

[54] **HIGH FREQUENCY HEATING APPARATUS**

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[58] Field of Search...219/10.55, 412, 413; 200/50 A; 126/197, 200

[56]

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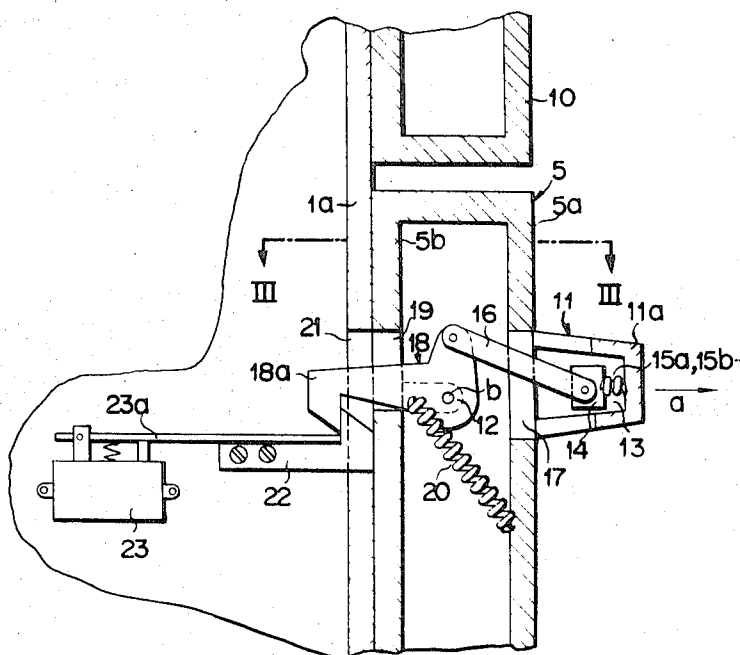
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[57]

ABSTRACT

In high frequency heating apparatus, typically an electronic oven, the door locking mechanism comprises an operating member mounted on the door outside the heating chamber, a switch in the cabinet and means interlocked with the locking mechanism for operating the switch for deenergizing the high frequency oscillator when the operating member is operated to unlock the locking mechanism.

