

[54] CERAMIC-TOP COOKING ASSEMBLY
FRACTURE DETECTOR

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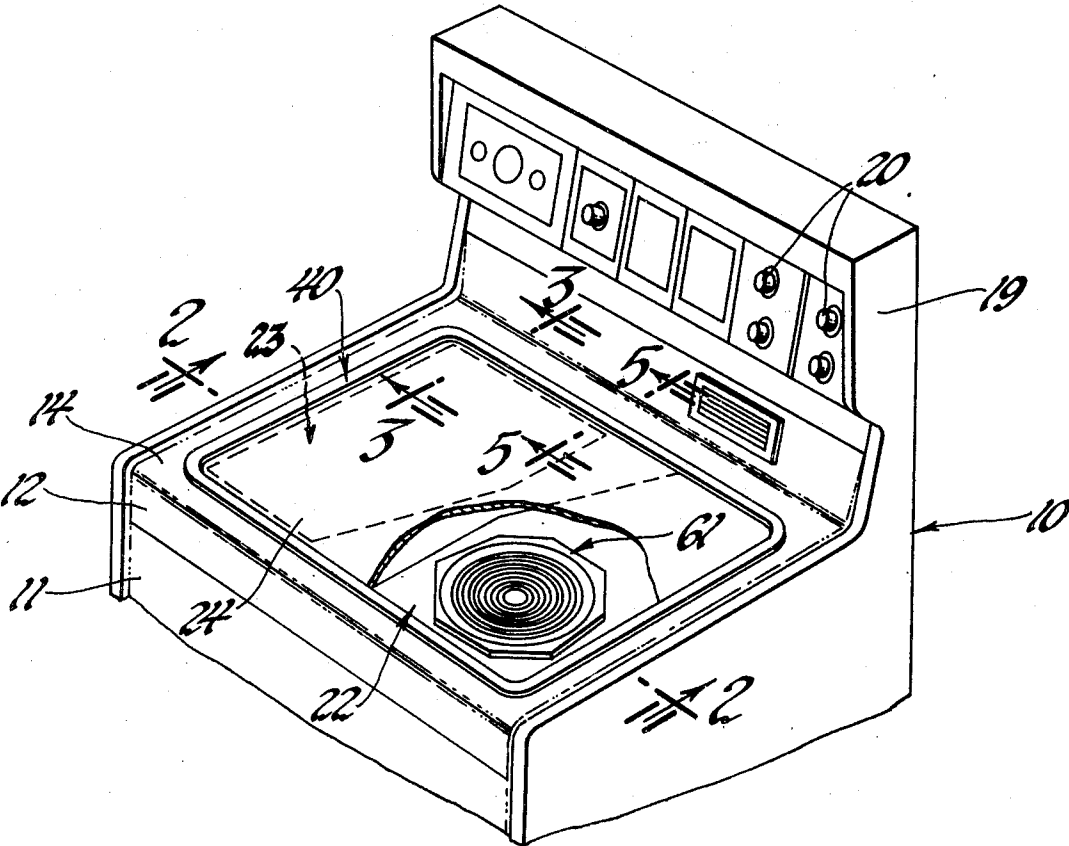
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[57] ABSTRACT

A protective circuit arrangement for an infrared radiant-type cooking assembly including a frangible utensil-supporting cover plate of infrared transmissive material with underlying heater blocks in contact with the cover plate and having an open-coil uninsulated resistance element supported on the heater blocks in spaced relation to the plate. A conductive stripe located around the periphery of the cover plate is connected in the circuit having an electronic switch arrangement for sequentially open circuiting the powerlines to the cooking assembly should breakage of the cover plate occur to obviate any shock hazard.

