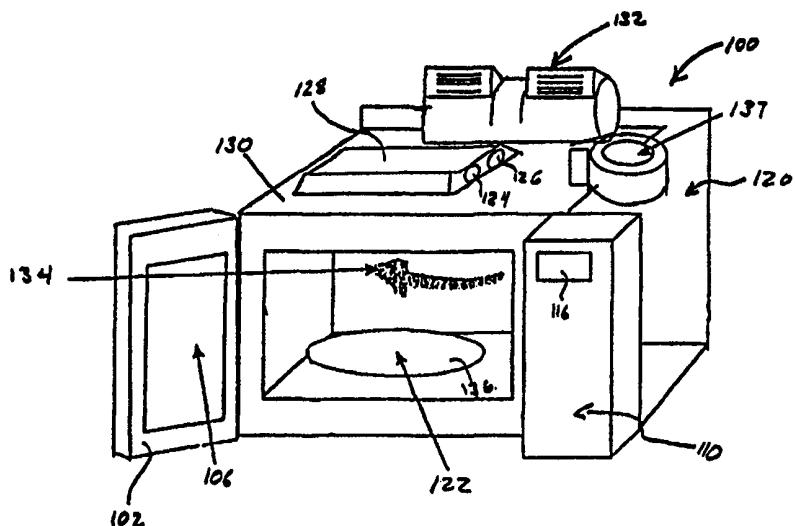


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## (54) Title: COMBINATION OVEN USING RADIANT AND MICROWAVE ENERGY



## (57) Abstract

The present invention relates to an oven that includes both radiant cooking elements and a microwave cooking element. The cooking elements are controlled to provide reduced cooking time as compared to known radiant ovens, yet a wide variety of foods can be cooked in the oven. The oven is operable in a speed cooking mode wherein both radiant and microwave cooking elements are utilized, a microwave only cooking mode wherein only the magnetron is utilized, and a radiant only cooking mode wherein only the lamps are utilized.

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## COMBINATION OVEN USING RADIANT AND MICROWAVE ENERGY

## CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. provisional application No. 60/115,744, filed January 13, 1999.

## BACKGROUND OF THE INVENTION

This invention relates generally to ovens and, more particularly, to a combination oven using both radiant and microwave energy.

Known ovens are either, for example, microwave or radiant cooking type ovens. For example, a microwave oven includes a magnetron for generating RF energy used to cook food in the oven cooking cavity. Although microwave ovens cook food more quickly than radiant ovens, microwave ovens do not brown the food. Microwave ovens therefore typically are not used to cook as wide a variety of foods as radiant ovens.

Radiant cooking ovens include an energy source such as lamps which generate light energy used to cook the food. Radiant ovens brown the food and generally can be used to cook a wide variety of foods. Radiant ovens, however, cook foods slower than microwave ovens. It would be desirable to provide an oven which provides the speed advantages of microwave ovens yet also can be used to cook a wide variety of foods such as with radiant ovens.

## BRIEF SUMMARY OF THE INVENTION

In an exemplary embodiment of the invention, an oven includes both radiant cooking elements and a magnetron, or microwave, cooking element. The cooking elements are controlled to provide reduced cooking time as compared to known radiant ovens, yet a wide variety of foods can be cooked

in the oven. The oven is operable in a speed cooking mode wherein both radiant and microwave cooking elements are utilized, in a microwave only cooking mode wherein only the magnetron is utilized for cooking, and a radiant only cooking mode wherein only the lamps are utilized for cooking.

- 5      In one aspect, the present invention relates controlling the power levels, and adjusting the power levels, in the speed cooking mode. More particularly, by controlling the power levels of the radiant cooking elements and the microwave cooking element, as well as the length of cooking time, desired cooking operations can be achieved.
- 10     In another aspect the present invention relates to adjusting the cooking time during cooking operations. Such adjustment is sometimes referred to herein as "active time adjustment." By enabling an operator to easily and quickly adjust the selected cooking time during cooking operation, the desired cooking can be achieved.
- 15     In yet another aspect the present invention relates to illuminating the cooking cavity during cooking operations, such as during microwave only mode cooking operations and cooking operations in which the lamps are not sufficiently energized to enable visualization of food in the cooking cavity. Since halogen lamps are used for radiant cooking, the oven door has a very dark glass window which does not enable visualization of the cooking cavity with typical microwave oven lighting. The present invention, however, provides for visualization of food in the cooking cavity during cooking operations by energizing a selected halogen lamp for a short period of time (i.e., 4 seconds) so that the cooking cavity is illuminated but negligible cooking is performed by the light energy output by the lamp.
- 20
- 25

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front view of an oven in accordance with one embodiment of the present invention;

Figure 2 is a perspective schematic view of a portion of the oven shown in Figure 1;

5 Figure 3 is a schematic illustration of the radiant cooking unit and the microwave cooking unit relative to the cooking cavity;

Figure 4 is a schematic illustration of the lower lamp of the oven shown in Figure 1;

10 Figure 5 is a schematic illustration of the reflector for the upper lamps of the oven shown in Figure 1;

Figure 6 is an illustration of a portion of the turntable of the oven shown in Figure 1;

Figure 7 is a schematic illustration of the cooking cavity of the oven shown in Figure 1, including a damper to control air flow;

15 Figure 8 is a functional block diagram of the oven shown in Figure 1;

Figure 9 is a circuit schematic diagram of the oven shown in Figure 1;

Figure 10 is a timing diagram illustrating target and command times for energizing the cooking elements;

20 Figures 11 - 14 illustrate messages displayed when adjusting/entering the power level and cooking time;

Figure 15 is a flow chart illustrating process steps executed when adjusting the cook time;

Figure 16 is a flow chart illustrating process steps for lamp power level control; and

Figure 17 is a flow chart illustrating process steps for the soft start of the Halogen lamps.

#### DETAILED DESCRIPTION OF THE INVENTION

5 The present invention is directed, in one aspect, to operation of an oven that includes at least two types of cooking elements, such as radiant and microwave cooking elements. Although one specific embodiment of radiant/microwave cooking oven is described below, it should be understood that the present invention can be utilized in combination with many other 10 such ovens and is not limited to practice with the oven described herein. For example, the oven described below is an over the range type oven. The present invention, however, is not limited to practice with just over the range type ovens and can be used with many other types of ovens.