10 Claims, 10 Drawing Figures



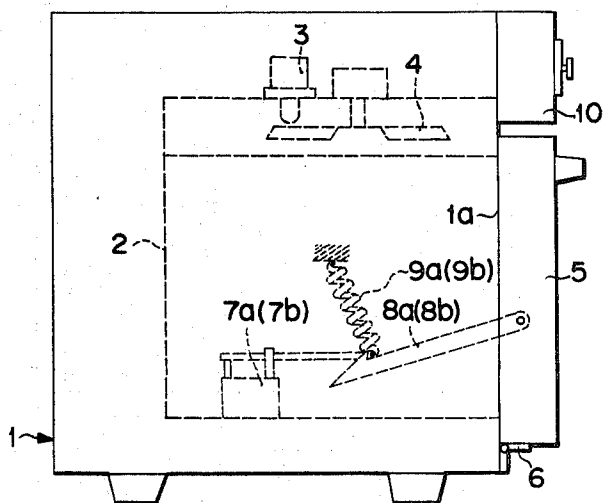


FIG. 1

FIG. 2

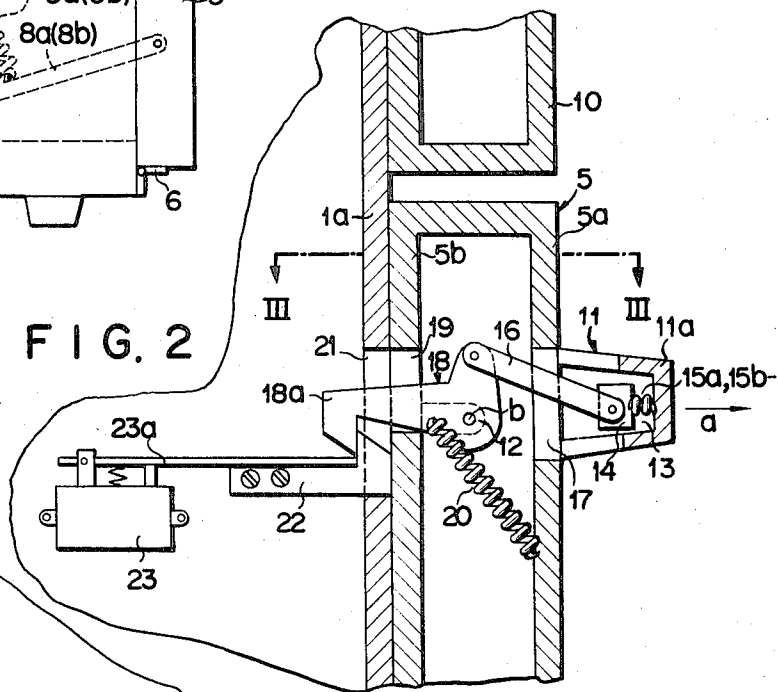
