May 8, 1962 J. T. DONER ET AL 3,033,463

THERMOSTATIC CONTROL OF GAS RANGE BURNERS

Filed April 28, 1958 2 Sheets-Sheet 1

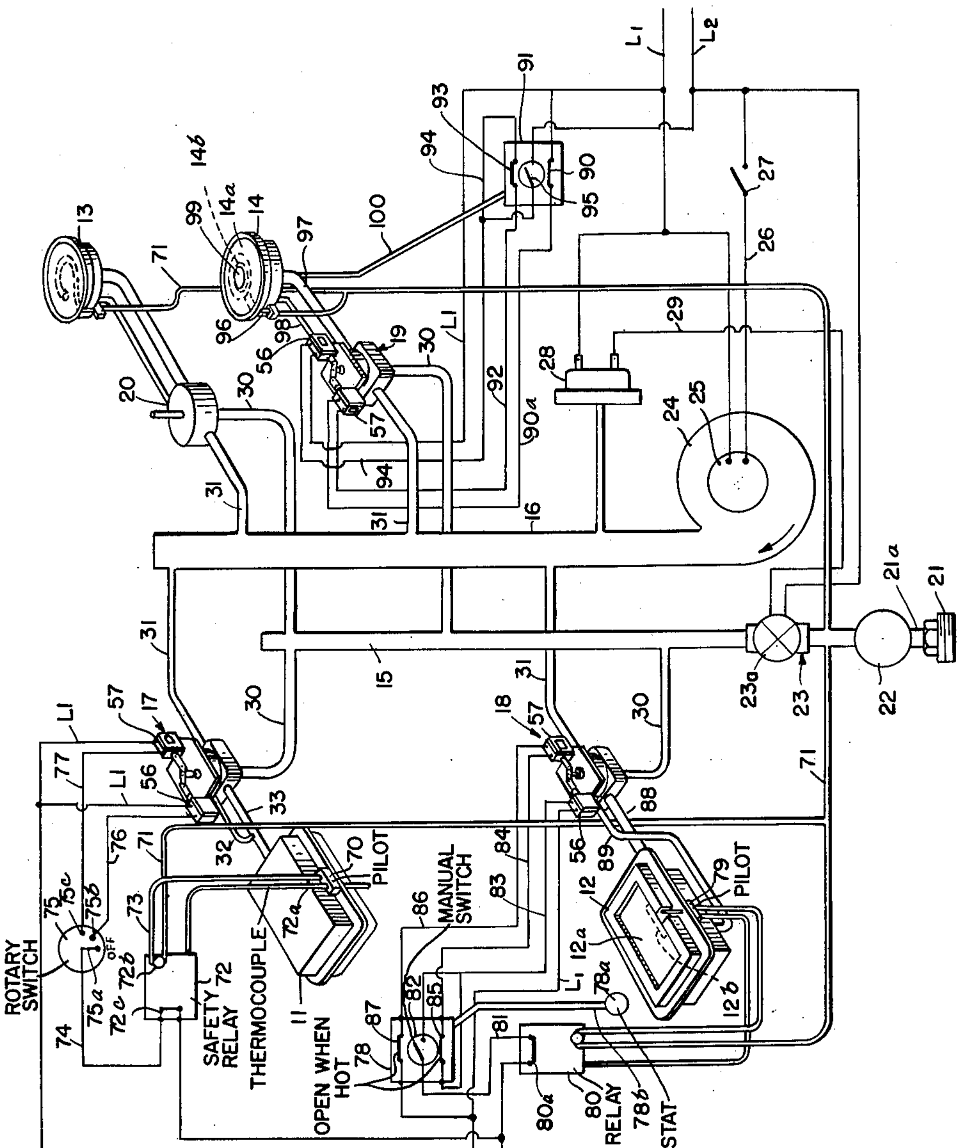

FIG. 1

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FIG. 2

