Aug. 21, 1934. W. B. MANGOLD ET AL 1,971,269

HEATING SYSTEM

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Fig. 2

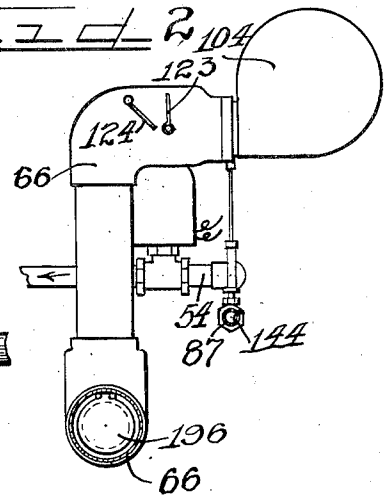


Fig. 1

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HEATING SYSTEM

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Fig. 3

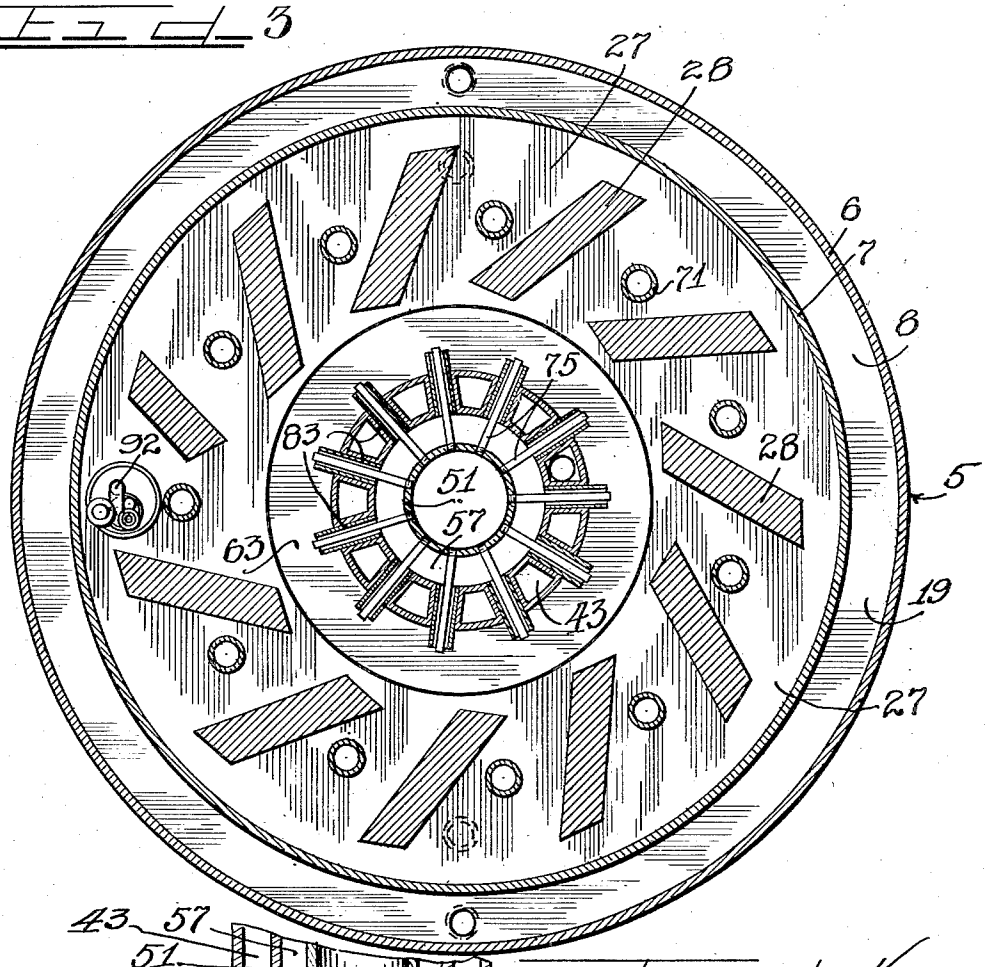
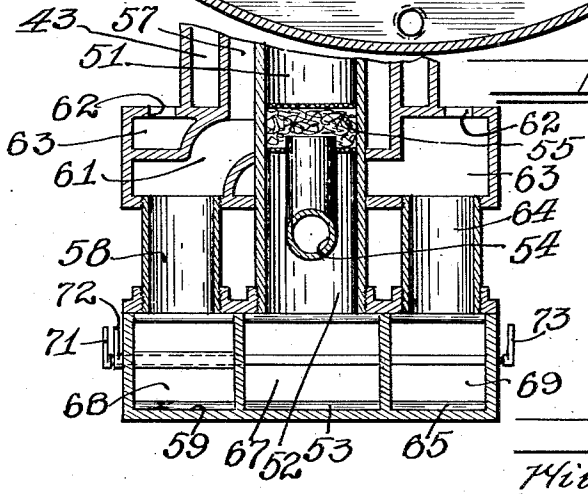