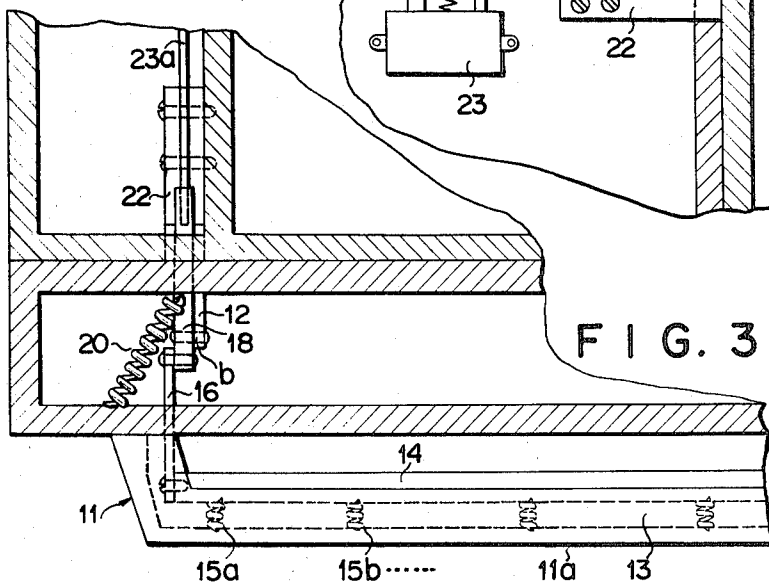
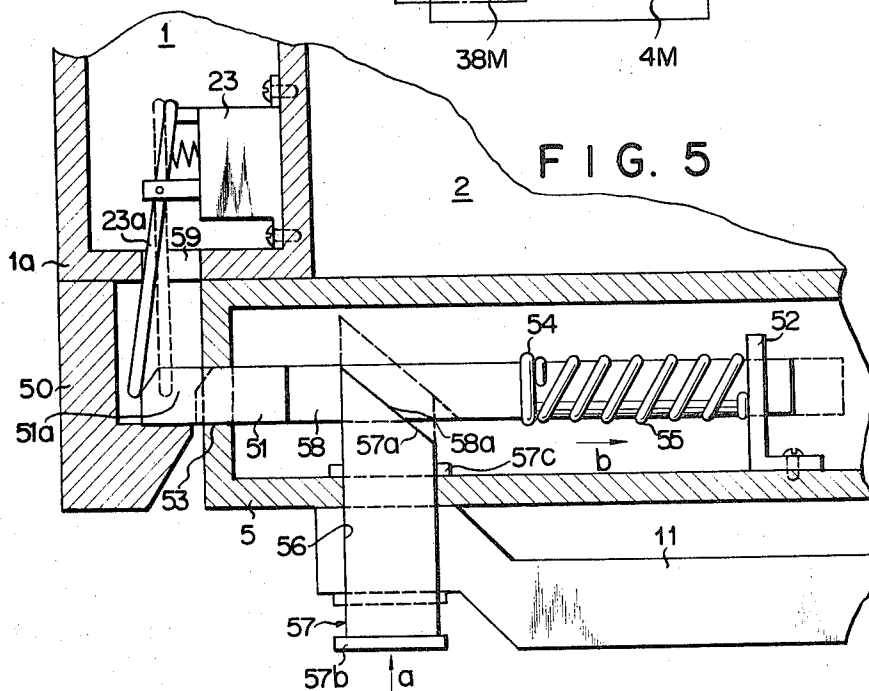
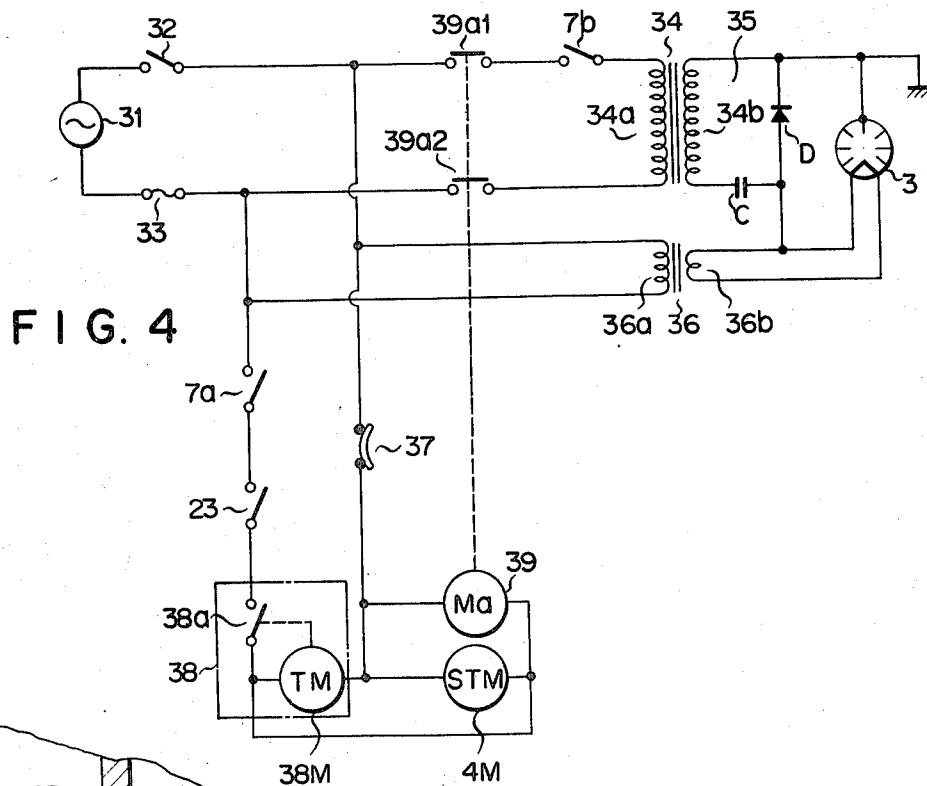