3 Claims, 9 Drawing Figures



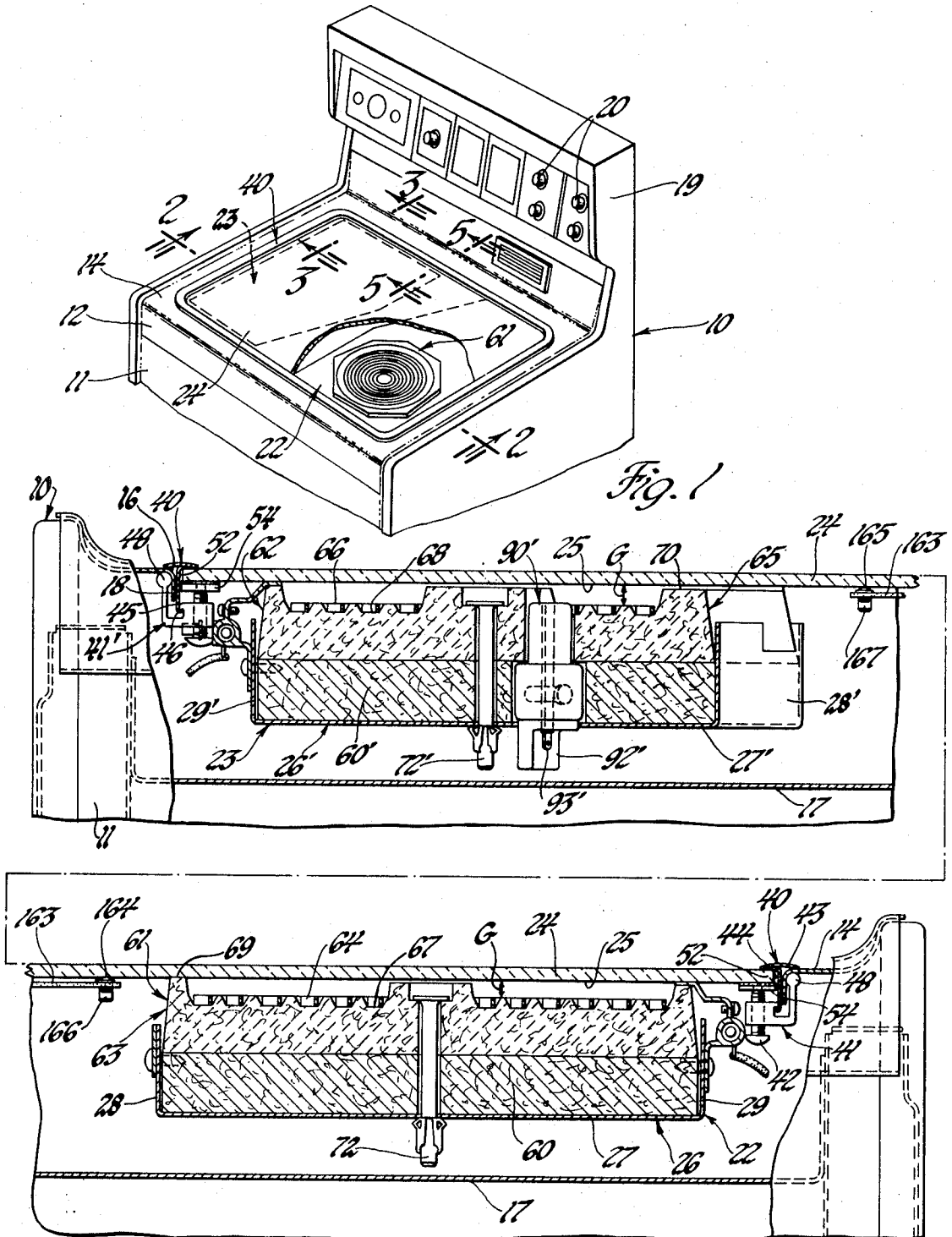


Fig. 2

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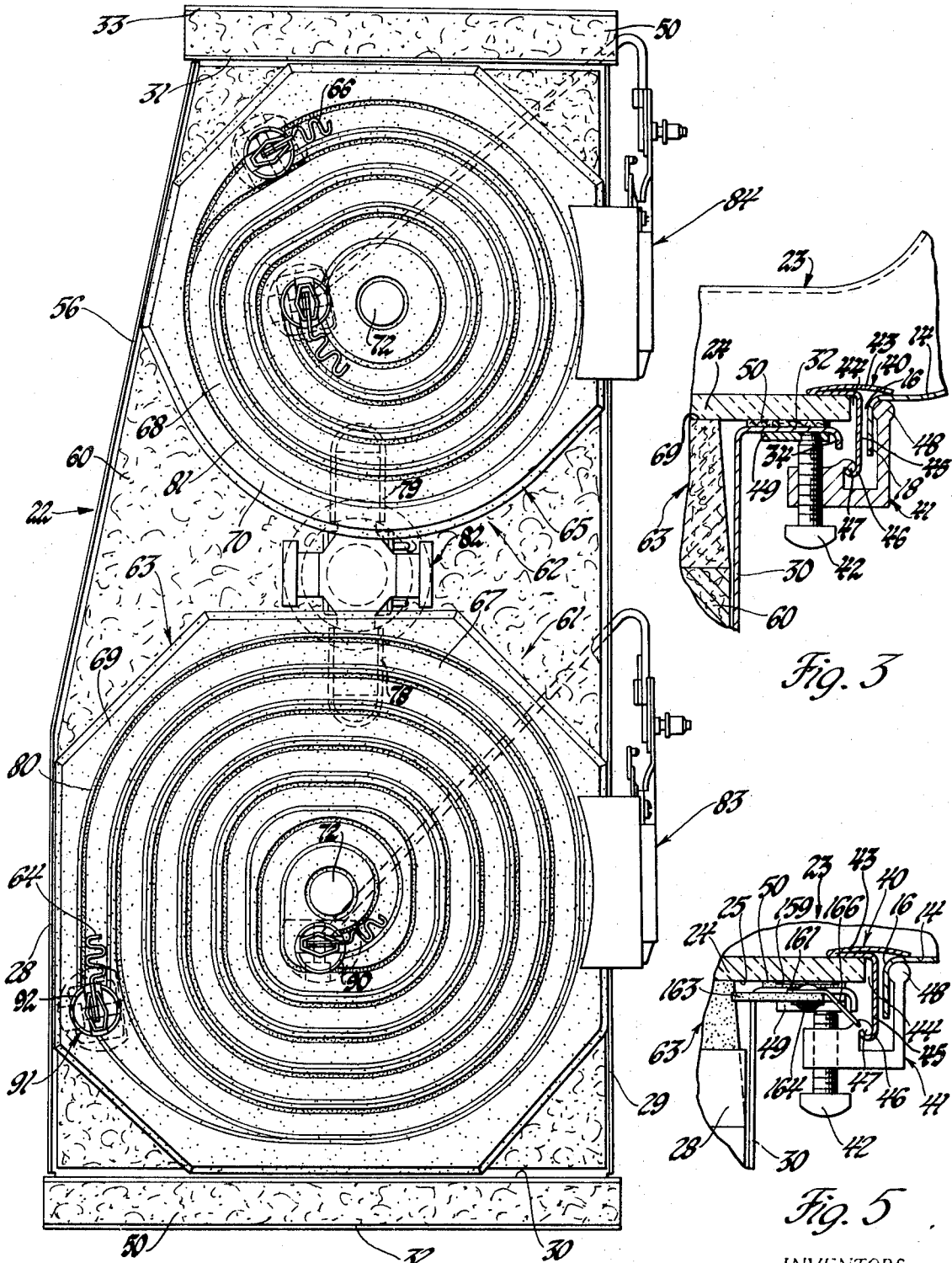
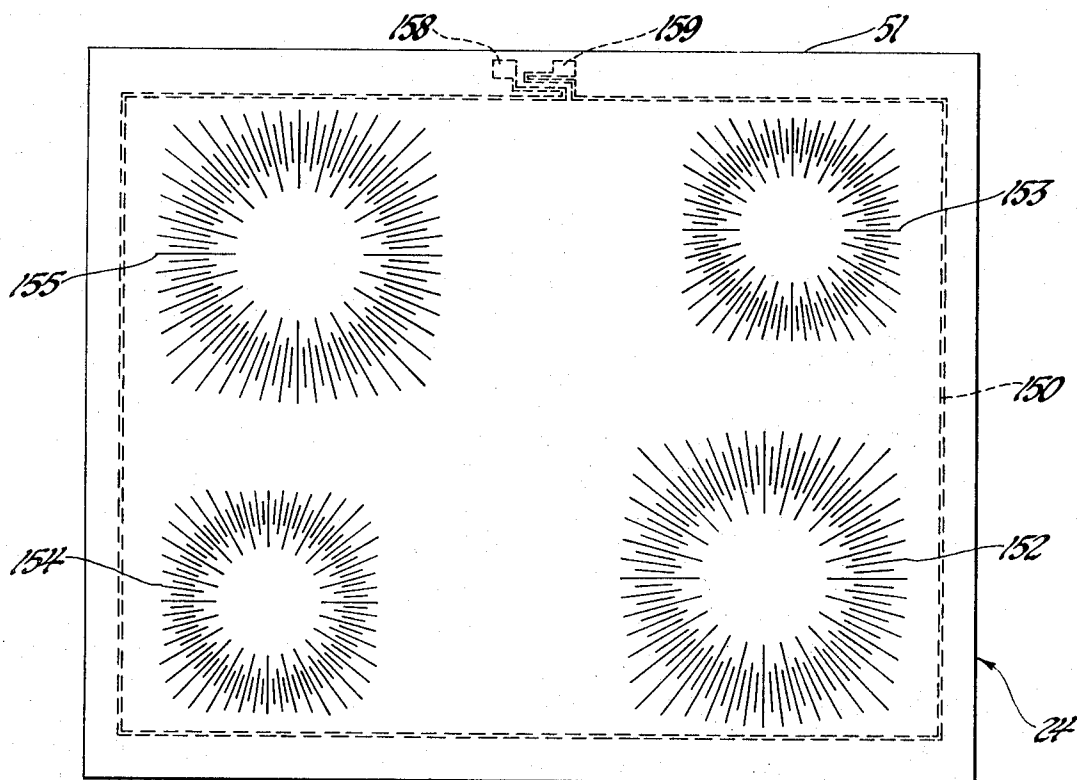
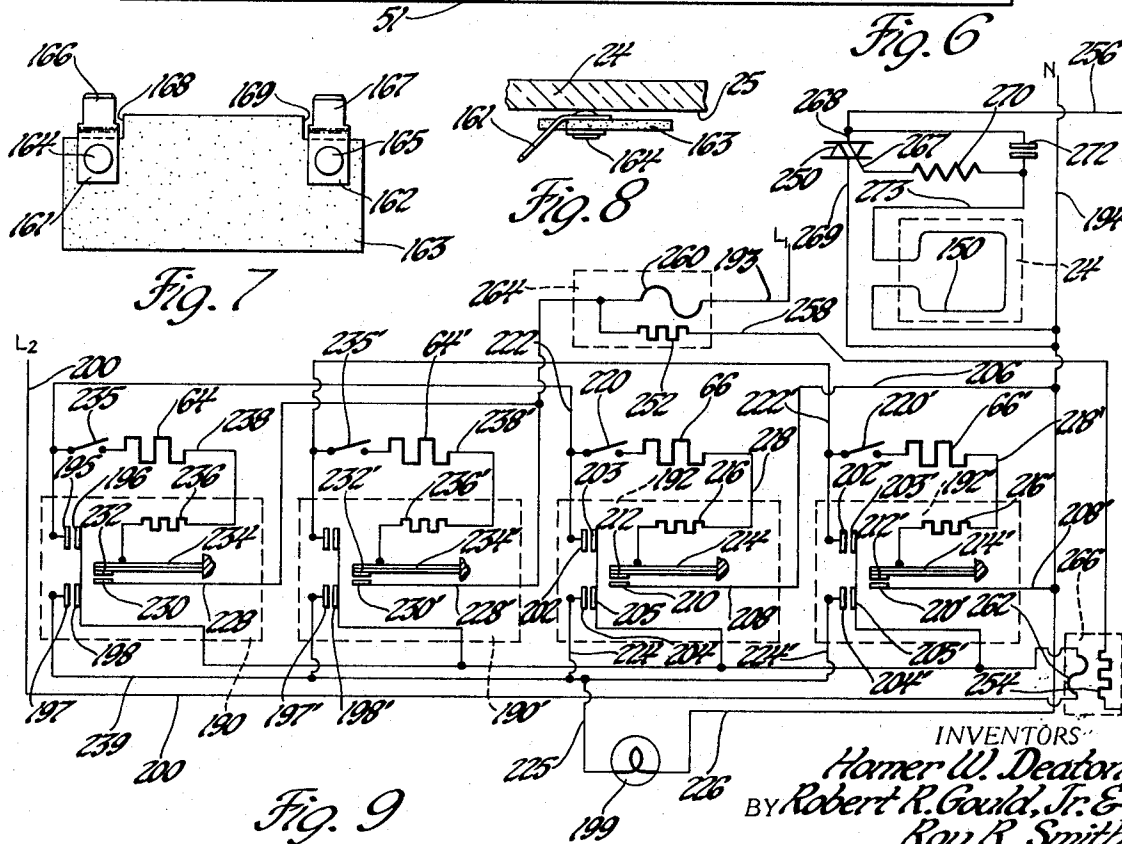


Fig. 4

Fig. 3

Fig. 5

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CERAMIC-TOP COOKING ASSEMBLY FRACTURE DETECTOR

This invention relates to domestic ranges and more particularly to an electric range having a ceramic-top cover plate provided with a protective circuit arrangement for obviating any electrical shock hazard should breakage of the cover plate occur.

In domestic ranges having a continuous cover plate of glass-ceramic material having underlying infrared-type radiant heating units of the type described in copending U.S. Pat. application Ser. No. 48,390, filed June 22, 1970, for example, one problem is possible breakage of the utensil-supporting cover plate occurring because of some accidental mechanical impact or unusually high thermal stress. Under normal conditions ceramic-top ranges as described in the aforementioned patent application do not present any shock hazard even when the glass-ceramic cover plate is cracked because the resistance elements are located within the range top so as to be inaccessible to the operator. Under rare conditions, however, if extreme fragmentation of the glass should occur the resistance elements may become accessible to the operator to present an electrical shock hazard. To obviate the possibility of this occurring, a means of detecting a fracture in the cover plate whereby the power circuit will immediately opened is the problem to which the instant invention is directed.

