

[54] **ELECTROMAGNETIC LOCKING
MECHANISM FOR A MICROWAVE OVEN**

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219/413; 126/197, 198; 292/144; 70/281;
200/50 A

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[57]

ABSTRACT

In a high frequency heating apparatus comprising a cabinet defining a heating chamber, a door for closing the heating chamber, a high frequency oscillator, and a timer for presetting the operating time of the oscillator, there are provided an electromagnetic locking mechanism which is energized together with the timer for locking the door in the closed position. Also provided is a switch operated by the locking mechanism for controlling the operation of the high frequency oscillator for deenergizing the high frequency oscillator when the door is unlocked.

8 Claims, 4 Drawing Figures

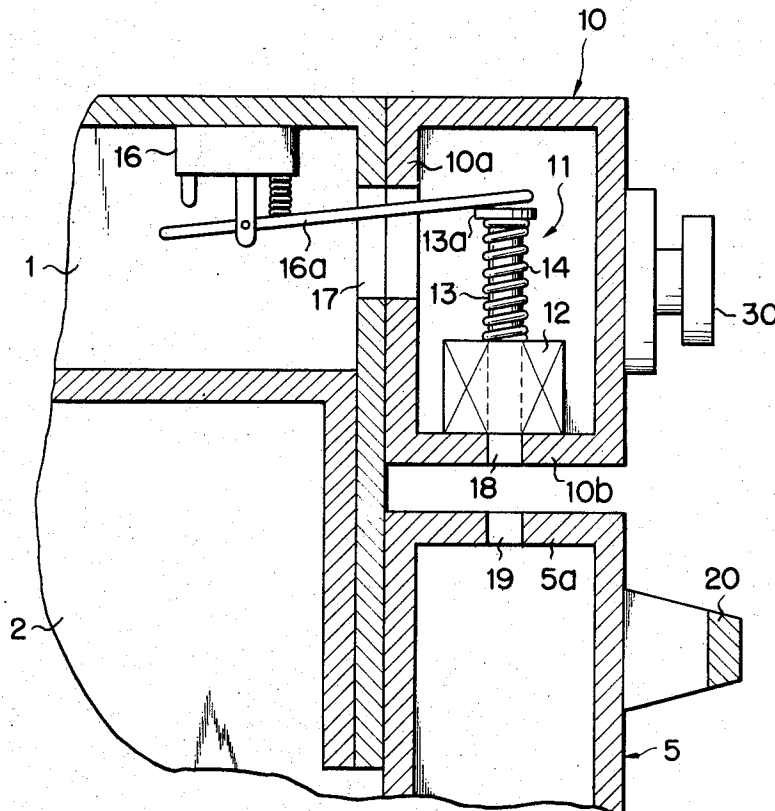


FIG. 1

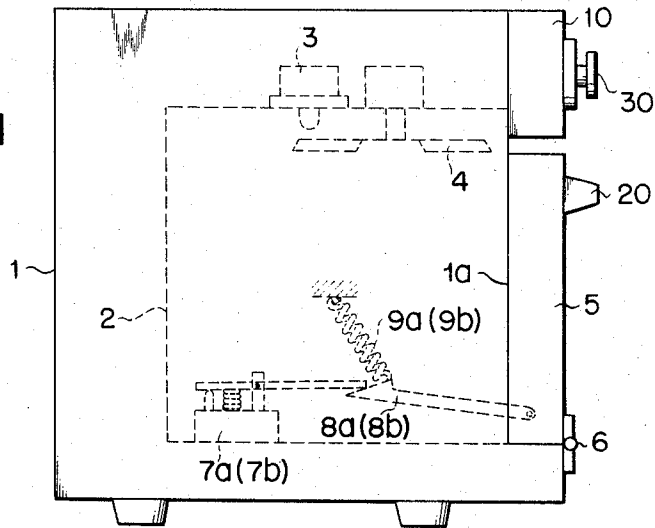
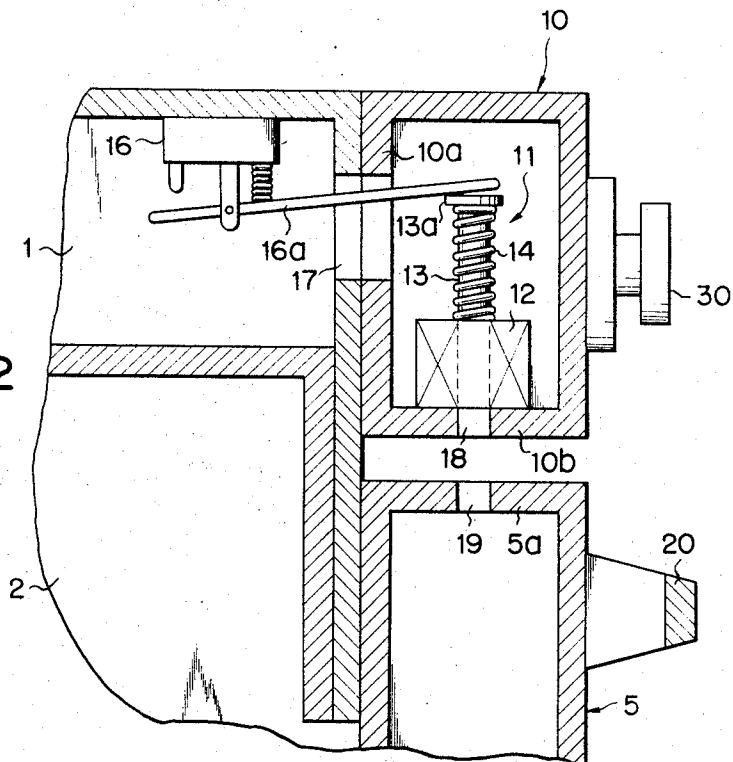


