Sept. 1, 1964 W. J. RUSSELL 3,146,945

THERMOSTATIC CONTROL FOR RANGE BURNERS

Filed Feb. 27, 1962 2 Sheets-Sheet 1

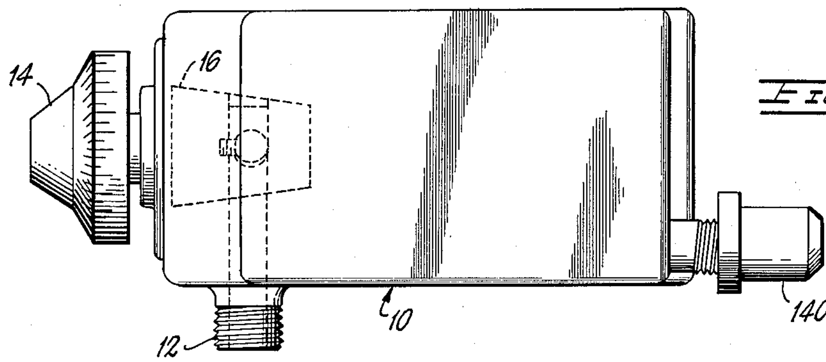
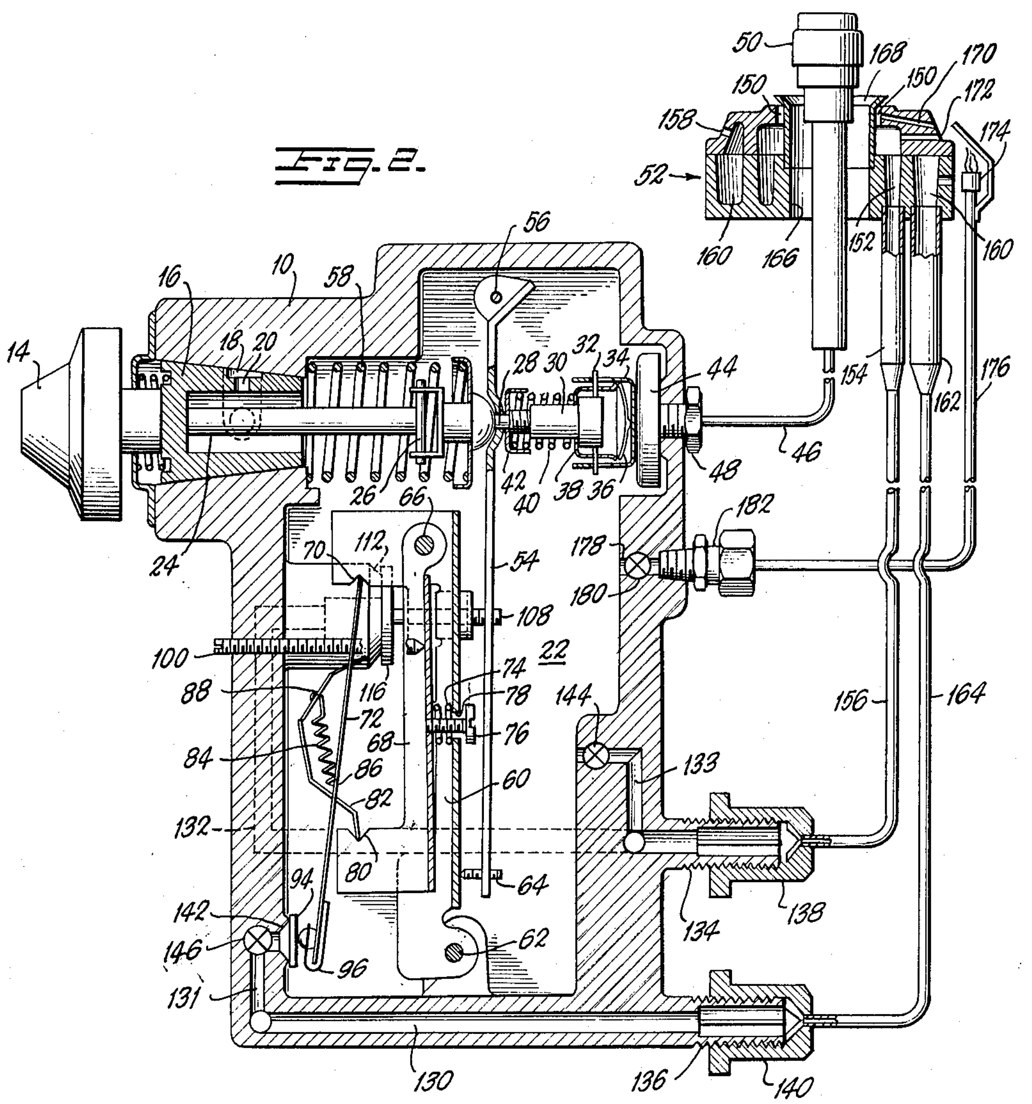