Fig. 4



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HEATING SYSTEM

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Fig. 9

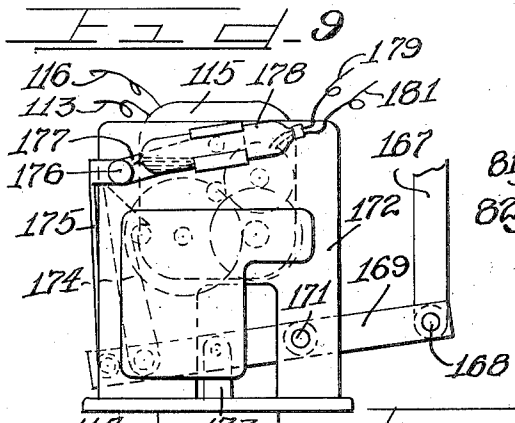


Fig. 6

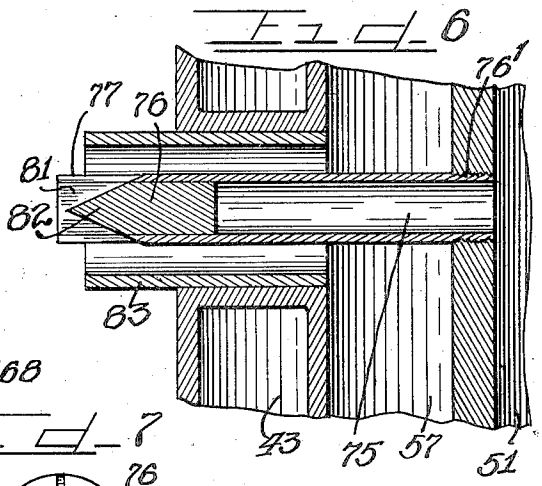


Fig. 7

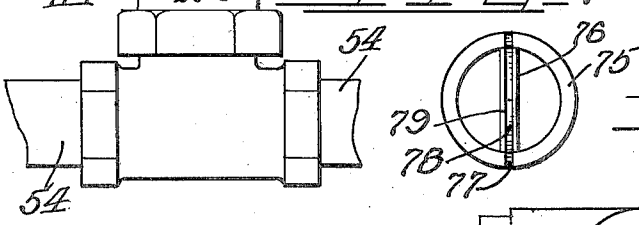


Fig. 8

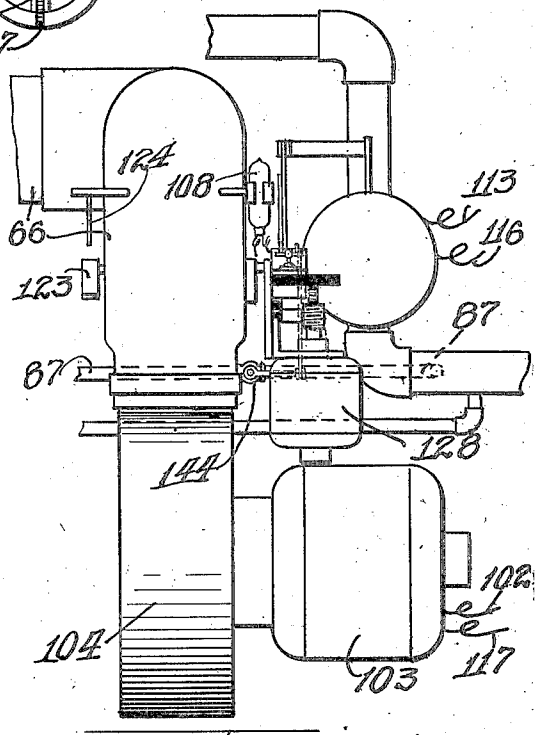
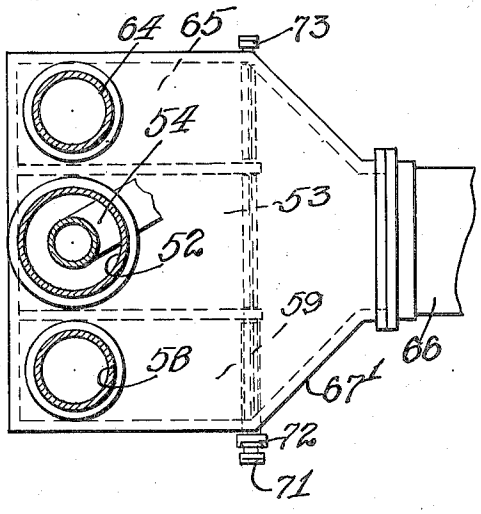


Fig. 5



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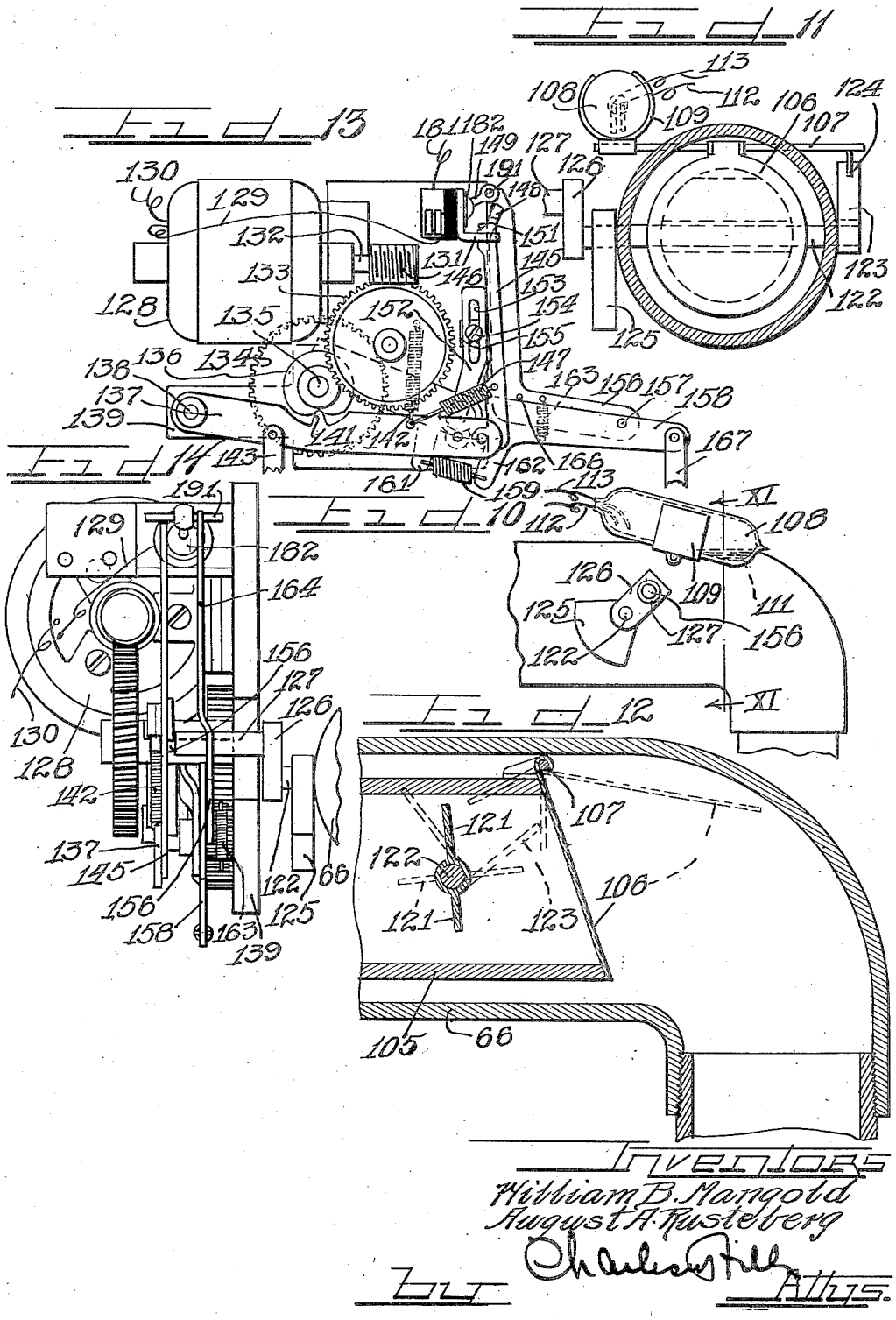
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HEATING SYSTEM