FIG. 3





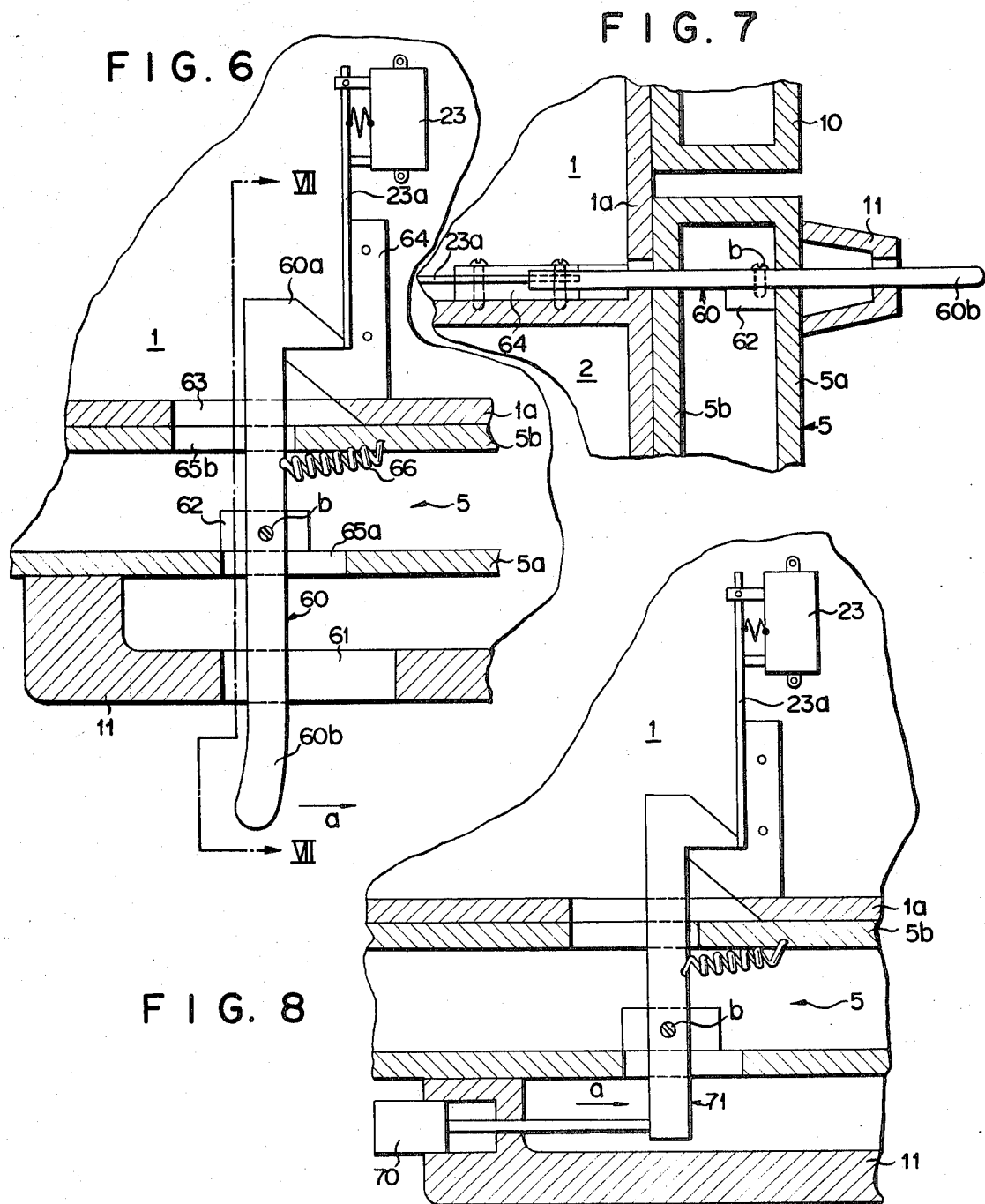


FIG. 9

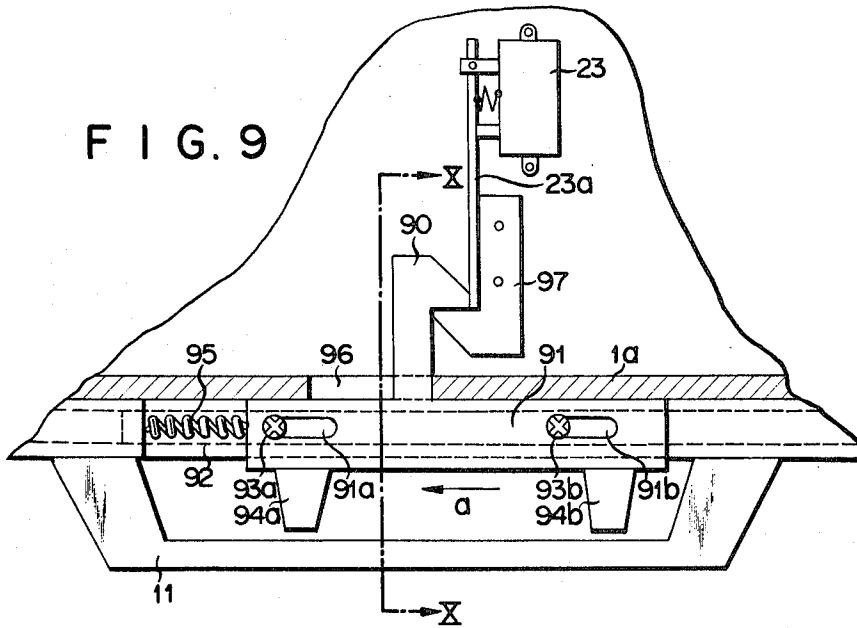
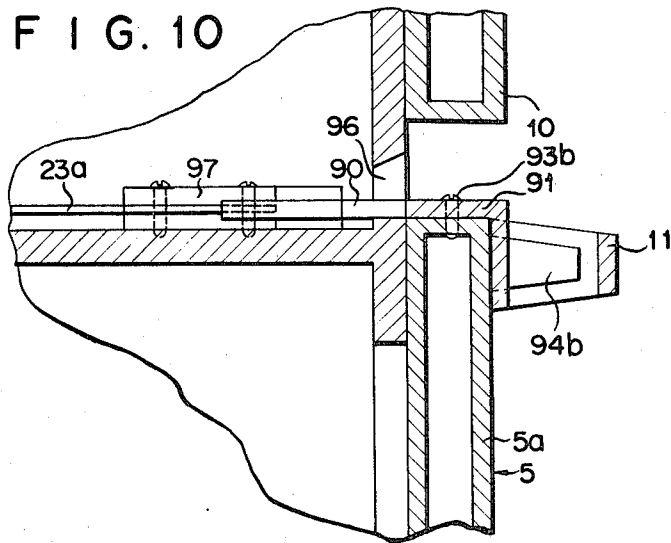


FIG. 10



HIGH FREQUENCY HEATING APPARATUS

This invention relates to a high frequency heating apparatus, more particularly to a high frequency heating apparatus including an improved door locking mechanism which controls the operation of a high frequency oscillator utilized to energize the heating apparatus.

