Jan. 21, 1969 F. H. BERGQUIST 3,423,021

THERMOSTATIC OVEN CONTROL

Filed Aug. 15, 1966 Sheet 1 of 4

Fig. 1

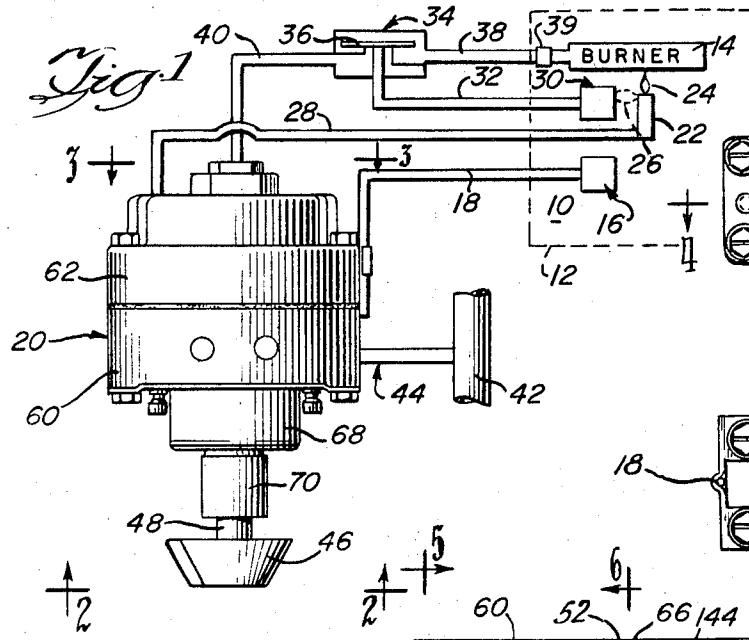


Fig. 2

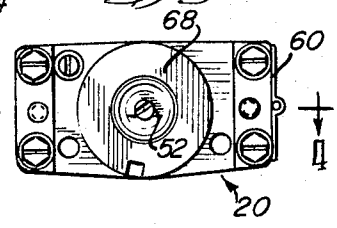


Fig. 3

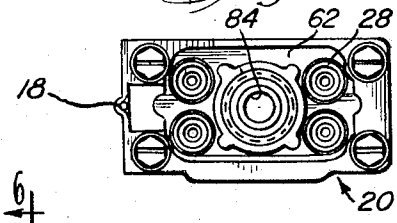
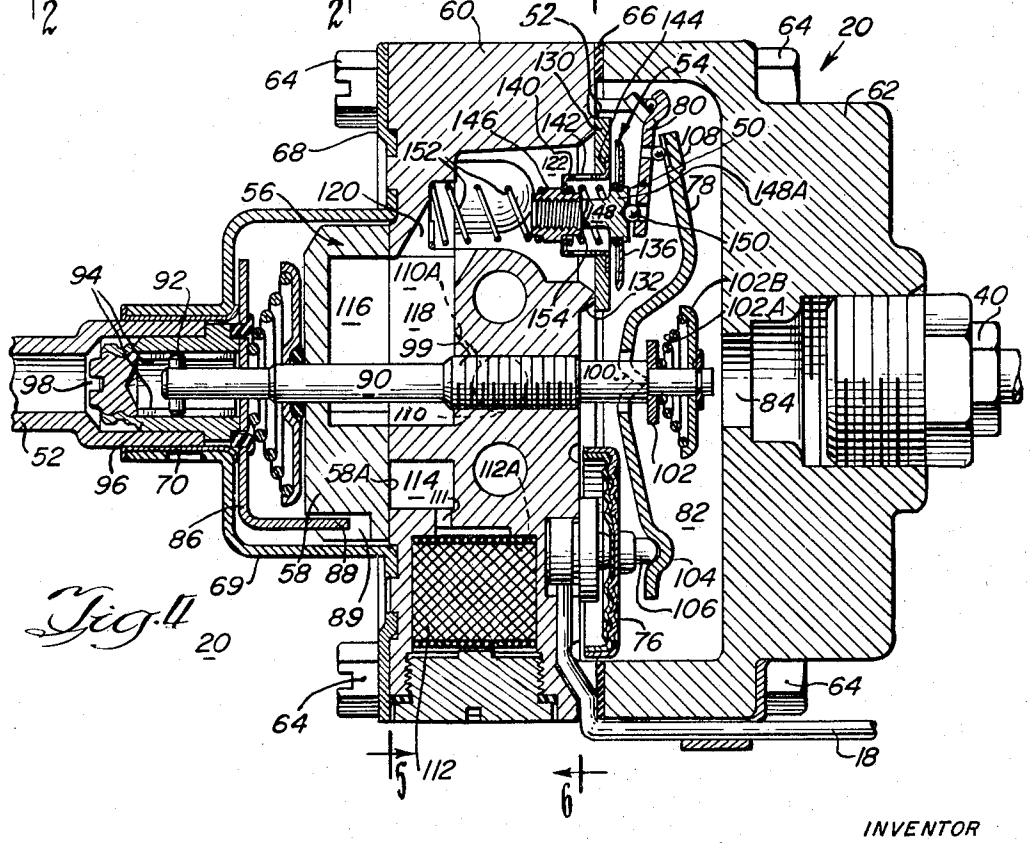


