Dec. 20, 1966 S. B. WELCH 3,293,410

OVEN THERMOSTAT WITH ANTICIPATOR HEATER

Filed June 12, 1964 2 Sheets-Sheet 1

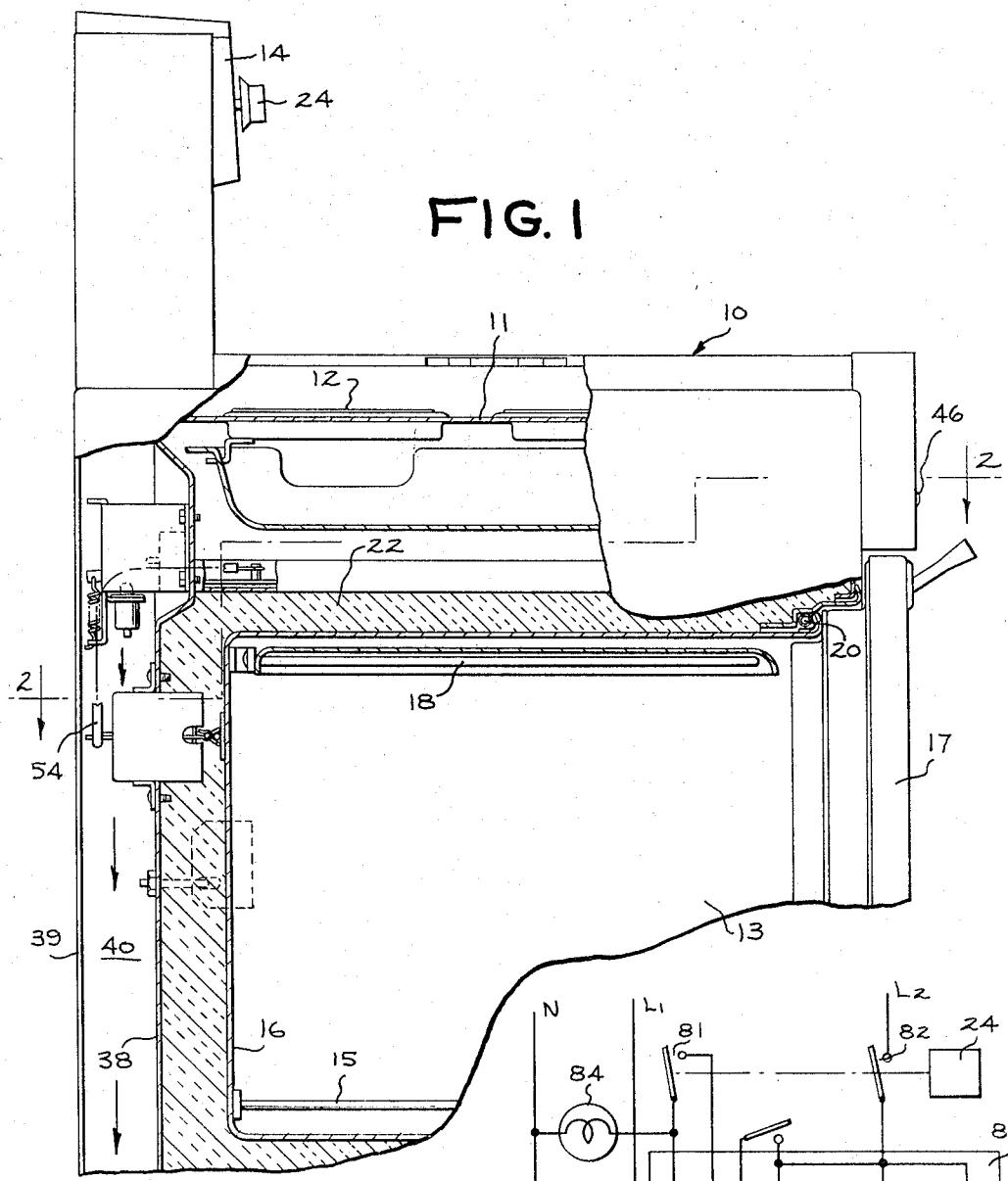



FIG. 1

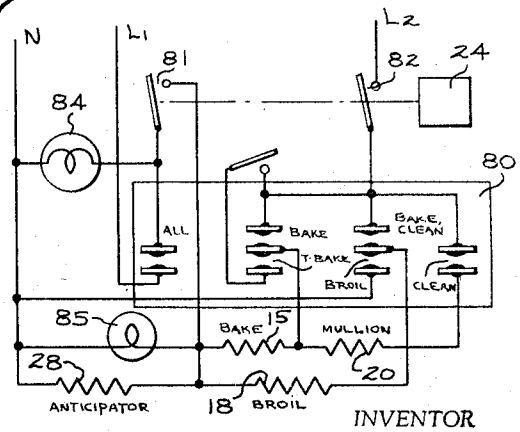