FIG. 1.

FIG. 2.



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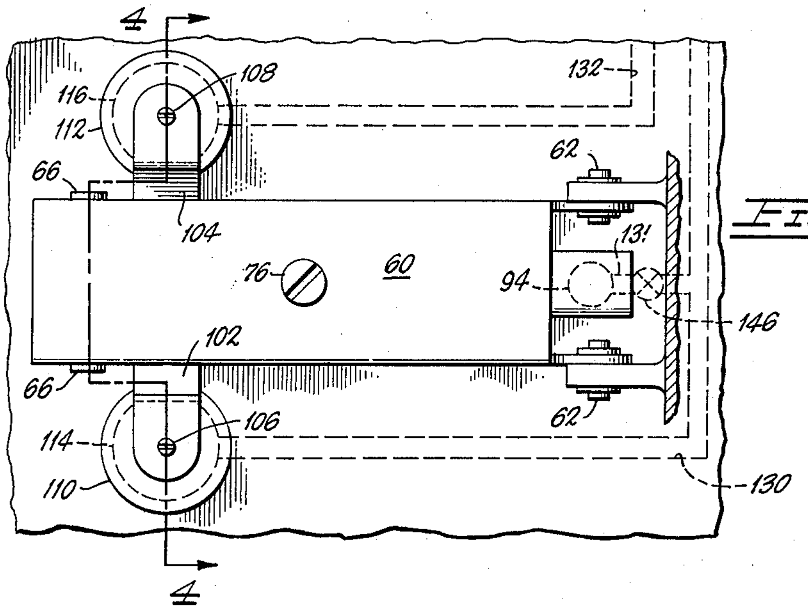

Fig. 3.

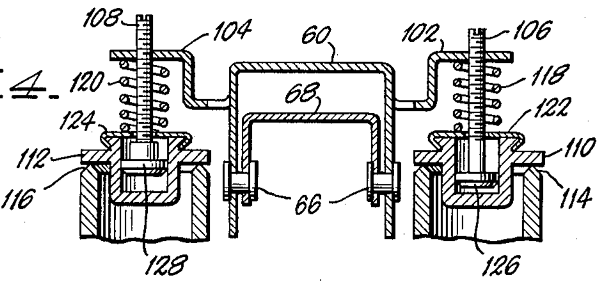

Fig. 4.