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Fig. 16

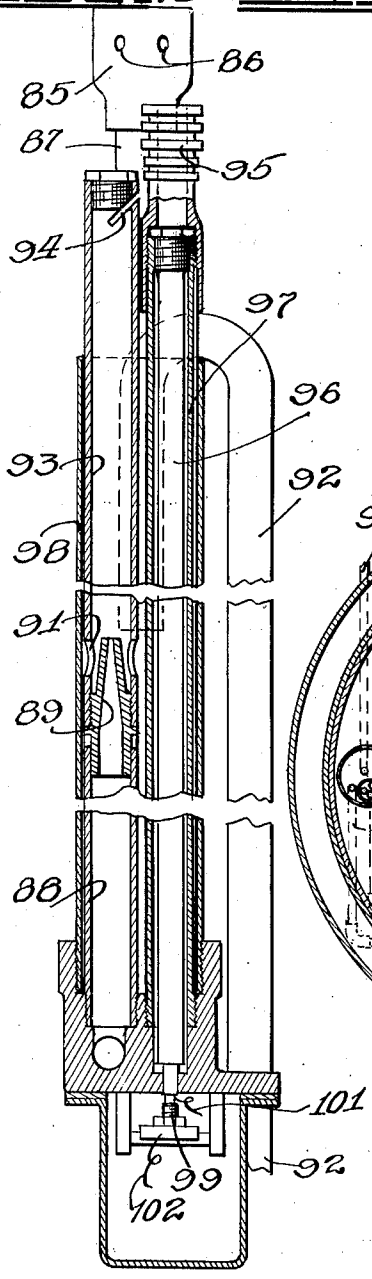


Fig. 17

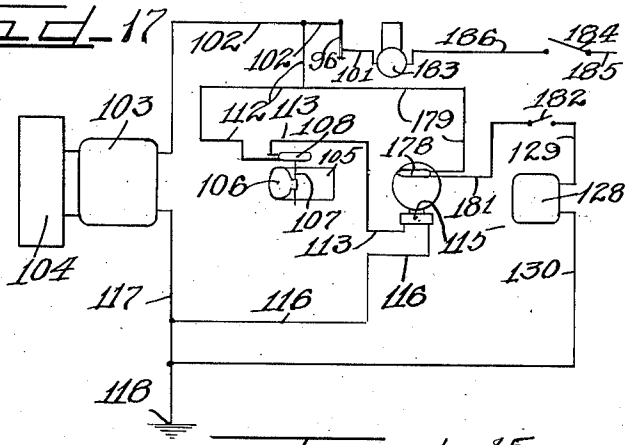
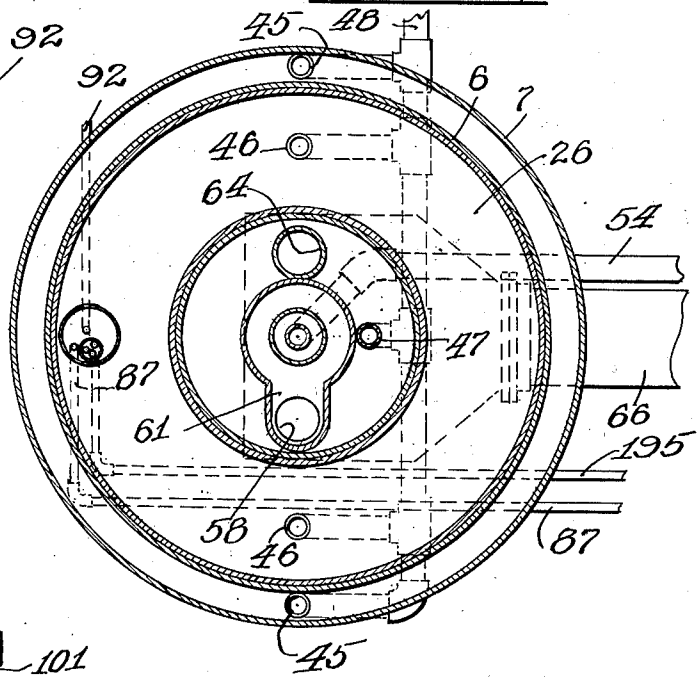


Fig. 15



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UNITED STATES PATENT OFFICE

1,971,269

HEATING SYSTEM

William B. Mangold, Oak Park, and August A. Rusteberg, Chicago, Ill.

Application August 5, 1932, Serial No. 627,610

26 Claims. (Cl. 122—156)

This invention relates to a heating system and will be described as incorporated in a gas heater and controlling mechanism therefor.

An object of this invention is the provision of an improved heating system particularly suitable for the efficient burning of gas and the heating of a boiler or the like.

