July 25, 1950 M. J. BOCK 2,516,503

CONTROLLING DEVICE FOR COOKING APPARATUS

Filed Dec. 14, 1946 3 Sheets-Sheet 1

FIG. 1.

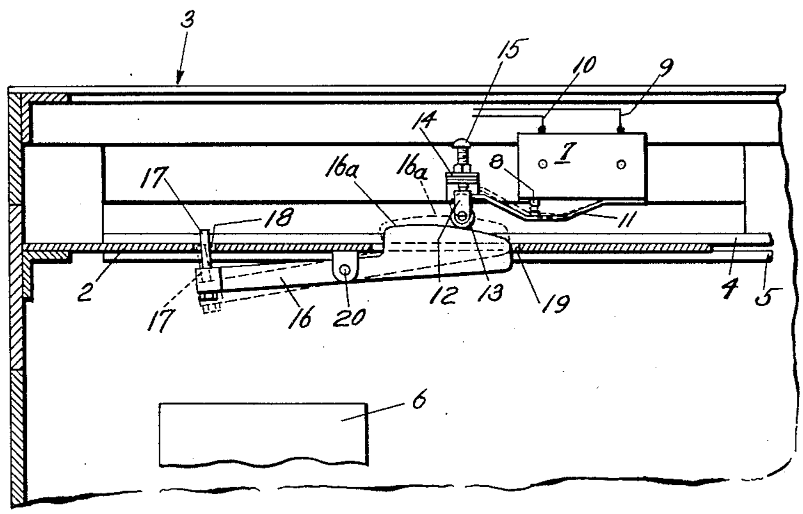


FIG. 2.

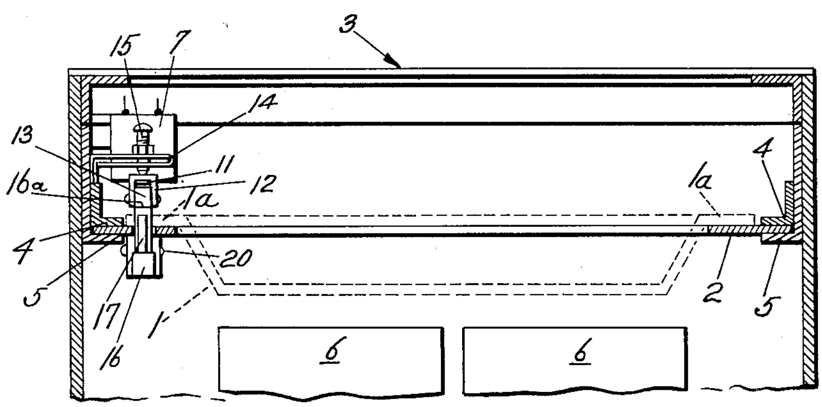


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FIG. 3.