FIG. 5

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OVEN THERMOSTAT WITH ANTICIPATOR HEATER

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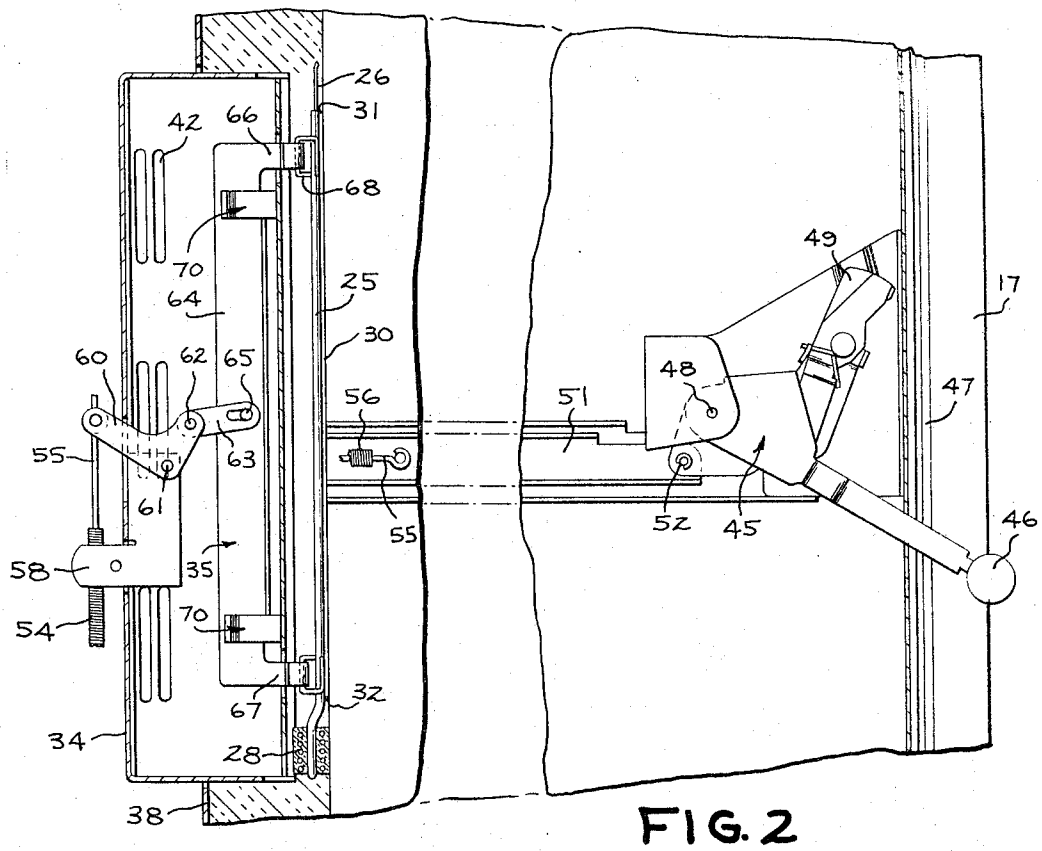



