

United States Patent

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[54] HIGH FREQUENCY HEATING APPARATUS

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200/61.62, 61.73, 61.81, 61.82

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[57] ABSTRACT

In high frequency heating apparatus, particularly a high frequency electronic oven having a door with a perforated metal plate, a transparent cover plate is removably mounted on the door on the outside of the perforated metal plate and means is provided to operate a switch in the oven for deenergizing the high frequency oscillator in response to the removal of the transparent plate.

5 Claims, 6 Drawing Figures

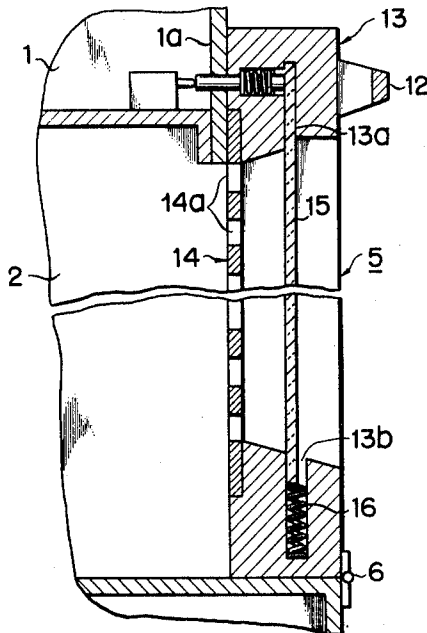


FIG. 1

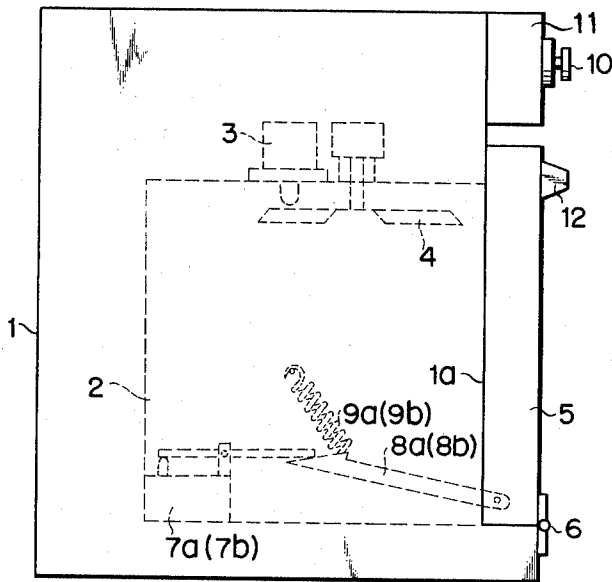


FIG. 2

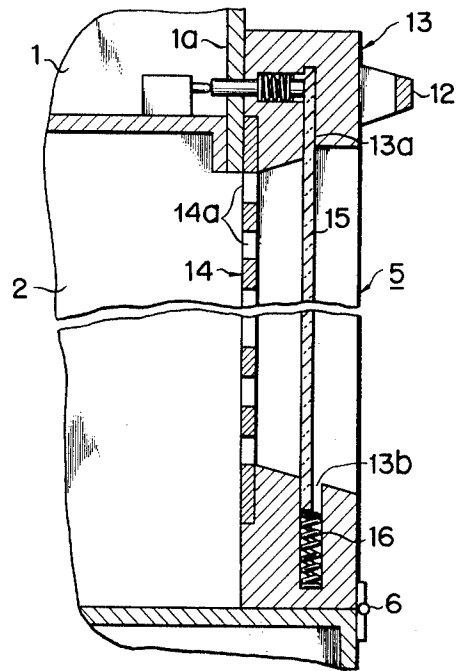
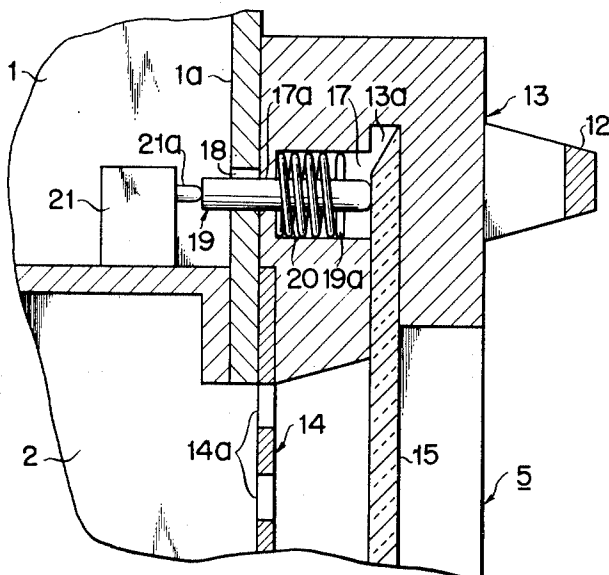