15 Figure 1 is a front view of an over the range type oven 100 in accordance with one embodiment of the present invention. Oven 100 includes a frameless glass door 102 having an injection molded handle 104. A window 106 is provided for visualizing food in the oven cooking cavity. Door 102 has an inner metal frame that extends around the door periphery and comprises an RF door choke. The glass of door 102 has, for example, a thickness of about 20 1/8" and can withstand high temperatures, as is known in the art, and is secured to the inner metal frame by an adhesive. Handle 104 also is secured to the metal frame by bolts that extend through openings in the glass. Oven 100 also includes an injection molded plastic vent grille 108 and a frameless glass control panel 110.

25 Rubber tactile switch covers 112 are located over each key pad of panel 110, and an injection molded knob or dial 114 is provided for making multiple

selections. Selections are made using dial 114 by rotating dial 114 clockwise or counter-clockwise and when the desired selection is displayed, pressing dial 114. The various selections available, in an exemplary embodiment, from dial 114 are set forth in Appendix A. Instructions and selections are displayed 5 on a vacuum fluorescent display 116.

Referring now to Figure 1 and Appendix A, wherein in one exemplary illustration of the operation of dial 114 and display 116 the steps necessary to program oven 100 to cook a 0.5 inch (1.3 cm) beef steak until well done are presented. The SELECT FOOD TYPE menu is first displayed on display 116. 10 Next, dial 114 is rotated until the MEATS food type is displayed and dial 114 is then pressed to selected the MEATS food type. Next, the SELECT MEAT: menu is displayed. Next, dial 114 is rotated until the STEAKS (BEEF) meat is displayed then the dial is pressed to select STEAKS (BEEF) meat. Next, the SELECT THICKNESS: menu is displayed and 0.5 INCH (1.3 cm) beef 15 thickness is selected. Next, a SELECT HOW DONE: menu is displayed and dial 114 is rotated until the MEDIUM menu is displayed, then the MEDIUM menu is selected. Next, an instruction is displayed indicating "Use ROUND METAL TRAY", and the Upper Power Level (UPL) and Lower Power Level (LPL) settings are displayed. It is noted that UPL and LPL may be changed, as 20 further described below. It is understood that the above illustration is but one example of many cooking selections which may be made for programming oven 100 to cook a plurality of foods.

The following functions can be selected from respective key pads of panel 110.

CLEAR/OFF      Selecting this pad stops all cooking and erases the current 25 program.

DELAYED      Selecting this pad results in a delay in the start  
START      of cooking.

HELP Selecting this pad enables an operator to find out more about the oven and its features.

MICROWAVE Selecting this pad enables defrosting, heating beverages, reheating leftovers, popcorn, vegetables, and all types of microwave cooking.

5 MICROWAVE Selecting this pad enables quick and easy EXPRESS warming of a sandwich, or reheat of coffee.

OPTIONS Selecting this pad enables access to the auto ON/OFF night light, beeper volume control, clock, clock display, and display scroll speed features.

10

OVEN LIGHT Selecting this pad during microwave cooking illuminates the cavity.

POWER LEVEL Selecting this pad enables adjusting the power levels for speed cooking and microwave cooking.

15 REMINDER Selecting this pad enables an operator to select a time at which an alarm is to sound.

REPEAT LAST Selecting this pad facilitates cooking repetitive items such as cookies and appetizers.

20 SPEED COOK Selecting this pad enables an operator to MANUAL manually enter speed cooking time and power levels.

START/PAUSE Selecting this pad enables an operator to start or pause cooking.

SURFACE LIGHT Selecting this pad turns ON/OFF the surface light for the cooktop.

**TIMER ON/OFF** Selecting this pad controls a general purpose timer (e.g., minutes and seconds)

**VENT FAN** Selecting this pad enables an operator to clear the cooktop area of smoke or steam.

5 Figure 2 is a perspective schematic view of a portion of oven 100. Oven 100 includes a shell 120, and a cooking cavity 122 is located within shell 120. Cooking cavity 122 is constructed using high reflectivity (e.g., 72% reflectivity) stainless steel. Halogen lamps 124 and 126, and a reflective plate 128 are mounted to an upper panel 130 of shell 120. As described below in  
10 more detail, a halogen lamp also is located at a lower section of shell 120. An exhaust system 132 also is mounted to shell 120. Air flows through cavity 122 in a direction indicated by arrow 134. A cooling system 137 is mounted to shell 120 for cooling oven components. Exemplary dimensions of oven 100 are set forth below.

15

**Shell**

Exterior Height (front) 15 11/16"

Exterior Height (rear) 16 1/2"

Exterior Width 29 4/5"

20 Exterior Depth 14 4/5"

**Cooking Cavity**

Cavity Height 8 2/5"

Cavity Width 19 2/7"

Cavity Depth	13 3/5"
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Figure 3 is a schematic illustration of oven 100, and particularly of halogen lamp cooking units 150 and 152 and microwave cooking unit 154 relative to cooking cavity 122. As shown in Figure 3, upper cooking unit 150 includes 5 two halogen lamps 124 and 126 and cooking unit 152 includes one halogen lamp 156. Lamps 124, 126, and 156, in an exemplary embodiment, are 1500 W halogen lamps having a color temperature of approximately 2300K, each with an output power of about 1.5 kW (4.5 kW total for all three lamps). Lamp 124 is referred to as the upper center lamp, and lamp 126 is referred to as the 10 upper exterior lamp. Lamp 156 is referred to as the lower lamp. Glass plates 158 and 160 extend over cooking units 150 and 152 between lamps 124, 126, and 156 and cavity 122. Also, twist mesh screens 162 and 164 having an opening ratio of about 80% are provided for additional protection. Additional details are provided below with respect to reflector 128. A magnetron 166 of 15 microwave cooking unit 154 is located on a side of cavity 122. Magnetron 166, in an exemplary embodiment, delivers a nominal 950 W into cavity 122 according to standard IEC (International Electrotechnical Commission) procedure.

With respect to lower lamp 156, and referring to Figure 4, lamp 156 is located 20 off center and at an angle relative to a bottom surface 172 of cavity 122. Such location of lower lamp 156 results, for example, in lowering the temperature of the rollers on turntable 136.