Another object is the provision of such a heater which has combined and associated therewith an improved controlling mechanism.

Other objects and advantages of this invention will become apparent from the following detailed description with reference to the accompanying drawings.

On the drawings:

Figure 1 is a vertical sectional view through a gas heater incorporating my invention.

Figure 2 is a vertical section taken on the line II—II of Figure 1.

Figure 3 is a horizontal section taken on the line III—III of Figure 1.

Figure 4 is a vertical section through a portion of that shown in Figure 1 and taken substantially on the line IV—IV of Figure 1.

Figure 5 is a horizontal section taken on substantially the line V—V of Figure 1.

Figure 6 is a vertical section through a fragment of the multiple burner, disclosing a burner and associated parts fragmentarily.

Figure 7 is an end elevation of a burner element of the type disclosed in section in Figure 6.

Figure 8 is a plan view of a portion of the controlling mechanism and is taken on the line VIII—VIII of Figure 1.

Figure 9 is an elevation of the main gas valve operating mechanism.

Figure 10 is a fragmentary elevation of a portion of the air conduit and associated mechanism.

Figure 11 is a section taken on substantially the line XI—XI of Figure 10, showing the mercury switch tube in elevation.

Figure 12 is a longitudinal section taken through the mechanism shown in Figure 10.

Figure 13 is a side elevation of timing mechanism for actuating the lighting device for the burner and

Figure 14 is an end elevation of that shown in Figure 13, disclosing associated parts fragmentarily.

Figure 15 is a horizontal enlarged section taken on the line XV—XV of Figure 1.

Figure 16 is an elevational view, with parts in section, of the pilot light and thermostat control.

Figure 17 is a layout of the wiring diagram of the electrical system.

As shown on the drawings:

The gas heater herein disclosed for illustrating the preferred form of my invention includes a boiler designated generally by numeral 5 and including spaced walls 6 and 7 forming an annular water chamber 8 adapted to contain water in the lower portion and steam in the upper portion. The top portion of the boiler is provided with spaced walls 9 and 11 providing therebetween a space for the accumulation of steam designated by a numeral 12. A steam discharge conduit 13 is suitably fixed to the wall 9 by a collar 14 having a flange 15 secured to the wall 9. The wall 11 has an opening therethrough in which is fitted a conduit 17 which passes through the steam chamber 12 and through the wall 7 where it communicates with a conduit 18 and is held in alignment therewith, and rigidly in position by a collar 16 fixed to the wall 7. The conduits 17 and 18 serve for the discharge of the products of combustion from the combustion space in the boiler.

The lower edges of the walls 6 and 7 are rigidly held in spaced relation at the bottom by a base wall 19 which seats on the main supporting base 21. The base 21 is provided with a base flange 22 adapted to rest on a floor or the like, and with a boiler flange 23 within which the boiler structure is seated and thereby held in place. A flange 24 adjacent the opposite end of the base is provided for confining and holding in place, a housing 25 adapted to contain controlling mechanism.

Also seated on the base 21 inwardly of the walls 7 is an annular boiler chamber 26 on the top wall 27 of which are disposed a plurality of refractory elements 28 which are disposed in position such that they will be impinged by flames from the multiple gas burner to be hereinafter described, for effecting a turbulent motion to the contents of the combustion chamber to aid in the process of combustion and distribution of heat by convection and radiation to the various water chambers comprising the boiler. A plurality of water tubes 31 extend from the boiler chamber 26 to a larger water chamber 32 disposed thereabove. The water chamber 32 comprises an annular side wall 33 and top and bottom walls 34 and 35. The upper end of the chamber 32 is connected by short tubes or pipes 36 with the steam space 12 to permit the flow of steam from the chamber 32 in the manner shown in Figure 1.

A relatively narrow space is provided between the wall 33 of the chamber 2, and the wall 6 for permitting the passage of the products of com-

bustion around the edges of the chamber 32 to the discharge conduit 17. This space is indicated by numeral 38 in Figure 1. A similar space 39 is provided above the top wall 34 of the chamber 32 for the same purpose. In addition to the spaces 38 and 39, tubes 41 are provided through the chamber 32 which tubes lead from the lower portion of the combustion chamber 42, to the space 39 for facilitating the heating of water in the chamber 32 by passing the products of combustion directly through the chamber 32.

A water compartment or chamber 43 formed of inner and outer walls and a top wall is positioned centrally in the heater and connected for communication with the chamber 32 through a water tube 44. Water is admitted to the chambers 8, 26 and 43 through the conduits 45, 46 and 47 respectively as shown in Figure 15. The conduits 45, 46, and 47 are each connected to a water intake conduit 48 which may receive water for the boiler from any suitable source.

Applicant's multiple burner herein illustrated comprises a mixing chamber 51 centrally disposed in the bottom portion of the combustion chamber. The lower end of the mixing chamber forms an air intake conduit 52 adapted to receive air from the conduit 53. The main gas line 54 for supplying gas to the multiple burner, passes through the side of the conduit 52 and has its ends turned upwardly and terminating in a filtering and mixing device 55 best shown in Figures 1 and 4. Air is admitted to the chamber 57 through a conduit 58 from a conduit 59 and upwardly through the passageway 61 shown in Figures 4 and 15. Air is admitted to the combustion chamber around the multiple burner, through openings 62 from the annular chamber 63 which receives air through the conduit 64 communicating with a conduit 65. The conduits 53, 59, and 65 communicate with the main air conduit 66 through a flared hood element 67' best shown in Figures 1 and 5. The conduits 53, 59, and 65, are provided respectively with controlling dampers 67, 68, and 69 respectively having associated therewith controlling levers 71, 72, and 73 which may be actuated in any suitable manner for controlling the relative amounts of air to be admitted to the respective conduits.