In high frequency heating apparatus, typically an electronic oven, high frequency electromagnetic waves of about 2450 MHz are used to cook various foodstuffs. In such an oven, if the door of the cabinet does not completely close the access opening of the cabinet, the electromagnetic waves leak to the outside through a narrow air gap around the periphery of the door, thus adversely affecting nearby electric devices, such as a television receiver, and the operator. Accordingly it is desirable not only to perfectly close the door but also to deenergize the electronic oven or the high frequency oscillator when the door is opened. Accordingly, the electronic oven is usually designed such that it is provided with a switch interlocked with the door so that the high frequency oscillator is deenergized whenever the door is opened during or after completing the cooking operation. However, since some degree of mechanical play is inevitable in the interlocking mechanism between the door and the switch, if the door is opened carelessly during the operation of the oven, the electromagnetic waves leak outwardly through the air gap around the door from an instant at which the door is begun to open until the switch deenergizes the high frequency oscillator. Should the switch fail to operate normally due to welding of the contacts thereof, for example, there is a risk of the leakage of a large quantity of the electromagnetic waves.

Accordingly, it is the object of this invention to provide a high frequency heating apparatus having an improved door locking mechanism which in response to the operation of the door accurately controls the operation of the high frequency oscillator, thus positively preventing leakage of the high frequency electromagnetic waves when the door of the heating apparatus is inadvertently opened during the operation thereof.

SUMMARY OF THE INVENTION

According to this invention, in high frequency heating apparatus of the type comprising a cabinet for defining a heating chamber having an access opening at one side thereof, a door mounted on the cabinet for closing the access opening, a high frequency oscillator contained in the cabinet for radiating high frequency electromagnetic waves in the heating chamber, and a locking mechanism for locking the door in the closed position, there is provided an operating member for the locking mechanism, which is mounted on the door outside the heating chamber, a switch mounted in the cabinet and means interlocked with the locking mechanism for operating the switch to deenergize the high frequency oscillator when the operating member is operated to unlock the locking mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a side view of a high frequency oven embodying this invention;

FIG. 2 shows a partial sectional view of the cabinet shown in FIG. 1 to show the door locking mechanism of the oven;

FIG. 3 shows a partial sectional view of the cabinet taken along a line III—III in FIG. 2;

FIG. 4 shows a connection diagram of the high frequency oven to explain the operation of this invention;

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

FIG. 6 shows a similar view illustrating another modification of this invention;

FIG. 7 shows a partial sectional view taken along a line VII—VII in FIG. 6;

FIG. 8 shows a modification of the embodiment shown in FIGS. 6 and 7;

FIG. 9 shows still further modification of this invention; and

FIG. 10 shows a partial sectional view taken along a line X—X in FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout the drawings and the following description like parts are designated by the same reference numerals.

The high frequency electronic oven shown in FIG. 1 comprises a metal cabinet 1 containing a heating or cooking chamber 2 having an access opening at one side for loading and unloading foodstuffs to be cooked. On the top wall of the cooking chamber are mounted a magnetron oscillator 3 and a stirrer fan 4 for randomly distributing the high frequency electromagnetic waves of about 2450 MHz radiated in the cooking chamber 2 by the magnetron 3 for uniformly cooking the foodstuffs loaded in the cooking chamber. The high frequency electromagnetic waves may be radiated through a wave guide from the magnetron oscillator 3 into the cooking chamber. To close the access opening of the cabinet, a door 5 is pivotally mounted as at 6 at the lower edge of access opening. To control the operation of the magnetron 3 in response to the opening and closing operations of the door, first and second switches 7a and 7b are contained in the space between the inner and outer side walls of the cabinet 1, and first and second levers 8a and 8b are provided to operate the switches 7a and 7b, the outer ends of these levers being pivotally connected to the door 5 and the inner ends extending into the cabinet through slots, not shown, formed through the front wall 1a of the cabinet. The inner ends of levers 8a and 8b are normally biased in the clockwise direction about the outer ends pivotally connected to the door by means of springs 9a and 9b. When the door is closed, the inner ends of levers 8a and 8b urge upwardly the actuator of door switches 7a and 7b, thus closing these switches. When the door is opened, levers 8a and 8b are pulled outwardly by being guided by said slots with the result that the actuator of door switches 7a and 7b are returned to their original positions, thus opening the switches. An ornamental panel board 10 carrying a timer and the like, not shown, is mounted on the upper front wall of the cabinet 1.

