized upon closing of valve 72. Consequently, the diaphragm plate 60 lowers under the force of gravity to permit the valve stem 52 to return to valve closed position. In this respect, particular attention is called to the fact that because of the valve stem arrangement of the invention the gas control valve 82 will close prior to the closing of the air control valve 50, and that this mode of operation provides advantages as will be explained in detail hereinafter.

A second valve stem 80 mounting a gas inlet control valve 82 is disposed in vertical alignment with and above the valve stem 52. The valve 82 is disposed within a gas inlet chamber 84 which is in open communication with the gas inlet conduit 42 and mounted upon the valve casing 44 in open communication with the interior thereof. A transverse annular partial wall 86 is arranged to provide a seat for the valve 82, and the parts are so proportioned and arranged that when the valves 82 and 50 are seated there is a substantial gap as at 88 between the two valve stem members. Thus, when the valve stem 52 is first raised by the diaphragm 62 to lift the valve 50 from its seat the valve 82 remains in gas sealing relation upon its seat. However, as the stem 52 is further lifted under the diaphragm pressure

closes the gap between the two valve stem members and the stem 80 subsequently raises to open the valve 82 whereupon gas from the conduit 42 flows into the valve casing 44 and thence into the fuel tube 39, mixing with the air being admitted thereto as hereinabove explained.

The operation of the device is automatically controlled by means of a thermostat device 100 which may be of any suitable room temperature control type electrically connected into the circuit controlling the solenoid 78. Thus, as long as the temperature of the atmosphere adjacent the thermostat 100 is lower than that called for by the adjustment of the thermostat under any given condition, the operating elements of the thermostat will remain in circuit-closed condition and the solenoid 78 will maintain the valve 72 above its seat, thus allowing the diaphragm 62 to maintain the valves 50 and 82 in open position for fuel delivery purposes. Upon attainment of the desired temperature of the atmosphere surrounding the thermostat 100 the actuating elements thereof will move into circuit open position and the solenoid 78 will be de-energized thus allowing the valve 72 to move downwardly to closed position, whereupon the diaphragm 62 will withdraw from contact with the valve stem 52 and allow the valves 82 and 50 to assume closed positions, thus cutting off the supply of fuel and air to the burner head. As explained hereinabove, during the movements of the valve members 82 and 50 toward closed positions the valve 82 will reach its seat some time prior to the closing of the valve 50. Thus, upon termination of the flow of gas into the fuel tube 39 there will be a further flow of air thereto to scavenge the burner head of any unburnt gas that might otherwise remain therein. By reason of this feature of the invention it will be understood that the danger of accumulation of unburnt gas in the working parts will be eliminated.

Upon movement of the actuating elements of the thermostat 100 to circuit closed position the solenoid 78 will be energized and the valves 50 and 82 will be caused to open in the order named, as explained hereinabove. Thus, a supply of air will first be introduced into the burner head and combustion chamber, and then a flow of gas will be added thereto. As a result of this mode of gas introduction the danger of gas explosions during the ignition period is avoided.

A constant burner tube 110 is provided in conjunction with the apparatus and so arranged as to have its outlet end adjacent the burner head 37 and its intake end in open communication with a gas inlet tube 112, and with an air inlet tube 114 (Fig. 3). The air inlet tube 114 is in communication at its other end with the interior of the air conduit 41, and the gas inlet tube 112 is in open communication with a main gas supply conduit 116 (Fig. 2). As shown in Fig. 2, the pressure in the gas supply conduit 116 is automatically regulated by means of a suitable pressure regulator 118 so that the gas delivered therefrom into the primary gas conduit 42 and into the constant burner conduit 112 is of constant pressure. An adjustable needle valve 120 is provided in the line of the conduit 112, and a similar valve 122 is provided in the line of the conduit 42, for independent adjustment of the flow of gas therethrough. Thus, it will be understood that the constant burner tube 110 is normally provided with a constant supply of mixed air and gas, and therefore a pilot light will re-

main burning at the burner head 35 to provide ignition of the main fuel supply passing there-through upon re-starting operations of the thermostat control device.