Fig. 4



INVENTOR

Frank H. Bergquist

BY Mason, Kolehmainen, Rathburn & Wyss

ATTORNEYS

Jan. 21, 1969 F. H. BERGQUIST 3,423,021

THERMOSTATIC OVEN CONTROL

Filed Aug. 15, 1966 Sheet 2 of 4

Fig. 5

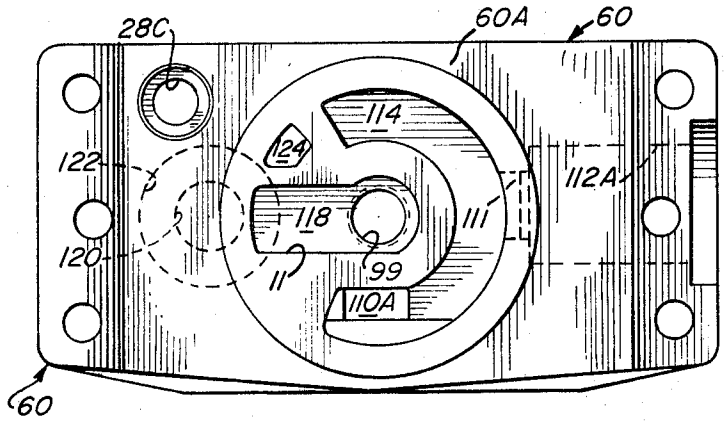


Fig. 6

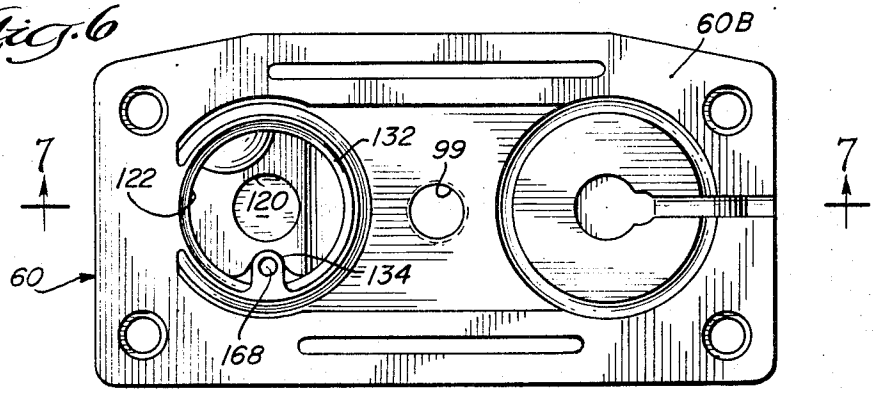
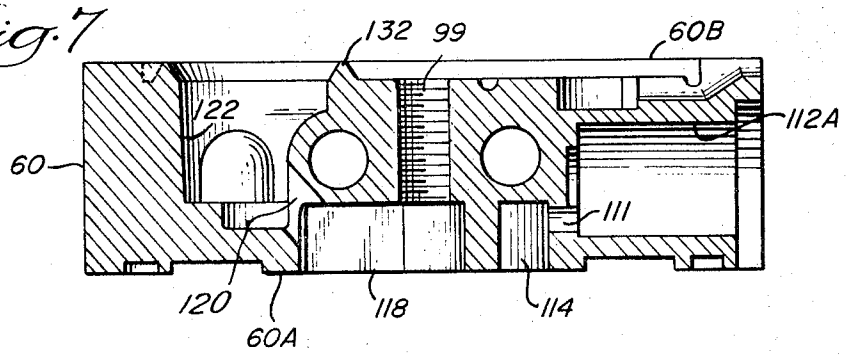


