

United States Patent

Duffner et al.

[15] 3,659,068

[45] Apr. 25, 1972

[54] **MICROWAVE OVEN SAFETY
INTERLOCK**

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[22] Filed: **Sept. 23, 1970**

[21] Appl. No.: **74,576**

[52] U.S. Cl. **219/10.55**, 219/413

[51] Int. Cl. **H05b 9/06**

[58] Field of Search 219/10.55, 413

[56] **References Cited**

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[57] **ABSTRACT**

A safety latching device for a microwave oven in which the oven door can not be opened until the microwave generator circuit in the oven has been deenergized and wherein power can not be applied to the microwave generator circuit until the oven door has been latched to a closed position against the oven cavity.

9 Claims, 5 Drawing Figures

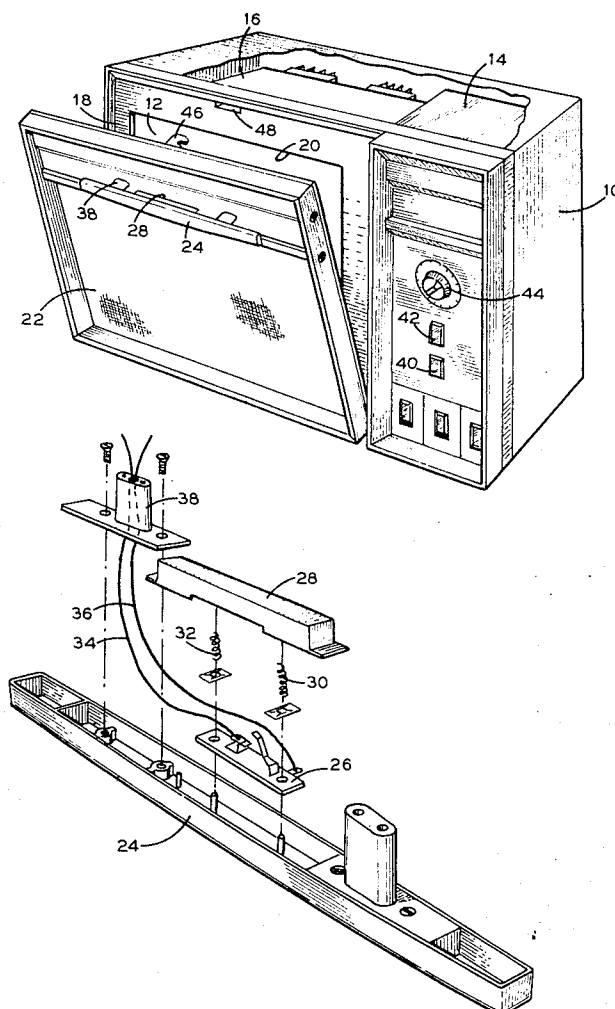


FIG. 1

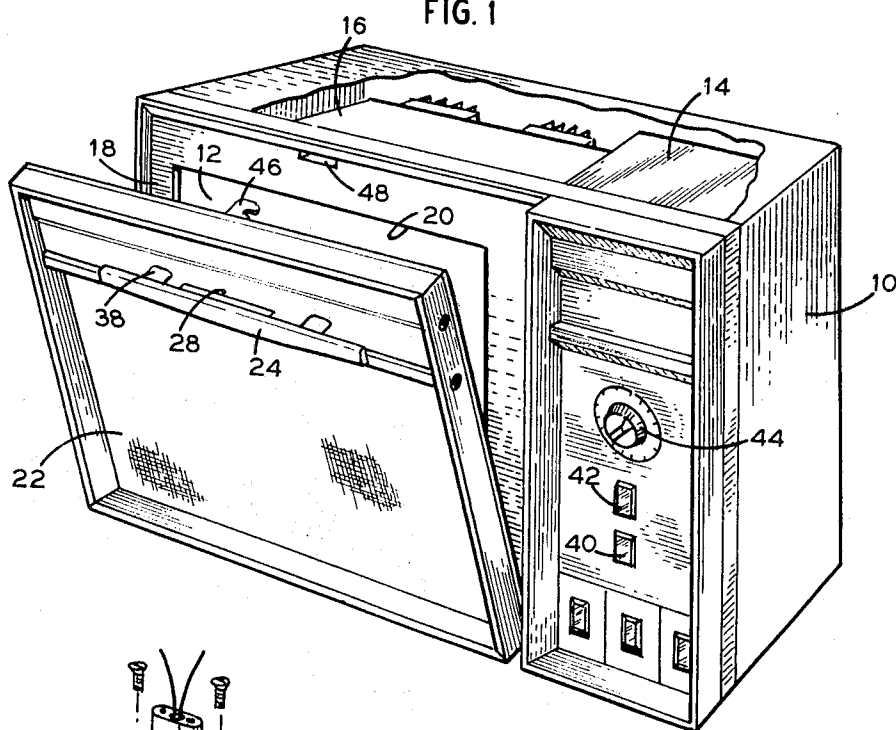
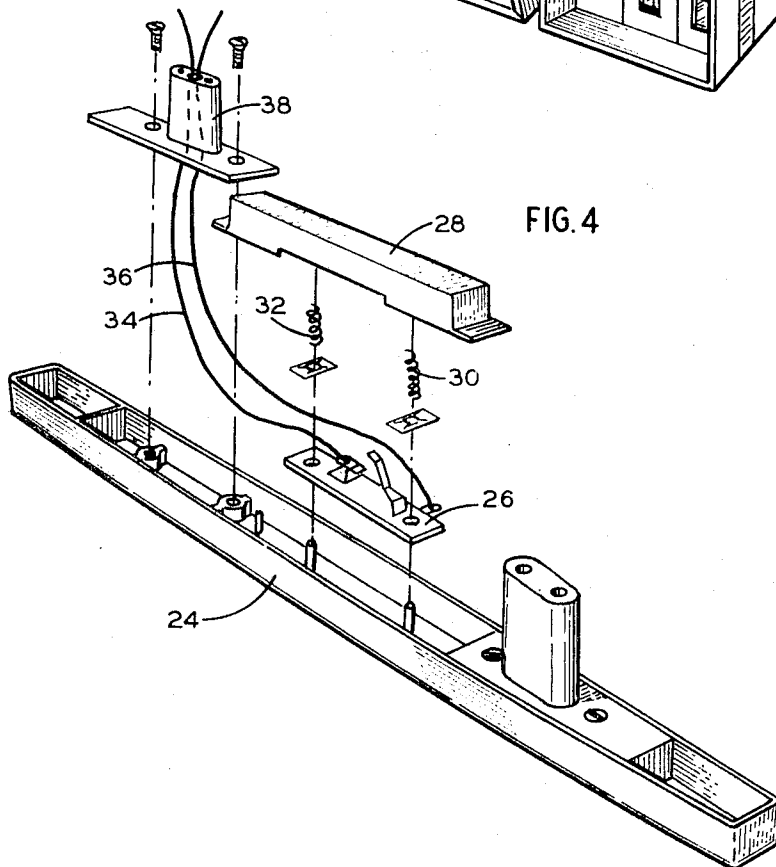