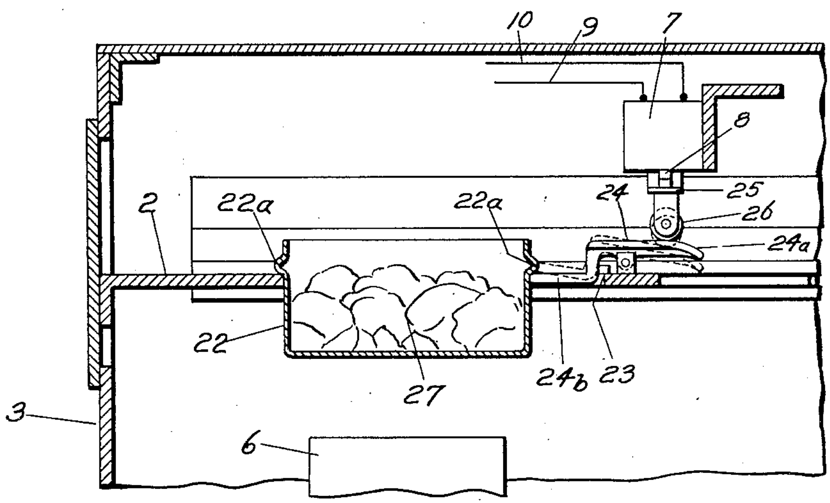
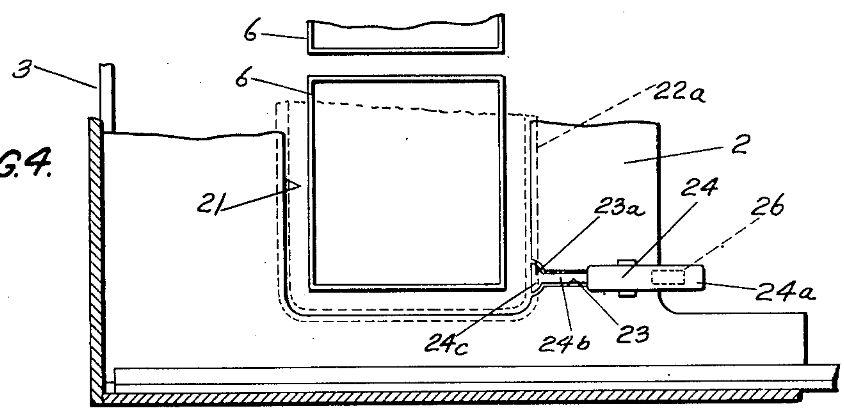



FIG. 4.

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CONTROLLING DEVICE FOR COOKING APPARATUS

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FIG. 5.

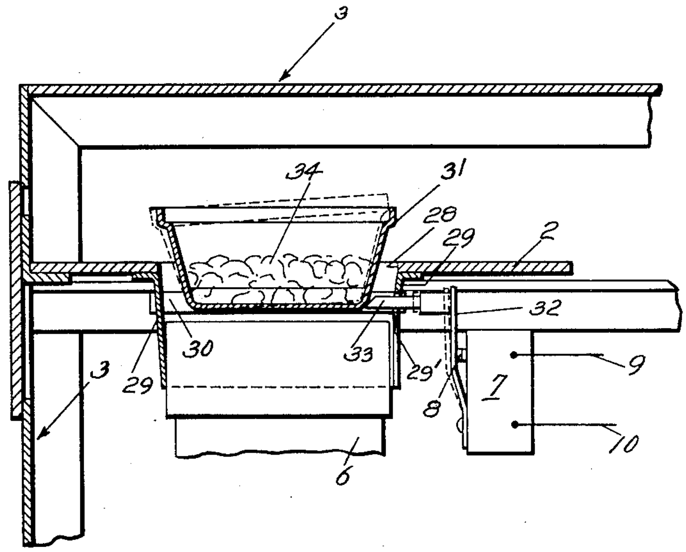
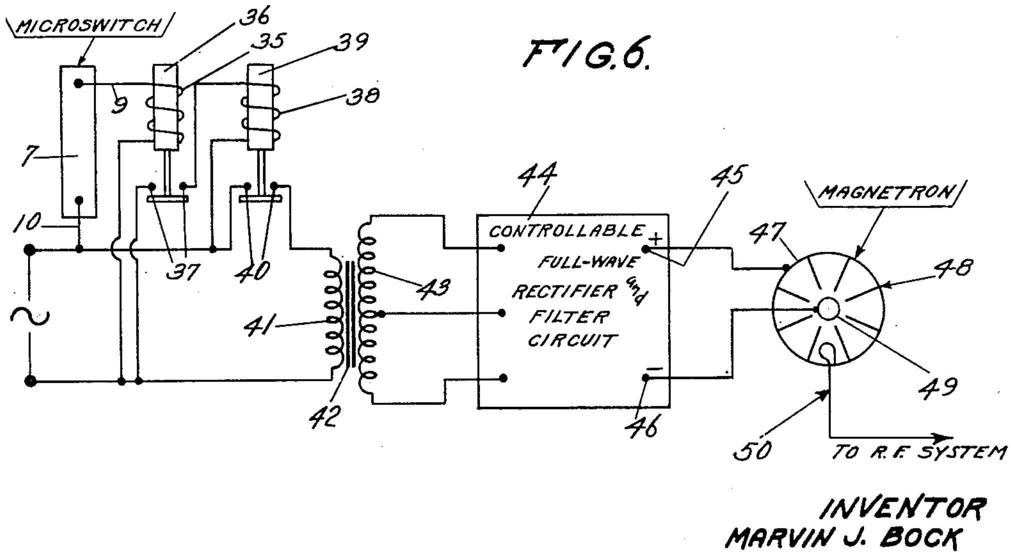


FIG. 6.

