United States Patent

Perl

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[54] GAS SMOOTH TOP RANGE

[72] Inventor: **Richard L. Perl,** Mansfield, Ohio

[73] Assignee: **The Tappan Company,** Mansfield, Ohio

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[52] **U.S. Cl.** .....**126/39 J,** 431/215, 431/328

[51] **Int. Cl.** **F24c 3/04**

[58] **Field of Search**.....126/39, 39 J; 431/215, 328, 431/329

[56] **References Cited**

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3,299,938	1/1967	Bally et al.	431/215 X
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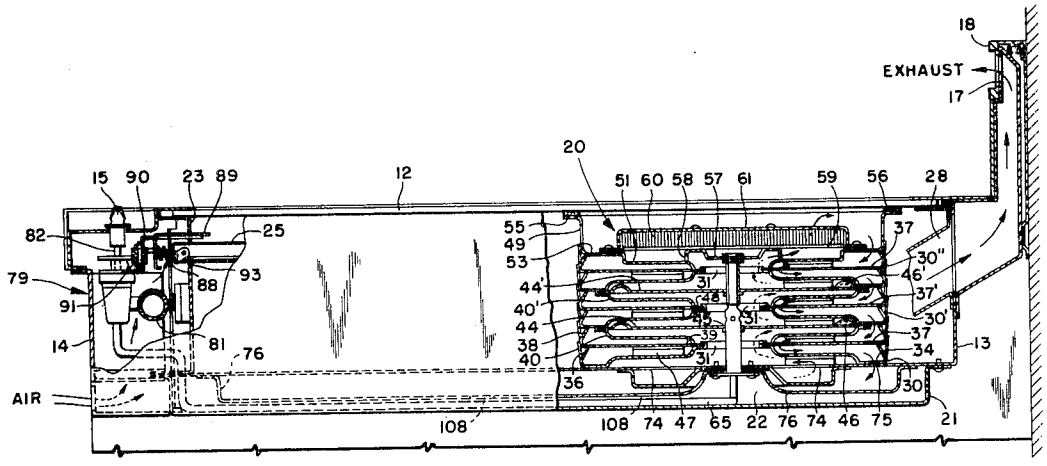
Primary Examiner—Charles J. Myhre

Attorney—Oberlin, Maky, Donnelly & Renner

[57] **ABSTRACT**

The range has plural radiant burners with individually associated heat exchangers and a common pressurized exhaust system. Each burner has a supply air tube the inlet end of which is obstructed by a coil spring which is variably expanded to act as an adjustable shutter regulating the amount of air that enters through its turns in response to actuation of the gas control valve for the burner. The burners have center simmer sections for low heat and single gas lines with port controlled terminals which variably direct the gas to the center simmer sections or to the main burner sections depending upon the rate of delivery of the same. A safety circuit prevents flow of gas to the range except when exhaust fans are properly operating, and a taut wire exposed to heating by all burners expands when any is above a selected temperature to signal such condition.