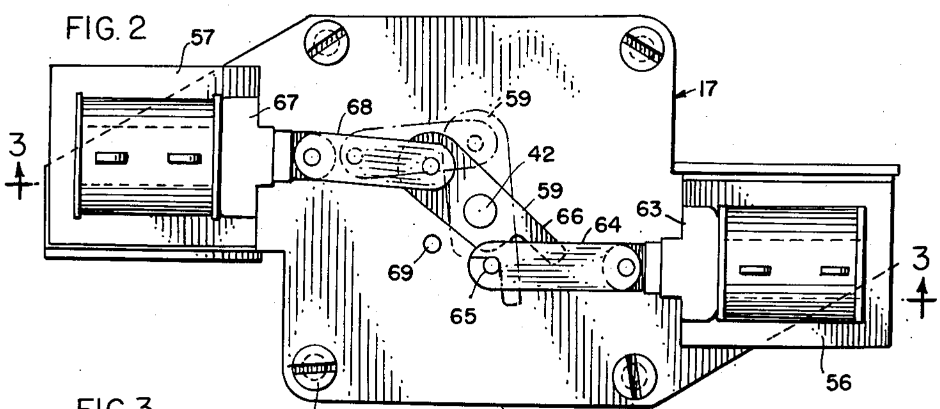


FIG. 3

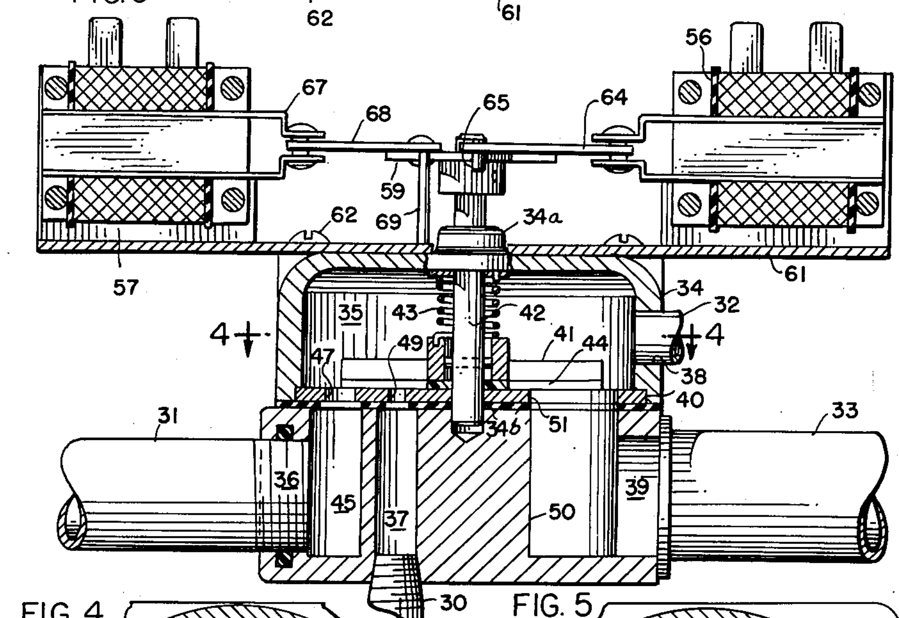


FIG. 4

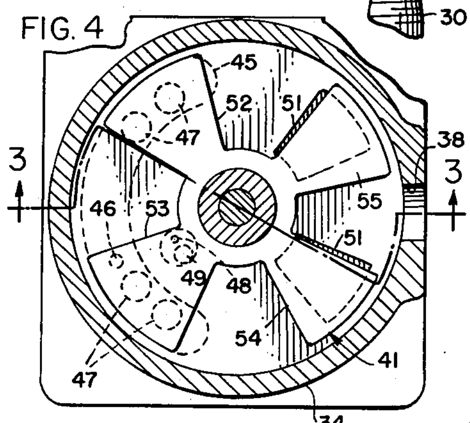
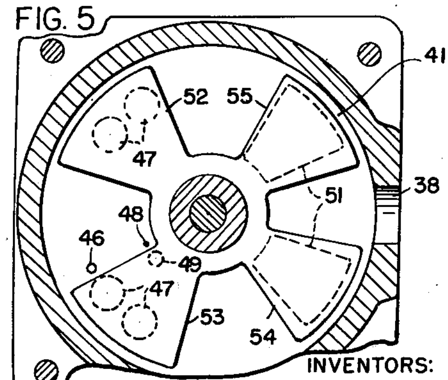