FIG. 2



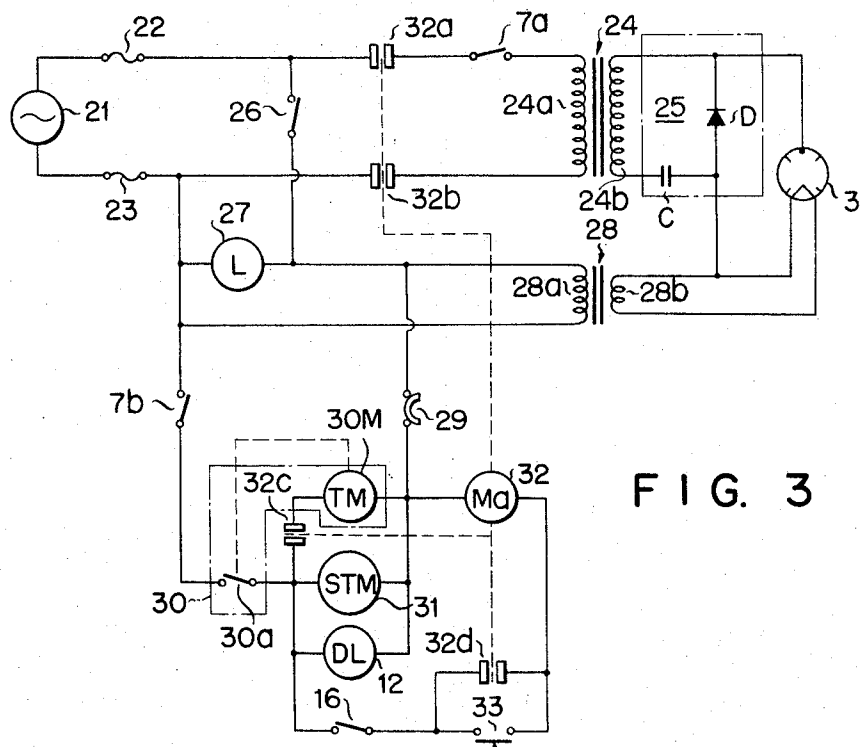


FIG. 3

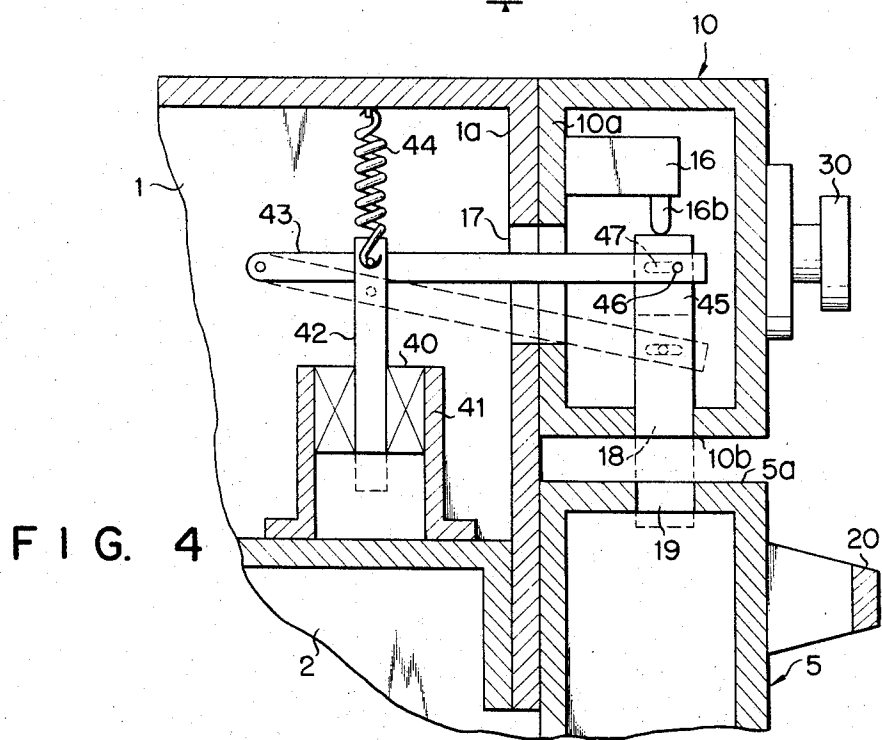


FIG. 4

ELECTROMAGNETIC LOCKING MECHANISM FOR A MICROWAVE OVEN

BACKGROUND OF THE INVENTION

This invention relates to a high frequency heating apparatus for heating various objects by utilizing high frequency electromagnetic waves of 2,450 MHz, for example, and more particularly to a high frequency heating apparatus including an improved device for preventing the leakage of the high frequency electromagnetic waves.

Although such high frequency heating apparatus are now widely used in many applications including drying and bonding of wood pieces, for the sake of description, the invention will be described hereunder in terms of an electronic oven for cooking foodstuffs. An electronic oven typically comprises a cabinet defining therein a heating or cooking chamber, a magnetron oscillator for radiating the high frequency electromagnetic wave in the cooking chamber and a door for closing the cooking chamber. Should the door fails to completely close the cooking chamber, the electromagnetic wave would leak outwardly through a small gap between the door and the cabinet thus adversely affecting nearby communication apparatus, a television receiver for example, and a human body. Accordingly, it is highly desirable to deenergize the magnetron oscillator whenever the door is opened. To this end, it has been the practice to use an electric switch so interlocked with the door that it deenergizes the magnetron oscillator. Such a switch, however, cannot be operated quickly because of its inherent time lag in the opening of its contacts and the mechanical lost motion of the mechanism interlocking the switch and the door. Thus, inadvertent opening of the door causes