FIG. 2

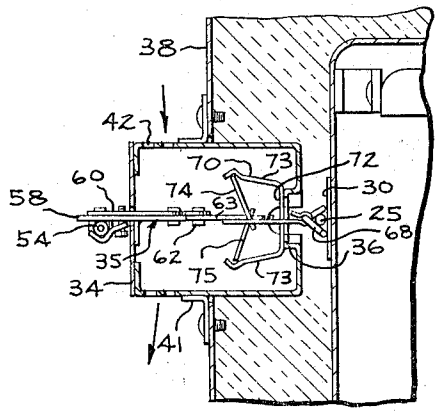



FIG. 3

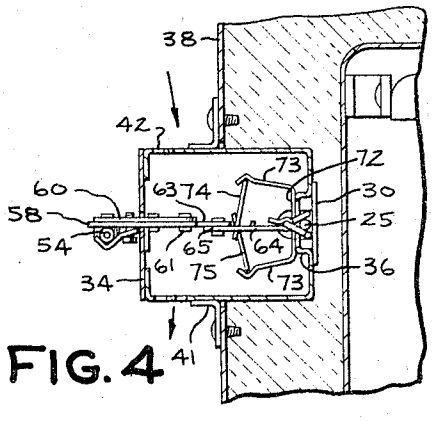



FIG. 4

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3,293,410

# OVEN THERMOSTAT WITH ANTICIPATOR HEATER

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6 Claims. (Cl. 219—393)

The present invention relates to a domestic oven, and particularly to an oven having a hydraulic thermostatic control system which will operate through two temperature ranges such as the normal cooking range of about 150° F. and 550° F. as well as in a heat cleaning temperature range having a maximum temperature somewhere between about 750° F. and 950° F.

Hydraulic oven thermostats have been used for many years, and they have been perfected to a high degree of reliability. One such thermostat design is disclosed in the patent to W. J. Ettinger No. 2,260,014 dated October 21, 1941 and assigned to General Electric Company, the assignee of the present invention. Such hydraulic thermostats include an elongated bulb or probe formed on the end of a capillary tube, and this tube is in turn joined to a bellows or diaphragm within the thermostat housing. Such a housing is usually mounted on the control panel or backsplash of the range. The normal oven cooking temperatures have always been below about 550° F. maximum, and the thermally responsive fluids used in such thermostats have been able to withstand this degree of temperature without difficulty. However, the known thermally responsive fluids available today cannot be operated at temperature much above 650° F.

In recent years a self-cleaning oven design has been perfected which automatically cleans the food particles and grease spatterings from the inner walls of the oven cavity to free the housewife of the drudgery of washing, scrubbing or scraping the baked-on soil that normally accumulates during the normal cooking operations. For a better understanding of the principles of a self-cleaning oven, attention is directed to Patent No. 3,121,158 of Bohdan Hurko which is also assigned to the General Electric Company, assignee of the present invention.

Heretofore, strong chemical agents have been devised and are commercially available for the express purpose of removing food soil of this type under these conditions. However, even the best of these cleaning agents require strong rubbing action and a great deal of time and energy to complete the task satisfactorily. Also, there exists a safety hazard that the chemicals might cause injury to the user's hands or eyes if the directions for use are not followed closely.

Once the principle of automatic heat cleaning of domestic ovens by the method of pyrolysis was perfected many different systems of applying the heat and controlling the cleaning operation were devised to obtain the optimum results. In order to gain the maximum reliability, standard components were used where possible to take advantage of the years of engineering development and know-how gained by working with the components. The high temperatures experienced during a heat cleaning operation within the oven raises a problem as to how to protect the fluid in the hydraulic thermostat so that it remains operational.

The principal object of the present invention is to provide a hydraulic thermostat for a high temperature oven including an external temperature sensor that is provided with an anticipator heater so as to reduce the temperature lag between the oven air and the sensor.