Figure 5 is a schematic side illustration of reflector 128. Reflector 128 includes angular side sections 180 and 182 and angular center sections 184 and 186. 25 The dimensions (in millimeters) indicated in Figure 5 are exemplary and have been found suitable for at least one oven. By selecting the reflector dimensions as indicated in Figure 5, upper lamps 124 and 126 are believed to provide more even cooking of items located on turntable 136.

Figure 6 illustrates a portion of turntable 136. Turntable 136 has an open grille construction with about a 70% energy transmission. Turntable 136 rotates at about 6 r.p.m. and has a diameter of about 11 1/8". Turntable 136 includes metal segments 190 with ceramic rollers 192, one of which is illustrated within circle 194.

Figure 7 illustrates a damper 194 located below microwave cooking unit 154. Damper 194 is open when in the microwave only mode to enable air to flow through cavity 122. In the speed cooking and radiant only mode, damper 194 closes to prevent air from flowing in a reverse direction and back towards microwave cooking unit 154.

Figure 8 is a functional block diagram of oven 100. As shown in Figure 8, oven 100 includes a mounting system 200, a structural system 202, a control system 204, an electrical system 206, RF generation 208, a component cooling system 210, halogen lamps 212, and a food containment system 214. Various features of each system are indicated in Figure 8. Mounting system 200 is provided to enable mounting oven over the range. Mounting system 200 also provides connection with an exhaust to enable removal of fumes from over the cooktop into the exhaust. Structural system 202 generally refers to shell 120, which provides an enclosure. Control system 204 includes an interface, i.e., keypads 112 and dial 114, and also distributes power to the other oven systems. Electrical system 206 powers the control and safety devices. RF generation 208 is performed by magnetron 166, and RF energy output by magnetron 166 is selectively used to cook food in food containment system. Component cooling system 210 is provided to cool the other system and to remove moisture from cavity 122. Halogen lamps 212 generate light energy used for cooking food in food containment system 214.

Figure 9 is a schematic diagram of oven 100. Power is provided to oven 100 via lines L1, L2, and N. Relays R1 - R13 are connected to a microcomputer

which is programmed to control the opening and closing thereof. Lower lamp 156 is electrically connected to line L1 via a thermal cut off 300. Energization of lower lamp 156 is controlled by relays R1 and R2. An electronic switching device is in series with relay R1 to provide a soft start, as 5 described below in more detail. Upper lamps 126 and 124 are connected to line L2 via thermal cut offs 304 and 306. Electronic switching devices 308 and 310 are in series with relay R4. In one exemplary embodiment electronic switching devices 302, 308, 310 and 326 are TRIACSTM.

Relays R1 and R4 are air gap type relays, and are in series with electronic 10 switching devices 302 and 308, respectively. Relays R1 and R4 are closed in the soft start operation of respective lamps 124, 126, and 156 to enable energization of electronic switching devices 302 and 308. After completion of the soft start, relays R1 and R4 are open. Relays R2, R3, and R6 are controlled by the microcomputer to close after the soft start is completed to hold lamps 15 124, 126, and 156 on based on the particular power setting.

Oven 100 also includes an upper blower motor 312 and a lower blower motor 314 for cooling. A small synchronous motor 317 when energized, closes damper 194. Thermal cut outs 318 and 320 and a fuse 322 also are provided to protect oven components, e.g., from overheating or an overcurrent condition. 20 Cooktop lamps 324 are electrically connected in series with a electronic switching device 326 and are provided for illuminating the cooktop.

A vent motor 328 having low, slow, and high speeds selectable via relays R7, R8, and R9 is provided for removing fumes from over the cooktop. An oven lamp 330, fan motor 332, and a turn table motor 334 are controlled by separate 25 relays R10, R11, and R12. A primary interlock switch 336 is located in door 102 and prevents energization of cooking elements unless door 102 is closed. A relay R13 controls energization of microwave cooking unit 154. Microwave cooking unit 154 includes a high voltage transformer 338 which steps up the

supply voltage from 120V to 2000V. A high voltage capacitor 340 and a high voltage diode 342 circuit steps up the voltage from transformer 338 from about 2000V to about 4000V. This high voltage is supplied to magnetron 166 and the output of magnetron 166 is supplied to a waveguide 344 which directs RF energy into cooking cavity 122. As also shown in Figure 9, oven 100 includes a door sensing switch 346 for sensing whether door 102 is opened, a humidity sensor 350 for sensing the humidity in cooking cavity 122, a thermistor 352, and a base thermostat 354.

With respect to speed cooking operation of oven 100, the microcomputer controls relays R1 - R6 and R13 based on the power level either associated with the preprogrammed cooking program or manually entered. In the speed cooking mode, for example, if a power level 9 is selected, the upper exterior lamp 126 has a target on-time of 29 seconds of a 32 second duty cycle, upper center lamp 124 has a target on-time of 25 seconds of a 32 second duty cycle, lower lamp 156 has a target on-time of 29 seconds of a 32 second duty cycle, and magnetron 16 has a target on-time of 29 seconds of a 32 second duty cycle. A duty cycle of 32 seconds is selected for one particular implementation. However, other duty cycles could be utilized. Set forth below is a chart which sets forth the target on-times based on power level.

20	Upper		Upper		Power Level	
	Exterior	Center	Lower			
			<u>Lamp</u>	<u>Lamp</u>	<u>Lamp</u>	<u>Magnetron</u>
	0	0	0	0	0	
	1	3	3	3	3	
25	2	6	5	6	6	
	3	10	8	10	10	

4	13	11	13	13
5	16	14	16	16
6	19	16	19	19
7	22	19	22	22
5	8	26	22	26
9	29	25	29	29
10	32	27	32	32

To increase lamp reliability, a soft start operation is used when energizing lamps 124, 126, and 156. Particularly, in accordance with the soft start operation, triacs 302, 308, and 310 are utilized to delay lamp turn-on. For example, upper exterior lamp 126 and lower lamp 156 are delayed for one second from commanded turn-on to actual turn-on. Upper center lamp 124 is delayed for two seconds from commanded turn-on to actual turn-on. Therefore, the target turn-on times are different from the commanded on-times. Set forth below is a table containing the commanded on-times based on power level selected.