As shown in more detail in FIGS. 2 and 3, an operating handle 11 is mounted on the upper portion of the

outer surface of door 5 and a locking mechanism is provided for locking the door to the cabinet when the door is closed. More particularly, this locking mechanism comprises a stationary locking member or latch 22 fixedly secured to the inner wall of the cabinet 1, a locking lever 18 having its outer end pivotally connected to the door 5 by means of a supporting arm 12 and extending into the cooking chamber 2 through a perforation 19 in the inner wall 5b of the door 5 and a perforation 21 on the front wall 1a of the cabinet, said locking lever having a hook 18a at its inner end for engaging the locking member 22 to lock the door to the cabinet a spring 20 is connected between the locking lever 18 and the outer wall 5a of the door for biasing the locking lever in the counterclockwise direction as viewed in FIG. 2. As shown in FIG. 3, the locking mechanism comprises an operating lever 14 contained in an elongated groove 13 formed in the grip 11a of the handle 11 and yieldingly connected thereto by means of a plurality of springs 15a, 15b . . . , and connecting rod 16 connected between the locking lever 18 and operating lever 14 and extending through a perforation 17 in the outer wall 5a of the door. The rod 16 is connected to the locking lever 18 in such a manner that when the operating lever 14 is operated in the direction of arrow a shown in FIG. 2, the connecting rod 16 causes the locking lever 18 to rotate in the clockwise direction. There is also provided a microswitch 23 close to the locking member 22 for controlling the operation of magnetron 3. The micro-switch 23 is actuated in response to the locking and unlocking operation of the locking mechanism. Thus, when the door 5 is closed and locked to cabinet 1, the actuator 23a of the micro-switch 23 is pressed by the hook 18a of the locking lever 18 to close it. Under these conditions, when the operating lever 14 is moved in the direction of arrow a for opening the door, the locking lever 18 is rotated in the clockwise direction about a pivot pin b by connecting rod 16 against the force of spring 20 to release the actuator 23a, thus opening micro-switch 23. This clockwise rotation of the locking lever 18 also unlocks the door.

FIG. 4 shows a connection diagram of the high frequency oven. As shown, a series circuit including a source switch 32, the normally opened contact 39a1 of an electromagnetic contactor 39, the second door switch 7b, the primary winding 34a of a high voltage transformer 34, the normally opened contactor 39a2 and a fuse 33 is connected across an a-c power source 31. The secondary winding 34b of the transformer is connected to the anode electrodes of magnetron 3 through a rectifier circuit 35 comprising a diode D and a capacitor C. The juncture between the source switch 32 and normally opened contact 39a1 and the juncture between the fuse 33 and normally opened contact 39a2 and the juncture between the fuse 33 and normally opened contact 39a2 are connected across the primary winding 39a of a low voltage transformer 36, the secondary winding 36b thereof being connected across the cathode heater of magnetron 3. One terminal of this secondary winding is connected to the juncture between the capacitor C and anode electrode of diode D. Connected in parallel with the primary winding of transformer 36 is a series circuit including a temperature responsive switch 37 which is opened when the

temperature of the magnetron 3 exceeds a predetermined value, and an operating motor 38M of a timer 38 for setting the cooking time, the micro-switch 23 and the first door switch 7a. A motor 4M for driving the stirrer fan 4 and the operating coil of the electromagnetic contactor 39 are connected in parallel with the timer motor 38M.

The embodiment shown in FIGS. 1 to 4 operates as follows. After loading a foodstuff in the cooking chamber 2, the door 5 is closed. Then door switches 7a and 7b are closed. At the same time the door is locked by the locking mechanism described above whereby the micro-switch 23 is closed. Under these conditions, closure of the source switch 32 connects the source 31 to the low voltage transformer 36, thus initiating the preheating of the cathode heater of the magnetron. Then, the timer 38 is set to a desired cooking time. Then its time delay contact 38a is closed to energize the timer motor 38M and electromagnetic contactor 39, thus starting the operation of the timer 38. Energization of the electromagnetic contactor 39 closes its normally opened contacts 39a1 and 39a2 thus connecting the high voltage transformer 34 across the source 31 to energize the anode electrodes of the magnetron 3 through the rectifier circuit 35. In this manner, the magnetron begins to oscillate to supply the high frequency electromagnetic waves in the cooking chamber 2 for heating the foodstuff contained therein. After a predetermined time preset by the timer 38, its time delay contact 38a is opened thus deenergizing the timer motor and the electromagnetic contactor 39. Then, the normally opened contacts 39a1 and 39a2 are opened to deenergize the magnetron 3.