An object of the present invention is to provide a new and improved protective control arrangement for a ceramic-top range in which the electrical power to the range is effectively disconnected by the gating of a symmetrical controlled rectifier switch for actuating protective circuit means when breakage of the glass-ceramic cover plate occurs.

Another object is to improve frangible ceramic-top cooking assemblies having domestic use by the provision of an electrically conductive stripe that detects a break in the glass-ceramic cover plate and which will automatically disconnect the electrical power from the range by symmetrical controlled rectifier switch means sequentially activating by means of unequal heaters their associated thermal line fuses in each powerline to delay the interruption of the protection circuit powerline and thereby insure that both powerlines will be fused.

The present invention, in accordance with one form thereof, is embodied in a protective control system having a solid-state electronic switching device such as a symmetrical controlled rectifier or bidirectional thyristor which conducts current in both directions. The load control terminal of the switch is connected in series with a pair of heating elements, such as cylindrical power resistors, surrounding thermal fuses in each of the cooking assembly powerlines. A series current-limiting network consisting of a capacitor and resistor is connected between the main current terminal and gate-triggering terminal of the symmetrical controlled rectifier. This series circuit provides the small gate current necessary to turn the symmetrical controlled rectifier on. The midpoint of this series circuit is connected to the neutral line through a conductive strip on the undersurface of the glass-ceramic cover plate. During normal operating conditions with the cover plate intact, the small triggering current that would flow through the series circuit and turn the symmetrical controlled rectifier switch on is shunted to the neutral conductor through the conductive strip on the undersurface of the glass-ceramic cover plate. The arrangement is preferably such that if breakage of the conductive stripe occurs, it immediately renders the symmetrical controlled rectifier switch conductive, thus energizing the unequal fuse heating elements to sequentially remove the powerlines from the cooking assembly to insure that the line supplying the protection circuit heaters is interrupted last.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

FIG. 1 is a fragmentary perspective view of a domestic range with parts broken away to show the present invention;

FIG. 2 is an enlarged view in vertical section taken along the line 2—2 in FIG. 1;

FIG. 3 is an enlarged view in vertical section taken along the line 3—3 in FIG. 1;

FIG. 4 is a top elevation view of the right-hand heating assembly removed from the range;

FIG. 5 is an enlarged view partly in section taken on line 5—5 of FIG. 1;

FIG. 6 is a view in top elevation of the cover plate portion of the range top;

FIG. 7 is a plan view of the terminal connector board of the present invention;

FIG. 8 is a side view of the terminal board of FIG. 7; and

FIG. 9 is a circuit diagram of the instant invention.

Referring now to the drawings, in FIG. 1 a domestic range 10 is illustrated having a metal body 11 supporting an upper casing 12 which includes a collar 14 around the top edge thereof forming a top opening 16. As seen in FIG. 2, the top opening 16 is located above upper wall 17 of the range body and is defined by a continuous depending flange 18 located therearound while the peripheral collar 14 merges with the rearwardly located control panel 19 having a plurality of control knobs 20 thereon for selectively energizing infrared radiant heating units.

A pair of substantially rectangular heating assemblies, indicated generally at 22 and 23, are especially adapted to be installed in the upper casing 12 of the range for location above the wall 17.

The heating assemblies 22, 23 are oriented in spaced side-by-side relationship below the opening 16 with their longitudinal axes oriented parallel to the sides of the range. As the heating assemblies 22, 23 are identical in construction, like reference characters will be used to designate like or corresponding parts with the exception that for the left-hand assembly 23 the reference characters will be primed. Within the top opening 16 an upper utensil-supporting cover plate 24 that defines the complete surface cooking area of the range 10. The cover plate 24 extends throughout the planar extent of the opening 16 and has continuous undersurface 25 that contacts underlying heating units forming part of the assemblies 22, 23 in a manner to be described.

It should be noted that while the instant invention will be described in conjunction with a freestanding range depicted in FIG. 1, it is to be understood that the present invention is not intended to be so limited and that the control device could be used, for example, with counter or "drop-in" type cooking arrangements without departing from the scope of the invention. Furthermore, the invention contemplates a single heating assembly having a cover plate located in a range top or counter providing one or more heating areas.

The utensil-supporting cover plate 24 is preferably formed of a high-strength infrared transmissive material such as recrystallized glass-ceramic sold under the trade name Cervit by Owens-Illinois or Herculit by Pittsburgh Plate Glass. It will be appreciated however that other infrared transmissive material, such as high silica glass, for example, could be used with the invention without departing from the scope thereof. The cover plate 24 is shown in a preferred embodiment having a rectangular configuration with a length of approximately 25 inches, a width of approximately 20 inches and a thickness of approximately ¼ inch providing a smooth-top cooking surface that will accommodate four radiant heating areas in a manner similar to a conventional four surface unit electric range.

Turning now to FIGS. 2 and 3, the mounting arrangement for the glass-top range in conjunction with the heating assemblies will now be described in sufficient detail as is relevant to the present invention. For a more complete description of the heating assemblies and radiant heating units therein, reference should be had to the aforementioned patent application Ser. No. 48,390. FIG. 2 shows the assemblies 22, 23 having housing or pan member 26 comprising a bottom wall 27 provided with marginal sidewalls 28 and 29 upstanding from the bottom wall 27 and a pair of marginal end walls 30, 31 upstanding

from the bottom wall 27. The end walls are identical in construction and terminate in substantially horizontal upper flange walls 32, 33 and having a downwardly directed lip portion represented at 34 in FIG. 3.

As indicated above the cover plate 24 together with the underlying heating assemblies 22, 23 are mounted in the opening 16 substantially flush with the upper surface collar 14 by continuous pressure type securing means. The securing means includes a substantially rectangular trim or sealing ring indicated at 40 in FIG. 2 together with a plurality of cooperating L-shaped clips 41 having individual pressure screws 42. As best seen in FIG. 3, the trim ring 40 is substantially T-shaped in cross section and includes a head 43 spanning gap 44 formed between the collar 14 and the longitudinal and transverse edges of the cover plate 24, together with a depending stem 45 disposed in the gap. The stem 45 has formed along its lower end a hook portion 46 which provides shoulder means for interlocking engagement with the cooperating hook portions 47 of the clip members 41.