A further object of the present invention is to provide a hydraulic oven thermostat with an external temperature sensor or bulb in thermal contact with the outside of



an oven liner during normal cooking operation, with means for moving the bulb away from the oven liner a predetermined amount before a heat cleaning operation is started so the bulb then senses a temperature which is an analog of the oven liner temperature and the bulb temperature never rises above about 550° F.

A further object of the present invention is to provide a hydraulic oven thermostat with an external temperature sensor of the class described in association with an air cooled box structure or heat sink for drawing off heat from the sensor during the heat cleaning operation.

A still further object of the present invention is to provide a self-cleaning oven with a hydraulic thermostat having an external temperature sensor provided with an anticipator heater, there being a latching mechanism for a door of the oven and a connection between the latching mechanism and the temperature sensor so that when the door is latched for the heat cleaning operation the sensor will automatically be withdrawn from contacting the oven liner.

The present invention, in accordance with one form thereof, is incorporated in a domestic oven that has an oven cavity formed by a box-like oven liner and a front-opening access door. Heating means is provided for supplying heat energy to the oven cavity both for normal cooking operations as well as for raising the temperature above the normal cooking temperatures during an automatic heat cleaning cycle. A hydraulic thermostatic control system is incorporated with the oven to sense the oven temperature and govern the heating means for holding a desired preset temperature within the oven cavity.

The hydraulic thermostat of the present invention includes an external temperature sensor or bulb that is located outside the walls of the oven liner and in heat transfer contact therewith to sense the temperature of the oven wall. An anticipator heater is associated with the bulb, and the heater is energized whenever the said heating means is energized so as to reduce the temperature lag between the oven air and the bulb. Other modifications include means for separating the bulb from the oven liner prior to the heat cleaning operation so that the bulb temperature is an analog of the oven wall temperature and never rises above a maximum temperature of about 550° F. If found desirable, an air cooling means could be associated with the bulb in its retracted position to draw off heat from the bulb and provide maximum protection.

My invention will be better understood from the following description taken in conjunction with the accompanying drawings and its scope will be pointed out in the appended claims.

FIGURE 1 is a left side elevational view of a free-standing electric range embodying the present invention with parts broken away to show the top portion of the oven cavity and particularly the location of the external temperature sensor of the hydraulic thermostat.

FIGURE 2 is a top cross-sectional plan view of the oven showing a door latching mechanism and its connection with the external temperature sensor or bulb, the view being taken on the line 2—2 of FIGURE 1.

FIGURE 3 is a transverse cross-sectional elevational view at the back of the oven showing the bulb in thermal contact with the oven liner and a portion of the connection means between the latching mechanism and the bulb to effect the retraction of the bulb prior to the heat cleaning operation.

FIGURE 4 is a cross-sectional view similar to that of FIGURE 3 except the bulb is shown in its retracted position away from the oven liner as it would appear during the heat cleaning operation.

FIGURE 5 is a schematic diagram showing the heating means, and circuit control and temperature control means for the oven of the present invention.

Turning now to a consideration of the drawings and in particular to FIGURE 1 there is shown for illustrative purposes a free-standing electric range having a body or cabinet structure **10** with a recessed top cooking surface **11** including a plurality of surface heating elements **12**, and oven **13** located beneath the cooktop **11**, and a backsplasher **14** arranged along the back edge of the cooking surface **11** and including a control panel (not shown) on which many of the control components such as a hydraulic thermostat **24** would be mounted for governing the energization of the various heating elements of the range. The oven **13**, has an oven cavity formed by a box-like oven liner **16** and a front-opening access door **17**. The oven includes two standard electric heating elements; namely, a lower bake element (not shown) arranged just above the bottom wall of the oven liner and an upper broil element **18** which is located just under the top wall of the oven liner. Because it is important to have generally uniform temperatures on the walls of the oven liner and door during the heat cleaning operation, an additional heating element known as a mullion or perimeter heater **20** is assembled around the front of the oven adjacent the door opening. This mullion heater surrounds the oven liner in such a way that the oven door **17** protrudes through the plane of the mullion heater as is clearly shown in the drawing, FIGURE 1. Thermal insulating material **22** such as fiberglass or the like surrounds the outside of the oven liner for retaining as much of the heat within the oven as is possible for efficient operations as well as to prevent excessive temperatures on the outer surfaces of the range body **10** which might otherwise result in personal injury.