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Patented July 25, 1950

2,516,503

# UNITED STATES PATENT OFFICE

2,516,503

## CONTROLLING DEVICE FOR COOKING APPARATUS

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Application December 14, 1946, Serial No. 716,353

6 Claims. (Cl. 219—43)

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This invention relates to a controlling device, and more particularly to a weight-responsive switch for a radio-frequency cooking device.

In a certain type of microwave cooking apparatus, radio-frequency energy, for example in the microwave region of the frequency spectrum, is supplied from a high-frequency source, such as a discharge device of the so-called magnetron type, to a hollow wave guide or horn, along which such energy is propagated to impinge on food placed adjacent the open end thereof, thereby heating the same.

Energy is absorbed by the food when such is present at the mouth of the horn, so that the amplitude level of energy reflected from a reflecting surface (which is placed on the opposite side of the food from the horn) is quite low when food is present. Since the reflected energy level is low, the standing wave ratio in the horn and in the magnetron output line is also low. This is the desired or optimum condition of operation, since magnetrons operate most efficiently when the standing wave ratio in the radio-frequency system is low.

When food is not present at the mouth of the horn, there is nothing to absorb the microwave energy, so that a large proportion of the energy is reflected from the reflecting surface, producing a high standing wave ratio in the radio-frequency system, such a ratio being detrimental to the operation of the magnetron and being, therefore, undesirable.

An object of this invention is to devise a means, responsive to the absence of food in the food tray of a microwave cooker, for cutting off the radio-frequency energy supply from the horn of said cooker.

Another object is to provide a means for preventing the setting up of a high standing wave ratio in a radio-frequency transmission system.

A further object is to devise a weight-responsive protective means for a microwave cooker.

A still further object is to devise a weight-responsive switch for connecting a magnetron to a supply voltage source.

The foregoing and other objects of the invention will be best understood from the following description of some exemplifications thereof, reference being had to the accompanying drawings, wherein:

Fig. 1 is a longitudinal vertical sectional view through a portion of a microwave cooker utilizing one embodiment of the invention;

Fig. 2 is a vertical sectional view taken at right angles to Fig. 1;

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Fig. 3 is a view similar to Fig. 1 but of another embodiment;

Fig. 4 is a horizontal sectional view of the device of Fig. 3;

Fig. 5 is a view similar to Fig. 1 but of still another embodiment; and

Fig. 6 is a circuit diagram applicable to the embodiments shown in Figs. 1–5.

Referring now to Figs. 1–2, a shallow tray 1, shown in dotted lines in Fig. 2, is adapted to have food to be cooked placed therein. This tray is made of material which is transparent to microwave energy and is supported by means of horizontal ears 1a, in and by an apertured shelf 2 which is mounted for horizontal sliding movement in a fixed support or frame 3, as by means of two pairs of inwardly-projecting upper and lower members 4 and 5 engaging each side of said shelf, said members being fixed to the opposite side walls of frame 3. Shelf 2 is shown in its closed position, and is adapted to travel to the left in Fig. 1 toward its open position, and thereafter to the right in Fig. 1 to be again closed.

A pair of horns or hollow waveguides 6 are fixedly mounted side by side in frame 3 as shown in Fig. 2, these horns having open upper ends and being so positioned that their open ends are located immediately below the bottom of tray 1 when shelf 2 is in its closed position. Microwave or radio-frequency energy is supplied to the lower end of each of the horns 6 from any suitable source, such as a magnetron, and propagates upwardly in said horns and out the open ends thereof, impinging on the food in tray 1 and heating or cooking said food.