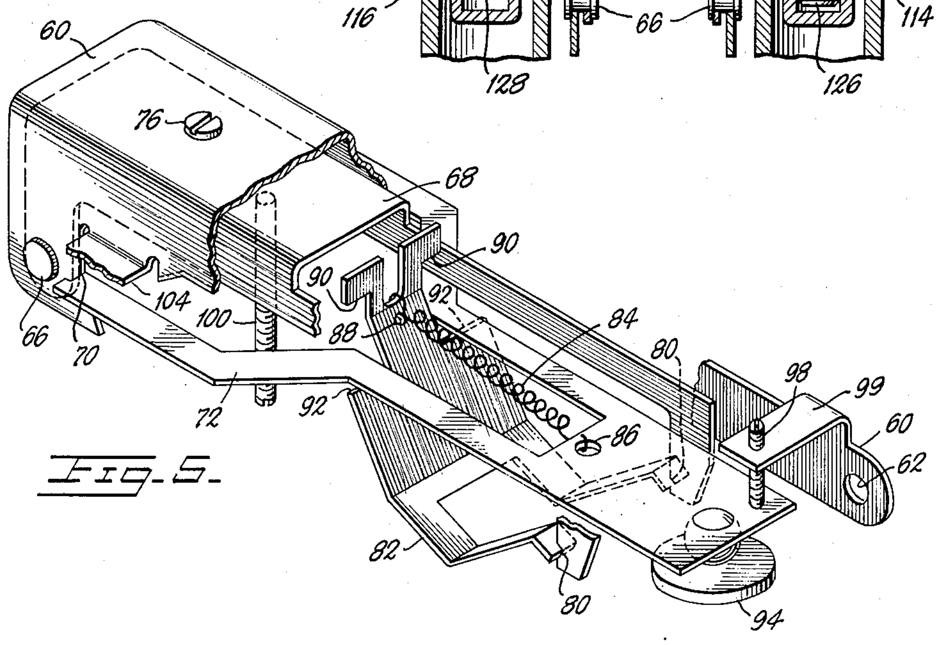

Fig. 5.

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THERMOSTATIC CONTROL FOR RANGE BURNERS

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This invention relates to gas range burner controls, and deals more particularly with thermostatic regulation of double throat range top burners.

The operational temperature span of domestic cooking equipment represents an important characteristic whose limits restrict adaptability of the equipment and confine the versatility of the cooking function. Automatic temperature control over a wide span becomes increasingly complicated since sensitivity and uniformity of operation of the regulating equipment become difficult to maintain at all temperature levels.

These and other difficulties encountered in automatic burner control are overcome by the present invention which effects the desired control over a wide span of temperature settings. Accordingly, it is an object of the present invention to thermostatically control in stages the surface burners of a gas range.

Another object of this invention is to obtain inherent flame to provide sizing of a gas range surface burner by a single dial temperature control.

A further object of the invention is to insure stable flame characteristics and high cooking efficiency.

A further object of this invention resides in the achievement of rapid and reliable burner ignition characteristics for the surface burners of a gas range.

In practicing the present invention, pivoted means actuate a first valve means, which is adjustable for actuation at different positions of the pivoted means to modulate fuel flow to a range top burner at discrete flow levels. An overcenter snap mechanism actuated by the pivoted means controls second valve means which effect a distinct variation in the fuel flow intermediate the discrete levels. Temperature control means actuate the pivoted means to maintain a predetermined set temperature at the burner.

The exact nature of the present invention, as well as other objects and advantages, will become apparent from the following description considered in connection with the accompanying drawings wherein:

FIG. 1 is an end view of a control device embodying the present invention;

FIG. 2 is a longitudinal section of FIG. 1 with the addition of a schematic diagram of a burner control system;

FIG. 3 is a partial plan view of a detail of FIG. 2 showing an overcenter snap mechanism;

FIG. 4 is a partial section view, taken along the line 4—4 of FIG. 3; and

FIG. 5 is a perspective view of the overcenter snap mechanism of FIG. 2.

With reference to FIGS. 1 and 2, the control mechanism of the invention includes a hollow housing **10** having an inlet tapping **12** adapted for conventional connection to a range fuel manifold (not shown), and a dial **14** with graduated markings thereon conventionally constructed to be readily removed and replaced in its correct relationship to a gas cock **16**. Rotation of gas cock **16** permits fuel to flow from the manifold through a passage **18** and an orifice **20** into the housing cavity **22** during the "On" position of dial **14** which exists over an arc of approximately 250°.

A drive rod **24** is slidably connected through a pin **26** to an adjusting screw **28** which when rotated threads

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itself axially into an adjusting nut **30**. A pin **32** extends outwardly from opposite sides of nut **30** and through aligned slots formed in a cup-shaped member **34** to prevent rotation of nut **30**. A bimetallic disc **36** provides for ambient temperature compensation, while a cup **38**, operating in conjunction with a spring **40** compressively supported by a retaining cup **42**, provides for overshoot movement as is well known in the art. A power element or diaphragm **44**, securely attached to cup **34** as by welding, communicates through a capillary tube **46**, supported in housing **10** by a tapped nut assembly **48**, with a temperature sensing bulb **50** centrally positioned in a burner assembly generally indicated at **52**. The power element **44**, tube **46** and temperature sensing diaphragm **44** is filled with suitable thermostatic fluid or charge to effect expansion and contraction of diaphragm **44** in response to temperature variations sensed by bulb **50**.