FIG. 5



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THERMOSTATIC CONTROL OF GAS RANGE BURNERS

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1 Claim. (Cl. 236—1)

This invention relates to gas ranges.

The presently conventional range utilizes secondary air to support combustion at the burners, control of the heat produced being effected by modulating the gas flow to the burner by suitable controls such as thermostatic controls. We have found, however, that the improved efficiency of operation of power burners utilizing only pressurized primary air makes it highly desirable to utilize power burners in such range applications in lieu of the relatively inefficient secondary air type burners. However, the delivery of the gas-primary air mixture to the power burner presents a relatively complex problem. It is necessary to control the gas flow. It is also preferable to control the air flow and maintain the proper ratio of air-to-gas in each of different predetermined combustion conditions. The present invention provides these controls.

The principal feature of this invention is to provide a new and improved gas heating means.

Another feature is the provision of such a heating means having new and improved means for controlling operation of a power burner.

A further feature is the provision of such a heating means including a new and improved mixing valve for controlling the operation of the power burner.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a schematic representation of an arrangement in a gas range of heating means including control apparatus embodying the invention;

FIG. 2 is a plan view of a mixing valve thereof, shown in a "Low Heat" arrangement in full lines and a "High Heat" arrangement in broken lines;

FIG. 3 is a vertical section taken approximately along the line 3—3 of FIG. 2, showing the valve shutter means in the "High Heat" position;

FIG. 4 is a fragmentary section taken approximately along the line 4—4 of FIG. 3, but showing the valve shutter means in an "Off" position; and

FIG. 5 is a fragmentary section generally similar to that of FIG. 4, the valve shutter means being shown in a "Low Heat" position.

In the exemplary embodiment of the invention, as disclosed in the drawing, the heating elements of a range comprise a broiler power burner **11**, an oven power burner **12**, a manually controlled surface power burner **13**, and a thermostatically controlled surface power burner **14**. A mixture of combustible gas and primary air is delivered to the burners from a gas manifold **15** and an air manifold **16**. To control the delivery of the gas-air mixture to the burners and to assure accurate maintenance of the proper gas-to-air ratio in the mixture, similar automatic mixing valves **17**, **18** and **19** are associated with broiler burner **11**, oven burner **12**, and thermostatically controlled surface burner **14**, respectively. A manually operable mixing valve **20** is associated with surface burner **13**. Each of the burners includes low heat means and high heat means, the associated valve functioning to preclude the delivery of the air-gas mixture to the burner in an "Off" condition, provide a limited delivery of air-gas mixture to the low heat means, in a "Low Heat" condition, and provide a large delivery of air-gas mixture to the high heat means concurrently with a delivery of air-gas mixture to the low heat means in a "High Heat" condition.

As indicated above, the combustible gas and air are delivered to the mixing valves from gas manifold **15** and air manifold **16**. Combustible gas is supplied to the gas manifold from a gas supply (not shown) connected by means of a conventional fitting **21** to a duct **21*a*** leading through a suitable pressure regulator **22** and a normally closed solenoid valve **23**. Air is delivered under pressure to manifold **16** from a blower **24** driven by a motor **25**. Motor **25** is connected directly to one power supply line **L1** and to the opposite power supply line **L2** through a lead **26** and a disconnect switch **27**. To assure that a proper air supply is available for mixture with the combustible gas in the mixing valves, operation of gas solenoid valve **23** is controlled by a pressure switch **28** which, when a proper predetermined air pressure exists within manifold **16**, closes a circuit from line **L1** through a lead **29** to one side of the solenoid **23*a*** of solenoid valve **23**. The other side of the solenoid **23*a*** is connected directly to line **L2** to complete the circuit.

