The present invention relates to gas valves and particularly to thermostatic gas valves and associated controls for gas burners and has for its primary object the provision of a new and improved gas burner control including manually operable thermostatic valve particularly adapted for an oven burner of a domestic gas range used for baking and broiling but usable elsewhere in the control of a burner utilized to heat a space.

Another object of the present invention is the provision of a new and improved gas burner control including an adjustable thermostatic valve for an oven and providing positive gas shut-off, baking and a continuous flame broil, and in which temperature rise will not exceed a predetermined and safe value such as about 60° above the setting of the thermostatic valve in the event of certain malfunctions.

A further object of the present invention is the provision of a new and improved gas burner control including a combined shut-off and thermostatic valve for controlling the baking and broiling operations of an oven burner and selectively providing a modulating type of control for the broiler burner to maintain a selected temperature and which is constructed and arranged under runaway conditions to decrease the flow of gas to the burner to prevent the oven temperature from rising an excessive amount above the temperature setting of the thermostatic valve.

A further object of the invention is to provide a new and improved manually adjustable and thermostatically controlled valve constructed and arranged so that the temperature selected to be maintained by the valve will rise to a controlled amount, i.e., have a controlled runaway above that selected to be maintained.

Another object of the present invention is the provision of a new and improved valve of the character set forth in the preceding paragraphs in which the controlled runaway is provided by a thermostatically controlled auxiliary valve associated with and coming into operation when a main thermostatically controlled valve is closed, whereby the need for a fixed flow bypass around the main thermostatic valve is eliminated.

Another object of the invention is the provision of a valve that is extremely small in size, which can be made economically and which includes a stator or body and a disc type rotor, the latter being provided with radially extending slot or passageway for interconnecting inlet and outlet passageways in the body.

Another object of the invention is the provision of a valve having a body having on one side a surface with one or more valve seats and having on the opposite side a rotary disc facing surface that can both be flat lapped.

Another object is the provision of a gas valve with a control knob rotatable a full 360° between off and broil positions and having adequate seals in both the off and broil positions and in which the necessity of declutching of the valve stem from the rotor disc is eliminated.

In brief, the control and valve of the present invention is primarily adapted for a burner utilized for both baking and broiling in a domestic gas range oven although usable in other space heating installations. It provides positive gas shut-off, a continuous flame broil and a cycling or on-off type of baking operation and it is so constructed and arranged as to limit the temperature rise within the oven to about 60° (which may be termed a controlled runaway) above the thermostatic setting. The valve is utilized in conjunction with a control in which burner ignition and the supply of gas to the burner may be controlled by pilot burner means including a continuous pilot and a second pilot (although the two pilots may be combined as a single tubed pilot) which may operate as a heater and/or an ignitor pilot (hereinafter referred to as a heater pilot) and a flame sensing device responsive to the presence of a flame at the second pilot and arranged to open a first valve for the supply of gas to the burner in response to flame. Additionally, the system includes a conventional thermostat within the oven space for control of the thermostatic valve of the present invention. The latter is of the type including a manually operable shut-off and thermostatic valve. The thermostatic valve referred to as second valve, is actuated by the oven thermostat and it controls the flow of gas to the previously mentioned first valve which is operated by the flame sensing device. The combined shut-off and thermostatic valve are conjointly manually operable by a knob which not only opens the shut-off valve, referred to as a third valve but also selects or sets the temperature to be maintained in the oven. The arrangement is such that two different modes of operation are provided, one for baking and a second for broiling. When set for baking as in a range between 140° to 550° F., the thermostatic valve operates in a cycling or on-off manner to control the flow of gas to both the heater burner and first valve so that the first valve which is operated by the flame sensing device, is cyclically opened and closed. When set for broiling, usually above 550° F., gas is supplied continually to the heater pilot. Under these conditions the heater pilot is on continuously and the first valve open and the thermostatic valve provides a full flow of gas to the main burner for heat-up. The temperature generally determined by an adjustable discharge orifice is associated with the burner. Upon attainment of the selected broil temperature, a main valve element of the thermostatic valve is closed and a limited flow of gas is supplied in a modulated manner by an auxiliary valve. The auxiliary valve not only provides a modulated supply of gas to the broil burner, thereby to provide a continuous flame control, but it also is constructed and arranged...
so as to limit the temperature rise to about 60° above a selected temperature in the event of certain malfunctioning of the apparatus which may occur as a result of the flame detecting means maintaining the associated first valve open, something which may result from an unduly high oven temperature with the thermostat set for some low temperature or when the heater pilot maintains the flame sensing device operated and first valve open even though the thermostatic valve should have cut off the flow of gas to the heater pilot but does not do so. The valve of the present invention eliminates a continuous fixed bypass around the thermostatic valve that is generally used, provides a controlled runaway and can be made economically.