FIG. 4



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FIG. 2

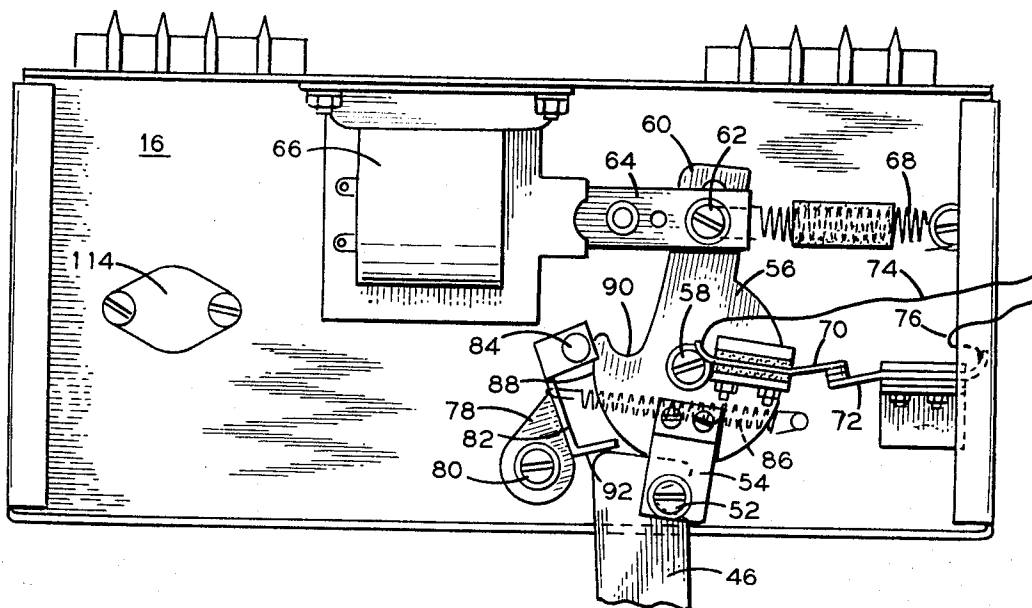


FIG. 3

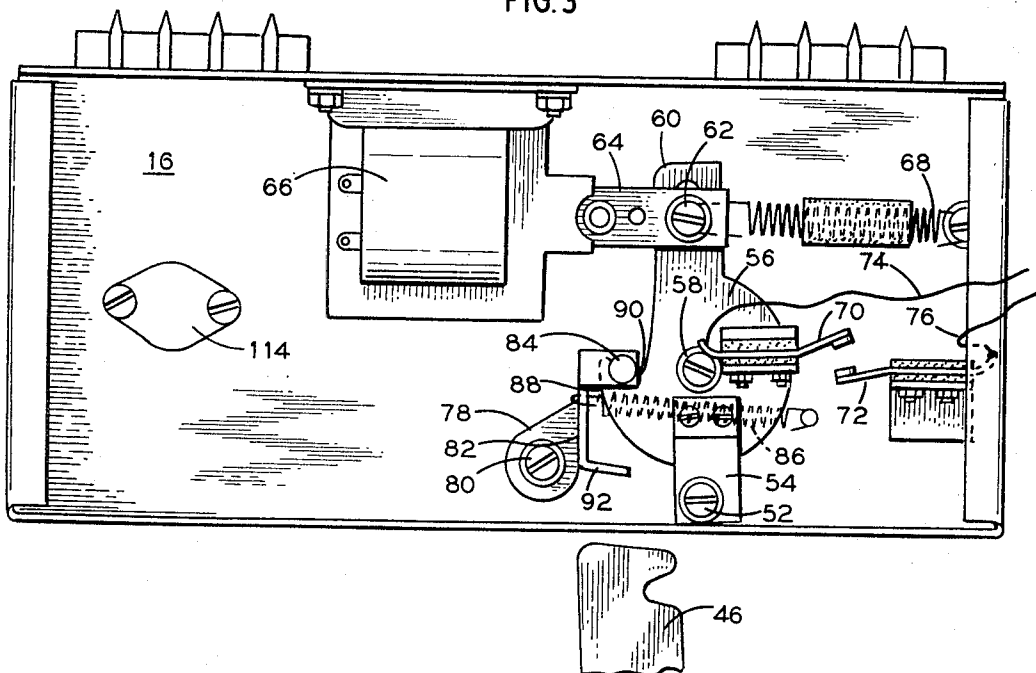
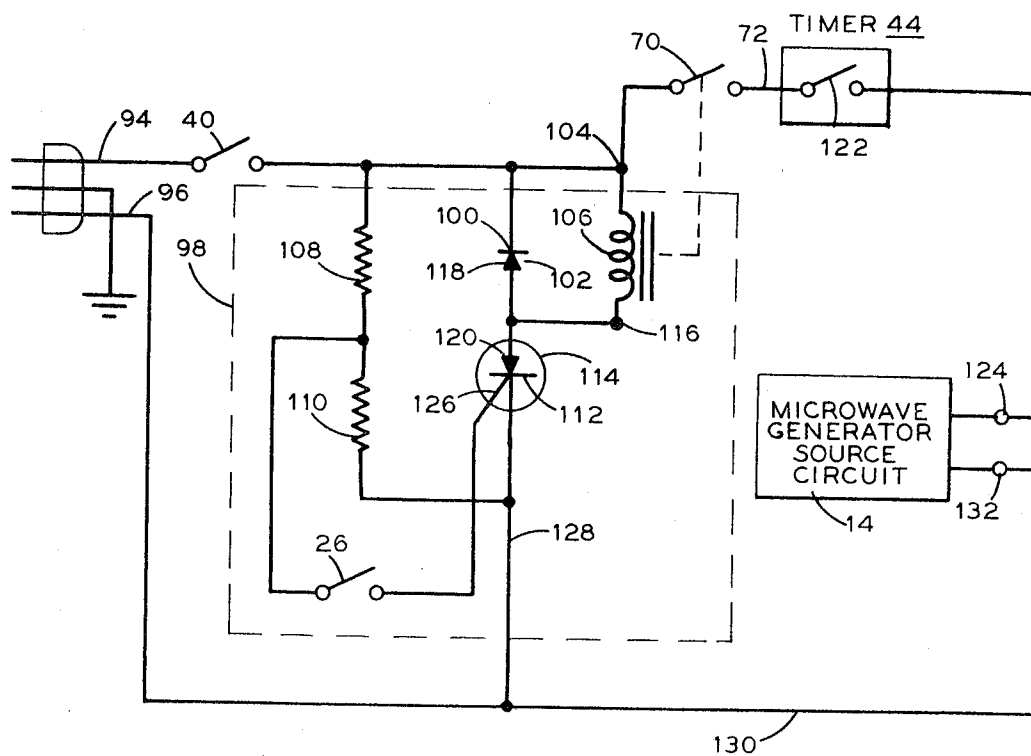