Gas is delivered from manifold **15** to each of the mixing valves through an inlet duct **30** and air is delivered from manifold **16** to each of the inlet valves by an inlet duct **31**. It is the function of the individual mixing valves to mix the combustible gas and air in the proper proportion to effect theoretically perfect combustion in the associated burner. From the mixing valve, the air-gas mixture is delivered to the associated burner through suitable duct means such as low heat duct **32** and high heat duct **33** associated with burner **11**. Each of the burners comprises a burner plate formed of a porous material, such as disclosed in the Bone et al. Patent No. 1,223,308 issued April 17, 1917.

Mixing valves **17**, **18** and **19** are identical in construction, thus a detailed description of one such valve, namely valve **17**, will suffice for all. Referring now more specifically to FIGS. 2 throough 5, mixing valve **17** comprises a valve body **34** defining a mixing chamber **35**, an air inlet chamber **36**, a gas inlet chamber **37**, a first, low heat outlet **38** and a second, high heat outlet **39**. An orifice plate **40** extends transversely across the inner ends of inlets **36** and **37**, and outlet **39** and is sealed to valve body **34** by a suitable gasket **34*b***. A shutter plate **41** is associated with the orifice plate **40** to control the flow of gas and air through the orifice plate into chamber **35** and the flow of the mixed gas and air from the chamber through the orifice plate to the high heat duct **33**. Shutter plate **41** is fixed to a shaft **42** extending outwardly through a seal **34*a*** in body **34**, and urged by a spring **43** into sliding facial engagement with orifice plate **40**. Spring **43** is secured to the shutter plate and to body **34** in such manner as to bias the shutter plate and, thus, shaft **42** in a clockwise direction, as seen in FIG. 2. To facilitate the sliding action between the shutter and orifice plates, and to assure a proper seal therebetween, the shutter plate is provided with a gasket **44** formed of a low friction resilient sealing material such as nylon. A valve structure broadly similar to the instant valve structure is that disclosed and claimed in the co-pending application of J. K. Lamp Jr. and C. R. Van Der Aue, Serial No. 721,809, filed March 17, 1958, and assigned to the assignee of the instant application.

The portion of inlet **36** directly under orifice plate **40** comprises an upwardly opening arcuate recess **45**. The portion of orifice plate **40** overlying recess **45** is provided with a plurality of openings, namely a small low heat opening **46**, and a plurality of larger high heat openings **47** arranged in spaced pairs over opposite ends of the recess **45**. The orifice plate is further provided with a pair of gas orifices overlying the cylindrical gas inlet **37**. The gas orifices comprise a small, low heat orifice **48** radially aligned with low heat orifice 46 relative to the axis of shaft 42, and a larger, high heat orifice 49 radially aligned with one of the air high heat orifices 47. The inner end of high heat outlet 39 comprises an upwardly opening arcuate recess 50, and orifice plate 40 is provided with a pair of spaced openings 51 overlying recess 50 adjacent the ends thereof.

Shutter plate 41 (including gasket 44 thereof) comprises a plurality of circumferentially spaced, radially extending shutters 52, 53, 54 and 55. In the "Off" position of the valve, as seen in FIG. 4, shutter 52 overlies one pair of high heat air orifices 47, and shutter 53 overlies gas orifices 48 and 49, low heat air orifice 46 and the remaining pair of high heat air orifices 47. At the same time, shutters 54 and 55 are slightly displaced from an overlying relationship with outlet openings 51, wherein mixing chamber 35 is slightly vented through the main outlet duct 33.