Upper			Upper		
Exterior		Center	Lower		
		<u>Power Level</u>	<u>Lamp</u>	<u>Lamp</u>	<u>Magnetron</u>
			0	0	0
5	1	4	5	4	3
	2	7	7	7	6
	3	11	10	11	10
	4	14	13	14	13
	5	17	16	17	16
10	6	20	18	20	19
	7	23	21	23	22
	8	27	24	27	26
	9	30	27	30	29
	10	32	29	32	32

15 For example, if upper lamps 124 and 126 are to operate at power level 7, then upper lamp 124 would be commanded to operate for 21 seconds and upper exterior lamp 126 would be commanded to operate for 23 seconds. Lamps 124 and 126 would be commanded to turn-on for 21 and 23 seconds, respectively, at the beginning of each 32 second duty cycle. Due to the soft-start delays, lamps 124 and 126 would actually be on for 19 seconds (lamp 124) and 22 seconds (lamp 126) of each 32 second duty cycle.

20

Figure 10 is a timing diagram illustrating the state of lamps 124, 126, and 156, and magnetron 166. In the example, refrigerated crescent rolls are to be cooked in accordance with the following:

Total Time:	4:30
5	Upper Power Level: 10
	Lower Power Level: 3
	Microwave Power Level: 3

As shown in Figure 10, upper center lamp 124 is commanded on (dashed line) two seconds before it actually turns on (solid line). Lamp 124 is on for 27 seconds of each 32 second period. Upper exterior lamp 126 is always on during this period. Lower Lamp 156 is on one second after it is commanded to turn on, and is on for 10 seconds out of each 32 second period. Magnetron 166 has no delay between command and execution of on time, and is on for 10 seconds of each 32 second period.

An operator may adjust the power level of the upper lamps, the lower lamp, and the microwave during operation. To change the power level, the operator selects the POWER LEVEL pad and a select icon flashes on display 116. A message "Select UPPER POWER" then is displayed as shown in Figure 20 11. Rotation of dial 114 then enables an operator to select the upper power level (clockwise rotation increases the power level and counter clockwise rotation decreases the power level). When dial 114 is pressed to enter the selection, a short beep sounds and "Select LOWER POWER" is displayed as shown in Figure 12. Dial rotation then alters the current lower power level, 25 and when dial 114 is pressed, a short beep is sounded. Then, "Select MICRO POWER" is displayed as shown in Figure 13. Dial rotation now alters the

microwave power level. When dial 114 is pressed to enter the selection, a short beep is sounded and the OVEN icon flashes and the SELECT icon is turned off. "ADJUST TIME or START" is then displayed as shown in Figure 14. The time may be adjusted or the START pad pressed.

5 When the power level pad is pressed at an acceptable time during lightwave cooking, i.e., one or more of the lamps are energized, the cooking countdown continues and the UPL (Figure 11), LPL (Figure 12) and MPL (Figure 13) displays appear. The same operation as described above is utilized except that after entering the new microwave power level, 2 short beeps are sounded and the countdown and UPL, LPL and MPL display continue for 2.0 seconds.

10 After 2.0 seconds, the UPL, LPL and MPL displays are removed and only the cooking countdown continues. If the power level pad is pressed when it is not allowed to change/enter or recall the power level, a beep signal (0.5 seconds at 1000 hz) sounds and the message "POWER LEVEL MAY NOT BE

15 CHANGED AT THIS TIME" scrolls on display 114. After the scroll has completed, the previous foreground features return. If the power level pad is pressed at a time when a change/entry is allowed, but no dial rotation or entry occurs within about 15 seconds, the UPL, LPL and MPL display are removed and the display returns to the cooking countdown.

20 Figure 15 is a flow chart 400 illustrating process steps executed when adjusting the cook time during cooking operations. During cooking operations, a main cooking routine COOK is executed. If dial 114 is not moved 404, the main cooking routine continues to be executed 406. If dial 114 is moved, then the microcomputer determines whether a time change can be

25 made, e.g., is the time remaining within the change limits 408. For example, if only 15 seconds remain in a cooking operation, no time change may be allowed to prevent an operator from shutting down a cooking operation by rotating dial 114 until zero is displayed, sometimes referred to as a "hard

shutdown", which may not be desirable. If the remaining time is not within the change limits, then the main cooking routine continues to be executed 406. If the remaining time is within the change limits, then the microcomputer determines whether dial 114 was moved clockwise 410. It is understood that the change limit may also be zero seconds. If no (i.e., dial 114 was moved counterclockwise), then for each increment that dial 114 is moved, the cook time is decremented by one second 412. If yes, then for each increment that dial 114 is moved, the cook time is incremented by one second 414.

Figure 16 is a flow chart illustrating process steps 450 for lamp power level control. Such control is used to control energization of lamps 124, 126, and 156 (Figure 9). More particularly, a main cooking routine 452 is executed during normal cooking operations. A power counter is incremented 454 for each one second interval, and the microcomputer then checks whether a power cycle is complete 456. For example, and as explained above, each duty cycle has a duration of about 32 seconds. If the duty cycle is complete, then the power counter is reset 458. If the duty cycle is not complete, or after resetting the counter, then the microcomputer checks whether the power count is greater than the "on time" 460. The "on time" is equal to the time corresponding to the selected power level for each lamp, as explained above. If the power count is greater than the "on time", then the particular lamp is de-energized 462 and cooking continues with the main cooking routine 464. If the power count is less than or equal to the "on time", then the microcomputer checks whether the lamp is already on 466. If yes, then cooking operations continue 464. If no, then the microcomputer checks whether the soft start has been completed 468. If the soft start has been completed, then operations continue with the cooking routine 464. If soft start operations are not complete, then the soft start routine is called 470.

Figure 17 is a flow chart illustrating process steps for the soft start routine 500. As explained above, the soft start for the halogen lamps is utilized to increase the lamp reliability. When routine 500 is called from the power level control routine 502, the microcomputer then increments a soft start counter 504. The 5 microcomputer then determines whether the soft start is complete (e.g., depending on the lamp, the soft start has a duration of 1 or 2 seconds, as explained above). If soft start is complete, then the microcomputer resets the soft start counter 508, turns on the lamp control relay 510, and turns off the lamp control triac 512. Operations then proceed to the cooking routine 514. If 10 soft start is not complete, then the microcomputer turns on the lamp control triac for a soft start count  $\times$  10% of the line cycle 516. Operations then proceed to the cooking routine.