FIG. 3



HIGH FREQUENCY HEATING APPARATUS**BACKGROUND OF THE INVENTION**

This invention relates to high frequency heating apparatus for heating, bonding or drying various articles and for cooking foodstuffs.

While applicable to many other applications, for the sake of description, the invention will be described hereunder as being applied to an electronic oven for cooking various foodstuffs by dielectric heating.

As is well known in the art, the electronic oven generally comprises a cabinet defining therein a heating or cooking chamber having an access opening at one side thereof, a door for closing the access opening and a high frequency oscillator for radiating high frequency electromagnetic wave in the heating chamber. The door is provided with a perforated metal plate for venting the steam or gas generated by the foodstuff during cooking. As such perforated metal plate is exposed, should children inadvertently insert a metal rod such as a knife or fork into the perforation while the oven is operating an electric spark would be struck between the rod and the metal plate or the electromagnetic wave would leak to the outside through the metal rod.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved high frequency heating apparatus, especially an electronic oven which can prevent access to the perforated metal plate of the cabinet door.

Another object of this invention is to provide a removable transparent cover plate for the perforated metal plate and means for deenergizing the high frequency oscillator in response to the removal of the transparent plate.

According to this invention, in high frequency heating apparatus of the type comprising a cabinet defining therein a heating chamber having an access opening on one side thereof, a door mounted on the cabinet for closing the access opening; the door including a frame having a window and a perforated metal plate secured to the frame for closing the window and a high frequency oscillator for radiating high frequency electromagnetic wave in the heating chamber, there are provided a switch disposed in the cabinet for controlling the operation of the high frequency oscillator, a transparent plate removably mounted on the door on the outside of the perforated metal plate and means responsive to the mounting and dismounting of the transparent plate to actuate the switch for controlling the operation of the high frequency oscillator.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 shows a side elevation of an electronic oven embodying the invention;

FIG. 2 shows a partial sectional view of the oven shown in FIG. 1;

FIG. 3 is an enlarged sectional view of a portion of the oven shown in FIG. 2;

FIG. 4 shows an electric circuit of the electronic oven;

FIG. 5 shows a partial sectional view of a modified embodiment of this invention; and

FIG. 6 shows a partial sectional view of another embodiment of this invention.

Throughout the drawings, like parts are designated by the same reference characters.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

The electronic oven shown in FIG. 1 comprises a cabinet 1 in which is defined a heating or cooking chamber 2 having an access opening at its front side. On the top of the cooking chamber are disposed a high frequency oscillator 3, for example, a magnetron oscillating at a frequency of 2,450 MHz and a stirrer fan 4 for randomly radiating the high frequency electromagnetic wave radiated by the oscillator throughout the cooking chamber. A door 5 is pivotally mounted on the cabinet by hinge 6 at the lower edge of the cooking chamber for closing the same. First and second door switches 7a and 7b are disposed in the space between a side wall of the cooking chamber and a side wall of the cabinet. For operating these door switches in response to the closing and opening operation of the door there are provided first and second levers 8a and 8b extending through slots, not shown, of the front side wall of cabinet 1. Outer ends of these levers are pivotally connected to the inner wall of the door while their inner ends are normally biased in the clockwise direction as viewed in FIG. 1 by means of springs 9a and 9b connected to the side wall of the cabinet. When the door is closed, the inner ends of levers 8a and 8b engage the operating levers of respective door switches 7a and 7b to close them. As the door is opened, levers 8a and 8b disengage the operating levers of the door switches 7a and 7b thus opening them. A panel board 11 having a timer 10 is mounted above the door on the front wall 1a of the cabinet 1.