FIG. 5



MICROWAVE OVEN SAFETY INTERLOCK

This invention relates to microwave ovens which include a door and microwave cavity and in particular to an interlock mechanism for such ovens wherein opening of the oven door is inhibited until the microwave generator circuit is deenergized.

One object of the present invention is to provide an improved interlock mechanism of this type.

Another object of the invention is to provide a door latching mechanism for a microwave oven wherein energization of the microwave circuit is inhibited while the oven door is open and where the oven door is unable to be opened while the oven is energized.

In accordance with one illustrative embodiment of the present invention, a microwave oven apparatus includes camming means supporting one of a pair of switch contacts. Closing of the door to the oven cavity causes the camming means to move to a position to mechanically couple to an actuator means on the door and latch the door to a locked position over the oven cavity and at the same time electrically couple the two switch contacts together and permit the microwave generator circuit to be energized. To open the door, means are provided for effecting movement of the camming means to release the door actuator and open the switch contacts thereby deenergizing the generator circuit.

Other objects together with a fuller understanding of the invention will be had by referring to the following description and drawings in which:

FIG. 1 is a perspective view partially broken away of a microwave oven embodying a safety interlock mechanism constructed in accordance with the principles of the present invention;

FIG. 2 is an enlarged top view of a control chassis portion of the oven to show the latching mechanism with the oven door in a closed position;

FIG. 3 is an enlarged top view of the control chassis portion of the oven exposed to show the latching mechanism with the oven door in an open position;

FIG. 4 is an exploded perspective view of the door handle and switch assembly of FIG. 1; and

FIG. 5 is a simplified schematic diagram showing the electrical interconnections between the interlock mechanism and the microwave generator circuit.