13 Claims, 7 Drawing Figures



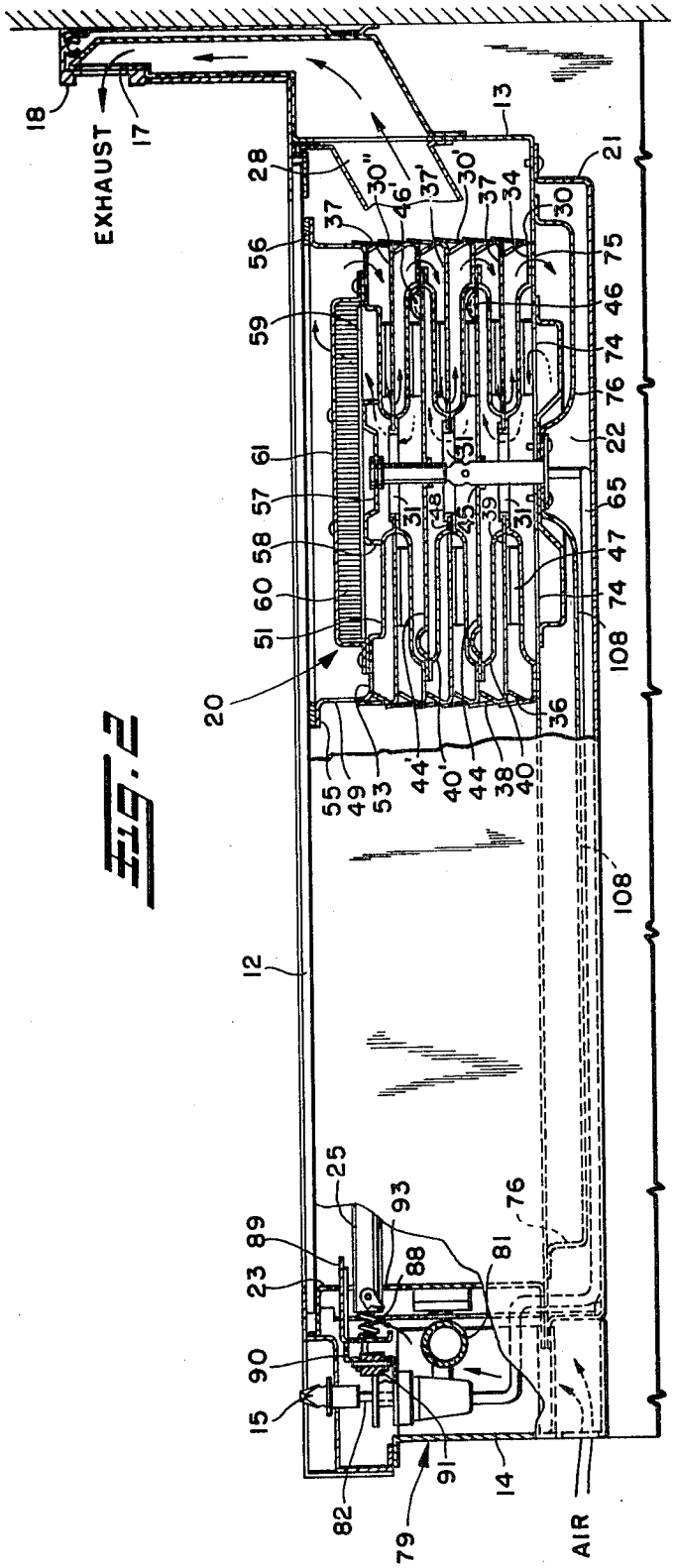


FIG. 2

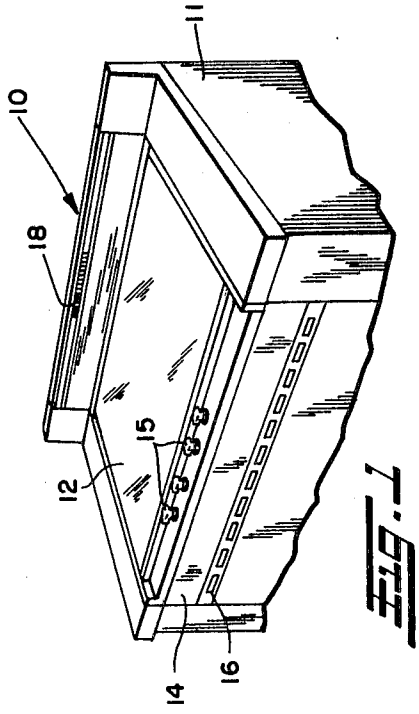


FIG. 1

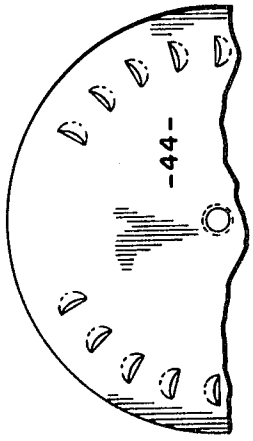


FIG. 4

INVENTOR.
RICHARD L. PERL

BY

Oberlin, Maky, Donnelly & Renner
ATTORNEYS

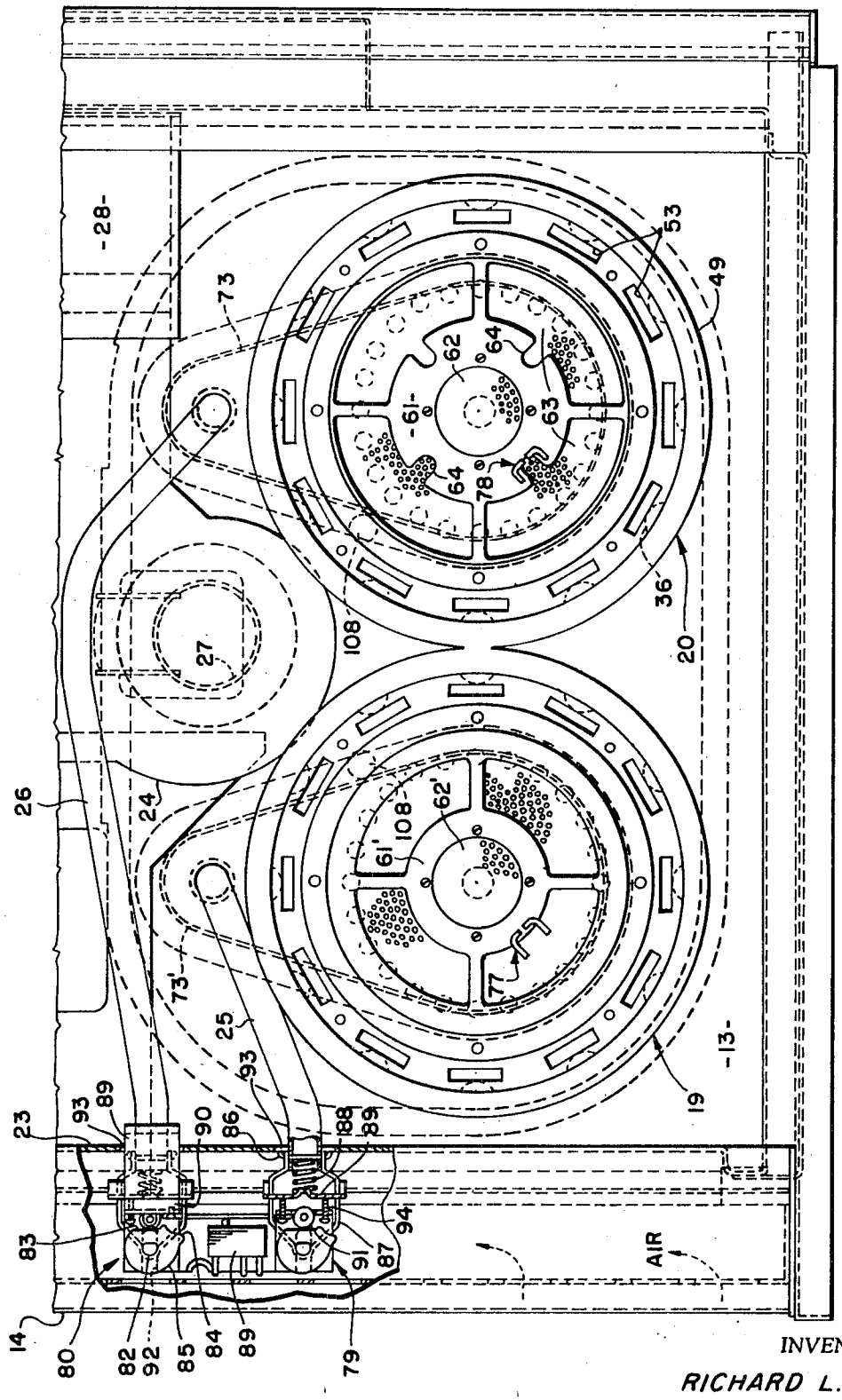


FIG. 3

INVENTOR.
RICHARD L. PERL

BY

Oberlin, Maky, Donnelly & Renner
ATTORNEYS

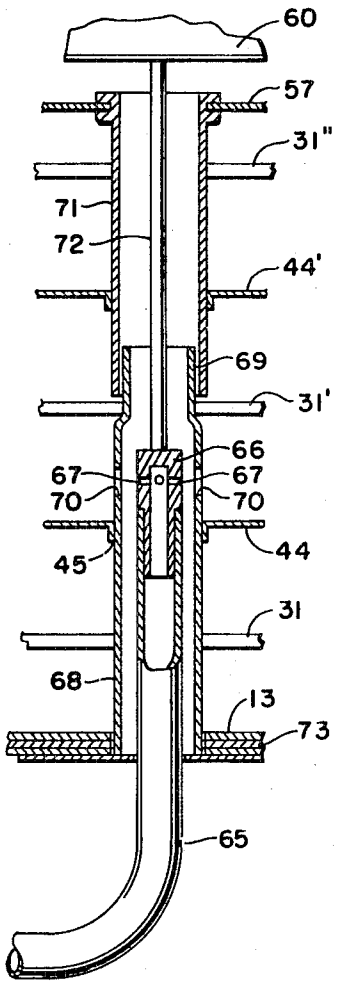


FIG. 5

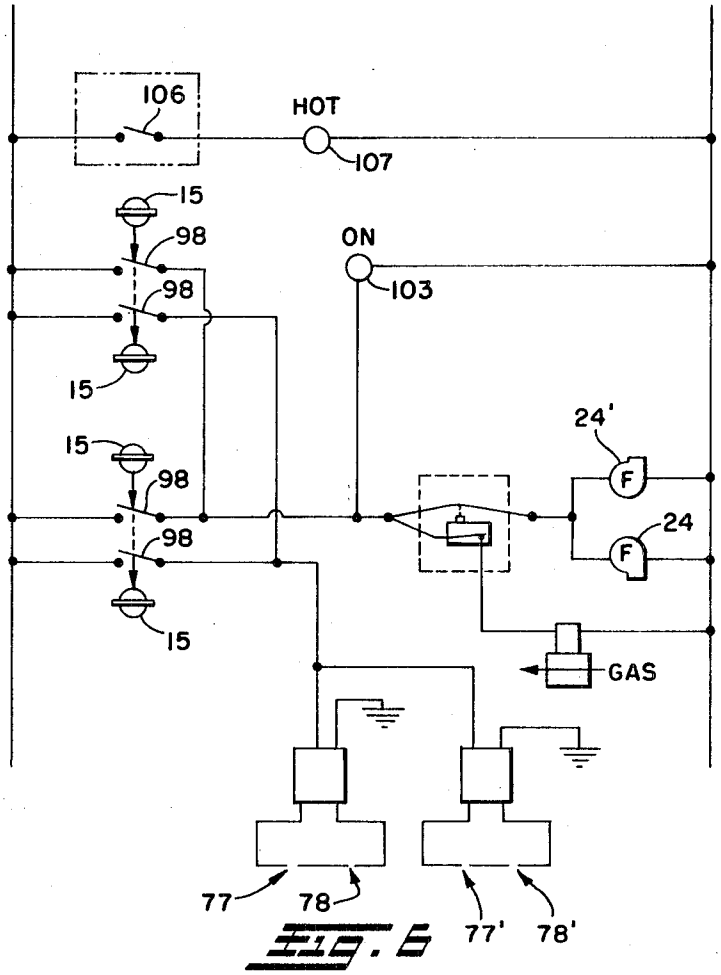


FIG. 6

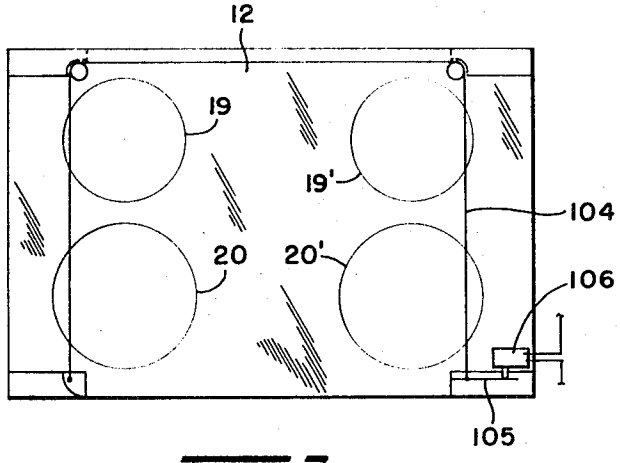


FIG. 7

INVENTOR.
RICHARD L. PERL

BY

Oberlin, Maky, Donnelly & Renner
ATTORNEYS

GAS SMOOTH TOP RANGE

This invention concerns closed or smooth top ranges in which gas burning devices selectively and controllably serve as plural heat sources for cooking in utensils and the like placed on the top surface of the range.

The presently preferred combination of burner and smooth top in such an appliance uses for the latter a glass ceramic material having an essentially zero temperature coefficient of expansion and a high intensity radiant gas burner having a powered air supply. When plural burners are provided, the traditional minimum for surface cooking in a domestic range being four, the hot exhaust from the appliance should not be discharged directly to the room, and various expedients have been proposed for cooling the exhaust within the unit to a safe and tolerable level prior to room discharge to obviate the need for exterior venting. U.S. Pat. No. 3,241,542 shows, for example, a substantial vertical flue for the purpose in such a range, and in U.S. Pat. No. 3,494,350 there is disclosed a rotary heat exchanger commonly serving the four burners which are used.