As shown in FIG. 2, door 5 comprises a rectangular frame 13, a handle 12 secured to the upper portion of frame 13, and a metal plate 14 for closing the window of the frame 13. The metal plate 14 is provided with a plurality of small perforations 14a of a size not to leak the high frequency electromagnetic wave. Grooves 13a and 13b are formed in the upper and lower sides of the frame to removably receive a transparent cover plate 15 which is held in position by means of springs 16 contained in groove 13b.

As best shown in FIG. 3, the upper side of door frame 13 is provided with a recess 17 communicating with an opening 17a of smaller diameter on the other side. A rod 19 extends through opening 18 through the front wall 1a, opening 17a and recess 17 for operating a micro-switch 21 disposed in the cabinet 1. A spring 20 is interposed between the bottom wall of recess 17 and a flange 19a secured to rod 19 to normally urge it away from the micro-switch 21. When the transparent plate 15 is mounted on door 5, rod 19 is moved to the left as viewed in FIG. 3, thus closing the micro-switch 21. Upon removal of the transparent plate 15, rod 19 is moved to the right under the action of spring 20 to disengage the operating member 21a of the micro-switch 21, thus opening the same. The upper end of the transparent plate 15 is slanted to permit easy insertion of the plate 15 into groove 13a.

FIG. 4 shows an electric circuit of the embodiment described above. The primary winding 25a of a high

voltage transformer 25 is connected across an A.C. source 22 through fuses 23a and 23b, normally opened contacts 24a and 24b of an electromagnetic contactor 24 and a second door switch 7b. The secondary winding 25b of transformer 25 is connected to the anode and cathode electrodes of a magnetron 3 via a rectifier circuit 26 comprising a diode D and a capacitor C. A lamp 30 for illuminating the interior of the cabinet is connected across junctures between fuse 23a and contacts 24a and between fuse 23b and contacts 24b through a source switch 27. Serially connected capacitors C₂ and C₃ are also connected across these junctures. The primary winding 28a of a low voltage transformer 28 and an electric motor 29 for driving cooling fan, not shown, are connected in parallel with lamp 30, and the secondary winding 28b of the low voltage transformer is connected to the cathode heater of magnetron 3. A series circuit including a thermal switch 31 responsive to an excessive temperature rise of magnetron 3, a motor 10M for driving timer 10 which is used to set a cooking time, a normally opened contact 10a of timer 10, micro-switch 21 described above and the first door switch 7a is also connected in parallel with lamp 30. The operating coil of the electromagnetic contactor 24 and a motor 4M for driving the stirrer fan 4 are connected in parallel with timer motor 10M. Across a series circuit including timer motor 10M and normally opened contact 10a is connected a series circuit including a buzzer 33 which is operated when the time interval preset by the timer has elapsed and a normally closed contact 10b of timer 10.

The embodiment shown in FIGS. 1 to 4 operates as follows.

Mounting of the transparent plate 15 closes microswitch 21 by rod 19. After loading a foodstuff in the cooking chamber 2, door 5 is closed. Then door switches 7a and 7b are closed. Under these conditions, when source switch 27 is closed, the cathode heater of magnetron 3 will be preheated from source 22 through low voltage transformer 28. Then, timer 10 is set to a desired time interval to close its normally opened contact 10a whereby the electromagnetic contactor 24 is energized to close its contacts 24a and 24b. Closure of these contacts applies a high DC voltage across the anode-cathode electrodes of the magnetron 3 through high voltage transformer 25 whereupon the magnetron commences to oscillate to radiate high frequency electromagnetic wave in the cooking chamber 2. In this manner, the cooking of the foodstuff is initiated. When the set time of the timer has elapsed, normally opened contact 10a of the timer 10 is opened to deenergize electromagnetic contactor 24, thus opening its contacts 24a and 24b. Consequently, the magnetron stops to oscillate. At the same time, contact 10b of the timer 10 is closed to operate buzzer 33 thus informing completion of the cooking. Buzzer 33 is deenergized when door 5 is opened for taking out cooked foodstuff from the cooking chamber 2 because of the opening of door switch 7a.