The glass of the oven door is very dark and does not enable visualization of food within cavity 122 unless at least one of the Halogen lamps is on and 15 sufficiently energized to illuminate cavity 122. Therefore, in some cooking operations such as the microwave only mode of cooking or when radiant cooking at low power levels, and in order to visualize food in cooking cavity 122, an operator may select the microwave button on keypad 112. When this 20 pad is selected during cooking, the microcomputer energizes upper center lamp 124 for four seconds at full power (i.e., power level 10), with a soft start, i.e., two seconds of soft start and two seconds of power level 10 energization for a total of four seconds, as described above. Lamp 124 illuminates the cooking cavity sufficiently so that an operator can visualize the food through window 106.

25 While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.

## WHAT IS CLAIMED IS:

1. A speed cooking oven comprising:
  - a cooking cavity;
  - a microwave cooking unit for delivering microwave energy into said cooking cavity;
- 5 a plurality of radiant lamps for delivering radiant energy into said cooking cavity; and
  - a control panel operatively connected to said microwave cooking unit and said plurality of radiant lamps for selective control thereof.
2. A speed cooking oven in accordance with Claim 1, wherein said control panel is adapted to receive user input of selected power levels to operate said microwave cooking unit and said plurality of halogen lamps in a speed cooking mode.
- 10 3. A speed cooking oven in accordance with Claim 1 wherein said speed cooking oven further comprises:
  - 15 a shell comprising an upper panel and a lower section;
  - an upper cooking unit comprising at least one upper radiant lamp mounted to said upper panel; and
  - a lower cooking unit comprising at least one radiant lamp mounted to said lower section.
- 20 4. A speed cooking oven in accordance with Claim 3 wherein said upper cooking unit comprises an upper center lamp and an upper exterior lamp.

5. A speed cooking oven in accordance with Claim 3 wherein said cooking cavity comprises a bottom surface, said lower radiant lamp mounted at an angle relative to said bottom surface.
6. A speed cooking oven in accordance with Claim 3 wherein said radiant lamps comprise halogen lamps with a color temperature of approximately 2300K.
7. A speed cooking oven in accordance with Claim 3 wherein said lamps are electrically coupled to electronic switching devices for soft start operation.
8. A speed cooking oven in accordance with Claim 1 wherein said control panel is selectively operable between a microwave only cooking mode, a radiant only cooking mode, and a speed cooking mode.
9. A speed cooking oven in accordance with Claim 8, wherein, said oven further comprising a damper adjacent to said microwave cooking unit, said damper adapted to be open in said microwave only mode and closed in said speed cooking and radiant only modes.
10. A speed cooking oven in accordance with Claim 1 wherein said control panel comprises rubber tactile switch covers.
11. A speed cooking oven in accordance with Claim 1 wherein said power levels of said microwave cooking unit and said plurality of radiant lamps are independently adjustable during operation of said oven.
12. A speed cooking oven in accordance with Claim 1 wherein said control panel is further adapted for user input and adjustment of a cooking time.
13. A speed cooking oven in accordance with Claim 1 wherein said control panel is coupled to a microcomputer, said microcomputer programmed to

operate said microwave cooking unit and said plurality of heating lamps for a pre-selected target on time corresponding to a selected power level.

14. A speed cooking oven in accordance with Claim 13 wherein said oven further comprises a rotary dial coupled to said control panel, said power 5 levels and said cooking time adjustable with said rotary dial.

15. A speed cooking oven in accordance with Claim 13 wherein said microcomputer is programmed to operate said microwave cooking unit and said plurality of radiant lamps at a duty cycle of about 32 seconds.

10 16. A speed cooking oven in accordance with Claim 13 wherein said microcomputer is programmed to energize one of said plurality of radiant lamps for a pre-selected time to illuminate said cooking cavity.

15 17. A method for operating a speed cooking oven including a microcomputer, a plurality of radiant lamps coupled to the microcomputer and a microwave cooking unit coupled to the microcomputer, said method comprising the steps of:

accepting a power level input for each of the radiant lamps and the microwave cooking unit;

accepting a cooking time input for a cooking mode; and

20 energizing the microwave cooking unit and the plurality of lamps at the selected power levels for the selected cooking time.

18 A method in accordance with claim 17, further comprising the step of accepting a user adjustment of the power level input for the microwave cooking unit and plurality of lamps during operation of the oven.

5 19. A method in accordance with claim 18, further comprising the step of accepting a user adjustment of cooking time during operation of the oven.

20. A method in accordance with Claim 19 wherein said oven further includes a rotary dial input, said step of accepting an adjustment of cooking time comprises the steps of:

10 sensing whether the rotary dial has been rotated beyond a predetermined increment, thereby indicating a desired cooking time adjustment;

determining whether the indicated cooking time adjustment is within an acceptable limit;

15 incrementing the cooking time by one second for each rotated increment of the dial in a first rotational direction when the indicated cooking time adjustment is within acceptable limits;

decrementing the cooking time by one second for each rotated increment of the dial in a second rotational direction when the indicated cooking time adjustment is within acceptable limits; and

20 preventing adjustment of the cooking time when the indicated cooking time is not within acceptable limits.

21. A method in accordance with Claim 19 wherein said microcomputer increments a respective power counter for each second of energization of each radiant lamp, said step of energizing the plurality of lamps comprises the steps of:

comparing the power center to an on time for each of the plurality of lamps corresponding to the input power levels;

de-energizing off each lamp when the respective power count exceeds the respective on time; and

5 energizing each lamp that is not energized when the respective power counter is less than the respective on-time.

22. A method in accordance with Claim 21 wherein the step of energizing each lamp comprises the steps of:

incrementing a soft start count;

10 determining whether the soft start is complete;

executing soft start energization when the soft start is incomplete; and

de-activating soft start energization and resetting the soft start count once the soft start is complete.