Features contributing to the latter include small size, a disc type valve having a disc engaging the seat, a disc extending radially from its axis, a valve body that has a valve seat and a disc engaging surface that can be flat lapped, and requiring no clutch between the control knob and stem and the shut-off valve.

Other objects and advantages of the present invention will be apparent from the ensuing description of an illustrative embodiment, in the course of which reference is had to the accompanying drawings, in which:

FIG. 1 is an elevational view of the valve of the present invention shown in conjunction with a diagrammatic and schematic illustration of an associated burner and control;

FIG. 2 is a top end view of the valve taken along the line 2—2 of FIG. 1 with the manual operating knob omitted;

FIG. 3 is a view of the opposite end of the valve taken along the line 3—3 of FIG. 1;

FIG. 4 is an enlarged axial cross-sectional view taken along the line 4—4 of FIG. 2 with the valve in the off position;

FIGS. 5 and 6 are plan views of the valve body casting taken along the lines 5—5 and 6—6 of FIG. 4;

FIG. 7 is an axial cross-sectional view through the body casting taken along the line 7—7 of FIG. 6;

FIG. 8 is somewhat diagrammatic illustration of the valve during the "heat up" when adjusted to provide a baking operation with the control knob turned to maintain a temperature between 140° and 550°;

FIG. 9 is a fragmentary view corresponding to FIG. 10 but with the heating requirements satisfied;

FIG. 10 is a view corresponding to FIG. 9 but with a higher temperature bake setting and illustrating operation controlling the runaway protection;

FIG. 11 illustrates the apparatus when adjusted for broil and during the "heat-up" period; and

FIG. 12 is a fragmentary view illustrating the valve adjusted for broiling and in which a modulated flow of gas is supplied to the burner to provide a continuous flame broil and runaway protection is afforded.

Referring now to the drawings and first to FIG. 1, the control and valve of the present invention are illustrated in conjunction with the oven 10 of a gas range 12. A gas burner 14, sometimes referred to as a main burner, used for both baking and broiling is shown mounted in the oven. Also mounted in the oven is a fluid type thermostat 16 which may be of known type and connected as by capillary tubing 18 to the valve of the present invention which is indicated as a whole by the reference character 20. Other types of thermostats may be used.

Ignition of the gas supply to the burner is shown as being effected as by pilot burner means 22. The means illustrated is what is generally termed the single tube type having a continuous pilot flame 24 and a larger igniter or heater pilot flame 26 which exists only at certain times and is ignited from the continuous pilot flame 24. Gas is supplied to the pilot burner means through tube 28. However, the flames 24 and 26 may be produced by separate burners supplied with gas through separate lines. For convenience the flame 26 will be referred to as a flame produced by a heater pilot for the reason that it is utilized to heat a flame sensing device indicated as a whole by reference character 30. The latter may comprise a tube or bulb containing vaporizable mercury connected by capillary tubing 32 to a valve indicated as a whole by reference character 34 which has been discontinued and is shown schematically as comprising a normally closed valve movable element 36 adapted to be open in response to the pressure of flame at the heater pilot 32.

The valve 34, hereafter generally referred to as a first valve, is adapted to be opened in response to the presence of a flame at the heater pilot and is schematically shown as supplied to the oven burner 14 through a conduit 38 at a maximum rate determined by a conventional adjustable discharge orifice 39 associated as with a venturi tube, not shown, communicating with the burner. Gas is supplied to valve 34 through a conduit 40 to which it is delivered through valve 20 of the present invention. Gas is supplied to the valve 20 from a suitable source such as the manifold 42 through a conduit 44.