The clips 41 are dispersed at spaced intervals around the cover plate to engage the underside of the range collar 14 by seating circular bead portion 48 of the clip in the radiused area formed by the depending flange 18 of the opening, whereupon the clip pressure screws 42 are taken up to retain the plate and the heating assemblies in the opening 16. Pressure screws 42 have rectangular plate members 49 located on the ends thereof for pressure contact with the underside of flange walls 32, 33 when the pressure screws are taken up. The result is the housing 26 together with the cover plate 24 are anchored to the range collar 14 in a manner to hold heating units to be described in pressure contact with the undersurface of the cover plate.

Cover plate cushion members formed of fibrous insulating materials such as asbestos pads 50 are provided between the underside of the cover plate and the upper surfaces of the end flange 32, 33. Appropriate sealing material, located between the inner and outer strips of the trim head 43 and the underlying peripheral borders of the cover plate 24 and collar 14 provide a liquid-type seal therebetween. An example of such a material is manufactured by Dow Corning under the trade name RTV Silicone and cures to form a high-temperature rubberlike seal to prevent spillage on either the cover plate or the range collar from entering the gap 44.

It will be noted that the heating assemblies 22, 23 are secured to the range collar 14 and cover plate 24 by housing flange walls 32, 33 only along the longitudinal edges 51 of the cover plate. As seen in FIG. 2, the borders adjacent transverse edges 52 of the plate 24 are retained to the range collar 14 by means of the trim and clip assembly described. Annular washer type pressure members 54, used on the pressure screws 42 along the transverse plate edges 52, have resilient cushioning pads on their upper surfaces formed from suitable material such as heat-resistant silicone rubber.

In the illustrated form of the invention each housing 26 provides a boxlike receptacle defined by its side-, end and bottom walls for receiving a resilient insulation mat 60 formed from a suitable inorganic fiber insulation material such as rock wool, glass wool, asbestos fibers or the like. The mat 60 in the preferred embodiment has a thickness of approximately 1 inch and a density of approximately 6 pounds per cubic foot. As indicated in the plan view of FIG. 4 the mat 60 extends throughout the bottom of the housings 26 conforming to the shape of bottom wall 27. It will be noted that in the disclosed form of the housing 26 there is an oblique wall portion 56 forming part of the sidewall 28 to accommodate a smaller-sized heating unit to be described.

As seen in FIG. 4 the insulation mat 60 has located thereon a pair of heating units indicated at 61, 62. Each of the units 61, 62 comprises a heater support block and a heater resistance element with the heating unit 61 having its heater block shown at 63 supporting a ribbon-shaped resistance element 64 while the unit 62 has a heater block 65 supporting a similar resistance element 66. In the form shown the continuous re-

sistance element 64 is located with a convolute-shaped groove 67 defining an annular heater area approximately 8 inches in diameter while the continuous resistance element 66 is located within a convolute-shaped groove 68 to define a heater area approximately 6 inches in diameter.

In the case of the right-hand heating assembly 22 it is shown oriented with the larger heating unit 61 at the front of the range while the left-hand assembly 23 has been reversed to locate the smaller heating unit at the front of the range top. In this way the heating assemblies 22, 23 are able to provide alternate small and large surfaced heating areas or burners at both the front and rear of cover plate to provide maximum space for cooking utensils. It will be observed that the larger heating block 63 has a generally octagon shape when viewed in FIG. 4 locating three of its sides respectively adjacent to and substantially parallel with the end wall 31 and sidewalls 28, 29 of the housing 26. The smaller or 6-inch heater block has an irregular shape in plan to conform to the oblique wall portion 56 of the housing along with the housing walls 29 and 30.

As seen in FIG. 3 representing the heater block 63 for the left-hand assembly both the blocks 63, 65 have an overall thickness which when combined with the thickness of the supporting mat 60 locates their upper peripheral faces 69, 70 respectively, a defined distance above the housing flange walls 32, 33 such that the peripheral faces 69, 70 are brought in flush pressure contact with the undersurface 25 of the cover plate. The faces 69, 70 of the heater blocks are held in cushioned pressure abutment with the cover plate by means of the trim ring 40 and clip 41 arrangement previously described.

The heater blocks 63, 65 are retained in the housing 26 prior to final assembly by means of a holddown pin shown at 72 in FIG. 2 which extends through a central bore in the blocks together with aligned bores in the mat 60 and housing bottom wall 27 for reception on the free end of the pin of a suitable retaining member such as a spring clip of known commercial type. A complete description of the heating unit mounting device may be found in copending Pat. application Ser. No. 55,815, filed July 17, 1970 and assigned to the same assignee of this application.

The heater blocks 63, 65 are cast or molded to provide disk-shaped hollows defining recessed substantially circular areas 80, 81 in the block upper faces 69, 70 respectively. In a preferred form, the blocks 63, 65 have substantially identical thicknesses, within casting tolerances, of approximately 1.25 inches. For the purpose of this disclosure the heater blocks differ only in their outer configuration and size of their recessed areas to provide different-sized heated areas or burners for the cover plate. Accordingly only the larger heating unit 61 need be discussed in detail with all remarks being applicable to the smaller unit 63 with the single exception that unit 63 has a lower wattage output.

It will be observed that the blocks 63, 65 are formed with opposed cavities indicated at 78, 79 respectively to receive one end of a central heat-sensing device indicated generally at 82 forming part of a surface temperature indicating light circuit. For details of this indicator light arrangement reference should be had to copending U.S. Pat. application Ser. No. 55,816, filed July 17, 1970, assigned to the common assignee of this application. It will be noted that each of the heating units has a temperature control means generally indicated at 83, 84 in FIG. 4 for the right-hand assembly shown. The control means 83, 84 are part of a cover plate temperature cutoff control device to insure that the temperature of the cover plate does not exceed a maximum upper limit. The control means 83, 84 form no part of the instant invention and are described in U.S. Pat. application (A-13,708), also assigned to the common assignee of the present invention.