An oven thermostat **24** is located in the control panel or backsplash **14**, and it serves as a temperature control means for the energization of the heating means; namely, the bake element **15**, the broil element **18**, as well as the mullion heater **20**, in the case of the heat cleaning operation. It is necessary for the thermostat **24** to have a temperature sensor that is in heat transfer relation with the oven for determining the oven temperature and signalling this temperature to the thermostat **24** which in turn receives and then acts upon this temperature information and controls the temperature to a degree determined by the adjustable setting of the thermostat. Such a sensor is represented by an elongated copper bulb **25** best shown in FIGURE 2 as being positioned against the outer surface of the back wall of the oven liner **16**. It is shown as being horizontally disposed adjacent the upper portion of the oven to be near the broil element **18**. This bulb **25** is joined to the thermostat **24** by a capillary tube **26** as is conventional in this art. A temperature-responsive fluid such as phenyl, di-phenyl chloride is used in the system; but as mentioned previously, it cannot be relied upon at temperatures much above 600° F. because it starts to chemically decompose and lose its desired properties. Also, the copper bulb **25** and capillary tube **26** begin to soften and oxidize at around 700° F. and this oxidation can continue for only a short time before the fluid will begin to leak out of the system and thus render the thermostat inoperative. The most common location for the thermostat bulb is within the oven cavity, but since the present invention is primarily for use with a high temperature self-cleaning oven, measures must be taken to insure that the temperature of the bulb never approaches near 600° F. This explains one reason for placing the bulb **25** outside of the oven liner so that rather than detecting oven air temperatures as heretofore, it detects the oven wall temperature.

Ordinarily, the temperature of the thermostat bulb would lag behind the oven air temperature by about 100° F. This is caused by the lag of the oven wall temperature of about 75° F. plus the relatively high thermal mass of the bulb and the high thermal resistance between the bulb and the oven wall. This characteristic causes a high initial oven temperature overshoot and high amplitude cycling. In addition, the thermal resistance between the bulb and the oven wall is not constant and this results in variations in controlled temperature.

As a solution, I have incorporated an anticipator heater **28** over the tip of the bulb **25** as is best seen in FIGURE 2. This heater **28** may be in the form of an insulated wire wound around the bulb or preferably a commercially available wire-wound resistor, and its use reduces the temperature lag effect and partially compensates for the variable thermal resistance between the bulb and oven. The heat generated by the anticipator heater **28** causes the temperature of the bulb **25** to lead the oven wall temperature. With high thermal resistance, the temperature of the bulb may be effectively raised about 100° F. With low thermal resistance a larger portion of the anticipation heat would flow to the oven wall and not be effective in raising the bulb temperature. In order to obtain good thermal conducting action, a thin copper plate **30** is formed integral with the bulb for the greater portion of the length of the bulb as for instance, from point **31** to point **32**. This plate member **30** is mounted on the side of the bulb to be in full contact with the oven wall so as to obtain generally uniform heat distribution along the bulb. This plate member **30** stops short of the tip of the bulb so the anticipator heater **28** can be threaded over the tip and held in place. During normal cooking operations such as Bake, Broil or Time-Bake the themostat bulb **25** is in contact with the oven wall and the anticipator heater **28** is energized simultaneously with any one of the oven heaters. Thus the anticipator heater **28** adds to the heat from the oven to reduce the temperature lag between the oven wall and bulb during the operation of the thermostat.