It is a primary object of the present invention to provide a combined gas burner and heat exchanger which is particularly suited for this closed top range use and forms an operating subassembly in which the burner and exchanger are very closely structurally united. As a result, the device is very compact and actually requires little added space in a rough-in box, for example.

The exchanger, basically, brings ambient air flowing to the burner into heat transfer relation to the combustion gases from the latter, and it is a further object of the invention to improve the efficiency of this section of the device. The ability of the incoming air to extract heat from the outgoing exhaust gases is of course an important determinant in sizing the exchanger section, and it will be understood that in a full range employing four or more heat sources, with the new individual exchanger sections for the burners, the benefits are correspondingly multiplied.

It is also an object to provide such a burner-exchanger device for a unit having high and low conditions of operation, preferably in a configuration defining a main annular port section and a center section therein which may be operated alone for relatively low heat demands, such as in a simmer position of adjustment. This advanced control has, moreover, been provided with a single gas supply line to the burner, as compared to the two-line arrangement generally found in burners equipped with center simmer sections.

With further regard to the full range, especially with a glass ceramic top or equivalent, there has been concern for safety in the event of breakage of the top, and various measures have been proposed to ensure that the burners are fully disabled from operation if such condition should exist. The provision of a safety on this order is another object of the present invention.

It is also thought desirable that the user should be alerted when any burner is hot, since even with the glass ceramic top, the material is preferably translucent and there is a definite lag between the time a burner is turned on and the usual red image becomes visible at the top surface, and again between turning off of the unit and return to substantially room temperature. There can be significant heat at the top surface in these periods, and a still further object of this invention is to provide an indicator control which will tell the user when there is any burner in the range above a selected temperature, regardless of the control settings.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a perspective view of a smooth top range in accordance with the present invention and on a relatively reduced scale;

FIG. 2 is a side elevation of the range partially broken and showing in transverse section one of the new burner devices and the associated control;

FIG. 3 is a top plan view of half of the range, which is symmetrical about its transverse centerline, with the glass top removed and the enclosure at the valve area broken away to expose the valving;

FIG. 4 is a fragmented top plan view of one component of the heat exchanger section combined with the burner;

FIG. 5 is a vertical section on an enlarged scale of the gas supply section of the burner;

FIG. 6 is a diagram of the wiring of the range; and

FIG. 7 is a simplified plan view of the rough-in box and burners in which an indicator control is shown.