Referring now to the drawings, and first to FIG. 1 thereof, the microwave oven apparatus shown includes a generally rectangular housing 10 enclosing an oven chamber or microwave cooking cavity 12, a generator source 14 for supplying microwave energy to the cavity, and a control chassis 16 mounting the safety interlock mechanism of the invention. A frame portion 18 surrounds an opening 20 for receiving foodstuffs into the cavity 12 and a door member 22 is fitted to the frame by a hinge mounting (not shown) so as to provide a movable closure means for the cavity opening 20. When in closed position, the fit of the door against the frame in such as to provide for the suppression of microwave energy leakage in accordance with accepted safety standards.

A handle 24 is mounted on the front of the door 22 to facilitate manual movement of the door between its open and closed positions. As shown in the exploded view of the handle assembly in FIG. 4, the underside of the handle is hollowed and mounts therein a microswitch 26 and a cover bar 28. The bar 28 is biased by springs 30 and 32 against closure of the switch 26. Electrical connection from the switch 26 to the control chassis 16 is via leads 34 and 36 which may be passed through an opening in the handle support 38, along the interior of the door, and then to the oven housing. Grasping of the handle so as to apply normal pressure against the bar 28 will cause closure of the switch 26 to complete a circuit path to the interlock mechanism and provide for release of the oven door latch. To the right of the oven door as viewed in FIG. 1, there is mounted a main power on-off switch 40, indicator light 42 and a timer and control switch 44 for energizing the microwave generator circuit for operation of the oven.

Referring now to FIGS. 2 and 3 along with FIG. 1, the control chassis 16 is positioned near the top portion of the oven housing 10. An actuator arm 46 is mounted on the inside of the door 22 such that upon closure of the door, the arm is received through a slot 48 in the frame 18 and extends into the oven housing 10 adjacent the control chassis 16. The actuator arm 46 includes a recess or notch 50 which serves as a catch means for cooperation with a conforming latch means provided on the control chassis.

More particularly, and as shown in FIG. 2, the latch means includes a pin 52 supported on a bracket 54 which in turn is secured to and extends outwardly from a cam member 56. Alternatively, the latch pin could be formed as an integral part of the cam member. The cam 56 is pivotally mounted to the chassis 16 at 58 so as to be movable from the position shown in FIG. 2, hereinafter referred to as the latch position, to the position shown in FIG. 3, hereinafter referred to as the release position. In the FIG. 2 position, the latch pin 52 is received in a notch 50 formed in the actuator arm 46 to secure the oven door in closed position over the cavity opening.

As shown in FIGS. 2 and 3, the upper portion of the cam 56 forms an arm 60 which is coupled, as by a pivot pin mounting 62, to the movable core or plunger member 64 of an electromagnetic means or solenoid 66 mounted on the control chassis 16. Operation of the solenoid is such that when energized, the plunger will be drawn into the solenoid housing 66 so as to cause the cam member 56 to rotate about its pivot mounting at 58 in a counterclockwise direction as viewed in the figures. To counter the pull of the solenoid plunger 64, a return spring 68, anchored at one end to the control chassis 16 is connected at its other end to the pivot pin mounting 62 of the cam arm position 60. Mounted on one side of the cam member 56 is one of a pair of heavy duty tungsten switch contacts which are used for coupling an energizing voltage to the microwave generator source circuit 14. More particularly, and in accordance with providing a fail safe feature of the invention to prevent opening of the oven door closure means until after deenergization of the microwave generator circuit, the one contact 70 is mounted on the cam 56 for movement with the cam between its two positions, i.e., the release position and the latch position of the cam member. The release position is shown in FIG. 2. The other switch contact 72 is stationary and is mounted on the control chassis in a position relative to the one switch contact on the cam member such that it will be engaged and make electrical contact with the one switch contact 70 only when the cam member has been rotated to its latch position. Leads 74 and 76 provide for electrical connections of respective switch contacts 70 and 72.