A lever **54** is engaged by a hemispherical portion of adjusting nut **28** and by retaining cup **42** to be pivoted about a pin **56** by axial movement of adjusting nut **28** in response to dial **14** or movement of diaphragm **44**. A load spring **58** compressively engaged between the nut **28** and an internal shoulder of housing **10** biases nut **28** and the associated linkage toward the diaphragm **44**. Rotation of lever **54** controls rotation of a lever **60** about a pivotal axis defined by pins **62** through the action of a stud **64** adjustably threaded through the free end of lever **54** for controlling the operation of a valve-actuating overcenter snap mechanism, as will be described hereinafter.

A valve carrying lever **60** has a generally inverted U-shaped cross section, the legs of which are pivotally mounted on one end to the pins **62** mounted in an internal wall of housing **10** and on their opposite end carry aligned pins **66** for pivotally mounting a second lever **68** having a similar cross section. Spaced inwardly and downwardly from pins **66**, the legs of lever **60** are notched with V grooves **70** in which a bifurcated snap lever **72** is pivoted. A spring **74** is compressively engaged between levers **60** and **68** and is held in place by a snap adjusting screw **76** (FIG. 2) which threadedly engages lever **68** and extends through an enlarged opening **78** in lever **60**. On the end opposite the pins **66**, the legs of lever **68** are notched with V grooves **80** which are pivotally engaged by a toggle lever **82**. A snap spring **84** is stretched across apertured portions **86** and **88** on levers **72** and **82**, respectively. One end of toggle lever **82** is formed with extended edges **90** and **92** which alternately bear on opposite sides of snap lever **72**. A valve disc **94** is pivotally mounted on the free end of the lever **72** by means of a ball and clip assembly **96** (FIG. 2). An adjustable stop screw **98** is threaded through a horizontally extending arm **99** to engage the free end of snap lever **72** and limit counterclockwise rotation thereof about the V grooves **70**. A stud **100** is adjustably threaded into housing **10** for engagement by lever **68** to provide a stop therefor.

Adjacent the pivot pins **66**, the legs of lever **60** are formed with oppositely extending tangs **102** and **104** which threadedly carry adjusting screws **106** and **108**, respectively. Cup-shaped valve discs **110** and **112** are slidably carried on the ends of screws **106** and **108** for engagement with valve seats **114** and **116**, respectively formed in the housing **10**. The valve discs **110** and **112** are biased towards the seats **114** and **116** by a pair of coil springs **118** and **120** respectively mounted in compression between the tangs **102** and **104** and a pair of clips **122** and **124** which carry the valve discs **110** and **112**. The screws **106** and **108** extend through enlarged openings in the clips **122** and **124** and have enlarged end plugs **126** and **128** respectively disposed for reciprocation in the interior of the cup-shaped valve discs **110** and **112**.

The valves 110 and 112 are sequentially operated and each of the valves modulates a separate gas flow from the housing cavity 22 through their corresponding valve seats. When screws 106 and 108 are moved in an upward direction, as viewed in FIG. 4, by rotation of arm 60, the end plugs 126 and 128 engage clips 122 and 124 to lift discs 110 and 112, the process being reversed to close valve seats 114 and 116 by downward movement of screws 106 and 108. It will be noted that plugs 126 and 128 may be adjusted to lift discs 110 and 112 at different times, and in the embodiment described herein plug 126 is adjusted lower than plug 128 to open valve seat 114 subsequent to the opening of valve seat 116; conversely, valve seat 114 is closed prior to the closing of valve seat 116.

Each of the valve seats 114 and 116 respectively open into gas passageways 130 and 132 located within the walls of housing 10 and communicating respectively with a pair of tapped outlet spuds 134 and 136 on which a pair of orifices 138 and 140 are mounted. Passageway 130 is intersected by a bypass passage 131 which leads to a valve seat 142 engaged by the snap acting disc valve 94. Passageway 132 is also intersected by a bypass passage 133 which directly communicates with the housing cavity 22. The bypass flows may be adjusted by means of a flow adjusting key 144 in the bypass passageway 133 and by a similar key 146 in the bypass passageway 131.