Referring now to the drawings in detail, the range of the invention is designated generally by reference numeral **10** in FIG. 1 and shown as incorporated in kitchen counter structure **11**. The top of the range is preferably a single sheet or layer of glass ceramic material **12** which is substantially transparent to infrared radiation and has for practical purposes in this application a zero temperature coefficient of expansion.

The glass layer is the top closure of a relatively shallow box housing **13** fitted with a control section **14** at the front edge within which there are four vertically oriented valves, to be later described more in detail, respectively actuated by control knobs **15**. The range front wall is provided with openings **16**, and the exterior configuration is completed by a hollow backsplasher at the rear having a horizontal discharge slot **17** at the top front in which a decorative grill **18** or the like is mounted. As will also appear more fully, the operation of the range involves an intake of air through the front louvered openings for the burner devices and exhaust of the combustion gases through the backsplasher slot.

The four valves of course indicate that the unit contains four burner devices and, as earlier explained, the mechanical design is symmetrical with respect to the plane of the transverse centerline. The details of the right half of the range shown in FIGS. **2** and **3** will thus provide adequate description of the whole, and it may be noted initially that the two burners at this side, **19** at the front and **20** in line at the rear, are of essentially the same design and differ in that the former is of smaller size than the latter.

A sheet metal pan **21** is applied over the main bottom exterior of the box **13** and forms the actual bottom wall of the appliance, while defining with the box an enclosed chamber **22**. The burner area is separated from the forward control section by a vertical partition **23** which extends across the width of the unit. In the main area of the box behind this partition at the right there are the two burners **19**, **20**, a motor driven exhaust fan **24**, and two air tubes **25**, **26** extending from the partition horizontally and then vertically to the box floor at points respectively adjacent the burners. The fan has its intake **27** at an opening in the floor and its outlet connected to one-half of a discharge duct **28** extending to the rear and then upwardly through the backsplasher to the discharge slot **17** in the same.

With regard now to the design of the burner **20** or, more exactly, burner-exchanger combination, this device is made up of a series of inexpensively formed sheet metal parts in vertical stacked assembly. The bottom piece **30**, referring to FIG. **2**, is a circular pan having a center aperture **31** and a relatively raised bottom **32** leaving a ring channel form about the outer periphery in which there are slots or holes **34**. The outer wall of this pan is provided with inner dimples **36** serving as stops beneath the top edge for application of a plate **37** having the same outside diameter and a similar dimpled outer flange or wall **38**. Plate **37** is nested at the exterior within the bottom pan and further has a center opening **39** of larger diameter than the pan aperture **31**. Next in succession is a small baffle **40**, with a center aperture that does correspond to aperture **31** and shaped so that its main body section is offset vertically

with respect to both its center apertured section and its outer edge section.

It will be noted that the outer diameter of the small baffle is less than that of the pan and plate, and the inner edge of the pan is crimped over the corresponding registering edge of the baffle as shown. A closure disc **44** of the same smaller outside diameter is applied to the top of the small baffle **40**, and this disc is formed with a relatively small center hole **45** and a series of raised louvers **46** which extend normal to radii of the disc in the same rotative direction. Spacers **47** are secured between these elements for rigidifying the structure, with some baffling effect, and the abutting edges of the small baffle and disc are welded together.

The assembly of circular pan **30**, plate **37**, small baffle **40**, and louvered disc **44**, is repeated in building the stack as shown by the primed reference numerals, with a gasket **48**, however, preferably interposed at the joint of the inner edges of pan **30'** and plate **37'**. Added to this full repetition are one further pan **30''** and plate **37''**, and then a deeper drawn burner pan **49** as the uppermost component.

The burner pan has a center opening in register with that of the pan **30''**, with the edge of the latter crimped over the former at **31''**, and a stepped body form providing intermediate wall **51**, an outer ring portion in which there are openings **53**, and a relatively higher wall which nests in the plate **37''**. The wall of the burner pan is moreover flanged outwardly at its top **55** and, with the bottom pan **30** of the stack resting on the bottom of the box **13**, the burner pan top flange is closely opposed to the underside of the top glass plate or layer **12**. A gasket **56** is placed between the last two opposed surfaces for sealing the unit to the glass.