Considering now the heating unit 61 of FIGS. 2, 3 and 4 it will be seen that the convolute groove 67 provides a path for locating the continuous resistance element ribbon 64 such that one end is positioned for electrical connection to an inner terminal member 90 and its opposite end located for connec-

tion to an outer terminal member 91. The terminal members 90, 91 are identical so as to be interchangeable with either heating unit and comprise an insulating column 92 formed of electrical porcelain or the like provided with an axial chamber receiving a vertical terminal blade 93 therein as shown in section view of FIG. 2. The details of the terminal connectors form no part of the instant invention and are described and claimed in the copending U.S. Pat. application Ser. No. 55,815, filed July 17, 1970, assigned to the assignee of the instant invention.

By virtue of the foregoing description it will be noted that the resistance element 64, which has a deeply undulating or sinelike pattern, is supported in the spiral groove 67 to establish a defined vertical air gap indicated G between the cover plate undersurface 25 and the element which in the form shown provides a minimum spacing therebetween of the order of 1/4 inch. The 1/4-inch gap G is the minimum distance permitted by Underwriters Laboratory between an uninsulated conducting member and an adjacent conductor.

To produce the required wattage output for the heating units of the preferred embodiment it was determined that an element be used which can be self-heated in the range of 1,500° to 2,000° F. and constructed of a high temperature resistance material from the iron-chromium-aluminum family. An iron-chromium-aluminum ferrite alloy is preferred because it has a higher melting point and a higher electrical resistivity allowing it to be operated at higher temperatures within the above-mentioned range. For further details of the resistance element together with the arrangement for supporting it on the heater block 63 reference should be had to the copending Pat. application Ser. No. 48,390 referred to previously.

In its preferred form the ribbon resistance element 64 is formed having a thickness of the order of 9 mils and a height of the order of 125 mils capable of developing a wattage output of approximately 2,000 watts at 236 volts AC. In the case of the resistance element 66 for smaller heating unit a continuous ribbon of the same height but having a somewhat reduced thickness of the order of 7 mils is used to provide a wattage output of 1,200 watts at 118 volts AC.

Considering now the instant fracture-detection invention the illustrated cover plate 24 is shown in FIG. 6 having a conductive strip or path 150 operatively affixed to the underside 25 of the cover plate and positioned as shown to extend around the outer periphery thereof to enclose the four heater or burner areas 152, 153, 154 and 155. The conductive strip 150 is composed of a suitable precious material well known to those skilled in the art with the disclosed embodiment comprising a silver conductive strip approximately 0.120 wide applied to the undersurface of the cover plate preferably by a silk-screening operation and adhered by a subsequent firing of the cover plate. The conductive strip 150 is located approximately 1 1/4 inches from the edges of the cover plate and is provided with enlarged conductive pads 158, 159 located at the approximate midpoint of the longitudinal edge 51 of the cover plate adjacent the range control panel 19.

The conductive pads 158, 159 are operatively connected to angles terminals 161, 162 affixed to the insulated terminal board 163 shown in FIGS. 7 and 8. The conductive strip 150 is electrically connected to the terminals 161, 162 by means of the heads of rivets 164, 165 which extend through suitable aligned openings therein and serve to secure the terminals to the board. Suitable leads are connected to the depending legs 166, 167 of the terminals for energizing the conductive strip 150. It will be noted that the terminal board 163, formed of suitable insulating material such as fiber glass resin for example, has notched positions 168, 169 to block the terminals from accidentally being turned towards each other.

Turning now to the circuit arrangement of FIG. 9 power is supplied to the range top from the usual single-phase, 236-volt, alternating current, three-wire Edison service entrance found in an adequately wired residence. The three wires are identified as line wires L₁ and L₂ and a neutral wire N, it being

understood that there is a potential of about 236 volts across lines L₁ and L₂, and about 118 volts across either line L₁ or L₂ and the neutral wire N.

Since the right-hand and left-hand heating assemblies 22, 23 are identical they are shown in the circuit diagram with the same elements identified with the same reference numerals; the exception being that each reference numeral for the left-hand assembly is primed. The line L₁ is connected to energy-pulsing infinite heat switch assemblies or controllers 190 and 190', shown boxed-in by dashed lines, by means of conductor 193 and the line N connects energy-pulsing infinite heat switches indicated similarly at 192, 192' by means of conductor 194. The switches 190, 190' and 192, 192' are of a conventional type more particularly set forth in U.S. Pat. No. 2,623,137 issued Dec. 23, 1952 and except for different wattage ratings are identical. The infinite heat switch assembly 190 has a first single-pole single-throw (SPST) line switch for the heating unit 61 providing a pair of contacts indicated at 195, 196 and a second single-pole single-throw switch for a signal lamp circuit having a pair of contacts 197, 198. As its associated control knob 20 is rotated from its off position both the first and second SPST switches close by a conventional cam arrangement (not shown) to route power to the unit 61 to light signal lamp 199.

As conductor 200 connects wire L₂ to line switch contact 198 it will be noted that the continuous resistance elements 64 of the 8-inch heater unit 61 is placed across a 236-volt source. The infinite heat switch assembly 190' functions in the same manner by positioning its control knob to energize the resistance element 64' across wires L₁, L₂ to provide 236 volts of power producing a wattage output therefrom varying from 0 to approximately 2,000 watts.

The infinite heat switch assembly 192 has a first single-pole single-throw line switch for the heating unit 62 having a pair of contacts 202, 203 and a second single-pole single-throw switch for the signal lamp circuit having a pair of contacts 204, 205. Again as the associated control knob 20 of infinite heat switch assembly 192 is rotated from its off position both the first and second SPST switches close to route power to the unit 62 and to light the signal lamp 199. As the conductor 194 of wire N is shown connected to the infinite heat switch assembly 192 while line contact 203 is connected by conductor 200 to wire L₂ it will be seen that the continuous resistance element 66 of the 6-inch heater unit 62 is placed across a 118-volt source to energize the element 66 to produce a wattage output therefrom varying from 0 to approximately 1,200 watts.