Referring now to Figures 6 and 7, the specific construction of the individual burners, is disclosed. Each burner comprises a gas supply tube 75 having threaded engagement in an opening 76' in the wall of the mixing chamber 51. The tube 75 extends substantially radially and is provided with a longitudinally extending partition adjacent the outer end, which partition serves to divide the gas passing through the tube 75. The partition 76 is provided with slots 81 at the outer end which slots unite at the end leaving a tapered portion 82 therebetween which serves as a guide to the air which enters the sides of the tube through the slots 77 therein, along the sides of the partition element 76. The slots 81 are narrower than the thickness of the partition element such that they leave side portions 79 dividing the gas as it leaves the tube 75. This arrangement permits the introduction of air into the center of the gas flame and eliminates the production of a vacuum at the end of the burner. The burner is preferably provided with air tubes 83 passing through the water chamber 43, which tubes are adapted to receive air from the air chamber 57 and direct the air to the end of the burner.

In order to light the multiple burner, I have provided a lighter 85 having gas openings 86 through which gas is ejected. The gas ejected from the openings 86 is directed over the ends of the individual burners of the multiple burner, such that the lighting of the multiple burner is effected. Gas is admitted to the lighter 85 through the gas conduit 87, the supply of gas through which is controlled as will be hereinafter described. A pilot burner is provided for igniting the lighter 85. The pilot burner consists of a tubular member 88 having therein a nozzle 89 and openings 91 adjacent the nozzle, through which air is admitted from the conduit 92. In the upper portion 93 of the tube 88 the gas and air is mixed and is discharged through a slot 94 adjacent the upper end of the tube. The mixture discharging from the slot 94 is normally ignited and impinges as a flame upon the refractory head 95 which spreads the flame and directs it upwardly beyond the gas outlets 86 in the lighter 85, to insure a quick and positive lighting of the gas discharging from the openings 86 which lighted gas in turn ignites the mixture of gas and air discharging from the individual burners of the multiple burner.

For the purpose of preventing overheating of the combustion chamber, I have provided a thermostatic rod 96 shown in Figure 16 which rod is disposed within a relatively non-expansible tube 97. The tubes 97 and 88 are preferably enclosed within a shield 98, however upon excessive heat in the combustion chamber, the thermostatic rod 96 expands longitudinally and opens a suitable switch 99 breaking the connection between conductors 101 and 102. As any suitable switch may be used, the details of such a switch are not herein illustrated or described. It will be understood that when the thermostatic element 96 again cools, the switch 99 again closes and the conductors 101 and 102 are again electrically connected.

In order to insure that gas will not be discharged into the combustion chamber of the boiler without sufficient supply of air for the complete combustion of the gas, I have provided suitable controlling means. An electric motor 103 is provided which operates an air blower or fan shown diagrammatically at 104 in Figures 1, 2, and 8. The blower 104 passes air through the conduit means 66 which conduit means is provided with an inner air tube 105 shown in Figure 12. The end of the tube 105 is normally closed by a lid 106 but is adapted to be lifted by the movement of air through the tube 105. If for any reason a backward force or explosion should occur in the combustion chamber, the lid 106 will close, to check the backward force. As shown in Figures 10, 11, and 12 the lid 106 is fixed to a rod 107 which passes through the conduit 66 and has secured on one end thereof a mercury tube 108 by means of a holder 109, such that when the lid is moved to the position shown in dotted lines in Figure 12, the mercury 111 in the tube 108 will flow to the opposite end of the tube and close a circuit through the electric conductors 112 and 113.

The closing of a circuit through conductors 112 and 113, completes a circuit through an electrically operated gas valve 114 by means of a motor 115 from which an electric conductor 116 extends to a conductor 117 which is connected to ground at 118.

Within the tube 105 shown in Figure 12, is disposed an air damper 121 mounted on a shaft 122 best shown in Figure 11, which shaft has on one end an arm 123 adapted to engage a de-

pending pin 124 on the rod 107 for facilitating the lifting of the lid 106 when the damper 121 is moved to the horizontal position shown in broken lines in Figure 12. The opposite end of the shaft 122 is provided with a weight 125 which normally holds the damper 121 in a substantially vertical position. Disposed on the end of the shaft 122 is a crank arm 126 having fixed thereto a crank element 127 adapted to be actuated by a timing mechanism for the lighter 85 as will be presently described.

A timing mechanism adapted to be actuated by a motor 128 disposed in the electric circuit of conductors 129 and 130, has a worm gear 131 on the armature shaft 132, which gear is adapted to drive a gear 133, which in turn actuates a timing gear 134 on a shaft 135 on which is also disposed a cam element 136. A lever arm 137 is pivoted at 138 on a rigid supporting member 139. Intermediate the ends of the arm 137, is provided a vertical projection or cam follower 141 which rides on the cam 136. The follower 141 is held in contact with the cam 136 by a coiled spring 142, in such a manner that the cooperating action of the spring 142 and the cam 136 causes the lever arm 137 to oscillate in a vertical plane upon rotation of the gear 134. Pivotally secured to the arm 137 intermediate its length, is a link member 143 extending to a valve 144 in the gas line 87 leading to the lighter 85. This link 143 best shown in Figures 13 and 1, is adapted to open and close the valve 144 by reason of its vertical movement. The link 143 comprises two vertically extending portions offset from each other by a horizontally extending portion, this arrangement being utilized for mechanical expediency only.

To the free end of the oscillating lever arm 137 shown in Figure 13, is pivotally secured a vertically extending switch actuating arm 145 movable through a guide member 146. The arm 145 is held against the guide portion or member 146 by a coiled spring 147. The extreme upper end of the arm 145 is provided with an outwardly turned end 148 adapted to serve as a cam when engaged by the end of the switch arm 149 for pressing the arm 145 outwardly and permits downward oscillation of the switch arm 149. Adjacent the upper end of the arm 145 is formed a cam portion 151 which upon upward movement of the arm 145 causes the same to move outwardly to the position shown in Figure 13. Upon downward movement of the arm 145, the cam portion 151 moves beneath the guide member 146 and the spring 147 draws the arm 145 sufficiently inwardly that the upper end 148 engages under the end of the switch arm 149 such that upon a subsequent upward movement of the arm 145, the switch arm 149 is oscillated upwardly. Secured adjacent the free end of the oscillating lever arm 137, is a link member 152 having a vertical slot 153 therein through which a screw 154 extends for adjustably locking a contact member 155 to the link 152. The contact member 155 engages the reduced end 156 on the shaft 127 shown in Figures 10, 11, 13, and 14, which shaft controls the movement of the air damper 121 on the shaft 122 best illustrated in Figure 12.