The use of the oven thermostat **25** is the same during the heat cleaning operation except the bulb is moved away from the oven wall a predetermined amount as is best seen in FIGURE 4. Associated with the bulb **25** is a box structure **34** which is slightly longer in length than the bulb and it includes a suitable linkage **35** for changing the position of the bulb **25** as will be better understood hereinafter. While the box **34** is associated with the bulb **25** at all times, the bulb is displaced from the box during normal cooking operations, as is best seen in FIGURE 3. However, for the heat cleaning operation, the bulb is moved away from the oven wall and into a recessed channel formation **36** in the nearest wall of the box **34** so that the plate member **30** of the bulb serves as a cover plate over the channel formation **36** thereby shielding the bulb within the confines of the box. In this position the bulb is not exactly in the box but it is more in the box than out of it.

The blanket of fiberglass insulation **22** covering the back wall of the oven liner **16** is partially supported by a vertical metal panel **38** which is spaced inwardly from the back wall **39** of the range body as is best seen in FIGURE 1. Hence, the space between the back wall **39** and the insulation guard **38** forms a vertical air channel **40** or wiring space at the back of the range. As is conventional in self-cleaning ovens, forced air passes down through this air channel. A fan (not shown) is located in the bottom of the range and air is drawn in through the back of the backsplasher **14** to cool the control components therein. The air passes under the oven liner to be discharged up the vertical sides of the oven and out from the range under one or more of the surface heating units **12**.

The box structure **34** of the thermostat bulb is supported by brackets **41** and **42** in an opening in the insulation guard **38** as is best seen in FIGURE 1. It will be noticed that the front half of the box is buried in the insulation **22**, while the back half of the box is located in the path of the air stream passing downwardly through the air channel **40**. The box **34** is provided with air vents

or louvers 42 in the top and bottom walls so that the movement of room air therethrough will draw off heat from the box and hence from the shielded bulb 25 during the high temperature heat cleaning cycle.

Means must be provided for retracting the bulb 25 before the heat cleaning operation can begin. Perhaps the most logical arrangement is to join the bulb 25 to a door latching mechanism 45 that locks the oven door 17 during the heat cleaning operation. Thus, whenever the door is locked the bulb 25 will automatically be withdrawn to its position of FIGURE 4. This door latching mechanism 45 does not form part of the present invention, thus, it is merely illustrated diagrammatically, since it is described and claimed in a co-pending application of Clarence Getman, Seral No. 277,174 which was filed on May 1, 1963, and is assigned to the General Electric Company, the assignee of the present invention. The latching mechanism includes a manually operable handle lever 46 which extends through an elongated slot 47 in the front edge of the cooktop 11 in a position just above and parallel to the top edge of the oven door 17. The handle lever is pivoted about a vertical axis 48 and it has an angle of movement of about 60°. It also has suitable pin and slot connections (not shown) with a swinging hook member 49 which is normally recessed within the range body 10, but it is capable of swinging outwardly for engagement with a suitable keeper (not shown) on the inner surface of the oven door 17. Pivotally connected to the handle lever 46 is a connecting rod 51 that extends rearwardly over the top of the oven, and this rod is capable of a reciprocating movement from its pivotal connection point 52 when the handle lever is moved between its open and closed positions.

A push-pull or choke cable 54 is fastened to the rear end of the connecting rod 51 and it is capable of exerting a pushing and pulling force by virtue of its wire core 55 covered by a flexible metal sheath 56. Naturally the two ends of the sheath must be fixed to a rigid support. For example, at the rear end a bracket member 58 is used, and it is supported from the rear wall of the box structure 34. The position of the wire core 55 is not fixed, but it is capable of sliding within the sheath 56 depending upon the movement of the latch mechanism 45. The rear extremity of the wire core 55 is connected to one end of a bell crank lever 60, while the lever is pivoted about its center to the bracket member 58 as at 61. The bell crank lever 60 is pivotally connected at its other end 62 to a simple link member 63. The link member 63 in turn is pivotally connected to a carrier plate 64 as at the pivot point 65 at the center thereof. This carrier plate has extremities 66 and 67 for connection to the bulb and plate assembly 25 and 30, respectively. Wire clip members 68 are formed integral with the back side of the plate member 30, and these clip members are engaged by the extremities 66 and 67 of the carrier plate 64 as is best seen in FIGURES 2 and 3.