As can be noted from the foregoing description, in order to open the door during cooking, it is necessary to unlock the door. When the door is unlocked, the micro-switch 23 is opened as above described, thus ceasing the oscillation of the magnetron. Therefore, according to this invention, as the magnetron is deenergized immediately prior to the opening of the door, there is no fear of leakage of the electromagnetic waves even when the door is inadvertently opened during the cooking operation, thus assuring a high degree of safety.

In the modified embodiment shown in FIG. 5, the locking mechanism comprises a locking member 50 secured to the cabinet and a slidable rod 51 disposed in the door 5. The slidable rod has one end extending through a supporting arm 52 secured to the inner surface of the outer wall of the door and a locking end 51a extending through a perforation 53 formed in a side wall of the door. The slidable rod 51 is normally biased to the left as viewed in FIG. 5 by a spring 55 interposed between a flange 54 and the supporting arm 52. The operating member for operating from outside the locking mechanism includes a slidable rod 57 slidably received in an opening 56 provided through the handle 11 and front wall of the door 5. The inner end of the slidable rod 57 is bevelled as at 57a while the outer end is provided with a push button 57b. A cross pin 57c is inserted through the slidable rod 51 to limit its outward movement by the engagement of cross pin 57c against the inner side of the front wall of the door.

The slidable rod 51 is formed with a slot 58 having an inclined surface 58a adapted to engage the inclined surface 57a of slidable rod 57.

When the door is closed, the end 51a of rod 51 is urged to project outwardly through perforation 53 to engage the locking member 50 at the same time to urge the actuator 23a of the micro-switch 23 extending outwardly through a perforation 59 of the front wall 1a of the cabinet 1 thus closing the micro-switch 23. When the slidable rod 57 is driven inwardly as shown by arrow *a*, the rod 51 is moved in the direction of arrow *b* against the force of spring 55 whereby its end 51a is retracted into perforation 53, thus unlocking the door and opening the micro-switch 23. To assure smooth closing of the door, it is advantageous to bevel both the end 51a of the rod 51 and the outer end of the locking member 50 as shown in FIG. 5.

In another modification of the invention shown in FIGS. 6 and 7, the operating member molded integral with a rotating lever 60 of the locking mechanism extends outwardly through a perforation 61 formed in handle 11. The lever 60 extends through perforations 65a and 65b formed through the front and rear walls 5a and 5b of the door 5 and is pivoted at *b* to a plate 62 secured to the inner side of the front wall 5a of the door. A hook 60a is formed on the inner end of the rotating lever 60 which is inserted into the cabinet through a perforation 63 formed in the front wall 1a of the cabinet 1 when the door is closed. The hook 60a engages a locking member 64 secured to the inside of the cabinet 1 to depress the actuator 23a of micro-switch 23 contained therein, thus closing the switch. A spring 66 is contained in the door to normally urge the hook in the clockwise direction. While the door is locked in its closed position, when the operating member 60b is driven in the direction of arrow *a*, the lever 60 is rotated in the counterclockwise direction about pin *b* thus unlocking the door and opening the micro-switch 23.

FIG. 8 shows a modification of the embodiment shown in FIGS. 6 and 7, wherein an operating lever 70 is provided to extend through one side of handle 11 to engage the side surface of a rotating lever 71 corresponding to lever 60 of the previous embodiment, so that when the operating lever 70 is driven in the direction of arrow *a* the lever 71 is rotated in the counterclockwise direction about pivot pin *b* to unlock the door.

In another embodiment shown in FIGS. 9 and 10, a recess 92 is formed on the upper edge of the door 5 to accommodate a slidable plate 91 integral with a movable lever 90. The slidable plate 91 is slidably mounted on the upper edge of the door by means of screws 93a and 93b cooperating with slots 91a and 91b respectively which are formed through the slidable plate 91. Further, the slidable plate 91 is provided with an extension extending downwardly along the front wall 5a of the door 5. Operating knobs 94a and 94b are secured to the extension near handle 11. The slidable plate 91 is normally biased to the right by means of a spring 95 connected between it and the door. When the operating knobs are operated to move the slidable plate 91 in the direction indicated by arrow *a* against the force of spring 95 while the door is closed, hook 90 is moved along a slot 96 formed in the front wall 1a of the cabinet to disengage from the locking member 97, thus opening micro-switch 23.