To arrange valve 17 for a "Low Heat" operation, the shutter plate 41 is rotated slightly counterclockwise to the "Low Heat" position of FIG. 5. In this position, shutter 52 remains in overlying relationship to the clockwise pair of high heat air orifices 47, and shutter 53 remains in overlying relationship to the other pair of high heat air orifices 47, and the high heat gas orifice 49. When positioned as in FIG. 5, shutters 54 and 55 overlie outlet openings 51 thereby precluding flow to the main outlet duct 33. However, in this position shutter 53 is no longer in overlying relationship to low heat air orifice 46 and low heat gas orifice 48 and thus a small volume of combustible gas and air is permitted to enter mixing chamber 35 wherein the gas and air are mixed and delivered through low heat outlet 38 and low heat duct 32 to the associated burner.

To effect a "High Heat" operation of the power burner, shutter plate 41 is rotated in a counterclockwise direction beyond the position of FIG. 5 until the shutters 52, 53, 54 and 55 are disposed intermediate the orifices and openings in orifice plate 40, thereby opening all of the orifices and openings in the orifice plate. Then air enters chamber 35 through all of the air orifices 46 and 47 and gas enters the chamber through both gas orifices 48 and 49. The mixed gas and air pass from the mixing chamber 35 through both the low heat outlet 38 and the high heat outlet 39.

Means for automatically positioning the shutter plate 41 in each of the "Off," "Low Heat," and "High Heat" positions comprise a pair of solenoids 56 and 57 and spring 43. The solenoids are arranged to operate a link 59 fixed to the outer end of shaft 42 and are fixed to a mounting plate 61 secured to the top of valve body 34 by screws 62. The plunger portion 63 of low heat solenoid 56 is provided with an arm 64 having a depending pin 65 engaging a finger 66 at one end of link 59 when the valve is in the "Off" and "Low Heat" positions. High heat solenoid 57 is mounted on plate 61 opposite low heat solenoid 56 (relative to shaft 42) and is provided with a plunger 67 having an arm 68 pivotally connected to the end of link 59 opposite the end defined by finger portion 66.

When neither of solenoids 56 or 57 is energized, spring 43 urges link 59 in a clockwise direction, as viewed in FIG. 2, to abut a stop 69 upstanding from plate 61 and position shutter plate 41 as seen in FIG. 4, thereby placing the valve in the "Off" condition. When solenoid 56 is energized, plunger 63 is drawn to the right, as seen in FIG. 2, and pin 65 on arm 64 forces finger 66 in a counterclockwise direction to the position shown in broken lines in FIG. 2, thereby positioning shutter plate 41 in the "Low Heat" position of FIG. 5. When solenoid 57 is energized, plunger 67 thereof moves to the left, as seen in FIG. 2, pulling arm 68 to the left to swing link 59 to its extreme counterclockwise movement, as seen in full lines in FIG. 2, whereby shutter plate 41 is moved to the position wherein the shutters are disposed intermediate the orifices and openings of the orifice plate 40, thereby placing the valve in the "High Heat" condition. De-energization of solenoid 57 permits spring 43 to return link 59 to the low heat position, as shown in broken lines in FIG. 2, and subsequent de-energization of solenoid 56 permits spring 43 to return the link to the "Off" position wherein it abuts stop 69.