A certain amount of spring bias or snap action is exerted by means of an over-center mechanism 70 which comprises a double assembly, one adjacent each end of the carrier plate 64 as is best seen in FIGURE 2. Each assembly comprises a large U-shaped spring member 71 with a base 72 and two spring arms 73. The base 72 is fastened to the inner surface of a wall of the box 34, while its two spring arms 73 straddle the carrier plate 64. A pair of opposing push rods 74 and 75, representing in unison an over-center spring device, are each wedged between the carrier plate 64 and the distal end of the adjacent spring arm 73. The innermost end of each push rod 74 and 75 extends through a small opening in the carrier plate 64. Thus, the natural tendency of the U-shaped member 70 to maintain generally parallel spring arms 73 is thwarted by the presence of the push rods 74 and 75. However, this spring tendency is enough to exert a reaction force on the carrier plate 64 so the plate member 30 is always held by a spring force in either one of its extreme positions such as the position in FIGURE 3 against the oven wall, and the position of FIGURE 4 against the wall of the box 34.

Turning now briefly to a consideration of the circuit diagram of FIGURE 5, the electric range of the present invention is provided with a standard electrical service of three-wire Edison source of power; nominally of 240 volts, single phase, 60 cycle, A.C. which is usually available in the average residence having adequate wiring. This voltage source has a pair of line wires L1 and L2 and a grounded neutral conductor N for supplying an oven selector switch 80 that controls the electrical load characterized by the three heating elements; namely, the bake element (unnumbered), the broil element 18, and the mullion or perimeter heater 20. The hydraulic thermostat 24 is a double pole thermostat having switch contacts 81 and 82 for breaking both sides of the line L1 and L2 bringing power to the selector switch 80. The oven selector switch 80 is shown with a plurality of switch contacts and these are labeled with designations of specific operations such as Bake, Broil, Time-Bake and Clean. The contacts labeled "All" are common switch contacts which are closed whenever the switch is in an energized position. The anticipator heater 28 that is mounted on the tip of the bulb 25 is shown connected across line L1 and Neutral whenever the common switch contact labeled "All" is closed and the thermostat contacts 81 are closed. During a baking operation the bake element and broil element 18 are connected in parallel across lines L1 and L2 at 240 volts.

During a broiling operation the broil element 18 is the only element that is energized and it is connected across line L1 and Neutral at 120 volts.

Next is the heat cleaning operation where the bake element and mullion heater 20 are connected in series across lines L1 and L2, while the broil element 18 is connected in parallel with the series connection of the bake and mullion heater across lines L1 and L2. A suitable pilot light 84 is connected across lines L1 and Neutral whenever the oven selector switch 80 is energized. Moreover, there is an oven indicator light 85 that is energized only when the thermostat contacts 81 and 82 are closed during a heating cycle.

Modifications of this invention will occur to those skilled in this art therefore it is to be understood that this invention is not limited to the particular embodiments disclosed but that it is intended to cover all modifications which are within the true spirit and scope of this invention as claimed.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A domestic oven comprising a cabinet having walls defining an oven cavity, heating means for said cavity, control means for said heating means to effect various cooking operations, a hydraulic temperature control means for said heating means settable to control the heating means to hold a selected temperature, said temperature control means comprising an elongated fluid-filled bulb having a capillary tube joined to a temperature responder, said bulb being located outside the walls of the oven cavity, and normally in heat transfer relation therewith to sense the temperature of the oven wall, an anticipator heater associated with the bulb, and means controlling said heater to be energized when the said heating means is energized so as to reduce the temperature lag between the oven wall and the bulb.