The burner 52 has an inner or simmer section which includes burner port means 150 fed through an annular chamber 152 by a mixing tube 154 which communicates with orifice 138 as by conduit 156. An outer or main section of the burner 52 includes burner port means 158 in the form of a series of ports disposed about the periphery of burner 52 and spaced below the simmer port means 150. The main port means 158 is fed through an annular chamber 160 spaced radially outwardly from chamber 150 and is connected to a mixing tube 162 which communicates with orifice 140 as by conduit 164. The inner burner port means 150 is defined by a port ring 168 centrally carried by the burner 52 so as to provide a central opening 166 through the burner.

An inclined bore 170 and a horizontal bore 172 in the burner 52 have their outer ends terminating in close proximity to a pilot burner 174. A conduit 176 is connected between the pilot burner 174 and a pilot flow passageway 178 in the housing 10 by means of a fitting 182; the pilot flow of gas from housing cavity 22 is adjustable by a flow adjusting key 180 intersecting the passageway 178. With such an arrangement, ignition is facilitated inasmuch as gas from inner chamber 152 is ignited at the outer end of bore 172 and in turn is flashed through the inclined bore 170 to the inner burner port means 150.

Operation

Turning dial 14 from the "Off" position to any desired temperature setting permits gas to flow from the range manifold through gas cock 16 into the housing cavity 22 and to pilot burner 174 which can then be ignited in any conventional manner. Drive rod 24 rotates with dial 14 and drives adjusting screw 28 axially by screwing it into adjusting nut 30 thereby pivoting lever 54 counterclockwise about pin 56. The lever 60 follows the lever 54 and pivots clockwise about the pivot pins 62. The initial movement of the valve carrying lever 60 causes the end plug 128 to gradually open the modulating valve member 112. The pivot pins 66 move with the lever 60 causing a clockwise movement of the lever 68 about the pivot pins 66 due to the bias of coil spring 74. Spring 74 carries V grooves 80 in a clockwise direction while V grooves 70 are also carried in a clockwise direction by lever 60. When V grooves 80 achieve a straight-line relationship with apertured portions 86 and 88, lever 82 snaps in a clockwise direction due to the action of spring 84 and extended edges 92 engage lever 72 thereby rotating lever 72 counterclockwise to cause seat disc 94 to snap open and permit gas flow through valve seat 142 and passageway 130 to the main section of the burner.

A significant feature of the operation of the overcenter snap mechanism described is the fact that there is no lessening of force on seat disc 94 as the system approaches snap point since the force angle between spring 84 and lever 72 does not change prior to the snapping action. This action is instantaneous, and with the force angle held constant, there is no change in the spring length. Therefore, the force on snap lever 72 remains constant until toggle lever 82 goes into snap motion.

Seat discs 110 and 112 are arranged to be opened by clockwise rotation of lever 60 and the sequence in which they open is determined by adjustment of screws 106 and 108 which control the distance through which plugs 126 and 128 must travel before they engage clips 122 and 124 to lift discs 110 and 112. With this adjustment made as herein described, seat disc 112 will lift to open valve seat 116 prior to the snapping of disc 94, and disc 110 will lift subsequent to the snapping of disc 94.

Thus, it will be seen that after dial 14 is rotated to the "On" position, fuel will flow through valve seat 116 and passageway 132 to the simmer section of burner 52, after which valve disc 94 will snap open to permit fuel flow through seat 142 and extension 131 to the main section of burner 52. Further rotation of lever 60 will subsequently cause valve seat 114 to open, thereby effecting increased fuel flow to the main section of burner 52 through passageway 130.

Temperature sensing bulb 50 which is in intimate contact with cooking utensils placed on burner 52 responds to temperature increases by causing diaphragm 44 to expand due to expansion of the thermal charging medium. As the contents of the utensil approach the temperature to which dial 14 has been set, expansion of diaphragm 44 effects clockwise rotation of lever 54, thereby rotating lever 60 counterclockwise, first closing valve seat 114 and cutting off fuel flow therethrough to the main section of burner 52. Disc 94 snaps shut following the closing of valve seat 114 when continued counterclockwise rotation of lever 60 causes lever 68 to engage stud 100, thereby rotating lever 68 counterclockwise about pins 66 to effect alignment of V grooves 80 with apertured portions 86 and 88. Then toggle lever 82 snaps counterclockwise, snap lever 72 being rotated in a clockwise direction by engagement therewith of extended edges 90.