23. A speed cooking oven comprising:

15 a microcomputer;

a cooking cavity;

an upper cooking unit for delivering radiant energy into said cooking cavity and operatively connected to said microcomputer;

20 a lower cooking unit for delivering radiant energy into said cooking cavity and operatively connected to said microcomputer;

a microwave cooking unit for delivering microwave energy into said cooking cavity and operatively connected to said microcomputer; and

a control panel operatively connected to the said microcomputer for user manipulation of a power level for each of said upper cooking unit, lower cooking unit, and microwave cooking unit and further for user manipulation of a cooking time; said microcomputer programmed to operate said oven in a 5 microwave only cooking mode, a radiant only cooking mode, and a speed cooking mode for a cooking time in accordance with user input to said control panel..

24. A speed cooking oven as recited in Claim 23, further comprising a rotary dial input operatively connected to said control panel for user adjustment of 10 respective power levels of said upper cooking unit, said lower cooking unit, and said microwave cooking unit and for user adjustment of selected cooking time during operation of said oven.

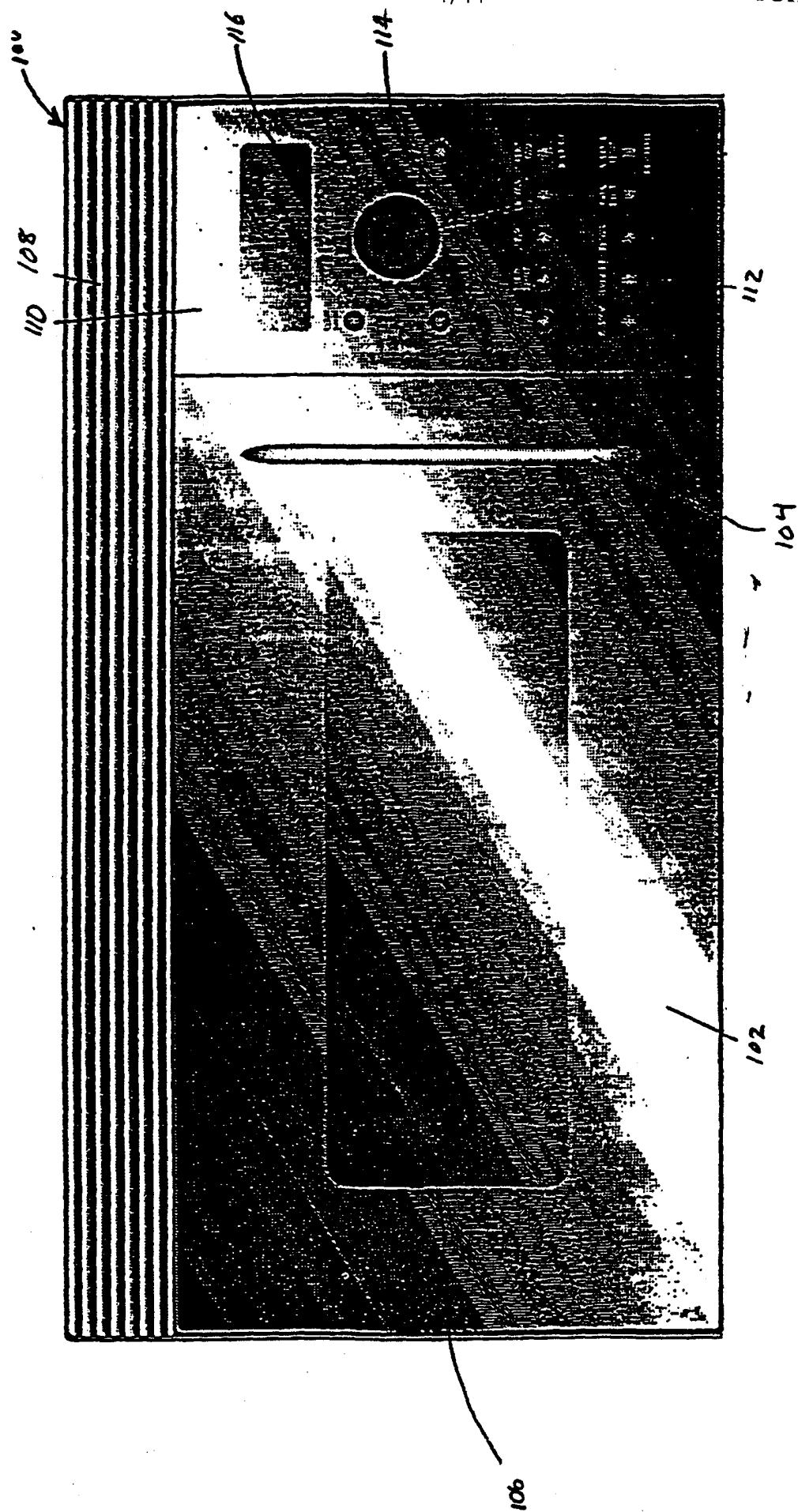
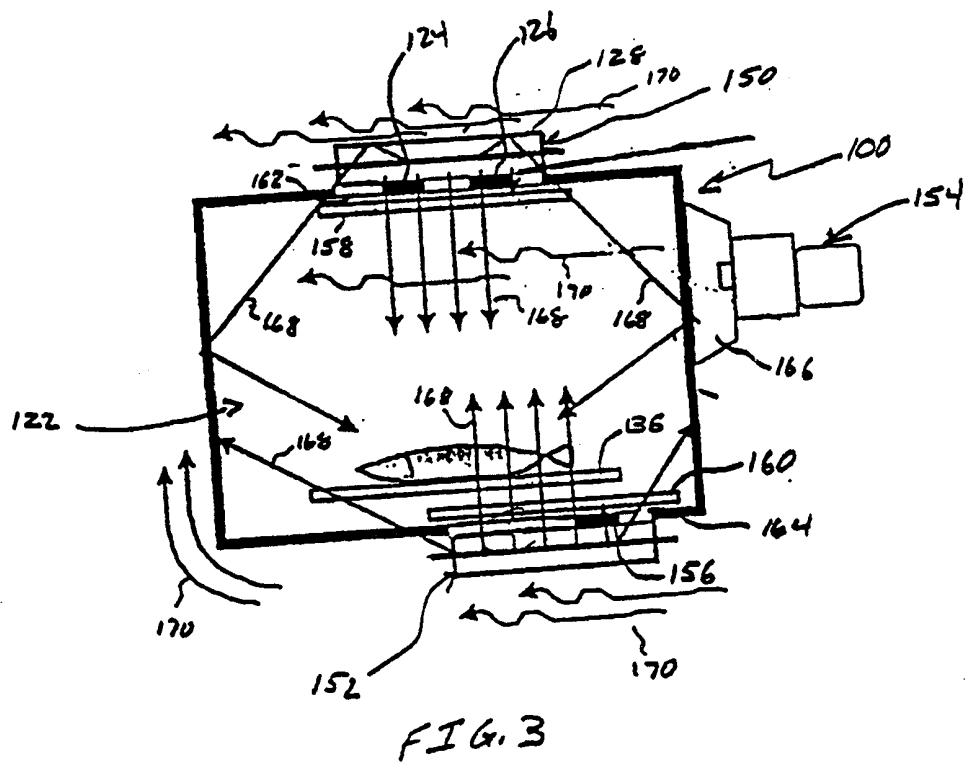
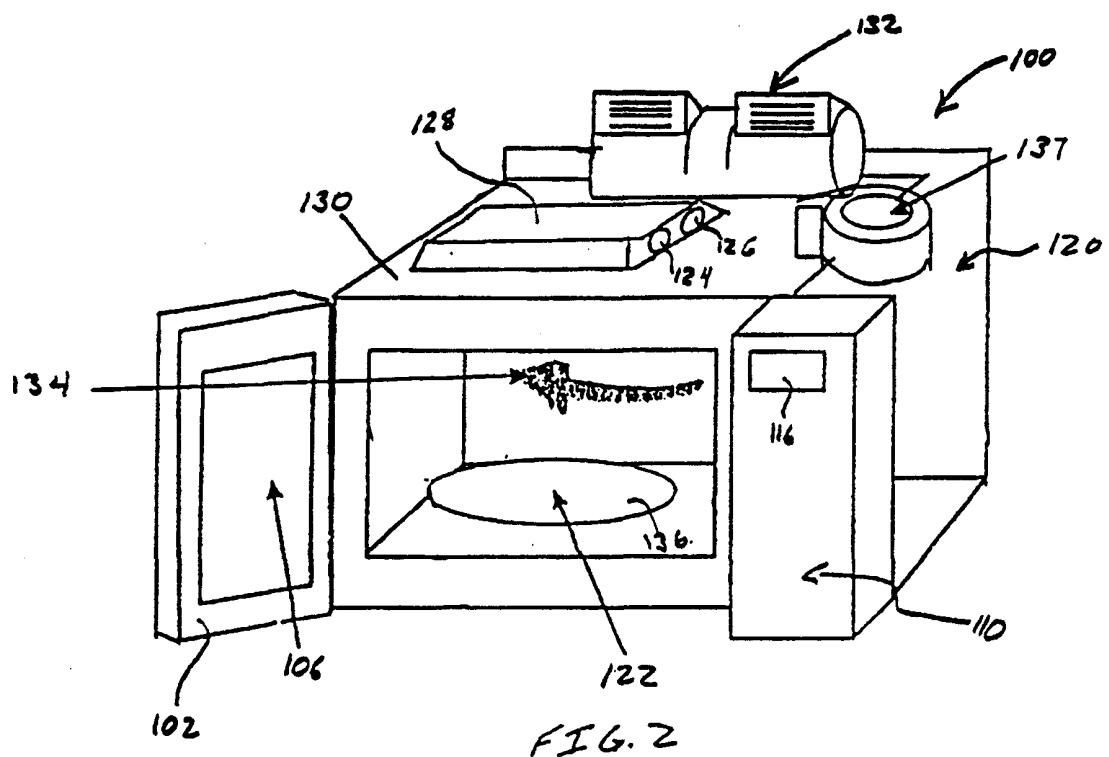