The valve 20 of the present invention is what may be termed a combined shut-off and thermostatic valve and it is operated through a single control knob 46 secured to the projecting end of a hollow stem 48. The thermostatic valve portion of valve 20 is indicated by the reference character 50, which will hereinafter be referred to as a second valve or valve means. It includes a main thermostatically operated normally closed valve 52 and an auxiliary normally open valve 54 both operating from the same oven thermostat. The auxiliary valve 54 is constructed and arranged to provide a continuous broiler flame of modulated nature and the runaway protection, as will be described later herein. The shut-off valve portion, or the third valve 56, is indicated by the reference character 56 which in accordance with another feature of the invention is constructed in novel manner as a disc type valve comprising a rotary valve disc 58 and a valve body 60 having a face 60A facing the adjoining surface 58A of the disc and having also an opposite face 60B.

The valve 20 is utilized to turn on the gas and to select the temperature to be maintained for either baking or broiling. The baking occurs in what may be considered to be a first range of temperatures such as from about 140° F. to about 550° F. In this range gas is supplied to the main burner 14 in cycling or on-off fashion under control of the thermostatic valve 50, particularly its main valve portion 52 and the first valve 34. In a second and higher temperature range constituting the broiling range, which is above 550° gas is continuously supplied primarily by auxiliary valve portion 54 of valve 50 to the burner 14 in a modulated manner to maintain a continuous flame and in both ranges the oven temperature is prevented from exceeding a selected temperature by more than about 60° F. whereby to provide what might be termed a controlled runaway as will be described in greater detail hereinafter following a description of the valve.

The valve 20 includes the body 60 which may be cast of aluminum, a rear housing 62 also of aluminum and a top plate 64, all of which may be suitably secured together as by the opposed bolts 64 extending into the body, with a sealing gasket 66 interposed between the body and housing. The top cap 68 has an intermediate diameter portion 69 for the rotor disc 58 and a smaller portion 70 through which the valve stem 48 extends.

The thermostatically actuated valve 50 with its main and auxiliary valves is actuated by an expandable diaphragm type power or motor element 72 and mechanically a pair of levers 78 and 80 mounted in an outlet chamber 82 in the rear housing 62 and provided with an outlet passage way 84 connected to the gas conduit 40 leading to valve 34 and thence to burner 14.

The knob 46 and stem 48 are operatively connected to the rotor disc 58 of the shut-off valve 56 and to lever 78 of the thermostatically actuated valve 50 whereby rotation of the knob effects rotation of disc 58 and the opening of the main valve portion 52 and adjustment of the temperature.
The elements 130 and 136 mounted thereon. The elements 130 and 136 move together until element 130 engages its seat after which element 136 moves in relation to it to reduce the flow of gas through a cup 140 mounted upon element 130 and the sidewalls of which are provided with a plurality of passages 142 through which gas flows from chamber 122 to the space between elements 130 to 136 to outlet chamber 82. Accordingly, movement of element 136 toward the element 130 after the latter is seated results in a modulated type of control of the flow of gas to the outlet chamber and then to the main burner. The cup is mounted on valve element 130 by an outer flanged rim 144 on the cup and the bottom of the cup is centrally apertured slidably to receive a retainer nut 146 fixedly secured as by a threaded connection to a support 148 having an enlarged outer end 148A to which the valve element 136 is secured. The support is operatively connected to lever 80 as by a ball 150 disposed between the two. The retainer nut 146 is adjustable on support 148 to adjust the gap between elements 130 and 136 of the auxiliary valve portion 54. Generally, the gap is adjusted to pass, when fully open, gas at a rate somewhat in excess of the flow required to maintain broil temperature.

The construction and operation of valve 50 will be described in greater detail shortly.

Gas is supplied to the valve housing 60 by the conduit 44 which communicates with an inlet passageway 110 having a port 110A open to a generally semi-circular inlet opening 114 at face 60A of the valve body. Inlet opening 114 communicates through passageway 111 with a filter 112 in chamber 112A connected to passageway 28A leading to the pilot burner means. Inlet opening 114 cooperates with a radially disposed passageway 116 in the valve disc 58a communicating with a radially disposed outlet passageway 118 at the face 60A of the valve housing communicating, in turn, through passageway 120 with a chamber 122 at the outlet of which valve 50 is located and through which gas flows to the outlet chamber 82 and the outlet 84. The valve face 60A is provided with another and smaller outlet passageway or port 124 leading to a passageway 126 through which gas is supplied to the pilot burner means by passageways 128 and 28A that lead to the pilot burner passageway 28. The port 124 is so located that gas is supplied to it to activate the heater pilot 26 by increased flow of gas to the pilot burner means in the broil operation when it is desired to maintain valve 34 continuously open to supply a continuous flame broil. The continuous pilot passageway 28 is further connected to inlet 110 by portions 28A and 28B at a rate determined by adjustment of valve 28C.