To the left of the cam member 56, as viewed in FIGS. 2 and 3, a cam follower 78 is pivotally mounted on the chassis at 80. The follower 78 includes a bracket 82 mounting a roller member 84 at one end and biased by means of a spring 86 so as to be urged toward the side wall surface 88 of the cam member. When the cam member 56 is pivoted to the release position, the roller 84 is received in a hook shaped recess 90 formed in the cam side wall 88 (FIG. 3). The capture of the roller 84 in the cam recess 90 serves to retain the cam member 56 in the release position.

On the other end of the bracket 82 opposite the roller 84, a trigger plate 92 is provided. The angled position of the plate 92 is such that when the door actuator arm 46 is received through the slot 48 in the housing frame 18, it will engage the plate 92 and cause the follower to pivot about the mounting 80 so as to effect release of the roller 84 from the cam recess 90 (FIG. 2).

Reference will now be had to the simplified block diagram of FIG. 5 showing the electrical interconnections between the components of the interlock mechanism and the microwave generator source.

Electrical power for operation of the oven is provided through the connection of leads 94 and 96 to a suitable source of power, as for example, a 120 volt A.C. line. In series with one of the leads 94 is the "on-off" power switch 40. From the

power switch 40 electrical connection is made to the interlock assembly (indicated by the dashed rectangle 98) and more particularly to the movable, switch contact 70 mounted on the cam member 56, the cathode electrode 100 of a diode 102, one end terminal 104 of the solenoid coil winding 106, and through voltage dividing resistors 108 and 110 to the cathode electrode 112 of a silicon controlled rectifier (SCR) 114. The other end terminal 116 of the solenoid coil 106 is connected to the anode electrode 118 of the diode 102 and the anode electrode 120 of the SCR 114. The stationary switch contact 72 in the interlock mechanism is coupled through a series connected switch 122 in the timing means 44 to one power input terminal 124 of the microwave generator circuit indicated by the block 14. The handle switch 26 is in series connection between the junction of resistors 108 and 110 and the gate electrode 126 of the SCR 114. The return path to the power source is provided via connection of leads 128 and 130 from the SCR cathode electrode 112 and the microwave generator circuit 14 other input terminal 132 to the power return lead 96.

The microwave generator source circuit may include, for example, a power transformer and magnetron in a circuit configuration such that in response to an operating potential applied between the input terminals 124 and 132, the microwave source circuit will be operative to provide for channeling to the oven cavity, microwave energy for cooking foodstuffs received therein. Such circuits are already known in the art and will not be further described here.

Operation of the interlock mechanism of the invention is as follows. With the oven door normally in a latched position over the oven cavity (FIG. 2), the cam member 56 will be in a position such that an electrical circuit path connection is established between the switch contacts 70 and 72. When the power switch 40 is closed, the A.C. line voltage is coupled to the switch contact 70 mounted on the cam 56, and a D.C. voltage is developed across the SCR 114 due to rectification of the line voltage by the diode 102. The SCR, however, will not conduct until triggered by a suitable voltage applied to its gate electrode 126. This trigger voltage is obtained from the junction of the resistors 108 and 110 and is coupled to the SCR gate electrode when the oven door handle bar 28 is depressed and the microswitch 26 thereby closed.

The timer 44 is next adjusted for a desired running time or period of operation of the microwave generator source circuit 14. Setting of the timer closes the timer switch 122 and completes the power circuit path from the switch contacts 70 and 72 to the microwave generator source circuit 14. Conversely, when the timer shuts off, the power circuit path is opened and the microwave generator circuit deenergized.

To open the oven door, either at the completion of a cooking cycle, or while the microwave generator circuit is energized, it is necessary for an operator to first depress the door handle bar 28, thereby to close the microswitch 26. This triggers the SCR 114 into conduction and completes the circuit path to energize the solenoid 66, which in turn operates to cause the cam 56 to rotate from the latch position (FIG. 2), to the release position (FIG. 3). As the cam rotates, the switch contact 70 separates from contact 72 and opens the circuit path connection between the two contacts, and the actuator arm 46 disengages from the latch means pin 52, thereby permitting the oven door to be mechanically released and opened. At the same time, the cam follower roller rides along the side wall surface of the cam 56 and is received in the recess 90 so as to lock the cam in release position. This operation of the interlock mechanism assures an operator that the power circuit to the microwave generator source will always be open or deenergized before the oven door can be opened. If the switch contacts 70 and 72 fail to open, because of welding together due to the passage of an excessive current for example, the cam 56 will not be free to rotate to the release position and unlatch the oven door.