As illustrated in Fig. 1, the outlet end of the constant burner tube 110 is disposed within the burner head 35 and centrally thereof. In transverse section the constant burner discharge end is provided with a laterally directed extension 111 (Fig. 2) so as to discharge the constant burner fuel against a substantially centrally located portion of the burner head plate 37. Thus, upon starting of the main fuel burning operation the fuel stream rising through the fuel tube 39 will substantially envelop the flame of the constant burner, and thus an improved form of fuel ignition will be obtained.

A safety control valve 130 is connected in the line of the main gas supply conduit 116 and is arranged to be actuated in response to operation of a thermocouple 132 (Fig. 2) disposed within the combustion chamber 30 and adjacent the constant burner flame. The thermocouple device is operatively associated with the moving parts of the valve 130 by means of interconnecting wiring 134 and is so arranged that as long as the constant burner is in operation the thermocouple device maintains the safety valve 130 in open condition. However upon cessation of the constant burner operation, as upon failure of the gas supply, the thermocouple operates to actuate the safety valve to closed condition, thus eliminating the danger of having the combustion chamber subsequently filled with unburnt gas upon resumption of the gas supply and in the absence of igniting means. A manually operable valve opening button 136 is provided in conjunction with the valve 130 to permit manual reopening of the gas supply circuit preparatory to re-starting the device subsequent to complete interruption of the service.

To operate the apparatus of the invention, it will first be started by closing the power switch 120 to the fan 20, thus creating a partial vacuum throughout the combustion chamber-radiator system. The thermostat 100 is then set to the desired temperature, and the main supply gas valve 117 is opened. The combustion chamber door 33 is then opened, and this destroys the partial vacuum in the combustion chamber whereupon the main gas and air inlet control valves 82 and 50 assume closed positions. The button 136 of the safety control valve 130 is then manipulated to permit a slight flow of gas there-through into the constant burner tube 110 where it mixes with a flow of air entering from the air inlet conduit 41. A burning taper is then applied to the burner head to ignite the fuel stream, and the button 136 is manually maintained in valve open position until such time as the heat of the fuel burning operation causes the elements of the thermocouple 130 to maintain the valve 130 in open position without assistance.

The combustion chamber door is then closed, and if the adjustment to the thermostat 100 calls for an increase in the temperature of the atmosphere thereabout the circuit controlling the solenoid 78 is closed and the valve 72 will be lifted from its seat and thus in turn cause the diaphragm 62 to open successively the air and gas valves 50 and 82, whereupon flow of fuel through the main burner tube will commence. As it emerges from the burner it ignites from the flame of the constant burner tube.

When the atmosphere adjacent the thermo-

stat device 100 reaches the desired temperature the circuit to the solenoid 78 is opened, thus allowing the valve stem 76 to move downwardly to seat the valve 72. Consequently, the pressures at opposite sides of the diaphragm 62 become equalized and the plate 60 withdraws from the valve stem 52 allowing first the gas valve 82 to close and subsequently the air valve 50 to close, whereupon only the constant burner remains in operation for repetition of the process as may be required by the thermostat device.

As a further safety feature of the invention, a thermostat device 140 is mounted upon the fuel tube 39. The thermostat 140 comprises essentially a bent bi-metallic element 142 (Fig. 4) extending into the interior of the fuel tube 39. The end portions of the element 142 normally contact electrical connection devices 144 to close the circuit to the solenoid operated valve 72. Upon flashback of flame into the interior of the fuel tube 39 the bi-metallic element is heated and deflects to break the circuit to the solenoid resulting in the closing of the main air-gas valves terminating flow of fuel through the tube 39. Subsequently, the bi-metallic element slowly cools and returns to normal condition wherein the contact is engaged and normal operation resumed.