A center spacer **57** of inverted pan form having holes **58** in its vertical wall is secured to the burner pan over the center opening of the same and supports a burner screen **59**. This screen in turn supports a body **60** of ceramic brick or tile, in one or more pieces and having a multiplicity of vertical ports, and overlying the top of the same is a metal retainer ring **61** which is cut to provide predetermined port areas, namely, a center circular section **62** and what is essentially an outwardly spaced annular section **63**. For a purpose to be explained, four equally spaced radial reliefs **64** are provided in the metal masking section separating the center section and the outer annular section, which is considered the main port section.

Gas is supplied to the burner device **20** through valving, which will be described below, and a steel tube **65** which extends from the forward control section **14** of the range through the bottom chamber **22** to the vertical centerline of the burner and then upwardly to a closed end within the same as best shown in FIG. **5**. The end of supply tube **65** is closed by a plug terminus **66** of the same outside diameter and having plural orifices **67** in the sidewall at an elevation above the lowermost louvered disc **44**. This end extent of the supply tube within the burner device is enclosed by a length of larger diameter tubing or surround **68** spaced about the same extending in effect from the closed bottom closely through the flanged center hole **45** of the disc **44** to an open and relatively reduced end **69** between this disc and the next succeeding louvered disc **44'**. Orifices **70** of larger diameter than the orifices **67** are provided in the tubing **68** respectively in register with the former, and the reduced upper end **69** of the tubing extends with clearance into another length of tubing **71** which proceeds upwardly closely through the uppermost louvered disc **44'** to a supporting attachment with the burner support and spacer **57**. A metal rod **72** extends from an upper end contact with burner screen **59** to contact with the top of the burner tube plug **66** to serve as a heat conductor therebetween for a purpose to be set forth in the following.

Reverting to FIG. **2**, it will thus be evident that this gas supply assembly within the burner **20** extends freely, that is, with appreciable clearance, through the center apertures at **31**, **31'** and **31''**, while cooperably engaging the louvered discs **44** and **44'** to block any central flow through the same at these levels.

The air tube **26** previously mentioned associated with the rear right burner **20** communicates through an opening in the floor of the box **13** with a pear-shaped housing **73** applied to the underside of the floor, and the latter is provided with openings **74** which permit the air to enter the bottom of the burner-exchanger assembly. The dashed arrows in FIG. **2** indicate this entry and flow reversely over pan bottom **32** and small baffle **40** to and through the directionally louvered openings **46** in the first closure disc **44**. These openings import a swirling movement to the flow, which continues upwardly past the gas supply holes **70** and reversely over pan **30'** and baffle **40'** to the further louvered disc **44'**. The latter produces further rotative movement of the upflow, now of course including gaseous fuel if supplied through the holes **70**, and continues over the inner or central path to the burner pan at the underside of the ceramic body. The gas-air mixture will flow trough the unblocked port areas defined by the top retainer or mask for ignition and heating of the body to incandescence to produce the desired infrared radiation.

The sealing of the burner pan **49** to the glass contains the hot combustion gases and these are caused to flow in the manner indicated by the full line arrows. More particularly, the flow is downwardly through the pan relatively at the outside openings **53** of the same, reversely over the opposite sides of plate **37''** to outer pan openings **34''**, and then similarly through the remainder of the stack. The bottom of the rough-in box **13** is also provided with openings **75** in register with holes **34** in the bottom pan, and a large generally rectangular exhaust pan **76** is applied to the exterior of the bottom to contain in spaced relation the air intake housing **73** and form an exhaust collector chamber.

This exterior exhaust pan **76** communicates with the opening **27** at the intake of the fan **24**, and the latter is thus operative to maintain the burner device under negative pressure for the described air and exhaust flows. Within the exchanger section, the counterflows of the air and exhaust are radial as well as vertical, with the noted swirling component in the former. When gas is supplied at the holes or ports **70**, a part of the exchanger serves as a mixing chamber for the fuel and air.

The mechanical design of the gas supply tube disclosed provides the desired two control settings for the burner noted at the outset through ordinary valve control of the velocity of the gas. With the gas delivered at high velocity, for example, at a rate corresponding to 6,500 to 8,000 B.t.u. per hour, the impingement against the closed end of the plug **66** will forcibly divert all of the gas outwardly through the holes **67** and the registering holes **70** to encounter the upward swirling air and proceed therewith through the outer main port section **63** of the burner. At a lower velocity, for example, at a rate equivalent to that of 500 to 600 B.t.u. per hour, the gas issuing from the plug holes **67** is pulled upwardly by the slightly negative pressure which exists at the burner surface through tubing **71** to the center or simmer section **62** for the reduced or low heat setting. In this case or condition of operation, combustion air is also drawn into tubing **71** over reduced end **69** of the lower tubing **68**.