leakage of the electromagnetic waves during an interval between initiation of the opening of the door and the actual opening of the switch. Should the switch fail to interrupt the circuit due to welding of the contacts thereof, for example, a large quantity of the electro-magnetic waves would leak out.

It is an object of this invention to provide a high frequency heating apparatus provided with an improved locking device for positively preventing leakage of the electromagnetic waves by locking the door in the closed position whenever the high frequency oscillator is operating.

SUMMARY OF THE INVENTION

According to this invention, in a high frequency heating apparatus of the class comprising a cabinet defining therein a heating chamber with an access opening, a door closing the access opening, a high frequency oscillator for radiating high frequency electromagnetic waves in the heating chamber, and a timer for presetting the operating time of the high frequency oscillator, there are provided an electromagnetic locking mechanism mounted on the cabinet, the locking mechanism being energized together with the timer for locking the door to the cabinet, a switch disposed in the cabinet for controlling the operation of the high frequency oscillator, and means for actuating the switch in accordance with the operation of the locking mechanism thereby to stop the operation of the high frequency oscillator when the locking mechanism unlocks the door.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 2 is an enlarged partial sectional view of the electronic oven shown in FIG. 1;

FIG. 3 shows an electric circuit of the electronic oven shown in FIGS. 1 and 2; and

FIG. 4 is an enlarged sectional view similar to FIG. 2 of a modified embodiment of this invention.