Referring now to FIG. 1, the operation of broiler burner 11 and associated mixing valve 17 will be described. To ignite the combustible gas in burner 11, a pilot 70 is associated therewith. Gas is delivered to pilot 70 from a distribution duct 71 connected to duct 21*a* on the inlet side of valve 23, a safety relay 72, and a delivery tube 73. A thermocouple device 72*a* is connected to safety relay 72 and operates the safety relay to close a valve 72*b* thereof connecting distribution duct 71 with tube 73, preventing further delivery of gas to the pilot should the flame thereof be extinguished. Safety relay 72 further includes a normally closed switch 72*c* connected in series with line L2 and a lead 74 connected to the moving contact 75*a* of a single pole, three position rotary switch 75. Movable contact 75*a* is selectably closable with a first fixed contact 75*b* connected to one side of solenoid 56 by a lead 76, and a second fixed contact 75*c* connected to one side of solenoid 57 by a lead 77. The other side of each solenoid is connected electrically to line L1 to complete the circuit. When switch 75 is manually adjusted to the position wherein contact 75*a* is in an "Off" position, as seen in FIG. 1, neither of solenoids 56 or 57 is energized and the mixing valve is arranged in the "Off" condition, as shown in FIG. 4. To effect a "Low Heat" operation of the broiler burner 11, such as for barbecuing, switch 75 is adjusted to close moving contact 75*a* with first fixed contact 75*b*, thereby establishing a circuit through solenoid 56, and arranging the mixing valve in the condition of FIG. 5. Thus, gas and air are delivered to the mixing chamber 35 thereof through openings 48 and 46, respectively, and the resultant mixture is delivered from the mixing chamber to broiler burner 11 through joined ducts 32 and 33. To effect a "High Heat" operation of broiler burner 11, such as for broiling, switch 75 is manually adjusted to close movable contact 75*a* with fixed contact 75*c*, energizing solenoid 57 and rotating the shutter plate 41 to the position where all of the orifices and openings in orifice plate 40 are uncovered, thereby delivering a predetermined large volume of gas and air mixture through ducts 32 and 33 to the broiler burner.

The operation of oven burner 12 and associated mixing valve 18 is modified somewhat from the operation of broiler burner 11, by the inclusion of a thermostat switch 78 in the associated control circuits. Switch 78 is thermostatically controlled by a thermoresponsive device 78*a* of conventional construction connected thereto by a connector 78*b*. Switch 78 effects a temperature regulation of oven 12 by a cyclical operation of high heat solenoid 57 of the mixing valve 18 while maintaining low heat solenoid 56 thereof continuously energized. Oven burner 12 is provided with a pilot 79 and a safety relay 80 functioning similar to pilot 70 and relay 72 associated with broiler burner 11. The normally closed switch 80*a* of safety relay 80 is connected in series from line L2 through a lead 81, a single pole, single throw manual switch 82, and a lead 83 to one side of low heat solenoid 56. Switch 82 may be manually operable or automatically operable by means such as an electric timer (not shown) as desired. The other side of solenoid 56 is connected directly to line L1. One side of high heat solenoid 57 is connected to lead 83 by a lead 84 and a thermostatically operated contact 85 of thermostat means 78. The other side of solenoid 57 is connected through a lead 86 and a second thermostatically operated contact 87 of switch 78 to line L1. To effect the desired operation of oven 12, manual switch 82 is closed. Thermostat contacts 85 and 87 of switch 78 are operated by thermostat 78*a*. Contacts 85 and 87 are normally closed and, thus, high heat solenoid **57** is energized to effect a "High Heat" delivery of gas-air mixture concurrently through a high heat duct **88**, to a main burner portion **12a** of burner **12**, and a low heat duct **89**, to a low heat portion **12b** of burner **12**. When the temperature of the oven reaches a predetermined upper value as set by thermostat means **78**, contacts **85** and **87** thereof open, thereby deenergizing solenoid **57**. However, as switch **82** is closed, solenoid **56** remains energized continuing a "Low Heat" delivery of gas-air mixture through duct **89** to low heat portion **12b** of burner **12**. Illustratively, valve **18** may deliver sufficient gas-air mixture in the "Low Heat" operation to provide approximately 1,500 B.t.u. per hour in the oven, and maintain the oven temperature at a minimum of 200 degrees Fahrenheit. Thus, the maintenance of the desired temperature in the oven is effected by a cyclical on-and-off operation of the high heat function under the control of the thermostat means **78** which operates, after the initial elevation of the temperature to the predetermined upper temperature, to cycle the high heat solenoid **57** rather than by modulating the gas-air delivery to the oven burner, a lower predetermined temperature of the oven during which said cycling may take place being the temperature provided by the "Low Heat" operation.