Fig. 7



INVENTOR

Frank H. Bergquist

BY Mason, Kolehmainen, Rathburn & Wyss

ATTORNEYS

Jan. 21, 1969 F. H. BERGQUIST 3,423,021

THERMOSTATIC OVEN CONTROL

Filed Aug. 15, 1966 Sheet 3 of 4

Fig. 8

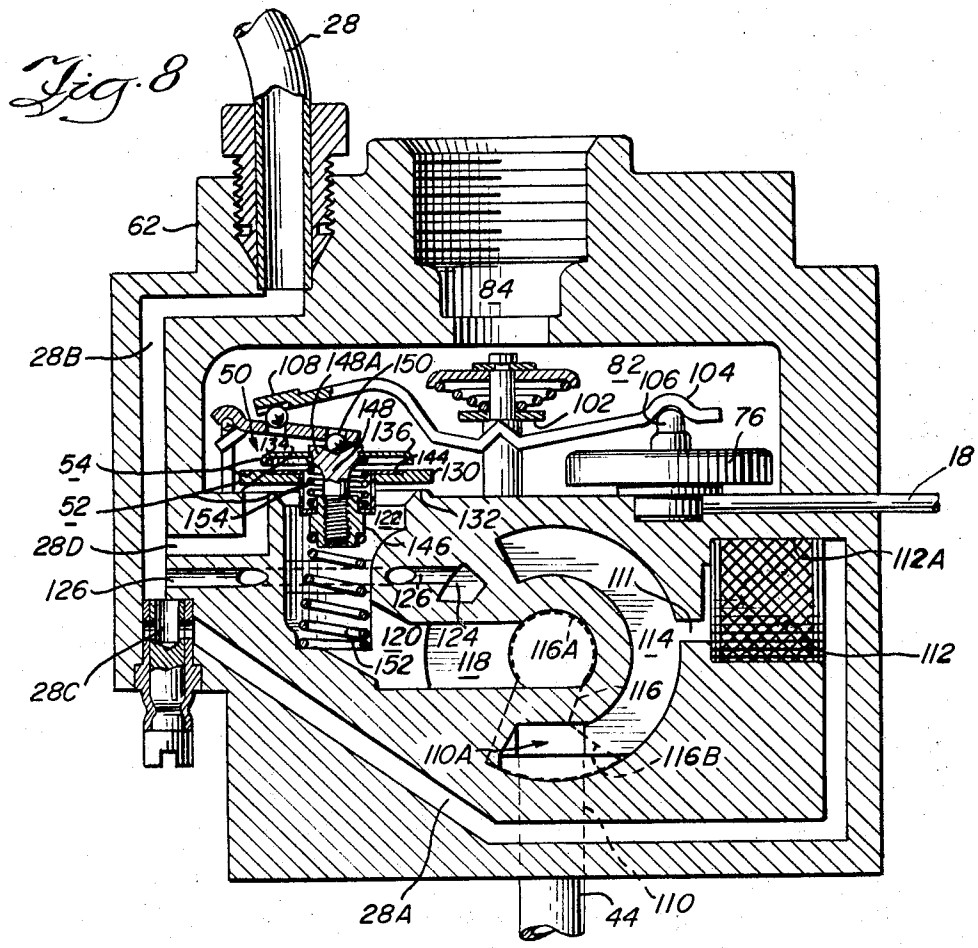


Fig. 9

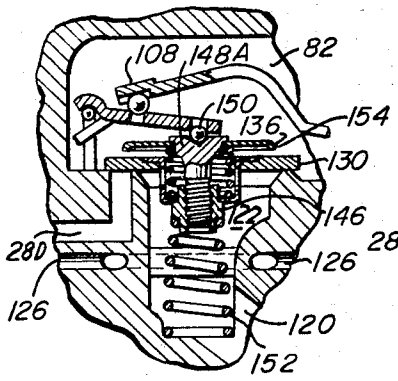
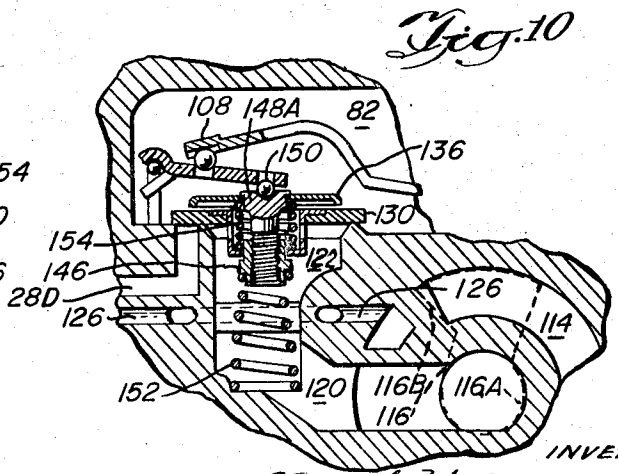