In the operation of the burner, the supply air to the same becomes preheated in the exchanger section and expands, and, without alteration of the supply, there is a tendency for the air-gas mixture to become relatively rich. The general heating of the environment does cause some rise in the temperature of the gas as it is delivered to the burner, as a compensating influence, and the rod **72** in acting as a heat bridge between the burner screen **59** and plug **66** very significantly accelerates and adds to this effect. Accordingly, the weight of the fuel is automatically reduced through this heating to more closely maintain the selected air and fuel ratio notwithstanding the noted weight loss in the air, and this benefits ignition and permits operation with less than the excess air which would be included ordinarily in the design. The flow rate reduction also provides protection against overheating of the top glass.

The front burner **19** at the same side is served by its own air tube **25** and comparable intake housing **73'**, while its exhaust is also collected in the pan **76** for delivery to the fan **24** and the noted discharge. As also noted earlier, this burner is of somewhat smaller size, and a modified masking retainer **61'** is used. In this case, the intervening band of metal between the center simmer section **62'** and the annular main port section **63'** does not have the reliefs **64** of the latter. The burners are ignited electrically by the paired electrodes **77** and **78**, and in the case of the large burner **20**, the reliefs provide a better bridge for assured flashing to the center simmer section. With the smaller burner, the separation is not great enough to require this assist.

The two burner devices **19** and **20** are respectively controlled by duplicate valves **79** and **80**, and all such valves in the range are served by a gasline **81** extending horizontally in the control section **14** and adapted for connection to an available external supply through a conventional solenoid valve and pressure regulator. Each valve actuating shaft **82** carries a cam having a flat **83**, a notch **84**, and a curved part **85**. These cams are opposite the open ends of the air tubes **25** and **26** forwardly of the partition **23**, and extending from fixed pins **86** traversing the tubes are yokes **87** which engage about the shafts **82** below the cams. These pins also serve as stops for coil springs **88** which project from within the tubes to bear against retainers **89** slidable on brackets **90** mounting rollers **91** vertically in contact with the cam edges.

The brackets **90** have forward end slots **92** permitting them to move relatively on the valve shafts and extend, together with the retainers **89**, through slots **93** in the partition **23**, so that the two pieces can move together in and out relative to the ends of the tubes and hence with expansion or compression of the springs **88**. The normal separation between the brackets and the retainers is determined by adjusting screws **94**.

The foregoing cam-spring devices provide automatic air regulation upon actuation of the gas valves, since air entering the open ends of the tubes must proceed through the turns of the springs **88** and the spacing of the same will vary depending upon the state of compression or expansion of the springs. The valves in respect of the gas control are of the usual plug type, and the spring action precludes stopping of the valve between the lowest main setting and the center simmer setting in the movement of the control from the former to the latter condition.

With particular reference to FIG. **3**, in which the valves **79** and **80** are both shown in off condition, it will be seen that turning either counterclockwise will first push the associated roller inward against the spring pressure until it seats in the cam notch **84**. This is made to correspond with the simmer or low setting of the controlled burner at the gas valve and some compression of the air tube spring is effected for predetermined ambient air inflow to the burner. Further turning of the valve shaft will increase the gas delivery opening to a main or maximum condition for the main port operation over the cam part **85** which has a relatively reducing radius, so that the roller can advance and permit the spring behind the same to expand for increased airflow into the associated air tube. The coil springs thereby act as shutters for adjustment of the air intake responsive to the settings of the gas supply valves.

Two normally open control switches **98** are mounted between the valves **79** and **80**, and resilient arms **97** bridge the brackets **90** in engagement with the operating plungers of these switches. Only one switch is evident in FIG. **3**, since the other is mounted directly beneath the same, with both however shown in the wiring diagram of FIG. **6**. It will be seen from FIG. **3** that any adjustment of either valve will cause the two leafs to cant or, if both are actuated, to move fully away from the switch plungers, and in both cases the plungers are released to close the switches.

As shown in the full range diagram of FIG. **6**, switches **98** first control the four electrode pairs **77**, **78**, **77'**, **78'**, for ignition, with any valve actuation causing energization of all ignitors. Another circuit is closed simultaneously through the control wire **100** of a normally closed hot wire relay **101** in common series with the motors of the two fans or blowers **24**, **24'** and a further circuit is completed through the relay **101** itself to energize the solenoid valve **102** which controls the flow of gas to the entire range. An "ON" indicating light **103** is included, and the wire **100** of the hot wire relay will preferably be located at some point in the ambient airstream to be responsive to the circulation produced by operation of the fans. For example, it can be positioned in the control section area where the room air is drawn in, and unless there is sufficient inflow of this relatively cool air, the wire will heat due to current flow therein and expand to open the normally closed relay **101** and deenergize solenoid valve **102**.