In order to effect the downward movement of the toggle switch arm 149, I have provided an L-shaped arm 156 pivoted at 157 to an oscillating link 158. A coiled spring 159 fixed at one end to a rigidly positioned element 161 and at the other end to a depending lug 162 on the link 158, normally urges the outer end of the link 158 downwardly. A coiled spring 163 engaging the L-shaped arm 156 and the link 158, serves to urge the vertical portion 164 of the arm 156 into contact with the toggle switch arm 129. Upon downward movement of the outer end of the link 158, the arm 156 is drawn downwardly while the spring 163 holds the upper arm thereof into contact with the toggle switch arm 149 for actuating the switch. In order to release the upper portion 164 of the arm 156 from the toggle switch arm, a pin 166 is provided in the arm 156, which pin is adapted to engage the upper surface of the link 158 as shown in Figure 13 whereby extreme downward movement of the arm 158 causes the upper end 164 of the arm 156 to be moved outwardly thereby disengaging the toggle switch arm sufficiently to permit the same to be moved upwardly by a subsequent upward movement of the controlling arm 145 on the oscillating lever arm 137 which is actuated by the cam 136 on the gear 134.

Adjacent the outer end of the link 158 is pivotally secured a depending link 167 shown in Figures 9 and 13 which link is pivotally secured at 168 to one end of the main valve actuating arm 169 shown in Figure 9. The arm 169 is pivoted at 171 to a support 172. A valve rod 173 on the actuating arm 169 is adapted to open and close the main gas valve in the gas line 54 disposed therebeneath. For actuating the arm 169 I employ a conventional mechanism of any suitable type herein illustrated as a motor 115 operating through a suitable train of gears to raise on a hook member 174 pivoted on the arm 169 for raising the same to actuate the gas valve. Also pivotally secured to one end of the arm 169 is a link 175 which is secured at 176 to an oscillating member 177 and on which is mounted a mercury switch element 178 such that when the motor 115 is actuated to open the gas valve, the oscillating arm 177 is moved upwardly or clockwise as shown in Figure 9 to close a circuit through the conductors 179 and 181 for closing a circuit through the timing mechanism by way of conductor 181, switch 182, and conductor 129 to the return conductor 130.

In Figure 17 I have shown a diagrammatic illustration of the wiring diagram, to which reference may be had for more clearly understanding the operation of this device. Numeral 185 designates an electric conductor extending from a suitable source of power not herein illustrated. When it is desired to actuate my improved gas heating mechanism, it is first necessary to close the main switch 184. Numerals 183 and 96 respectively designate a room thermostat and the heater thermostat which are actuated automatically at predetermined temperatures. Assuming that the temperature is sufficiently low that these thermostats close the circuit through the conductors 186, 101 and 102, to the blower motor 103, this motor operates the air blower indicated diagrammatically at 104. Air under pressure is thereby forced through the conduit means 66 and 105 which causes the air check valve 106 to open thereby oscillating the mercury switch 108 closing a circuit through conductor 112 and 113 to the main gas valve motor 115 which upon actuation opens the valve and closes the circuit by the mercury switch 178 through conductors 179 and 181 to the switch 182 which switch is actuated by the valve operating arm 169 through the associated link 167 and 158 together with the arm 156 the upper end of which 164 is provided with a hook portion engageable over the

pin 191 of the oscillating switch arm 149 of the switch 182 shown diagrammatically in Figure 17. Upon the closing of switch 182, a circuit is completed through conductor 129 through the timer motor 128 and through the return conductor 130 to ground at 118. This latter circuit causes the motor 128 to operate thereby rotating the gears 133 and 134 to oscillate the arm 137 by means of the cam 136 on the shaft 135 of the gear 134. As this cam rotates, the arm 137 is moved downwardly and through suitable linkage mechanism 143, causes the valve 144 to open the gas line to the lighting device for the main burner. The time required for one rotation of the stem 136 is a small interval of time as may be required such for instance as some ten to twenty seconds. As the cam 136 completes one revolution, the arm 137 again assumes its uppermost position moving with it the link 143 to close the valve 144 and at the same time vertically moving the switch control arm 145 which engages beneath the pin 191 on the oscillating switch arm 149 to oscillate the switch to the position shown in Figure 13 and open the same thereby breaking the circuit through the motor 128 and stopping the timing mechanism.

When the main switch 184 is first closed, the gas line 195 to the pilot 93 is open and the pilot is lighted which upon operation of the timing device as above pointed out ignites the gas from the lighter which gas is directed over the ends of the individual burners illustrated in Figure 3 to light the main burner. When the main gas valve is opened by the motor 115, gas passes through the conduit 54 and through the mixing chamber 51 to the individual burners 83 which are ignited in the manner hereinbefore set forth in detail. When the electric circuit through the motor 103 is broken either by the main switch 184 or by either of the thermostats, by reason of excessive temperature in the room to be heated or in the heater itself, the motor 103 stops permitting the air check valve 106 to close breaking the circuit through the gas motor 115. When the circuit to this motor is broken, the necessary torque required to hold the valve open, ceases and the valve is automatically closed by a reverse movement of the motor and the train of gears associated therewith caused by a suitable closing spring not shown which acts on the valve rod 173 to close the valve.

In addition to the above described air check valve 106 for preventing a return force through the conduit means 66, we have provided an additional check valve 196 which serves as an added safety in case of backfire.

From the foregoing description it will be appreciated by those skilled in the art that our invention as herein illustrated and described is susceptible of modifications without departing from the principle of the invention and we desire that the patent to be granted hereon shall not be limited except as required by the prior art.