Upon closure of the oven door, the actuator arm 46 engages the trigger plate 90 causing the follower 78 to pivot about the

mounting 80 and disengage the roller 84 from the cam recess 90. The tension in the return spring 68 then causes the cam 56 to rotate clockwise to the latch position (FIG. 2) so as to close the switch contacts 70 and 72 and cause the latch pin 52 to be received in the actuator arm notch 50, thereby to secure the oven door in closed position over the oven cavity.

It will be noted that due to the capture of the cam follower roller 84 in cam recess 90, the cam is inhibited from being rotated to the latch position, until, as described above, the oven door is closed, regardless of whether or not the solenoid is energized or the power switch 40 is in an "on" or "off" position. Thus, the power circuit through the switch contacts 70 and 72 can not be completed to provide for energization of the microwave generator circuit until the oven door has been properly latched in its closed position over the oven cavity.

What is claimed is:

1. In a microwave oven including a heating cavity, a microwave generator circuit energizable by a source of operating potential for supplying microwave energy to said cavity, and a door providing access to said cavity, the combination comprising:

switch means including a plurality of contact members providing a circuit path for connecting said operating potential to said generator circuit when the oven door is closed;

camming means carrying one of said contact members and rotatable to a first position for opening said door and to a second position for latching said door closed, the other of said contact members positioned to make electrical contact with said one contact member upon rotation of said camming means to said second position; and

means coupled to said camming means for driving said camming means from said second to said first position to permit opening of said door.

2. The combination as defined in claim 1 wherein said means for driving said camming means includes:

an electromagnet having a winding and an armature core coupled to said camming means so as to rotate said camming means and unlatch said door when said winding is energized;

an electrical circuit coupling said potential source to said winding; and

manually operated means mounted on said door for selectively completing said electrical circuit and thereby selectively energizing said winding.

3. The combination as defined in claim 2 and further including:

a handle mounted on said door and housing said switch means, said handle including means for depressing said switch means to energize said winding.

4. In a microwave oven having a cooking cavity, a door providing access to said cavity, and a generator source for feeding microwave energy to said cavity, the combination comprising:

camming means rotatable to a first position for locking said door closed and to a second position for unlocking said door;

electromagnetic means including a coil winding and an armature core said core coupled to said camming means so as to rotate said camming means to said second position when said winding is energized;

a first circuit for energizing said generator source in response to rotation of said camming means to said first position; and

a second circuit for energizing said winding so as to open said oven door.

5. The combination as defined in claim 4 wherein said first circuit includes:

means providing a source of electric energy;

first and second switch contact members coupled respectively to said generator source and said energy providing means, one of said switch contact members being carried by said camming means with the other of said switch con-

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tact members being positioned to electrically connect to said one contact for coupling electric energy to said generator source upon rotation of said camming means to said door closed position.

6. The combination as defined in claim 5 wherein said second circuit includes:

a switch coupled between said electric energy source and said electromagnetic means; and

a handle mounted on said door and coupled to said switch, said handle including means for actuating said switch to energize said winding and cause said camming means to rotate to said second position; thereby to separate said switch contact members and allow said oven door to be opened.

7. The combination as defined in claim 4 and further including:

bias means coupled to said camming means for rotating said camming means from said record position to said first position when said oven door is closed.

8. The combination as defined in claim 7 and further including:

an actuator arm mounted on said door so as to provide a latched engagement with said camming means upon closing of said oven door.

9. The combination as defined in claim 8 and further including:

follower means for maintaining said camming means in said first position when said door is open said follower means positioned to be driven by said actuator arm upon closing of said door to release said camming means for rotation to said second position.

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