In order to so control the microwave source that radio-frequency energy is propagated down horns 6 only when there is food in tray 1, thereby insuring that the magnetron will not be operating under conditions which would tend to produce undesirably high standing wave ratios, I proceed as follows:

A microswitch 7 is connected in a circuit, as described below, to control the circuit between the power supply of the magnetron or magnetrons and the magnetrons themselves. This circuit is arranged in such a way that when said switch is closed, the circuit between the magnetron power supply and the magnetron is completed and the magnetron is put into operation to serve as a source of microwave energy, but when said switch is open the magnetron will be disconnected from the power supply and will not be in operation to produce radio-frequency energy. Microswitch 7 has an actuating button 8 and a pair of leads 9 and 10 connected thereto.

Microswitch 7 is fixed to the side wall of frame 3 and has an elongated resilient arm 11 secured thereto in such a position as to cooperate with button 8 to depress said button to close said switch. The free end of arm 11 is fastened to a yoke structure 12 which supports, in a suitable bearing, a roller 13. In addition to the resistance to upward motion of roller 13 from a normal position provided by the resilience of arm 11, additional resistance to upward motion of said roller may be provided by a doubled-back flat spring member 14, one end of which is fixed to the side wall of frame 3, the free end of spring member 14 being adjustably connected to roller 13 by means of a bolt 15 which is threadedly connected to said member and the lower end of which bears on the upper surface of yoke 12.

A lever arm 16 is pivotally connected by means of a pin 20 to the underside of shelf 2 and is vertically aligned with roller 13, as shown in Fig. 2. An upwardly-projecting pin 17 is fixed to the front end of arm 16 and is adapted to extend upwardly above shelf 2 through a suitable aperture 18 therein. Pin 17 and aperture 18 are so located in shelf 2 that the lower surface of one of the ears 1a of tray 1 will engage the upper end of pin 17 when tray 1 is placed in the aperture in shelf 2. Rearwardly of pivot pin 20, arm 16 is made substantially thicker, and the thickness of said arm increases from the end thereof toward the pivot point thereof to provide an integral cam surface 16a which is adapted to extend above shelf 2 through a suitable aperture 19 provided therein rearwardly of aperture 18. Roller 13 is adapted to engage and roll along the cam surface 16a when said surface is moved with respect to said roller by the sliding movement of shelf 2.

Due to the increased thickness of arm 16 at end 16a, this end has more weight than the front end of said arm, so that arm 16 normally assumes a position in which the upper surface of the front end thereof contacts the lower surface of shelf 2, in which cam surface 16a projects only very slightly above the upper surface of shelf 2, and in which pin 17 extends a substantial distance above the upper surface of said shelf. Therefore, when shelf 2 is slid toward closed position when no tray is on said shelf, cam surface 16a will be in its lowermost position and will remain in this position as shelf 2 is slid closed. In this lowermost position, cam surface 16a will be too low to engage roller 13 (said roller being held in a normal position which is above the lowermost position of said cam surface by relatively stiff arm 11), so that as shelf 2 is slid closed, switch 7 will remain in its normally open position and the magnetron will remain unconnected to its power supply, so that no radio-frequency energy is produced by said magnetron.