Fig. 10



INVENTOR

Frank H. Bergquist

BY Mason, Kolehmainen, Rathburn & Wyss

ATTORNEYS

Jan. 21, 1969 F. H. BERGQUIST 3,423,021

THERMOSTATIC OVEN CONTROL

Filed Aug. 15, 1966 Sheet 4 of 4

Fig. 11

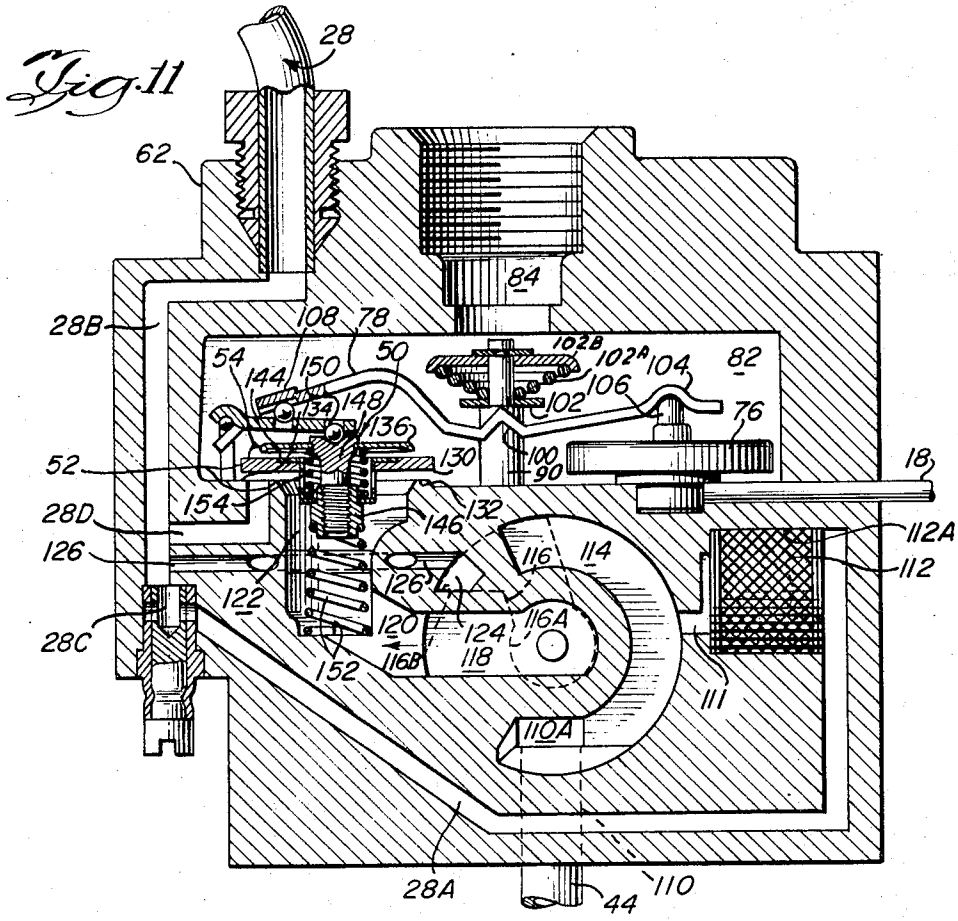
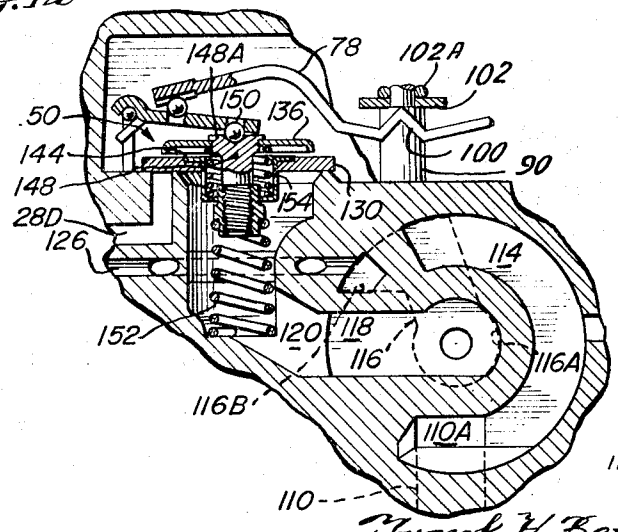


Fig. 12



INVENTOR

Frank H. Bergquist

BY Mason, Kolehmainen, Rathburn & Wyss

ATTORNEYS

United States Patent Office 3,423,021 Patented Jan. 21, 1969

3,423,021

THERMOSTATIC OVEN CONTROL

Frank H. Bergquist, Hinsdale, Ill., assignor to Harper-Wyman Company, Hinsdale, Ill., a corporation of Illinois

Filed Aug. 15, 1966, Ser. No. 572,465
U.S. Cl. 236—15 11 Claims
Int. Cl. G05d 23/275

ABSTRACT OF THE DISCLOSURE

A gas oven combined thermostatic and shutoff control includes a valve body having flat lapped valve surfaces on opposite faces, one cooperating with a rotor disc shutoff valve. The other surface supports a pair of valve elements, one controlling flow to a heater pilot and the other controlling flow to a valve which admits gas to a main burner in response to a heater flame at the pilot. A temperature responsive valve operating assembly closes the first valve at a selected temperature to discontinue flow to the pilot. If the oven temperature increases further, as during a runaway condition, the second valve modulates flow to hold the temperature at a temperature a fixed interval above the selected temperature. The second valve also maintains a modulated flow for broiling operation, when a direct passage from the shutoff valve to the heater pilot is opened.