Since the perforated metal plate 14 is covered by transparent cover plate 15, inadvertent insertion of a metal rod such as a fork into perforation 14a can be effectively prevented. When the transparent plate 15 is contaminated by oil and fat liberated by the cooked foodstuff to such extent requiring cleaning, the plate 15

can be readily removed by pulling it downwardly against the bias of spring 16. When the transparent plate 15 is removed, rod 19 is moved to the right by spring 20, thus opening micro-switch 21. Therefore whenever the transparent plate 15 is removed, oscillation of the magnetron is stopped thus providing a safe high frequency electronic oven.

In the modified embodiment shown in FIG. 5, door frame 13 includes a cavity 40 in which a U shaped supporting member 41 including legs 42 and 43 is secured to the rear wall 13c of frame 13. Legs 42 and 43 are provided with offset perforations 42a and 43a respectively. An operating member 44 comprises parallel but offset portions 44a and 44b slidably received in perforations 42a and 43a, respectively, and an inclined portion 44c interconnecting offset portions 44a and 44b. The operating member is biased downwardly by a spring 45 connected between it and leg 43. An operating rod 47 for actuating micro-switch 21 disposed in cabinet 1 extends through opening 50 of front wall 1a of cabinet 1 and a perforation 46 through the rear wall 13c of door frame 13 and supporting member 41 seating thereon. A compression spring 48 is interposed between supporting member 41 and a pin or flange 47a provided for the rod 47 to normally urge it against operating member 44. Thus, when the transparent plate 15 is mounted on frame 13 through its slot 49 formed in its lower wall 13d, the operating member 44 is moved upwardly whereby rod 47 is engaged by portion 44b. Accordingly, when the door is closed the inner end of rod 47 engages the operating member 21a of microswitch 21 to close the same. When the transparent plate 15 is removed the operating rod 44 is moved downwardly by the action of spring 45 to cause rod 47 to engage portion 44a thus opening the micro-switch 21.

In another embodiment shown in FIG. 6, the door frame 13 is provided with an opening 13f communicated with an opening 62 through the front wall 1a of the cabinet 1. A lever 60 is pivotally mounted on a pedestal 61 disposed in the opening 13f for operating micro-switch 21 in the cabinet. Lever 60 extends through opening 62 to engage the operating member 21b of micro-switch 21. When the transparent plate 15 is mounted on door frame 13 through groove 13b, the lever 60 is urged against the bottom of the groove 13b whereby the lever 60 is rotated in the clockwise direction to close micro-switch 21. Upon removal of the transparent plate 15, lever 60 is rotated in the counterclockwise direction by a spring 63 to open the micro-switch. If desired, springs 16 shown in FIG. 2 may be used to decrease the weight of the transparent plate 15 acting upon lever 60.

What we claim is:

1. In high frequency heating apparatus of the type comprising a cabinet defining therein a heating chamber having an access opening on one side thereon; a door mounted on said cabinet for closing said access opening; said door including a frame having a window, and a perforated metal plate secured to said frame for closing said window; and a high frequency oscillator for radiating high frequency electromagnetic waves in said heating chamber,

the improvement which comprises a switch disposed in said cabinet for controlling the operation of said

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high frequency oscillator, a transparent cover plate removably mounted on said door on the outside of said perforated metal plate, and actuating means responsive to the mounting and dismounting of said transparent plate to actuate said switch for controlling the operation of said high frequency oscillator, said actuating means comprising an operating member having parallel but offset portions, said operating member being mounted in said door frame to be moved by said transparent plate, spring means to urge said operating member to engage said transparent plate, and an operating rod for said switch, said operating rod being selectively engaged by said offset portions of said operating member for opening and closing said switch in response to the mounting and dismounting of said transparent plate.

2. Apparatus according to claim 1 wherein said door

frame includes means defining offset perforations for slidably receiving said operating member in said perforations.

3. Apparatus according to claim 2 wherein said means defining said perforations includes a generally U-shaped supporting member having said perforations in opposite legs thereof.

4. Apparatus according to claim 1 including means for biasing said operating rod for said switch against said operating member.

5. Apparatus according to claim 1 wherein said operating rod engages a first offset portion of said operating member when said transparent plate is mounted, and engages a second offset portion of said operating member when said transparent plate is dismounted.

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