When an empty food tray 1 is placed in shelf 2, one of the side ears 1a thereof contacts the upper end of pin 17. The weight of the empty tray is sufficient to force pin 17 down until its upper end is flush with the upper surface of shelf 2, pivoting arm 16 in a counterclockwise direction and raising cam surface 16a a substantial distance above the upper surface of said shelf, the position of arm 16 then being as indicated in dotted lines in Fig. 1. However, as shelf 2 is moved toward its closed position, roller 13 now comes in contact with cam surface 16a and rides thereon, due to the fact that said cam surface is now elevated. As explained above, there is substantial force opposing the upward motion of roller 13. The weight of the empty tray being insufficient to overcome this force, as shelf 2 is pushed toward the right, the roller 13 forces cam surface 16a downwardly, pivoting arm 16 clockwise and raising pin 17 and the corresponding end of the empty tray upwardly until, in the closed position of the shelf 2, the lever arm 16 has the position shown in solid lines in Fig. 1. In this case, due to the downward motion of cam surface 16a, roller 13 and arm 11 have not been moved upwardly a sufficient amount for arm 11 to contact button 8 and close microswitch 7, so that, again, switch 7 remains in its normally open position and the magnetron remains unconnected to its power supply. In this case, with no food in the tray, conditions in the radio-frequency system would be such as to tend to establish a high standing wave ratio therein; however, in this case, the magnetron remains unenergized and is therefore ineffective to supply microwave energy to the system.

Now, if a tray full of food is placed in shelf 2, arm 16 is pivoted in a counterclockwise direction as before, and cam surface 16a is again raised. Now, however, as shelf 2 is moved toward its closed position, cam surface 16a forces roller 13 upwardly, because the weight of the loaded tray is sufficient to overcome the force opposing upward motion of said roller. Considered in another way, the force inherent in springs 14 and 11 is insufficient to pivot arm 16 clockwise and raise one end of the loaded tray. Therefore, in the closed position of shelf 2 with a loaded tray, the positions of arm 16 and of roller 13 will be those indicated by dotted lines in Fig. 1. When roller 13 is in this position, arm 11 has been moved upwardly a sufficient distance for it to contact button 8, thereby closing microswitch 7 to connect the magnetron to its power supply. When the magnetron is thus energized, microwave energy is supplied to the horns 6 to heat or cook the food in the desired manner. In this case, with the proper amount of food in the tray, conditions in the system are such as to make the standing wave ratio low, and the magnetron does not require protection.

It will be seen that a weight-responsive switch has been provided for a cooker, in which the magnetron is energized only when there is food in the food tray.

Now referring to Figs. 3–4, another embodiment of the weight-responsive microswitch operating means is shown. Here, a shelf 2 is mounted for horizontal sliding movement with respect to a fixed frame or support 3, as in the previous embodiment. Shelf 2 has a substantially rectangular aperture 21 therein which is of sufficient size to accommodate a rectangular food tray 22, said tray having vertical side walls and being supported in said aperture by means of an outstanding horizontal bead or rib 22a which rests on the upper surface of shelf 2 immediately contiguous to aperture 21.

An elongated rather narrow slot 23 is cut through shelf 2, this slot extending at right angles to one of the longer sides of the rectangular aperture 21 and communicating with said aperture near one of the two rear corners of the rectangle 21, said slot extending rearwardly from aperture 21 for an appreciable distance. Slot 23 is made wider near its point of intersection with aperture 21, as at 23a.

Pivotally mounted on the upper side of shelf 2 is a lever arm **24**. As is shown in Fig. 3, the portion of arm **24** rearwardly of the pivot pin extends horizontally for a little distance, after which the arm curves downwardly and rearwardly to provide an upper cam surface *24a*. Forwardly of the pivot pin, arm **24** extends horizontally for a little distance, after which it turns substantially 90° and extends vertically to substantially the same horizontal plane as shelf **2**. Thence arm **24** is narrowed, and this narrower portion **24b** of the arm extends forwardly horizontally, in slot **23**, the arm terminating in the same vertical plane as the rear edge of aperture **21**, portion **24b** of the arm being sufficiently narrower than said slot to be capable of free movement therein. Arm **24** has a broadened portion **24c** adjacent its outer end which corresponds to the portion **23a** of slot **23**; the upper surface of said portion **24c** is adapted to lie in the same horizontal plane as the adjacent upper surface of shelf **2** and the outer end of portion **24c** is adapted to lie in the same vertical plane as the adjacent rear wall of aperture **21**.