Valve seat 116 closes last due to continued rotation of lever 60, and at this point the only fuel flowing to burner 52 will be through adjusting key 144 and bypass extension 133. Decrease in the temperature of the contents of the cooking utensil, as by the addition of cold food, water, etc., causes contraction of diaphragm 44 and counterclockwise rotation of lever 54, thereby reinitiating the valve opening procedure previously described to a degree sufficient to bring the contents of the utensil to the set temperature.

With the contents at set temperature, the simmer section of burner 52 will continue receiving fuel at a rate controlled by adjustment of key 144, which may be in the range of 200 B.t.u. per hour. The flame may be modulated from a rate of 200 B.t.u. per hour to approximately 1000 B.t.u. by the action of valve seat and disc 112, 116. From 1000 B.t.u. fuel input is snapped to 2000 B.t.u. (1000 B.t.u. on the main section of the burner) by the action of the overcenter snap mechanism and valve seat disc 94, 142. Operation of valve seat disc 110, 114 may be adapted to modulate to a full fuel input of over 12000 B.t.u. per hour which would be a minimal capability for bringing large loads to temperature with adequate speed.

Thus, there is provided the capability for performance of cooking operations over an entire wide span of temperatures normally required of range top burners. This span may be divided into three basic categories: the warming range which exists between 120° F. to 150° F.; the keep-warm or simmer-thru-boiling range from approximately 150° F. to slightly above 212° F.; and the frying range which would encompass temperatures from approximately 275° F. to 400° F.

The actual heat output at each desired temperature will vary in accordance with load and the 12000 B.t.u. required to bring loads quickly to temperature is therefore drastically reduced, after a time dependent on load size, once the desired temperature has been reached. Moreover, at each temperature level required, heat input will be automatically regulated to maintain the set temperature and to reestablish that temperature in the event that varying conditions cause it to change. Due to its flexibility with regard to levels of heat input, the present invention is able to maintain set temperature over a wide range with uniform sensitivity and accuracy at each temperature level.

Another significant advantage of this invention arises as a result of making the simmer or inner section capacity larger than conventional burners while maintaining small physical size and reduced capacity in the main section with normal port openings. The smaller physical size of the main section and reduced port ring diameter permits a smaller flame pattern from the main port ring, which combined with the larger inner section flame pattern attains more efficient heat transfer to the cooking utensil.

An additional advantage arising from utilization of a dual throat burner is the ability to achieve improved flame pattern with respect to pan size as opposed to a single burner of large capacity. The average temperature controlled top burner of 12000 B.t.u. capacity requires approximately 1200 B.t.u. for stable flame characteristics, thereby making low temperatures difficult to obtain and then only by sacrificing flame stability. The present novel combination, however, permits stable operation at an input as low as 200 B.t.u. per hour, thereby providing controlled temperatures with stability over an enlarged span. This feature combined with automatic control results in higher efficiency, improved ignition and stable flame characteristics, and elimination of the need for flame setting devices, thus attaining truly automatic performance.

While in the foregoing there has been disclosed a specific embodiment of the invention, it will be apparent that many modifications and variations thereof are possible. It should, therefore, be understood that all matter contained in the foregoing description and shown on the drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a control system for a gas range, the combination comprising a surface burner having a spaced pair of burner port means, first modulating valve means regulating a gas flow to one of said port means, snap acting valve means controlling an additional gas flow to said one port means, second modulating valve means regulating a gas flow to the other of said port means, thermally responsive means including means movable in response to temperature variations sensed at said burner, and valve actuating means operatively connected to said movable means and to said first and second modulating valve means and said snap acting valve means.

2. The combination as recited in claim 1 wherein bypass means supplies a bypass gas flow to said other port means to maintain a minimum flame at said surface burner.

3. The combination as recited in claim 2 wherein said one burner port means comprises a series of annularly spaced ports and said other burner port means is spaced inwardly and upwardly from said annularly spaced ports.

4. The combination as recited in claim 3 wherein a manually operable valve means is positioned upstream of said bypass means, said first and second modulating valve means and said snap acting valve means.