We claim as our invention:

1. A gas burner comprising a hollow gas supply member, a longitudinally disposed partition element in said supply member adjacent one end thereof, said supply member having apertures in the sides along the edges of said partition element, said partition element having slots in its edges extending to the outer end of the partition element, for receiving air through the apertures in the supply member to permit the introduction of air between the gas discharging on opposite sides of the partition, and prevent the formation of a vacuum at the outer end of the burner.

2. A gas burner comprising a hollow gas supply member, a longitudinally disposed partition element in said supply member adjacent one end thereof, said supply member having apertures in the sides along the edges of said partition element, said partition element having slots in its edges extending to the outer end of the partition element, for receiving air through the apertures in the supply member to permit the introduction of air between the gas discharging on opposite sides of the partition, and prevent the formation of a vacuum at the outer end of the burner and means disposed about said supply member for delivering air adjacent the outer end thereof.

3. In a gas burner unit comprising a central mixing chamber, means for introducing gas into said chamber, an air chamber surrounding said mixing chamber, there being perforations through the bottom of the mixing chamber for the entrance of air, a plurality of burners associated with said chambers and including a supply member for each burner communicating with said mixing chamber to receive commingled gas and air therefrom, and an air conduit for each said burners disposed about the outer portion of said supply member, being fully open at the end and terminating short of the end of said supply member and communicating with said air chamber.

4. In a gas burner unit comprising a central mixing chamber, means for introducing gas into said chamber, an air chamber surrounding said mixing chamber, there being perforations through the bottom of the mixing chamber for the entrance of air, a plurality of burners associated with said chambers and including a supply member for each burner communicating with said mixing chamber to receive commingled gas and air therefrom, and an air conduit for each said burners disposed about the outer portion of said supply member, being fully open at the end and terminating short of the end of said supply member and communicating with said air chamber and means for delivering air under pressure to said air chamber.

5. In a gas burner unit comprising a central mixing chamber, means for introducing gas into said chamber, an air chamber surrounding said mixing chamber, there being perforations through the bottom of the mixing chamber for the entrance of air, a plurality of burners associated with said chambers and including a supply member for each burner communicating with said mixing chamber to receive commingled gas and air therefrom, and an air conduit for eacn said burners disposed about the outer portion of said supply member, being fully open at the end and terminating short of the end of said supply member and communicating with said air chamber and a supplemental air chamber surrounding the outer ends of said burners.

6. In a gas burner unit comprising a central mixing chamber, means for introducing gas into said chamber, an air chamber surrounding said mixing chamber, there being perforations through the bottom of the mixing chamber for the entrance of air, a plurality of burners associated with said chambers and including a supply member for each burner communicating with said mixing chamber to receive commingled gas and air therefrom, and an air conduit for each said burners disposed about the outer portion of said supply member, being fully open at

the end and terminating short of the end of said supply member and communicating with said air chamber, a supplemental air chamber surrounding the outer ends of said burners and refractory baffles in said supplemental air chamber in the path of flame from said burners.

7. In a gas burner unit comprising a central mixing chamber, means for introducing gas into said chamber, an air chamber surrounding said mixing chamber, there being perforations through the bottom of the mixing chamber for the entrance of air, a plurality of burners associated with said chambers and including a supply member for each burner communicating with said mixing chamber to receive commingled gas and air therefrom, and an air conduit for each said burners disposed about the outer portion of said supply member, being fully open at the end and terminating short of the end of said supply member and communicating with said air chamber, a water jacket disposed about said air chamber and having apertures therethrough for receiving said air conduit.

8. In a gas burner unit comprising a central mixing chamber, means for introducing gas into said chamber, an air chamber surrounding said mixing chamber, there being perforations through the bottom of the mixing chamber for the entrance of air, a plurality of burners associated with said chambers and including a supply member for each burner communicating with said mixing chamber to receive commingled gas and air therefrom, and an air conduit for each said burners disposed about the outer portion of said supply member, being fully open at the end and terminating short of the end of said supply member and communicating with said air chamber, a water jacket disposed about said air chamber and having apertures therethrough for receiving said air conduit and a supplemental air chamber surrounding the outer ends of said burners.

9. In a gas burner unit comprising a central mixing chamber, means for introducing gas into said chamber, an air chamber surrounding said mixing chamber, there being perforations through the bottom of the mixing chamber for the entrance of air, a plurality of burners associated with said chambers and including a supply member for each burner communicating with said mixing chamber to receive commingled gas and air therefrom, and an air conduit for each said burners disposed about the outer portion of said supply member, being fully open at the end terminating short of the end of said supply member and communicating with said air chamber, a water jacket disposed about said air chamber and having apertures therethrough for receiving said air conduit, a supplemental air chamber surrounding the outer ends of said burners, and refractory baffles in said supplemental air chamber in the path of flame from said burners.

10. In a gas burner unit comprising a mixing chamber, means for introducing gas into said chamber, a water jacket disposed about and spaced from said mixing chamber, providing an air chamber therebetween, a plurality of gas burners extending through the water jacket and disposed to receive commingled gas and air from the mixing chamber, and additional air from the air chamber, a source of air supply, and means for proportioning the air supply to each chamber.

11. In a gas burner unit comprising a mixing chamber, means for introducing gas into said chamber, a water jacket disposed about and spaced from said mixing chamber, providing an air chamber therebetween, a plurality of gas burners extending through the water jacket and disposed to receive commingled gas and air from the mixing chamber, and additional air from the air chamber and a plurality of refractory baffles spaced apart and disposed vertically in the path of flame from the gas burners and at an acute angle to the direction of extension of the burners.

12. In a gas burner unit comprising a mixing chamber, means for introducing gas into said chamber, a water jacket disposed about and spaced from said mixing chamber, providing an air chamber therebetween, a plurality of gas burners extending through the water jacket and disposed to receive commingled gas and air from the mixing chamber, and additional air from the air chamber, the bottom of the mixing chamber being the top of a second air chamber and having perforations therethrough to permit the entrance of air to the mixing chamber from the second air chamber and a plurality of refractory baffles spaced apart and disposed vertically in the path of flame from said gas burners and at an acute angle to the direction of extension of said burners.