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

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The electronic oven shown in FIGS. 1 and 2 comprises a cabinet 1 defining therein a heating or cooking chamber 2 having an access opening on one side, a magnetron 3 and a stirrer fan 4 on the upper portion of the cooking chamber, the stirrer fan 4 serving to randomly distribute the electromagnetic waves radiated by magnetron 3 throughout the cooking chamber to uniformly cook the foodstuff loaded therein. To close the access opening, a door 5 having a handle 20 is pivotally mounted on the cabinet 1 by means of a hinge 6 located at the lower edge of the access opening. Spaced apart first and second door switches 7a and 7b are disposed in the space between the side walls of heating chamber 2 and cabinet 1. To actuate these door switches first and second door switch operating levers 8a and 8b are pivotally connected to the door at their one ends to extend into the cabinet through slots, now shown, in the front wall 1a of the cabinet. The inner ends of the switch operating levers 8a and 8b are biased upwardly by means of springs 9a and 9b connected between these levers and the side wall of the cabinet, thus closing door switches 7a and 7b when the door is closed. As the door is opened, the inner ends of the levers 8a and 8b disengage the operating levers of the door switches thus opening the same. A hollow panel board 10 provided with a timer 30 and another control member is mounted on the upper portion of the front wall 1a.

As best shown in FIG. 2, a locking mechanism 11 comprising an electromagnetic coil 12 and an armature or locking rod 13 freely extending through the electromagnetic coil is housed in the hollow panel board 10. The locking rod 13 is normally biased upwardly by means of a spring 14 interposed between a flange 13a on the upper end of rod 13 and the upper surface of coil 12. A micro-switch 16 is mounted in the cabinet 1. The operating lever 16a of the micro-switch extends into the upper portion of panel board 10 through an opening 17 formed in the front wall 1a of the cabinet and the rear wall 10a of the panel board. Thus, when the electromagnetic coil 12 is deenergized the rod 13 is moved upwardly by spring 14 to open micro-switch 16. Concurrently therewith, the lower end of locking rod 13 is positioned in an opening 18 in the lower wall 10b of the panel board 10. Upon energization of electromagnetic coil 12, the locking rod 13 is pulled downwardly against the action of spring 14 to protrude into an opening 19 in the upper side wall 5a of door 5, thus locking the same to the cabinet 1. At the same time, operating lever 16a is rotated in the clockwise direction to close micro-switch 16.

As shown in FIG. 3, the electric circuit of the electronic oven comprises a transformer 24 having a pri-

mary winding 24a connected across an A.C. source 21 through fuses 22 and 23, normal open contacts 32a and 32b of an electromagnetic contactor 32 and first door switch 7a. The secondary winding 24b of transformer 24 is connected across the anode electrodes and the cathode electrode of a magnetron oscillator 3 through a rectifier circuit 25 comprising a diode D and a capacitor C. Across the junctures between fuses 22 and 23 and contacts 32a and 32b is connected a lamp 27 through a source switch 27. Further, in parallel with lamp 27 is connected the primary winding 28a of a low voltage transformer 28, secondary winding 28b thereof being connected across the cathode heater of magnetron 3. One terminal of secondary winding 28b is connected to the juncture between diode D and capacitor C of the rectifier circuit. A series circuit including a thermal switch 29 responsive to an excessive temperature rise of magnetron 3, an operating motor 30M of a timer 30 for setting the operating time of the magnetron, the time delay contact 30a of the timer and the third normal open contact 32c of electromagnetic contactor 32 is connected in parallel with lamp 27. A motor 31 for driving stirrer fan 4 and the electromagnetic coil 12 are connected in parallel with timer motor 30M through contact 32c. A series circuit including the coil of electromagnetic contactor 32, the fourth normal open contact 32d and the micro-switch 16 is connected in parallel with stirrer fan motor 31. A cooking switch 33 is connected in parallel with the fourth normal open contact 32d.

Upon closure of switch 26, the cathode heater of magnetron 3 is energized through low voltage transformer 28 to preheat the cathode electrode. After loading a foodstuff to be cooked in the cooking chamber 2, door 5 is closed to close door switches 7a and 7b. When the timer 30 is set to a predetermined time, its contact 30a is closed to energize the electromagnetic coil 12 and stirrer fan motor 31. Thus, the locking rod 13 is pulled downwardly into opening 19, locking the door 5 to cabinet 1 concurrently with the setting of timer 30. At the same time, the operating lever 16a is released from the locking rod 13 to close micro-switch 16. Then, cooking switch 33 is closed to energize electromagnetic contactor 32 thus closing its normal open contacts 32a, 32b, 32c and 32d. Closure of contact 32d establishes a self holding circuit for the electromagnetic contactor around cooking switch 33. Closure of the third contact 32c energizes timer motor 30M to start its operation. On the other hand, closure of the first and second contacts 32a and 32b energizes the high voltage transformer from source 21 and the output of the high voltage transformer is applied to magnetron 3 via rectifier circuit 25. Thus, magnetron 3 initiates oscillation to supply the high frequency electromagnetic waves to the cooking chamber to cook the foodstuff therein. After elapse of the preset time of timer 30, its time delay contact 30a is opened to denenergize timer motor 30M and electromagnetic contactor 32, thus opening its contacts 32a, 32b, 32c and 32d whereupon magnetron 3 is denenergized to stop oscillation. Opening of time delay contact 30a also denenergizes electromagnetic coil 12 to restore locking rod 13 thus unlocking door 5.