The operation of surface burner **14** and associated mixing valve **19** is generally similar to that of oven burner **12** and associated mixing valve **18**, except that no safety relay is associated therewith, contact **90** of the thermostat switch **91** being connected directly to line L1. Thus, one side of solenoid **57** is connected through a lead **90a** and the first thermostatically controlled contact of switch **91** to line L1, and the other side of solenoid **57** is connected by a lead **92**, through the second thermostatically controlled contact **93**, a lead **94**, and a single pole, single throw switch **95** to line L2. One side of solenoid **56** is connected to lead **94** and the other side of the solenoid is connected directly to line L1. Surface burner **14** is provided with a pilot **96** and the gas-air mixture is delivered to a main burner portion **14a** of the burner by a high heat duct **97** and to a low heat portion **14b** thereof by a low heat duct **98**. The burner may be provided with a thermal sensing element **99** associated with thermostat switch **91** by a connection **100** to effect opening of contacts **90** and **93** of the thermostat whenever an upper predetermined temperature is reached at the burner. Thus, a desired temperature is maintained with surface burner **14** by an on-and-off cyclical operation of thermostat switch **91** to effect a cyclical operation of high heat solenoid **57**, solenoid **56** remaining energized to provide a maintained low heat operation continuously during use of the surface burner **14**. Illustratively, during a "Low Heat" operation, burner **14** may provide approximately 600 B.t.u. per hour, while in the "High Heat" operation the burner may provide approximately 1,000 B.t.u. per hour. As in the oven operation, the maintenance of the desired temperature by surface burner **14** is obtained by discontinuous, or on-and-off operation of the high heat means rather than by modulating the gas-air delivery.

As no modulation of the gas-air delivery is required, the control means for effecting automatic operation of the power burners is simple and economical, and employs conventional, readily available control parts. The novel mixing valves combine in one unit the control means for both the air and gas and assure a proper ratio thereof in the mixture delivered to the burners. To illustrate the invention, we have shown a range structure provided with a broiler, an oven, an automatic surface burner, and a manually controlled surface burner. It should be understood, however, that these or similar units may be utilized individually or in different combinations within the scope of the invention.

While we have shown and described certain embodiments of our invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claim.

We claim:

In a range, heating means comprising: a power burner; means defining a mixing chamber having a first inlet for delivering air under pressure to said chamber, a second inlet for delivering combustible gas under pressure to said chamber, a first outlet for delivering a mixture of air and combustible gas under pressure from said chamber at a fixed preselected high rate, a second outlet for delivering a mixture of air and combustible gas under pressure from said chamber at a fixed preselected low rate; means for conducting the mixtures of air and combustible gas from said outlets to said power burner; means providing a plurality of orifices across each of said inlets; a control member arranged in one position to close said second outlet and all of said inlet orifices, in a second position to close said second outlet and less than all of said inlet orifices, and in a third position to open said second outlet and all of said inlet orifices; and means for operating said control member to permit delivery of air and gas mixture through said second outlet continuously, permit delivery of air and gas mixture through said first outlet continuously until the temperature produced by the burner rises to a preselected upper temperature, and subsequently discontinue the delivery of air and gas mixture through said first outlet when the temperature produced by the burner drops to a lower preselected temperature, the temperature produced by the burner being subsequently maintained between said upper and lower preselected temperatures by the continuous delivery of air and gas mixture from the second outlet and the cyclical delivery of air and gas mixture from the first outlet.

References Cited in the file of this patent

UNITED STATES PATENTS

1,149,334	Bronder	Aug. 10, 1915
1,286,493	Bailey	Dec. 3, 1918
1,460,903	Haussler et al.	July 3, 1923
2,016,805	Kinnan	Oct. 8, 1935
2,051,401	Winterstein	Aug. 18, 1936
2,121,977	Newell	June 28, 1938
2,286,296	McGrath	June 16, 1942
2,341,177	Cope	Feb. 8, 1944
2,509,679	Evans	May 30, 1950
2,823,740	Morck	Feb. 18, 1958
2,840,153	Campbell et al.	June 24, 1958
2,885,151	Weber	May 5, 1959