More particularly, as shown in the power circuit of FIG. 9, the fracture detector for removing power from the radiant units is illustrated as including a conductor 206 from line 194 of wire N electrically connected to the contact-carrying arm 208 of the infinite heat switch assembly 192. When the control knob 20 is moved from "off" position it operates a cam and cam follower arrangement (not shown) that is rotatable to cause movement of the contact 210 on the arm 208 with respect to a contact 212 on the electrically conductive bimetallic arm 214 of the switch which has one end thereof fixedly connected to a suitable support means with respect to which the contact-carrying end of the bimetallic arm 214 is free to deflect. The switch assembly 192 further includes a heater 216 that is connected electrically to the arm 214 and by a conductor 218 to one end of the ribbon resistance element 66 of the right-hand 6-inch unit. The opposite end of the resistance element 66 is connected by means of a normally closed heat-limit or cutoff switch 220, forming part of the control means 84, to a conductor 222 which is in turn connected electrically to the contact 202 of the SPST line switch described. The surface pilot light 199 is connected to L₂ of the power source through the closed contacts 024, 205, conductors 224, 225 thence through the lamp 199 to a conductor 226 electrically connected to the line 194 of the neutral power source.

To complete the description the conductor 193 from L₁ is electrically connected to contact-carrying arm 228 of the infinite heat switch assembly 190. The arm 228 has contact 230 for pulsing contact with a contact 232 on the electrically conductive bimetallic arm 234 of the switch, and further includes a heater 236 electrically connected to the arm 234 and by a conductor 238 to one end of the resistance element 64 of the right-hand 8-inch radiant unit. The closed contacts 197, 198 of the switch assembly 190 energize the pilot light 199 through conductor 239.

In the illustrated fracture detector control device portion of the circuit the supply of electrical power is controlled by a solid-state electronic switching element consisting of a symmetrical controlled rectifier or bidirectional thyristor 250, capable of conducting current in either direction, connected in series with a pair of electric heaters 252, 254 by conductors 256, 258 thence to wire L₁ through a first thermal line fuse indicated at 260. A second thermal fuse 262 is located in the conductor 200 between the wire L₂ and the radiant heating units. In the preferred form the fuse assemblies, indicated by boxed-in areas 264, 266 comprise the thermal fuse links 260, 262, respectively, formed from any suitable fusible material or alloy which in the instant embodiment are manufactured under the trade name Microtemp No. 9257 and are rated at 257° F. The thermal fuse links 260, 262 are mounted axially inside associated tubular or sleeve-type, ceramic-coated, wire-wound resistors 252, 254 respectively, forming fuse electric heaters wherein the fuse links are easily replaceable. In the form shown the fuse heaters are manufactured under the trade name Ohmite with the heater 252 rated at 50 ohms $\pm$ 5 percent, 8 watts while the heater 254 is rated at 40 ohms $\pm$ 5 percent, 8 watts. It should be noted that alternative protective fuse arrangements could be used in combination with the disclosed fracture detector, such as the fuse device that is the subject of copending U.S. Pat. application (A-13,808) assigned to the same assignee as the instant invention, without departing from the scope of the present invention.

The switching element 250 has a control or gate electrode 267 by means of which current flow between the electrodes 268 and 269 may be gate controlled. The controlling electrode 267 of the symmetrical controlled rectifier 250 is connected to a resistor 270 and a capacitor 272 of a capacitive reactance circuit and via conductor 273 to the conducting strip 150 on the cover plate 24. The symmetrical controlled rectifier 250 is preferably an integration of two opposed controlled rectifiers comprising five semiconductive layers with the two connected control electrodes 268, 269. When said electrodes are properly biased, the symmetrical controlled rectifier 250 (Type E.C.C. No. Q2001PS), which in the preferred form may be purchased from the Electronic Control Corporation, under the trademark Quadrac conducts the current in both directions. The symmetrical controlled rectifier 250 is of a type which is essentially nonconductive in the absence of any bias on the control electrode or gate 267 and is rendered conductive by the application of a positive or negative gate current to permit conduction in either direction, depending upon the polarity of the voltage present between the electrodes 268 and 269.

In the illustrated control device during normal operation a small biasing current of a few milliamperes for the electrode 267 triggering circuit flows through the conductive strip 150 and the heater resistors 252, 254 whenever the range is connected to a domestic power supply L₁ and L₂. Since only milliamperes of current flows through the fuse heater resistors 252, 254, the current has no significant heating effect on the heater resistors. The triggering current is shunted through the low-resistance conductive strip and only negligible current flows from the electrode 268 to electrode 269 of the symmetrical control rectifier 250. Under such a condition, a high impedance is presented by capacitor 272 as seen in shunt with the symmetrical controlled rectifier 250 to limit the triggering current. In the event of a fracture of the cover plate 24 the crack will migrate across the cover plate to break the conduc-

tive strip causing the biasing or gate-triggering current to be applied to control electrode 267 through resistor 270 with the result that the symmetrical controlled rectifier 250 becomes conductive producing a load current in the fuse heaters 252, 254.

During the triggering operation the resistor 270 and the capacitor 272 provide a capacitive reactance circuit which has a current-limiting effect which both reduces the power of the biasing circuit and allows a smaller value of triggering current to drive the gate 267 of the controlled rectifier 250. This results because of the leading phase shift of the triggering current, when limited by capacitive reactance, with respect to the voltage applied across the main electrodes of the symmetrical controlled rectifier 250. In the instant circuit the resistor 270 has a rating of 2,200 ohms and ½-watt power rating while the capacitor 272 is rated at 0.33 mfd. at 200 v. AC. (nonelectrolytic).

In order to insure that both 115-v. AC main lines L₁ and L₂ are reliably interrupted, the main line L₁ which supplies power to both the heater resistors 252, 254, should always be interrupted last. This is accomplished by having the fuse heaters of unequal values with the present circuit designed such that heater 252 is a 40-ohm resistor and heater 254 is a 50-ohm resistor. In a series or constant current system, the larger resistance dissipates more power in accordance with $P=I^2R$ whereby the smaller fuse heater 252 is used in conjunction with the fuse 260 in line L₁, which supplies power to the protection circuit and interrupts line L₁ by fusing is associated fuse 260 only after the fuse 262 in line L₂ is fused.