13. In a gas burner unit comprising a mixing chamber, means for introducing gas into said chamber, a water jacket disposed about and spaced from said mixing chamber, providing an air chamber therebetween, a plurality of gas burners extending through the water jacket and disposed to receive commingled gas and air from the mixing chamber, and additional air from the air chamber, means for delivering air under pressure to said chambers and means for regulating the relative amounts of air being delivered to each of the chambers.

14. In a gas burner unit comprising a mixing chamber, means for introducing gas into said chamber, a water jacket disposed about and spaced from said mixing chamber, providing an air chamber therebetween, a plurality of gas burners extending through the water jacket and disposed to receive commingled gas and air from the mixing chamber, and additional air from the air chamber, means for delivering air under pressure to said chambers and means for regulating the relative amounts of air being delivered to each of the chambers and a plurality of refractory baffles disposed in the path of flame from the gas burners and at an angle to the direction of extension of said burners.

15. In a gas burner unit comprising a mixing chamber, means for introducing gas into said chamber, a water jacket disposed about and spaced from said mixing chamber, providing an air chamber therebetween, a plurality of gas burners extending through the water jacket and disposed to receive commingled gas and air from the mixing chamber, and additional air from the air chamber, the bottom of the mixing chamber being the top of a second air chamber and having perforations therethrough to permit the entrance of air to the mixing chamber from the second air chamber, means for delivering air under pressure to said chambers and means for regulating the relative amounts of air being delivered to each of the chambers.

16. In a gas burner unit comprising a mixing chamber, means for introducing gas into said chamber, a water jacket disposed about and spaced from said mixing chamber, providing an air chamber therebetween, a plurality of gas burners extending through the water jacket and

disposed to receive commingled gas and air from the mixing chamber, and additional air from the air chamber, the bottom of the mixing chamber being the top of a second air chamber and having perforations therethrough to permit the entrance of air to the mixing chamber from the second air chamber, means for delivering air under pressure to said chambers and means for regulating the relative amounts of air being delivered to each of the chambers, and a plurality of refractory baffles disposed in the path of flame from said gas burners and at an angle to the direction of extension of said burners.

17. In a gas heater in combination, a multiple gas burner and a plurality of water chambers for containing water to be heated, said multiple gas burner comprising a centrally disposed mixing chamber and a plurality of individual burners extending radially from said mixing chamber, separate means for delivering gas and air to said mixing chamber, refractory means comprising a separate baffle for each individual burner, and arranged in spaced relation and at a small angle to a radial direction and disposed to be impinged by flame from said multiple burner, said water chambers being disposed below and above said refractory means, and means providing communication between said water chambers.

18. In a gas heater in combination, a multiple gas burner and a plurality of water chambers for containing water to be heated, said multiple gas burner comprising a centrally disposed mixing chamber and a plurality of individual burners extending radially from said mixing chamber, separate means for delivering gas and air to said mixing chamber, refractory means disposed to be impinged by flame from said multiple burner, said water chambers being disposed below and above said refractory means, and means providing communication between said water chambers and another water chamber disposed inwardly of said refractory means to receive radiant heat therefrom.

19. In a gas heater in combination, a centrally and vertically disposed multiple gas burner and a plurality of water chambers for containing water to be heated, refractory means comprising a plurality of individual baffles arranged in spaced relation and at a small angle to a radial direction and disposed to be impinged by flame from said multiple burner, said water chambers being disposed above and below said refractory means, and means providing communication between said water chambers.

20. In a gas heater in combination, a multiple gas burner and a plurality of water chambers for containing water to be heated, refractory means disposed to be impinged by flame from said multiple burner, said water chambers being disposed above and below said refractory means, and means providing communication between said water chambers and other water chambers disposed respectively inwardly of said refractory means and outwardly of said refractory means to receive radiant heat therefrom.

21. In a gas heater in combination, a multiple gas burner and a plurality of water chambers for containing water to be heated, said multiple gas burner comprising a centrally disposed mixing chamber and a plurality of individual burners extending radially from said mixing chamber, separate means for delivering gas and air to said mixing chamber, refractory means disposed to be impinged by flame from said multiple burner, said water chambers being disposed below and above said refractory means, and means providing communication between said water chambers and other water chambers disposed respectively inwardly of said refractory means and outwardly of said refractory means to receive radiant heat therefrom.

22. In a gas burner, a centrally disposed mixing chamber for gas and air, a plurality of burner outlets therefrom, means for separately delivering gas and air to said mixing chamber, means for separately delivering secondary air enveloping each of said burners, and means for introducing a portion of the secondary air into the center of the flame beyond the ignition zone at the end of said burners.

23. In a gas burner, a mixing chamber for gas and air, a burner outlet therefrom, means for separately controlling the introduction of gas and air into said mixing chamber, means for separately delivering secondary air as an annular sheath surrounding the flame issuing from said burner, and means for introducing a portion of the secondary air into the center of the flame beyond the ignition zone at the burner outlet.

24. In a gas burner, a mixing chamber for gas and air, a burner outlet therefrom, means for separately controlling the introduction of gas and air into said mixing chamber, means for separately delivering secondary air as an annular sheath surrounding the flame issuing from said burner, and means for introducing secondary air into the center of the flame beyond the ignition zone at the burner outlet.

25. In a gas burner, a mixing chamber for gas and air, a burner outlet therefrom, means for separately controlling the introduction of gas and air into said mixing chamber, means for separately delivering secondary air as an annular sheath surrounding the flame issuing from said burner, and means for introducing a portion of the secondary air into the center of the flame at the burner outlet.

26. In a gas burner, a mixing chamber for gas and air, a burner outlet therefrom, means for separately controlling the introduction of gas and air into said mixing chamber, means for separately delivering secondary air as an annular sheath surrounding the flame issuing from said burner, and means for introducing secondary air into the center of the flame at the burner outlet.

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