As illustrated in Fig. 5 the discharge end of the gas inlet tube 112 is arranged and mounted within the lower end of the constant burner tube 110 in the form of a jet tube 162 extending a substantial distance into the interior of the tube 110 and having a reduced orifice 160 in the end thereof. The air inlet tube 114 is tapped into the constant burner tube 110 at a position adjacent the tube 162. Thus, under normal operating conditions, the partial vacuum in the burner tube 110 draws air through tube 114 to be mixed with the gas issuing through the orifice 160 for pilot burner operation. The rate of air flow through the tube 114 is arranged to be adjusted by means of a set screw 164 (Fig. 2), the inner end of which is adapted to be moved into and out of engagement with the inlet end of the tube 114 to control the flow of air therein. However, under interrupted electric power conditions the partial vacuum in the tube 110 is no longer available for drawing the required amount of air through the tube 114 to provide a blue flame at the constant burner head, and to meet this condition I provide an auxiliary air inlet port 170 adjacent the jet 160. The auxiliary air port 170 is normally closed by means of a cover disc 172 adapted to function in the manner of a check valve under the action of suction within the tube 110, but under fan-off conditions when suction in the burner head is absent the disc 172 is adapted to fall away from the port 170 under the force of gravity as to the broken line position shown in Fig. 5. Consequently, the flow of gas through the orifice 160 of the jet 162 will now operate in the manner of an inspirator to induce a flow of air through the inlet port 170 so that a proper mixture of gas and air will be obtained whereby a blue flame burning operation is obtained under all conditions of pilot burner operation.

The pressure regulator device 113 is of special form as illustrated in Fig. 6 and is shown therein as comprising generally a hollow casing 180 enclosing a flexible diaphragm 182. The gas conduit 116 opens into the casing 180 below the diaphragm 182, and the casing is vented as at 184 so as to permit gradual bleeding of air from the

outside atmosphere into and out of the casing above the diaphragm 182. The diaphragm 182 carries a center plate 186 upon which is mounted a valve stem 118 which in turn carries at its lower end a gas flow control valve 190 adapted to coact with a valve seat in the casing to control flow of gas from the main inlet conduit 131 into the conduit 116. Thus, the suction created by the fan 20 is transmitted through the apparatus by means of the conduit 116 into the casing 180 below the diaphragm and normally pulls the diaphragm downwardly to maintain the valve 190 in open position. However, whenever the pressure in the gas conduit 131 raises or lowers from the desired standard the effect thereof is immediately transmitted to the diaphragm 182 which accordingly either raises or lowers to partially close or further open the valve 190, whereby the rate of flow of gas into the conduit 116 is kept uniform at all times.

As illustrated in Fig. 1, an automatic vent device 195 is provided in an upper wall portion of the casing 31 and is so arranged that the disc member thereof falls forwardly to vent-open position upon stoppage of the fan 20, as under power interruption conditions. Consequently, the products of combustion from the constant burner are free to escape through the vent 195 and do not accumulate in the combustion chamber to snuff out the constant burner. Upon current resumption the suction of the fan reseats the vent disc and the products of combustion are then drawn through the radiator and expelled as explained hereinabove.

Attention is called to the fact that the gas-air inlet arrangement of the invention is of such form that whenever the thermostat control device is at "off" position the valves 50 and 82 are both closed. Consequently, although the suction fan is continuously in operation, there will be no flow of cold air through the combustion chamber and radiator unit under burner-off conditions such as would otherwise cool off the combustion chamber and radiator between each burning stage of operation. Consequently the heat previously stored in the combustion chamber and radiator structures is not wasted as would otherwise be the case by absorption thereof into the cold air stream passing through the combustion chamber and radiator structures and being discharged by the suction. Attention is also called to the fact that under burner "off" conditions the operation of the constant burner device is carried on under ideal conditions and without introduction of excessive amounts of air into the system. Consequently, the velocity of movement of air-gas mixtures through the system under such conditions is relatively slow, and the heat generated by the constant burner operation is fully utilized and transferred to the radiator heat exchange portions and thus usefully employed.