2. An electric oven comprising a box-like oven liner and an access door that form an oven cooking cavity, heating means for said cavity including an upper broil heating element and a lower bake heating element, circuit control means for said heating means to effect various cooking operations, a hydraulic thermostatic control means for the circuit control means to control the heating elements for holding selected temperatures, said thermostatic control means including an elongated fluid-filled

bulb located outside and in heat transfer relation with a wall of the oven liner near one of the heating elements, and an anticipator heater assembled with the bulb and connected to be energized whenever any one of the said heating elements is energized to reduce the temperature lag between the wall and the bulb.

3. A cooking apparatus comprising a box-like oven liner and an access door that form an oven cooking cavity, heating means for said cavity, control means for said heating means selectably operable to control the heating means to effect either a bake operation or a broil operation, a temperature control means for said heating means settable to control the heating means when in a bake operation to hold selected baking temperatures within the baking temperature range and to control the heating means when in a broil operation at a predetermined boiling temperature, said temperature control means including a hydraulic thermostat with an elongated fluid-filled bulb located against the outside of a rear wall of the oven liner, and an anticipator heater carried by the bulb, said heater being energized whenever the said heating means is operated so as to reduce the temperature lag between the rear wall and the bulb.

4. A cooking apparatus comprising a box-like oven liner and an access door that form an oven cooking cavity, heating means for said cavity, control means for said heating means selectably operable to control the heating means to effect either a bake operation, a broil operation or a high temperature heat cleaning operation, the bake and broil operations being within a temperature range between about 150° F. and 550° F. while the heat cleaning operation having a maximum temperature somewhere between 750° F. and 950° F., a temperature control means for said heating means settable to control the heating means for normal cooking operations as well as for the heat cleaning operation, said temperature control means including a hydraulic thermostat with an elongated fluid-filled temperature sensing bulb located against the outside of a wall of the oven liner, and an anticipator heater carried by the bulb and energized whenever the said heating means is operated so as to reduce the temperature lag between the oven liner and the bulb, and means for moving the bulb away from contact with the oven liner a predetermined amount before the heat cleaning operation is started so the bulb senses a temperature which is an analog of the oven liner temperature and which bulb temperature never rises above about 550° F. while the liner temperature rises to within the heat cleaning temperature range of 750° F. and 950° F.

5. An electric oven comprising a box-like oven liner and an access door that form an oven cooking cavity,



heating means for said cavity including an upper broil heating element and a lower bake heating element, circuit control means selectably operable to control the heating elements to effect either a baking operation, a broiling operation or a high temperature heat cleaning operation, the baking and broiling operations being within a normal cooking temperature range between about 150° F. and 550° F., while the heat cleaning operation has a maximum temperature somewhere between about 750° F. and 950° F., a temperature control means for said heating element settable to control the elements for normal cooking operations as well as for the heat cleaning operation, said temperature control means including a hydraulic thermostat having a temperature sensing bulb positioned against an outer surface of the oven liner, and an anticipator heater carried by the bulb and energized whenever the heating element is energized so as to reduce the temperature lag between the oven liner and the bulb, the bulb being in good thermal contact with the oven liner for obtaining accurate results, and means for moving the bulb away from the oven liner a predetermined amount for the heat cleaning operation so the bulb senses a relatively low temperature which is an analog of the oven liner temperature, and latching means for the oven door for use during the heat cleaning operation, and connecting means between the door latching means and the thermostat bulb so that when the latching mechanism is closed the thermostat bulb will move away from the oven liner.

6. An electric oven as recited in claim 5 wherein the thermostat bulb is provided with a plate member of high thermal conductivity integral therewith and extending for substantially the length of the bulb, said plate member being on the side of the bulb that engages the oven liner, the said anticipator heater being mounted onto the tip of the bulb, the said bulb being associated with a box member, the bulb during normal cooking being in thermal contact with the oven liner, while during the heat cleaning operation the bulb is in thermal contact with the box member, an air cooling means for the box member for withdrawing heat from the box and hence from the bulb during the heat cleaning operation.

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