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 includmanually 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 as 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 but 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 paragraph 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.

A further object of the invention is the provision of a valve with a control knob rotatable a full 280° 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 tube pilot) which may operate as a heater and/or an igniter 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 pilot 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 at maximum rate generally determined by an adjustable discharge orifice 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 its 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 rotor disc with a passageway extending radially from its axis, a valve body that has 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 become 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 front 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 operating conditions providing 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 effected to the broil 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** and which has been diagrammatically shown as comprising a normally closed valve movable element **36** adapted to be open in response to the pressure of flame at the heater pilot **26**.

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, when open, gas is 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 actuated by the 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 **20**, 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 **60**A facing the adjoining surface **58**A of the disc and having also an opposite face **60**B.

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. thereby 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 **68**, 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 expansible diaphragm type power or motor element **76** as through a pair of levers **78** and **80** mounted in an outlet chamber **82** in the rear housing **62** and provided with an outlet passageway **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 tempera-

ture at which valve **50** is operated. The valve stem is connected for direct drive to the disc **58** by a drive disc **86** secured to the inner end of the stem and having an axially projecting finger **88** extending into a slot **89** on the disc **58**. The opening of valve portion **52** and temperature adjustment is effected through a shaft **90** connected to the stem through a direct drive including a pin **92** secured to the end of shaft **90** and a slot **94** in a calibrating sleeve **96** within which is a calibrating pin having a screw driver slot at its end and whereby the shaft **90** may be initially adjusted for calibration purposes.

The rotation of the knob **46** rotates shaft **90** thereby to adjust the temperature setting of the thermostatic conrol to maintain a selected temperature in the oven. The adjustment is effected by axial movement of the shaft by means of its threaded mounting **99** in the valve body, thereby to vary the position of a fulcrum **100** provided intermediate ends of lever **78** and bearing against a washer **102** mounted near to the end of the shaft **90** in the chamber **82**. Washer **102** is biased against fulcrum **100** by a spring **102A** also bearing against another washer **102B** at the end of shaft **90**. An end **104** of lever **78** bears against an operating projection **106** provided on the diaphragm whereby expansion of the diaphragm moves the lever about the fulcrum **100** so that the opposite end **108** of the lever actuates lever **80** thermostatically to move valve **50** to the left as viewed in FIG. 4. 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 **58** 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 adjstment 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 **118** in positions other than off and also to port **124** when broiling is selected.

The main valve portion **52** of the thermostatically 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 **28** and, thus, 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 smaller relatively movable element **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 apertures **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 thermostatic valve **50** is biased to its open position by a spring **152**, one end of which engages the housing and the other end of which engages the retainer nut. The two valve elements **130** and **136** are biased apart by a second spring **154** bearing against the bottom of the cup and valve element **136**.

Another feature contributing to the small size and inexpensive construction of the valve is the use of a valve body **60** with valve faces **60A** and **60B** enabling flat lapping of the surfaces and especially of the valve seats **132** and **134** on surface **60A**. Surface **60A** has a considerable area that is flat to cooperate with the adjoining face **58A** of the rotor, which is of considerable area.

Before describing in detail the operation of the valve and control, it should be mentioned that the control knob **46** and stem **48** are directly connected to the valve disc and thermostatic control and no clutches are utilized. The construction further is such that the valve disc is rotatable from an off position in which the slot **116** in the valve disc is somewhat counterclockwise of its dotted line position in FIG. 8. In the off position the segmental portion **116B** of the slot is positioned a substantial distance from both ends of the inlet slot **114**. From its off position the valve disc is rotatable to a broil position in which the slot **116** occupies the position shown in FIG. 11.