Although only one form of the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In gas burning heating apparatus of that class in which the heated gaseous products of combustion are withdrawn from the combustion chamber of the apparatus through a heating radiator by a constantly operating suction device whereby combustion of the gas occurs under con-

ditions of subatmospheric pressure, a burner disposed within said combustion chamber and a conduit adapted to convey mixed gas and air to said burner, a gas valve controlling the admission of gas into said conduit, an air valve controlling admission of air into said conduit, a fluid pressure responsive movable element for actuating said valves, both said valves being of the poppet type and being relatively so spaced and so disposed in substantially longitudinal alignment that said air valve may be opened to a predetermined extent independently of any movement of said gas valve and further movement of said air valve will effect engagement between an element thereof and an element of said gas valve, to move said gas valve to open position, and mechanical means to transmit operative movement of said fluid pressure responsive element to said air valve and upon continued movement of said air valve to effect opening movement of said gas valve and said valves adapted upon a recessional movement of said actuating element to be restored in reverse order successively to valve-closed position, and controlling means to intermittently effect communication of the fluid pressure in said chamber to said element whereby said element may be intermittently operated under conditions of sub-atmospheric pressure in said chamber, and means to retard the speed of movement of said element, to increase the length of the period between successive operations of the successively moved valves.

2. In gas burning heating apparatus of that class, in which the heated gaseous products of combustion are withdrawn from the combustion chamber of the apparatus through a heating radiator by a constantly operating suction device whereby combustion of the gas occurs under conditions of sub-atmospheric pressure, which have a main gas burner and a constant pilot burner which is disposed adjacent to said main burner, the combination of an air and gas mixing valve mechanism for providing a combustible mixture for said burner, said mechanism comprising separate gas and air inlet valves and a movable valve operating element adapted to be intermittently actuated upon controlled intermittent communication thereto of sub-atmospheric pressure prevailing in said chamber, mechanical means to transmit an initial portion of the movement of said element to said air valve and to transmit a subsequent portion of such movement to said gas valve to effect sequential opening of said air and gas valves, and said valves adapted to be successively re-closed in reverse order upon recessive movement of said element, and means to retard the speed of movement of said mechanical means, whereby scavenging air will alone be supplied through said air valve to said main burner during the period intervening between the successive openings of said valves, and the period intervening between the successive closures of said valves.

3. In gas burning heating apparatus of that class, in which the heated gaseous products of combustion are withdrawn from the combustion chamber of the apparatus through a heating radiator by a constantly operating suction device whereby combustion of the gas occurs under conditions of sub-atmospheric pressure, which have a main gas burner and a constant pilot burner which is disposed adjacent to said main burner, the combination of an air and gas mixing valve mechanism for providing a combustible mixture for said burner, said mechanism com-

prising separate gas and air inlet valves and a movable valve operating element adapted to be intermittently actuated upon controlled intermittent communication thereto of sub-atmospheric pressure prevailing in said chamber, mechanical means to transmit the movement of said element to said valves whereby a combustible mixture is supplied to the burner, and said element adapted upon the recessive movement thereof to successively reclose said valves, said gas valve being first reclosed, and means to retard the speed of movement of said element to increase the length of the period between the closure of the gas valve and the closure of the air valve.

4. In gas burning heating apparatus of that class, in which the heated gaseous products of combustion are withdrawn from the combustion chamber of the apparatus through a heating radiator by a constantly operating suction device whereby combustion of the gas occurs under conditions of sub-atmospheric pressure, which have

a main gas burner and a constant pilot burner which is disposed adjacent to said main burner, the combination of an air and gas mixing valve mechanism for providing a combustible mixture for said burner, said mechanism comprising separate gas and air inlet valves and a movable valve operating element adapted to be intermittently actuated upon controlled intermittent communication thereto of sub-atmospheric pressure prevailing in said chamber, mechanical means to transmit an initial portion of the movement of said element to said air valve and to transmit a subsequent portion of such movement to said gas valve to effect sequential opening of said air and gas valves and said valves adapted to be reclosed upon recessive movement of said element, and means to retard the speed of movement of said mechanical means, whereby scavenging air will alone be supplied through said air valve to said main burner during the period intervening between the successive openings of said valves.

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