In connection with a feature of the invention contributing to the small size of valve 20, the rotor disc passageway 116 is radially disposed and provided with a generally circular portion 116A at its axis and a generally segmental outer portion 116B adapted to connect inlet passageway 114 to passageway 116 in positions other than off and to port 124 when broiling is selected.

The main valve portion 52 of the thermastically actuated valve 50 comprises a movable element or plate 130 and a circular valve seat 132 that encircles outlet 122 and overlies a small valve seat 134 associated with a passageway 28D communicating with passageways 28B and 28C and with the pilot burner means. When the passageways 122 and 28D are opened, gas flows to the first valve 34 and at an increased rate to the pilot burner means 22 to activate the heater flame pilot 26 and thus open the first valve 34 for supply of gas to the oven burner.

The auxiliary thermostatic valve portion of valve 50 is constituted by the movable valve element 130 and by a second and a smaller relatively movable element 136 mounted thereon.
the passageways 28D, 28S and 28W with the result that heater pilot flame 26 is produced. The latter heats the ignitor responsive device 30 to open valve element 36 of the first valvet means 34 so that gas flows to the burner 14 at a maximum rate determined by orifice 39. As the temperature increases the oven thermostat 16 is gradually heated and the diaphragm 76 expanded to move lever 78 in a counterclockwise direction about fulcrum 100. Lever 80 is actuated in a clockwise direction to move the composite valve 50 with its main auxiliary portions 52 and 54 until movable valve element 130 engages the valve seats 132 and 134 as shown in FIG. 9. This shuts off the main flow of gas to the outlet chamber 82, but, more importantly, the increased supply of gas to the pilot burner means is dropped back to its continuous flow rate with the result that the pilot heater flame 26 is extinguished and the first valve means is closed and shuts off the flow of gas to the burner 14. When the oven temperature thereafter decreases, the diaphragm 76 contracts with reverse movements of the thermostatically actuated levers 78-80 and the resulting movement of valve element 130 away from the valve seats 132 and 134. Gas flows at a greater rate to the outlet chamber and to the burner pilot means. The heater pilot flame 26 is again present to open the first valve means described openings of the composite valve in response to operation of the main valve portion 52 continues until the control knob is turned to off.

From the foregoing it will be noted that the supply of gas to the oven burner during the baking operation is of cyclic nature, i.e., cycling between on and off in response to the conjoint action of the thermostat valve 50 and the flame responsived first valve 34.

It sometimes happens that the heater pilot flame 26 is not extinguished for one reason or another. For example, the small valve seat 134 might have some dirt or the like on it and prevent termination of flow to the heater pilot which would then maintain valve 34 open. Also, under certain conditions, the pilot flame responsive means 30 might maintain the first valve means open even when the tube heater pilot is not on. In the event one or the other of these should happen the oven temperature would rise if not otherwise prevented as by the present invention to the broil temperature or to a temperature determined by the maximum rate of flow to the main burner ordinarily provided around the thermostatic valve, as between chambers 122 and 82.

Excessive temperature rise in the oven or "runaway" is prevented in accordance with the present invention by the auxiliary valve 52, which thermostatically reduces the flow of gas to the main burner so that the rise in oven temperature will not exceed 60° F. over that selected by the knob 46.

The mode of operation of the excessive temperature rise limiting means is illustrated particularly in FIG. 10, which shows this feature with the control knob adjusted to a bake temperature greater than the 140° of FIG. 8. As illustrated, the main valve portion 52 is closed by engagement of valve element 130 with the valve seats 132 and 134, although there may be some flow past the valve element to the heater pilot burner means as when there may be dirt on seat 134, as explained above. In any event, after the attainment of the desired temperature, should the oven temperature rise further, the diaphragm 76 continues to reduce and lever 78 and 80 are actuated to move the auxiliary valve element 136 toward the main valve element 130 thereby to reduce the flow of gas from chamber 122 to chamber 82 occurring through the openings 142 in cup 140 and between the two movable valve elements. Thus, the gas flow continues to the oven burner but at a reduced rate so that under what might be considered steady state abnormal conditions at which the oven temperature will rise about 60° F. above the preset temperature.