What we claim is:

1. In a high frequency heating apparatus comprising a cabinet for defining a heating chamber having an access opening at one side thereof, a door mounted on said cabinet for closing said access opening, a high frequency oscillator for radiating high frequency electromagnetic waves in said heating chamber, and a locking mechanism for locking said door in the closed position,

the improvement which comprises:

a door operating handle fixedly and immovably connected to said door for opening said door;

an operating member for said locking mechanism, said operating member being movably mounted on said door operating handle outside said heating chamber for operation when said handle is engaged and pulled;

a switch coupled to said high frequency oscillator, said switch being mounted in said cabinet; and

means interlocked with said locking mechanism for operating said switch to deenergize said high frequency oscillator when said operating member is operated to unlock said locking mechanism.

2. The high frequency heating apparatus according to claim 1 wherein; said locking mechanism comprises a locking member secured to said cabinet, a rotating lever pivotally connected to said door at one end thereof and provided at the other end with a hook cooperating with said locking member, and a spring connected between said rotating lever and said door for biasing said rotating lever to cause said hook to engage said locking member when said door is closed; said operating member comprises an operating lever movably mounted on said handle, and a connecting rod operatively interconnecting said operating lever and said rotating lever for rotating the said rotating lever against the action of said spring when said operating lever is operated to disengage said hook from said locking member; and said switch is provided with an actuator which is engaged by said hook when it engages said locking member for closing said switch and released when said hook is unlocked for opening said switch.

3. The high frequency heating apparatus according to claim 2 wherein said operating lever is disposed between the grip of said handle and the front surface of said door confronting said grip and is contained in said handle to be movable towards and away from the front surface of said door.

4. The high frequency heating apparatus according to claim 1 wherein a door operating handle is mounted on said door; said locking mechanism comprises a locking member secured to said cabinet, a movable rod mounted on said door to be movable in the longitudinal direction, and a spring connected between said door and said movable rod for causing one end of said rod to engage said locking member when said door is closed; said operating member comprises an operating rod movably connected to said handle; and said switch comprises an actuator which is engaged by said movable rod when it engages said locking member for closing said switch and released when said movable rod disengages said locking member for opening said switch.

5. The high frequency heating apparatus according to claim 1 wherein said locking mechanism comprises a locking member secured to said cabinet, a rotating

lever pivotally mounted on said door and having a hook at one end thereof, and a spring connected between said rotating lever and said door for biasing said rotating lever for causing said lever to engage said locking member when said door is closed; said operating member comprises an operating rod integral with said rotating lever and extending to the outside of said door; and said switch comprises an actuator which is engaged by said hook when it engages said locking member for closing said switch and released when said hook disengages said locking member for opening said switch.

6. The high frequency heating apparatus according to claim 1 wherein an operating handle is mounted on said door; said locking mechanism comprises a locking member secured to said cabinet, a rotating lever rotatably mounted on said door, said rotating lever having a hook at one end, and a spring connected between said rotating lever and said door for biasing said rotating lever for causing said hook to engage said locking member when said door is closed; said operating member of said locking mechanism comprises an operating lever slidably mounted on said door and including an end abutting the end of said rotating lever opposite said hook; and said switch comprises an actuator which is engaged by said hook when it engages said locking member for closing said switch and released when said hook disengages said locking member for opening said switch.

7. The high frequency heating apparatus according

to claim 1 wherein said locking mechanism comprises a locking member and a locking rod having a hook at one end thereof; said operating member of said locking mechanism comprises a slidable member slidably mounted on said door, said slidable member being connected to said locking rod, and a spring connected between said slidable member and said door for biasing said slidable member for causing said hook to engage said locking member when said door is closed; and said switch comprises an actuator which is engaged by said hook when it engages said locking member for closing said switch and released when said hook disengages said locking member for opening said switch.

8. The high frequency heating apparatus according to claim 2 wherein said switch actuator is interposed between said hook and said locking member when said hook engages with said locking member for locking said door.

9. The high frequency heating apparatus according to claim 2 wherein said operating member includes spring means interposed between said handle and said operating lever to bias said operating lever away from said handle and toward said door.

10. The high frequency heating apparatus according to claim 1 wherein said operating member is movable away from said door such that excessive pulling forces are applied to said handle.

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