A microswitch **7** having an actuating button **8** is attached to frame **3**. A resilient arm **25** is fastened to switch **7** in a position suitable for contacting button **8** to depress the same, thereby closing the normally-open switch. A roller **26**, similar to the roller **13** of Fig. 1, is mounted in a suitable bearing, the fixed portion of which is attached to arm **25**, in such a way that when said roller is moved upwardly from its normal position, arm **25** will be moved upwardly to contact button **8** and close microswitch **7**. Microswitch **7** and its roller **26** are mounted in such a position that, as shelf **2** is pushed rearwardly to the closed position, said roller will engage and ride on cam surface **24a** to either actuate or be actuated by lever arm **24**.

The weights of the portions of lever arm **24** on opposite sides of its pivot pin are so proportioned with respect to each other that said arm is normally balanced in a position in which portions **24b** and **24c** thereof lie substantially in a horizontal plane, as shown in solid lines in Fig. 3. In this normal position, roller **26** will engage cam surface **24a** as shelf **2** is closed. Now considering what happens when no tray **22** is in shelf **2** as it is closed, roller **26** first contacts the lowermost portion of cam surface **24a** and rides thereon as shelf **2** is pushed farther closed or to the rear. As roller **26** rolls on the upwardly-convex portion of said cam surface, roller **26** tends to remain in the same horizontal plane due to the natural resistance to upward motion of resilient arm **25**, and there is no weight acting on the outer end of lever arm **24** to oppose the pivotal movement of said arm. As a result, the force acting on roller **26** pivots lever arm **24** in a clockwise direction, said arm reaching the position shown in dotted lines in Fig. 3 when shelf **2** is in its closed position. In this case, roller **26** remains in its normal lowermost (or dotted-line) position when shelf **2** is closed, and switch **7** remains unactuated or open. Therefore, the magnetron which is connected to the radio-frequency horns **6** remains unenergized and no radio-frequency energy is propagated up said horns.

Now we will consider what happens when an empty tray **22** is in shelf **2** as it is closed. Now there is some weight applied through rib **22a** onto the upper surface of portion **24c** of the lever arm, this weight tending to oppose, somewhat, upward motion of portions **24b** and **24c**, or in other words tending to oppose somewhat clockwise pivoting of the lever arm **24**. However, the weight of the empty tray **22** is still insufficient to overcome the downward force exerted on roller **26** by the resilience of arm **25**. Therefore, as shelf **2** moves to the rear to its closed position, lever arm **24** again pivots in a clockwise direction, said arm reaching the position shown in dotted lines in Fig. 3 when shelf **2** is in its closed position. In this case, as portion **24c** of the lever arm moves upwardly it, by its engagement with rib **22a**, lifts the rear portion of tray **22** bodily upward. Roller **26** again remains in its normal or original dotted-line position because of the pivoting of lever arm **24**, so that microswitch **7** again remains open and the magnetron unenergized; no radio-frequency energy is propagated along horns **6**.

Next we will consider what takes place when a tray **22** containing a predetermined weight of food **27** is supported in and by shelf **2** as said shelf is closed. A substantial weight is now applied through rib **22a** onto the upper surface of portion **24c** of the lever arm, this weight opposing upward motion of portions **24b** and **24c** of said arm. The weight of the full or loaded tray **22** is sufficient to overcome the downward force exerted on roller **26** by arm **25**. Therefore, as shelf **2** moves to the rear toward its closed position, arm **24** does not pivot, but remains substantially in the position indicated in solid lines in Fig. 3. Roller **26** is forced vertically upward by the upwardly-convex cam surface **24a** as shelf **2** is pushed to the rear, said roller reaching its uppermost (or solid-line) position when shelf **2** is closed. Switch **7** is closed in response to the upward movement of roller **26** and arm **25**, thereby energizing the magnetron to supply radio-frequency energy to horns **6**. This energy propagates upwardly in horns **6**, flowing out the upper open ends thereof to impinge on food **27** to heat or cook the same.

It will be apparent that in this embodiment, also, a weight-responsive switch has been provided for a cooker, in which the magnetron is energized only when there is food in the food tray.