The switching action of the symmetrical controlled rectifier 250 is virtually instantaneous such that the heater current is instantly supplied to the fuse heaters 252, 254. Thermal lag however does delay power current interruption for several seconds during the melting of fuses 260, 22 so that the power supply is effectively disconnected from the cooking assembly, within a matter of seconds after breakage of the conducting stripe occurs with the result that there is no substantial lapse of time during which a shock hazard might exist.

While the embodiment of the present invention herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is:

1. In an infrared radiant cooking assembly, the combination of an upper utensil-supporting cover plate of infrared-transmissive frangible glass-ceramic material having a predetermined planar extent, a heater block supporting a resistance element in spaced relation from the undersurface of said cover plate, a circuit for energizing said resistance element across a pair of lines from an AC power source, said cover plate having an electrically conductive stripe incorporated thereon, said conductive stripe being electrically connected in said circuit, thermal fuse means in said circuit connected in each of said lines between said power source and said resistance element, a pair of heaters serially connected in one line of said AC power source such that each of said heaters is in thermal transfer relation with one of said fuse means, AC switching means connected in said circuit, said AC switching means comprising a symmetrical controlled rectifier having two main electrodes and a control electrode together with a series-connected resistor-capacitor network connected across one of said main electrodes and said control electrode, said conductive strip having one end connected to the junction of the capacitor and resistor of said network and its other end connected to the other of said main electrodes whereby said conductive stripe is connected in parallel with said AC switching means, said one main terminal of said symmetrical controlled rectifier being connected to said power source via said serially connected heaters, said capacitor of said network offering high impedance to the flow of current through said heaters, said resistor-capacitor network operative in the event that an open circuit occurs in said conductive stripe to provide capacitive reactance phase shifting of the current flow to said control electrode to permit a reduced value of current flow to said

control electrode to render said symmetrical controlled rectifier conductive, said symmetrical controlled rectifier upon being rendered conductive permitting increased current to pass to each of said heaters to fuse their associated thermal fuse means and thereby remove said cooking assembly from both lines of said power source.

2. In an infrared radiant cooking assembly, the combination of an upper utensil-supporting cover plate of infrared-transmissive frangible glass-ceramic material having a predetermined planar extent, a heater block supporting a resistance element in spaced relation from the undersurface of said cover plate, a circuit for energizing said resistance element across first and second AC power lines and a neutral line, said cover plate having an electrically conductive stripe incorporated thereon, said stripe being electrically connected in said circuit, thermal fuse means in said circuit, said fuse means comprising a first thermal fuse connected in said first powerline and a second thermal fuse connected in said second powerline, said fuse heater means comprising first and second resistance heaters connected in series in said first powerline in thermal transfer relation, respectively, with said first and second thermal fuses, AC switching means connected in parallel with said conductive stripe, said AC switching means comprising a symmetrical controlled rectifier having first and second current-carrying main electrodes and a control electrode, a series-connected resistor-capacitor network connected across said first main electrode and said control electrode, the capacitor of said network connected serially between one terminal of said conductive stripe and said first main electrode, the second terminal of said conductive stripe connected to said neutral line, the resistor of said network connected serially between said one terminal of said conductive stripe and said control electrode, said first main electrode connected in series with said first powerline via said second resistance heater and thence via said first resistance heater, said capacitor allowing a limited current flow through said first and second resistance heaters and said conductive stripe during normal operation of said cooking assembly, said control electrode rendering said symmetrical controlled rectifier conductive in the event of an open circuit in said conductive stripe thereby permitting increased current flow to said first and second heaters to fuse their associated first and second fuses, said second heater having greater resistance than said first heater whereby said second heater fuses said second powerline fuse before said first heater fuses said first powerline fuse to insure sufficient energization of said heaters such that both said fuses are fused.

3. In an infrared radiant cooking assembly for mounting in a range top or the like having an opening therein, said assembly comprising a frangible cover plate of infrared-transmissive glass-ceramic material including an upper utensil-supporting surface, said cover plate positioned in said opening whereby a continuous gap is defined between the edges of said cover plate and said opening, a lower housing positioned below said

cover plate having a bottom wall, end walls and sidewalls defining a boxlike receptacle, at least one radiant heating unit supported in said housing, said heating unit including a fibrous-ceramic heater block having a substantially planar raised peripheral face defining a central recessed area, said recessed area supporting an infrared-emissive uninsulated electrical resistance element thereon in spaced relation below the undersurface of said cover plate, a circuit for energizing said resistance element across first and second powerlines, continuous-pressure clamping means positioned in said gap for retaining said cover plate and said housing in said range opening, said cover plate having an electrically conductive continuous stripe positioned on the undersurface thereof, said stripe paralleling the edges of said cover plate and having a pair of terminal end portions located adjacent one edge of said cover plate, a terminal board spaced from the undersurface of said cover plate having a pair of spaced terminals therein whereby each said terminal electrically contacts one of said conductive stripe terminal end portions, said continuous-pressure clamping means operative with said terminal board to maintain said pair of spaced terminals in electrical contact with said conductive stripe terminal ends, first and second thermal fuses connected in said first and second power lines respectively, fuse heater means in said circuit in thermal transfer relation with said first and second fuses, said fuse heater means comprising first and second resistance heaters connected in series in said first powerline in thermal transfer relation, respectively, with said first and second thermal fuses, AC switching means connected in parallel with said conductive stripe, said AC switching means comprising a symmetrical controlled rectifier having first and second current-carrying main electrodes and a control electrode, a series-connected resistor-capacitor network connected across said first main electrode and said control electrode, the capacitor of said network connected serially between one terminal of said conductive stripe and said first main electrode, the second terminal of said conductive stripe connected to said neutral line, the resistor of said network connected serially between said one terminal of said conductive stripe and said control electrode, said first main electrode connected in series with said first powerline via said second resistance heater and thence via said first resistance heater, said capacitor allowing a limited current flow through said first and second resistance heaters and said conductive stripe during normal operation of said cooking assembly, said control electrode rendering said symmetrical controlled rectifier conductive in the event of an open circuit in said conductive stripe thereby permitting increased current flow to said first and second heaters to fuse their associated first and second fuses, said second heater having greater resistance than said first heater whereby said second heater fuses said second powerline fuse before said first heater fuses said first powerline fuse to insure sufficient energization of said heaters such that both said fuses are fused.

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