During operation gas is ordinarily supplied continuously to the manifold **42**, although a manual shut-off valve could be inserted in the connections to the manifold. Gas from the manifold is supplied through line **110** and port **110A** to the inlet slot **114** in the valve body. Gas is supplied to the pilot burner means **22** from slot **114**, passageway **111** and filter element **112** and passageways **28A**, B, D and **28**, at a rate determined by the adjustment of valve **28C** to provide the continuous burner flame **24**.

Ordinarily there would be no heater pilot flame **26** with the result that the first valve **34** would be closed. With the thermostatic valve **20** in its off position the rotor disc valve **58** is closed as is the main valve portion **52** of the thermostatic valve and no gas is supplied to the thermostatic valve or through passageway **126** to the pilot burner tube **28**.

When it is desired to use the oven for baking, the control knob **46** is turned from off to some desired baking temperature between 140° and 550° F. as illustrated in FIG. 8 where the knob is shown turned to maintain a temperature of 140° in the oven.

Gas is then supplied from the body inlet **114** through rotor disc slot **116** and passageways **118** and **120** to passageway **122** from which it will flow past the thermostatic valve to the outlet chamber **82** and through tube **40** to the first or ignition responsive valve **34**, which is initially closed. Additional gas flows to the heater pilot through

the passageways 28D, 28B and 28 with the result that heater pilot flame 26 is produced. The latter heats the ignition responsive device 30 to open valve element 36 of the first valve 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 34. The described opening and closing of the first 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 off and on in response to the conjoint action of the thermostatic valve 50 and the flame responsive 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 expand and levers 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 pre-set 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 heretofore 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 to the chamber 82 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 runaway temperature. Accordingly, the auxiliary valve 54 operates to prevent the oven temperature from running away or exceeding a limit of more than 60° than that selected by the knob 40.

As an illustration of the use with 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 limitative 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 normally open first and second valves controlling gas flow from the shutoff 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 shutoff 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 adjustably 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;

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

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;

valve operating means connected between said movable means and said first and second valves for closing said first valve at a first temperature upon an increase in oven temperature;

said valve operating means being effective upon a further increase in oven temperature to operate said second valve to modulate 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:

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

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;

means movable in response to changes in temperature produced by operation of the burner;

adjustable means for selecting an operating temperature;

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

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 first valve element engages said first valve seat.

9. A combined thermostatic and shutoff 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:

a shutoff valve adapted to be communicated with a supply of gas;

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

said first and second valve seats each being in communication with said shutoff valve;

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;

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

said adjustable means being coupled to said shutoff valve for closing said shutoff valve in the off position and for opening said shutoff valve when said adjustable means is moved from the off position;

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

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;

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 shutoff control of claim 9, further comprising a passageway extending from said shutoff valve for connection to the pilot burner in parallel with said first valve; said adjustable means being movable to a broil position; said shutoff 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 shutoff valve of claim 9, said predetermined interval being in the approximate neighborhood of sixty degrees.

References Cited

UNITED STATES PATENTS

1,849,689	3/1932	Rode	137—614.21 X
1,911,044	5/1933	Thrasher	137—614.21 X
2,571,047	10/1951	McWilliams	137—614.21
3,073,341	1/1963	Schernekau	137—614.21 X
2,766,773	10/1956	Grayson	137—630.22
2,889,115	6/1959	Weber	236—48
3,011,721	12/1961	Wiltz	236—15

(Other references on following page)

11

UNITED STATES PATENTS

3,146,945	9/1964	Russell	236—1
3,167,250	1/1965	Wantz et al.	236—68
3,212,712	10/1965	Hildenbrandt	236—68 X
3,288,366	11/1966	Fleer	236—68 X
2,831,504	4/1958	Coffey	137—630.15

12

ROBERT A. O'LEARY, *Primary Examiner.*

WILLIAM E. WAYNER, *Assistant Examiner.*

U.S. Cl. X.R.

236—1, 68; 137—614.21, 630.22; 431—42