Now referring to Fig. 5, another embodiment of the weight-responsive microswitch operating means is shown. Again, a shelf **2** is mounted for horizontal sliding movement with respect to a fixed frame **3**. Shelf **2** has a rectangular aperture **28** therein, and at the edges of said aperture flanges **29** extend downwardly on all four sides of said aperture, these flanges preferably extending down below the upper ends of horns **6**. The rear flange **29** has a slot **29'** cut therein, this slot extending upwardly from the bottom edge of said flange and being of sufficient width and depth to allow said flange to pass over the ends of horns **6** when shelf **2** is moved from front to rear, or from open to closed positions (that is, from left to right in Fig. 5).

A pair of horizontally-extending spaced support rods **30** have their opposite ends fixed in the front and rear flanges **29**, these rods being made of a suitable material, for example a plastic, which is transparent to radio-frequency energy. A food tray **31** is adapted to be supported on and by rods **30** within aperture **28**, this tray being prevented from moving sidewise by having a pair of upwardly-extending ribs on the bottom surface thereof which fit closely over the rods **30**. Tray **31** is rectangular in cross-section, and said tray has a greater cross-sectional area at its top than at its bottom, so that the side walls thereof taper inwardly from top to bottom.

A microswitch **7**, having an actuating button **8** and a resilient actuating arm **32**, is fixed to frame

3. A horizontally-extending actuating rod 33, made of insulating material, has one end attached to arm 32, its opposite end being adapted to extend through a suitable aperture provided in rear flange 29 and to contact the rear side wall of tray 31 when shelf 2 is pushed rearwardly to its closed position. The outer end of rod 33 has an upwardly-beveled face, as shown, and said rod is positioned so as to contact the rear side wall of tray 31 near the lower end of said side wall. It will be seen that when rod 33 is pushed to the right by tray 31, microswitch 7 will be actuated to its closed position, but when said rod is not pushed to the right, said switch will not be actuated.

When shelf 2 is slid rearwardly to its closed position, but is trayless, there will be nothing to touch rod 33 when shelf 2 is closed, so that switch 7 will remain in its normally-open dotted-line position and the magnetron will remain unenergized, so that no radio-frequency energy will be produced to be propagated along horn or waveguide 6.

Now assuming that an empty tray 31 has been placed on shelf 2 and it is being slid rearwardly or to the right to its closed position, the beveled edge of rod 33 will come into contact with the rear side wall of tray 31. Since the empty tray is very light, and since arm 32 has some resistance to movement thereof, due to its resilience, the beveled edge of rod 33 will slide along the inclined surface of the rear side wall of the tray, lifting the tray vertically, as shown by dotted lines. Because the tray is lifted, rod 33 is not moved horizontally, but remains in its left or dotted-line position, in which the switch 7 is unactuated, and the magnetron is unenergized. Therefore, no radio-frequency energy is produced by the magnetron.

Now assuming that a tray 31 loaded with food 34 has been placed on shelf 2 and the shelf is being closed, the beveled edge of rod 33 again will come into contact with the rear side wall of the tray 31. In this case the tray has substantial weight, so that it presents relatively greater resistance to upward motion by rod 33. This resistance of the tray is sufficient to overcome the inherent resistance to movement of arm 32, so that the tray is not lifted but remains in the position shown in solid lines and, as shelf 2 is slid home, the rod 33 does not slide along the tray wall, but is pushed thereby to the right to the position shown in solid lines.

This means that microswitch 7 is actuated to its closed position, in which the magnetron is energized. Therefore, radio-frequency energy is propagated along the horn 6, flowing out the upper open end thereof to impinge on food 34 and heat or cook the same.

Here, as in the other embodiments, a weight-responsive switch has been provided for a cooker, in which the magnetron is energized only when there is food in the food tray.

Fig. 6 shows a circuit in which the weight-actuated or weight-responsive microswitch 7 of any or all of the embodiments may be utilized for control purposes. Lead 10 of microswitch 7 is connected directly to one side of an alternating current source, while lead 9 of said microswitch is connected, in series with the operating winding 35 of a sensitive relay 36, to the opposite side of said source, so that when microswitch 7 is closed, relay 36 will be energized. The normally-open contacts 37 of relay 36 are connected, in series with the operating winding 38 of a power relay 39, across the source, so that when contacts 37 are closed by the energization of relay 36, relay 39 will be energized.