When it is desired to use the oven for broiling, the knob is turned to a broil position indicated in FIG. 11 at which time the rotor disc passageway 116 supplies gas to the outlet passageway and thermostatic valve as herebefore described and also supplies an increased supply of gas to the heater pilot through the passageway 126 in the valve body so that the heater pilot remains ignited and the flame responsive first valve 34 remains open for the supply of gas to the main burner. As also illustrated in FIG. 11, gas is supplied also through port 128 as earlier described past the thermostatic valve 50. When the broil temperature has been closely approached the movable valve element 130 engages its associated seats to terminate the main flow of gas to the outlet chamber 82 through valve portion 52 and also shuts off the flow of gas through passageway 28D to the heater pilot. However, the latter does not affect the heater pilot operation because it is supplied with gas at this time through passageway 126. Consequently, valve 34 remains open. Gas continues to flow to the main burner through the auxiliary valve portion 54 of the thermostatic valve, i.e., through the cup openings 142 and between the valve elements 130 and 136. This flow is modulated by the oven thermostat through the diaphragm bellows 76 and levers. It will be noted that the broil operation is much the same as that described above in baking and in connection with FIG. 10 preventing the excessive temperature rise. Thus, the auxiliary valve 54 operates to prevent the oven temperature from running away or exceeding a limit of more than 82° F. above that selected by the knob 40.

As an illustration of the use of the oven burner of a gas range, the oven burner capacity or rating could be in the range of twenty to twenty-four thousand B.t.u. In baking, gas is generally supplied at the maximum rate and reduced slightly as by about ten percent of the flow, at which the main burner is cut off. The slight reduction results from slight closing movement of the auxiliary valve 54 for a brief period, a matter of seconds, the time it takes for the first valve to close. The cycling operation is thus at what may be considered periodic full flow. In broil, the supply of gas to the main burner is through the auxiliary valve 54 which decreases the flow and modulates it as at about fifty percent of the full flow or to a rate somewhat in excess of that required to maintain the correct broil temperature.

While the present invention has been described in connection with the details of an illustrative embodiment thereof, it should be understood that these details are not intended to be limiting of the invention except insofar as set forth in the accompanying claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A combined shutoff and thermostatic gas valve including an adjustable shutoff valve and an adjustable thermostatically operable valve means arranged in series flow relationship to supply gas to an outlet chamber, common manually operable means for adjusting both said valves, said thermostatically operable valve means including adjustable thermostatically controlled normal open first and second valves controlling gas flow from the shut-off valve to said outlet chamber and of which the first valve is movable to a closed position at a predetermined temperature setting following which the second valve is thermostatically further movable to provide a reduced continuous and modulated gas flow to said outlet chamber said thermostatically operable valve including a thermostatically actuated power element, lever means actuated by the element for operating said first and second valves, said first and second valves comprising a valve body having a surface provided with a first valve seat and a pair of movable valve elements, a first of said elements being movable to close said first valve seat and provided with an aperture, portions of the first element around the aperture constituting a second valve seat for the second element, a cup secured to the first element having an apertured bottom and side walls and mounted to extend through the aperture in said element, means including a
support slidably extending through the bottom wall for supporting the second element on the first element for relative movement with respect to the first element, first spring means biasing the two valve elements apart, and second spring means acting on the support and biasing both elements away from their respective seats.

2. A gas valve as claimed in claim 1, said valve body having opposite sides with faces adapted to be flat lapped to provide valve seating surfaces, one of said surfaces comprising said first valve seat, the area of the other of said surfaces being of substantial extent, and said shut-off valve including a rotor disc having a flat surface of substantial area abutting said other body surface.

3. A gas valve as claimed in claim 2, wherein said other body surface has axial and spaced angular slots and the disc has a radial slot interconnecting said first mentioned slots.