In this manner, as the door is positively locked in its closed position while magnetron 3 is operating thus effectively preventing inadvertent opening of the door. Where it is necessary to open the door during cooking

it is necessary to open source switch 26 or to manually return timer 30 to the zero position for unlocking the door. In this manner, whenever the door is brought to the openable condition, the magnetron is always denenergized to solve the problem of the leakage of the electromagnetic waves. Should the door 5 not be positively locked, for example where locking rod 13 is not fully inserted into opening 19 of door 5, micro-switch 16 will be held in the opened condition so that closure of cooking switch 33 is not effective to energize electromagnetic contactor 32. In such a case, of course the magnetron is never energized. Thus, there is no danger of the leakage of the electromagnetic waves caused by improper locking operation.

In a modified embodiment of this invention shown in FIG. 4, an electromagnetic coil 40 is secured to the inside of cabinet 1 by means of a support 41. An armature 42 operated by the coil 40 has its upper end connected to a lever 43 with one end pivotally connected to cabinet 1. The lever 43 extends through opening 17 into hollow panel board 10 and is normally biased in the counterclockwise direction by a spring 44. The outer end of lever 43 is connected to the upper end of a locking rod 45 through a pin and slot connections 46 and 47. When electromagnetic coil 40 is not energized, the locking rod 45 is held in its upper position by the action of spring 44 wherein the lower end of locking rod 45 is positioned in opening 18 through the lower wall 10b of the panel board 10. Under these conditions, the upper end of rod 45 engages the operating button 16b of micro-switch 16 to open the same. Energization of the electromagnetic coil 40 drives locking rod 45 downwardly against the force of spring 44 thus inserting rod 45 into opening 19 of door 5 whereby the door is locked. Lowering of rod 45 releases the operating button 16b thus closing micro-switch 16. Similar to the first embodiment, the electromagnetic coil 40 is connected to be energized when timer 30 (FIG. 3) is set. When the coil is energized, armature 42, lever 43 and locking rod 45 are moved to positions indicated by dotted lines. After a predetermined time, that is after the elapse of the set time of the timer, electromagnetic coil 40 is denenergized to open micro-switch 16 and to unlock door 5.

What is claimed is:

1. In a high frequency heating apparatus comprising a cabinet defining therein a heating chamber with an access opening, a door for closing said access opening, a high frequency oscillator for radiating high frequency electromagnetic waves in said heating chamber, and a timer for presetting the operating time of said high frequency oscillator,

the improvement which comprises:

an electromagnetic locking mechanism mounted on said cabinet, said locking mechanism being energized together with said timer for locking said door to said cabinet,

a switch disposed in said cabinet for controlling the operation of said high frequency oscillator, and means operatively coupled to said locking mechanism for actuating said switch in accordance with the operation of said locking mechanism such that operation of said high frequency oscillator is disabled when said locking mechanism unlocks said door and is enabled only when said locking mechanism locks said door.

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2. The high frequency heating apparatus according to claim 1 wherein said locking mechanism comprises a coil and a spring biased locking rod operated by said coil to engage and disengage a locking rod receiving opening in said door.

3. The high frequency heating apparatus according to claim 1 wherein said locking mechanism comprises an electric coil disposed in said cabinet, an armature driven by said coil, an independent locking rod cooperating with a locking rod receiving opening in said door and with said switch, and a lever operatively interconnecting said armature and said locking rod.

4. The high frequency heating apparatus according to claim 1 wherein said heating apparatus further includes a hollow panel board mounted on said cabinet adjacent said door and said electromagnetic locking mechanism

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is positioned in said panel board.

5. The high frequency heating apparatus according to claim 3 wherein said lever is a spring biased lever.

6. The high frequency heating apparatus according to claim 5 wherein said lever is spring biased in such a direction as to normally maintain said high frequency oscillator disabled when said electromagnetic blocking mechanism is not operated.

7. The high frequency heating apparatus according to claim 2 wherein said means for actuating said switch includes a lever operatively interconnecting said blocking rod and said switch.

8. The high frequency heating apparatus according to claim 7 wherein said lever is spring biased.

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