The normally-open contacts 40 of relay 39 are connected, in series with the primary winding 41 of a transformer 42, across the A. C. source. The ends of the centertapped secondary winding 43 of transformer 42, as well as the centertap thereof, are connected as the input for a controllable full-wave rectifier and filter circuit 44, which may be of any desired type having a positive output terminal 45 and a negative output terminal 46. The terminal 45 is connected to the anode 47 of a magnetron 48, while the terminal 46 is connected to the cathode 49 of said magnetron. A suitable coupling device 50 couples the radio-frequency energy output of magnetron 48 to the horns such as 6.

When microswitch 7 is actuated to its closed position, the voltage of the source is applied to primary winding 41, this being accomplished through the action of relays 36 and 39. This voltage applied to winding 41 provides an input for circuit 44, which in turn provides a rectified high-voltage output for the energization of magnetron 48 and the consequent production of radio-frequency energy therefrom. In this case, the radio-frequency energy source 48 is turned on. When microswitch 7 is open, it can be seen that winding 41 is open-circuited, so that there is no input for circuit 44 and consequently no high-voltage output therefrom for energization of the magnetron. In this case, the radio-frequency energy source 48 is turned off.

It will be seen, from all of the above, that I have provided a weight-responsive microswitch for microwave cookers, which functions to turn on or connect the radio-frequency energy source to a power supply when there is a predetermined weight of food in the food tray, and which functions to leave said source turned off or disconnected from its power supply when the food tray has less than a predetermined weight.

Of course, it is to be understood that this invention is not limited to the particular details as described above, as many equivalents will suggest themselves to those skilled in the art. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of this invention within the art.

What is claimed is:

1. A control device for cookers comprising a container for holding food, a source of heat, means for supporting said container, said means being movable with respect to said source of heat, a switch for controlling said source, and means actuated by movement of said container by said supporting means into heat transferring relation with said source, and responsive to the weight of said container and said food for controlling said switch.

2. A control device for cookers comprising a container for holding food, a source of heat, means for supporting said container, said means being movable with respect to said source of heat, a switch for controlling said source, and means actuated by movement of said container by said supporting means into heat transferring relation with said source, and responsive to the weight of said container and said food for controlling said switch, said means acting to close said switch when said container and food have more than a predetermined weight.

3. A control device for cookers comprising a container for holding food, a source of heat comprising microwave energy, means for supporting

said container, said means being movable with respect to said source of heat, a switch for controlling said source, and means actuated by movement of said container by said supporting means into heat transferring relation with said source, and responsive to the weight of said container and said food for controlling said switch, said means being effective to leave said switch open when said container and food have less than a predetermined weight.

4. A control device for cookers comprising a container for holding food, a source of heat, means for supporting said container, said means being movable with respect to said source of heat, a switch for controlling said source, and means actuated by movement of said container by said supporting means into heat transferring relation with said source, and responsive to the weight of said container and said food for controlling said switch, said means acting to close said switch when said container and food have more than a predetermined weight and being effective to leave said switch open when said container and food have less than a predetermined weight.

5. A control device for cookers comprising a container for holding food, a source of heat, means for supporting said container, said means being slidable with respect to said source of heat, a switch for controlling said source, and means actuated by movement of said container by said supporting means into heat transferring relation with said source, and responsive to the weight of said container and said food for controlling said switch.

6. A control device for cookers comprising a container for holding food, a source of heat, means for supporting said container, said means being slidable with respect to said source of heat, a switch for controlling said source, and means actuated by movement of said container by said supporting means into heat transferring relation with said source, and responsive to the weight of said container and said food for controlling said switch, said means acting to close said switch when said container and food have more than a predetermined weight and being effective to leave said switch open when said container and food have less than a predetermined weight.

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