4. A control for a gas oven system of the type including a burner, a pilot associated with the burner, means for detecting the presence of a heating flame at the pilot, and a pilot responsive valve controlled by the detecting means for admitting gas to the burner in response to a heating flame at the pilot, said control comprising: means movable in response to oven temperature change;

5. first and second valves including first and second valve seats adapted to communicate respectively with the pilot and the pilot responsive valve;

6. first and second valve elements cooperating with said seats for controlling the flow of gas respectively to the pilot and to the pilot responsive valve;

7. valve operating means connected with said movable means and said first and second valves for controlling said first valve at a first temperature upon an increase in oven temperature;

8. said valve operating means being effective upon a further increase in oven temperature to operate said second valve to throttle the flow of gas to the pilot responsive valve for limiting the oven temperature to a second temperature above said first temperature; and adjustable means coupled to said valves for simultaneously adjusting said first and second temperatures.

5. The control of claim 4, said first valve element having an aperture therein and having a portion surrounding said aperture defining said second valve seat, first spring means urging said first valve element away from said first valve seat with a first force, and second spring means urging said first and second valve elements apart with a larger force for holding said elements apart until after said first valve element engages said first valve seat.

6. The control of claim 5, said valve operating means comprising a lever means having a first portion engaged by said movable means, a second portion engaged by said adjustable means, and a third portion coupled to said second valve element.

7. A control for a burner of a heating system of the type including a pilot burner and a pilot controlled valve, said control comprising:

8. first and second valves including first and second valve seats adapted to communicate with the pilot and pilot controlled valve respectively;

9. first and second valve elements cooperating with said seats for controlling the flow of gas respectively to the pilot burner and to the pilot controlled valve;

10. means movable in response to changes in temperature of the burner;

11. adjustable means for selecting an operating temperature;

12. means controlled by said movable means and by said adjustable means for closing said first valve upon an increase in temperature to the selected temperature; and

13. means operable upon a further increase in temperature to operate said second valve to throttle the flow of gas to said pilot controlled valve to maintain the temperature a fixed interval above the selected temperature.

8. The control of claim 7, said first valve element having an aperture therein and having a portion surrounding said aperture defining said second valve seat, first spring means urging said first valve element away from said first valve seat with a first force, and second spring means urging said first and second valve elements apart with a larger force for holding said elements apart until after said first valve element engages said first valve seat.

9. A combined thermostatic and shut-off control for use in a gas oven system of the type including an oven burner, a pilot burner associated with the oven burner, means for detecting the presence of a heating flame at the pilot burner, and a pilot responsive valve controlled by the detecting means for admitting gas to the oven burner in response to a heating flame at the pilot burner, said control apparatus comprising:

10. a shut-off valve adapted to be communicated with a supply of gas;

11. first and second valves including first and second valve seats adapted to communicate respectively with the pilot and the pilot responsive valve;

12. said first and second valve seats each being in communication with said shut-off valve;

13. first and second valve elements cooperable with said valve seats for controlling the flow of gas respectively to the pilot burner and to the pilot responsive valve;

14. adjustable means movable to an off position and to a range of baking temperature positions for selecting an operating temperature;

15. said adjustable means being coupled to said shut-off valve for controlling said shut-off valve in the off position and for operating said shut-off valve when said adjustable means is moved from the off position;

16. temperature responsive means movable in response to changes in oven temperature;

17. means controlled by said temperature responsive means and by said adjustable means for closing and opening said first valve upon increases and decreases in oven temperature beyond the selected temperature thereby to cycle the pilot responsive valve and maintain the selected temperature;

18. and means operable upon a further increase in oven temperature during a runaway condition to operate said second valve to throttle the flow of gas to said pilot responsive valve for maintaining the oven temperature at a value a predetermined interval above the selected temperature.

10. The combined thermostatic and shut-off control of claim 9, further comprising a passageway extending from said shut-off valve for connection to the pilot burner in parallel with said first valve; said adjustable means being movable to a broil position; said shut-off valve opening said passageway in the broil position for holding the pilot responsive valve open whereby said second valve throttles the flow of gas to the pilot responsive valve to maintain a broil temperature.

11. The combined thermostatic and shut-off valve of claim 9, said predetermined interval being in the approximate neighborhood of sixty degrees.

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