5. In a thermostatic control device, the combination comprising a housing having an inlet for receiving a fluid flow and a pair of outlets, a pair of spaced valve seats in said housing communicating with said pair of outlets, valve carrying means disposed in said housing for movement between a plurality of positions, modulating valve means on said valve carrying means cooperating with said pair of spaced valve seats to modulate fluid flow to said outlets, said modulating valve means including a first valve member movable into engagement with one of said valve seats when said carrying means is in one position and a second valve member movable into engagement with the other of said valve seats when said carrying means is in another position, snap acting valve means operatively connected to said carrying means for controlling an additional fluid flow to one of said outlets, and being actuated when said carrying means is in a position intermediate its said one and another position, and thermally responsive means operatively connected to said carrying means for imparting a regulatory movement thereto in response to temperature variations.

6. In a thermostatic control device, the combination comprising a housing having an inlet and first and second outlets, control valve means operably disposed in said housing adjacent said inlet for controlling a fluid flow into said housing, thermally responsive means including a movable element having a regulatory movement in response to temperature variations, a valve actuating lever pivoted in said housing for movement between first and second actuating positions, a first valve means for modulating a fluid flow to said first outlet, a second valve means for modulating a fluid flow to said second outlet, said first and second valve means being sequentially operated by said valve actuating lever, a third valve means for controlling an additional fluid flow to said second outlet, a snap acting mechanism operatively connected between said valve actuating lever and said third valve means and including overcenter means actuated at an intermediate position between the first and second actuating positions of said valve actuating lever whereby said third valve means is actuated with a snap action between the sequential operations of said first and second valve means, and an operating lever pivotally mounted in said housing in engagement with said valve actuating lever and said movable element of said thermally responsive means whereby said first, second and third valve means are operated in response to temperature variations.

7. The combination as recited in claim 6 wherein said snap acting mechanism includes a snap lever having one end pivotally engaging said valve actuating lever and an opposite end carrying a valve element of said third valve means, and pivotal lever means having one end pivotally carried by said valve actuating lever for movement thereby and an opposite end formed with V grooves, and wherein said overcenter means comprises a toggle link having one end pivotally mounted in said V grooves and an opposite end alternately engaging said snap lever, and a coil spring mounted in tension between said toggle link and said snap lever.

8. In a thermostatic control device for supplying fuel flow to gas range surface burner means having a simmer burner, a main burner and a pilot burner, the combination comprising a housing having an inlet and a valve chamber, control valve means operably disposed in said housing adjacent said inlet for controlling a fluid flow into said chamber, a pilot flow outlet from said chamber adapted to supply a pilot fluid flow to the pilot burner whenever said control valve means is in an operative position, a simmer flow outlet from said chamber adapted to supply a simmer fluid flow to the simmer burner whereby a minimum flame maintains the surface burner means at a minimum level of heat output, first modulating valve means in said chamber regulating a second simmer fluid flow to said simmer flow outlet whereby an increased simmer flame varies the surface burner means heat out-

put between the minimum level and a second level in response to modulation, a main flow outlet from said chamber adapted to supply a main fluid flow to the main burner, snap acting valve means in said chamber controlling a main fluid flow to said main flow outlet whereby a constant flame at the main burner increases the surface burner means heat output to a third level, second modulating valve means in said chamber regulating a second main fluid flow to said main flow outlet whereby an increased main flame varies the surface burner means heat output between the third level and a maximum level in response to modulation, a valve actuating lever pivotally mounted in said chamber for movement between first, intermediate and second actuating positions, said lever actuating said first and second modulating valve means when disposed in its first and second actuating positions, respectively, and actuating said snap acting valve means when disposed in its intermediate position, a levered operator pivotally mounted in said chamber in operative enagement with said valve actuating lever, an operative connection between said control valve means and said operator whereby movement of said control valve means causes sequential actuation of said first modulating valve means, said snap acting valve means and said second modulating valve means, thermally responsive means operable in response to temperature variations at the surface burner means, and an operative connection between said thermally responsive means and said operator causing sequential actuation of said second modulating valve means, said snap acting valve means and said first modulating means in accordance with a decreasing heat demand at the surface burner means.

9. A thermostatic device for regulating temperature at a burner comprising valve means adapted to control fuel flow to the burner, said valve means including a pair of valve seats and a cooperating pair of movable valve elements, pivoted means carrying said pair of movable valve elements in staggered relationship and sequentially actuating said pair of movable valve elements to modulate fuel flow to the burner, snap valve means actuated in accordance with movement of said pivoted means for effecting an additional fuel flow to the burner, and temperature control means actuating said pivoted means to maintain a predetermined temperature at the burner.

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