Another indicating control is shown which is further depicted in FIG. **7** and utilizes the fact that the top glass layer will experience substantially no thermal expansion in the operation of the appliance. A wire **104** having a positive temperature coefficient of expansion is stretched suitably through the unit over the edges of all four burners **19**, **20**, **19'**, **20'** and secured at a free end to a switch actuating arm **105**. The taut wire normally holds the arm against the plunger of a switch **106** mounted on the glass **12**, so that it is and remains fixed, to hold the switch contacts open, and significant heat in any burner causes the wire **104** to expand and, releasing the arm **105**, permit closure of the switch. Accordingly, regardless of the valve settings, a "HOT" lamp **107** in this circuit will be illuminated whenever any burner is above a selected temperature, and this value will of course be determined by the level of sensible heat at the top surface which is considered to be tolerable.

The full range in the disclosed embodiment, accordingly comprises four burners with individual heat exchangers and a shared or common exhaust system in which fans are located to pressurize the unit. As noted earlier, this particular arrangement maintains the burners under negative pressure, and holes **108** in the pan **76** provide an airflow over the bottom for cooling and to produce a slightly negative pressure within the box as well. Since the existence of this negative pressure is another indication of the fan operation, it might be used as a condition for the above-described safety interlock of the burners, for example, by means of a suitable pressure responsive switch controlling the main gasline solenoid valve.

It will also be appreciated that the range could be made to operate by pressurizing the supply air instead of the exhaust, with appropriate modification of the gas supply to the individual burners and sealing of the exhaust part of the system to control the discharge in this relatively reversed arrangement.

I, therefore, particularly point out and distinctly claim as my invention:

1. A gas smooth top range, comprising a plurality of gas burners, enclosure means therefor including an imperforate top plate for support of cooking utensils on the same above the burners, gaseous fuel and air supply lines connected to the burners, control valves operative in the fuel supply lines for user actuation to regulate the burners respectively, and individual heat exchanger means associated with the burners for cooling the hot gases discharged by the same and preheating the air supplied thereto for combustion, each heat exchanger means comprising boundary surfaces against the opposite sides of which the hot gases and combustion air are caused respectively to flow, with such surfaces having spaced annular portions over which the flows proceed radially in traversing the exchanger means.

2. A gas smooth top range as set forth in claim **1**, wherein the burners are provided with heat bridges between port sections of the same and their respective fuel supply lines to raise the temperature of the fuel delivered through the latter and thereby effect a relative reduction in the weight of the fuel with increase in the operating temperature of the burner.

3. A gas smooth top range as set forth in claim **1**, wherein the air supply lines to the burners include variable air inlet

controls coupled to the fuel control valves for automatic adjustment of the former in response to actuation of the latter.

4. The combination set forth in claim 10, wherein the burner has a fuel supply line, and a heat bridge is provided between an operating part of the burner and said fuel supply line to raise the temperature of the fuel delivered through the latter and thereby effect a relative reduction in its weight as the operating temperature of the burner increases.

5. A gas smooth top range as set forth in claim 1, wherein each exchanger means includes baffling for producing a swirling movement of the combustion airflow therethrough.

6. A gas smooth top range as set forth in claim 5, wherein the gas supply lines to the burners deliver the fuel to intermediate locations within the heat exchanger means for mixing with the swirling airflow therein.

7. A gas smooth top range as set forth in claim 6, wherein the burners have center simmer port sections and outer main port sections, and the gas supply lines include low velocity passages for conveying the fuel substantially directly to such simmer sections automatically when the fuel delivery velocity is below a selected value.

8. A gas smooth top range as set forth in claim 7, including safety means for providing a sensible signal whenever a burner is above a predetermined temperature.

9. A gas smooth top range as set forth in claim 8, including blower means at the exhaust side of the burners for establishing the flows of hot gases and combustion air.

10. In a combined gas burner and heat exchanger, means for establishing an outflow of the hot gases from the burner through one exchanger section in generally radial flow reversely over a succession of annular boundary elements forming one side of the section, and means for delivering combustion air to the burner through another exchanger section in a swirling advance over said boundary elements at the side opposite said one side to cool the outflow and preheat the combustion air.

11. The combination set forth in claim 10, wherein gaseous fuel supply means is included for delivering such fuel to the swirling flow of air within the exchanger.

12. In gas smooth top range structure including a gas radiant burner, a top plate over the burner made of a glass material which does not experience appreciable thermal expansion in operation of the range, and control means for regulating operation of the burner; the improvement which comprises safety means for indicating to a user a burner temperature above a predetermined value regardless of the setting of said control means, said safety means including cooperable switch members having two conditions of adjustment, one of said members being fixed and the other movable relative to the top plate, actuating means for said other member having an appreciable temperature coefficient of expansion and being exposed to heat produced by the burner, with such heating of the actuating means above a selected degree causing sufficient movement of said other member relative to the one member to alter the condition of adjustment thereof, and means responsive to such change of adjustment of the switch members to provide a sensible signal to the user.

13. Gas smooth top range structure as set forth in claim 12, wherein there is at least one additional burner beneath the top plate with separate control means, and the actuating means is commonly associated with the plural burners to indicate the predetermined heated condition of any one.

* * * * *