FIG. 1



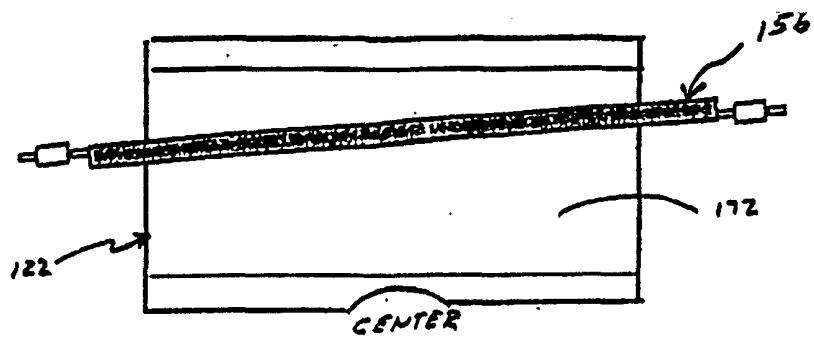


FIG. 4

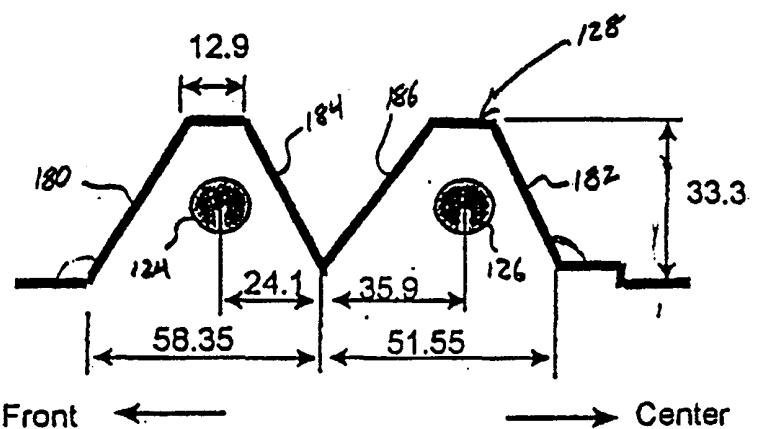


FIG. 5

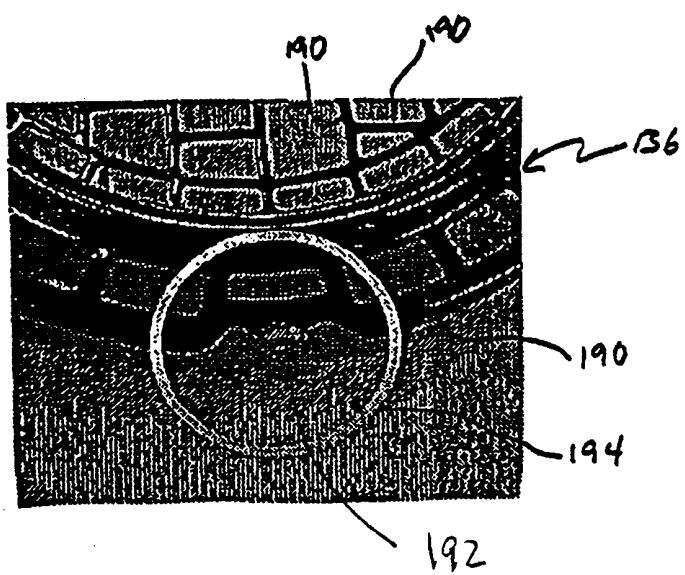


FIG. 6

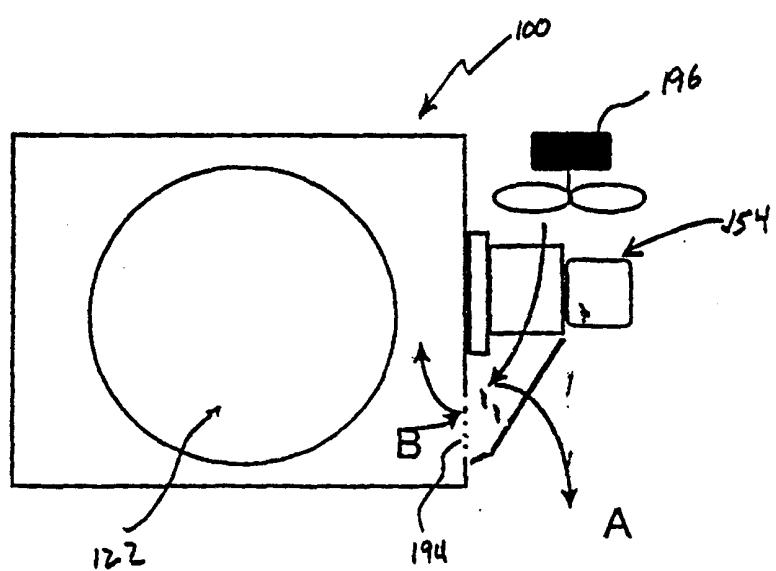
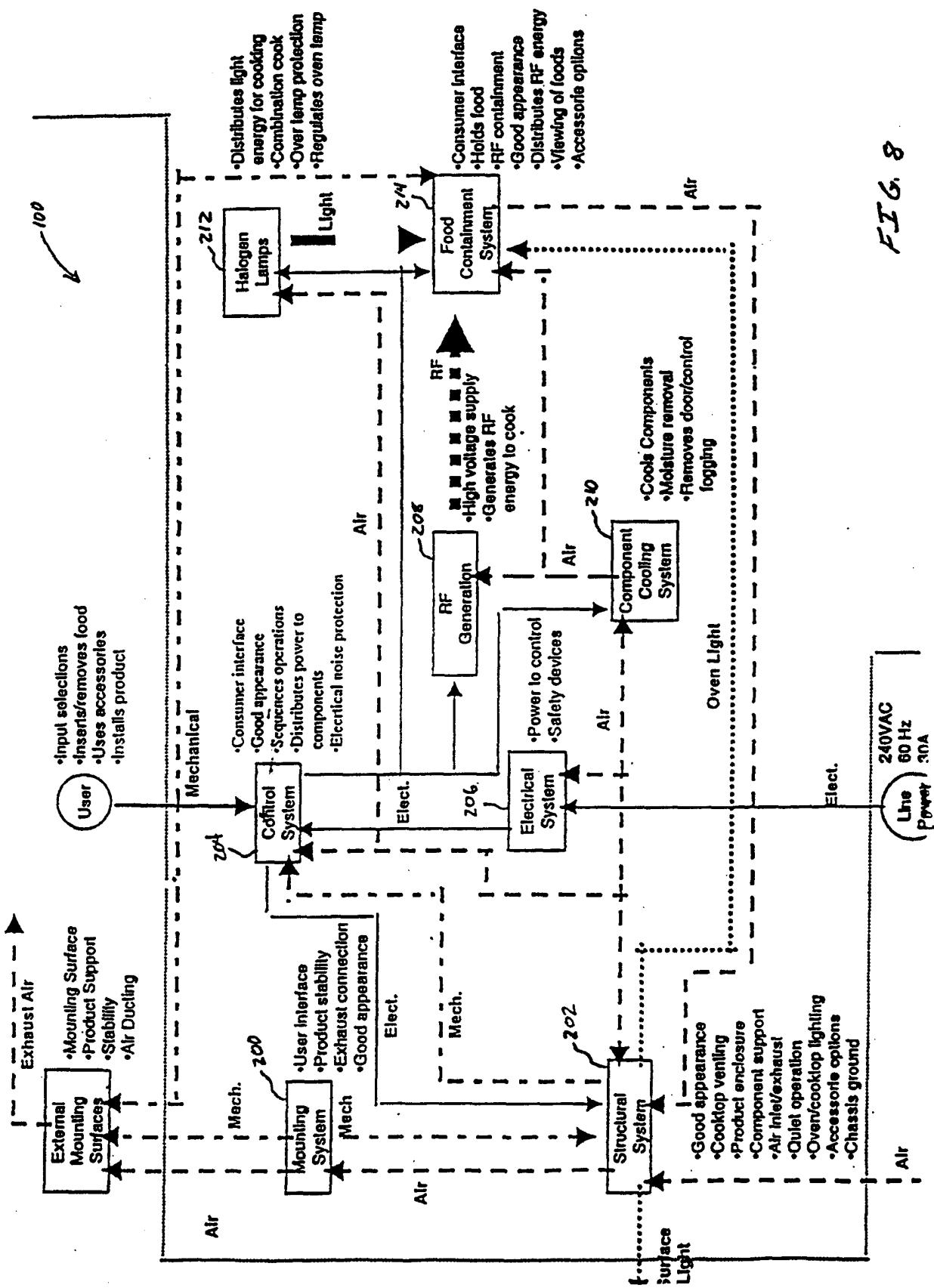
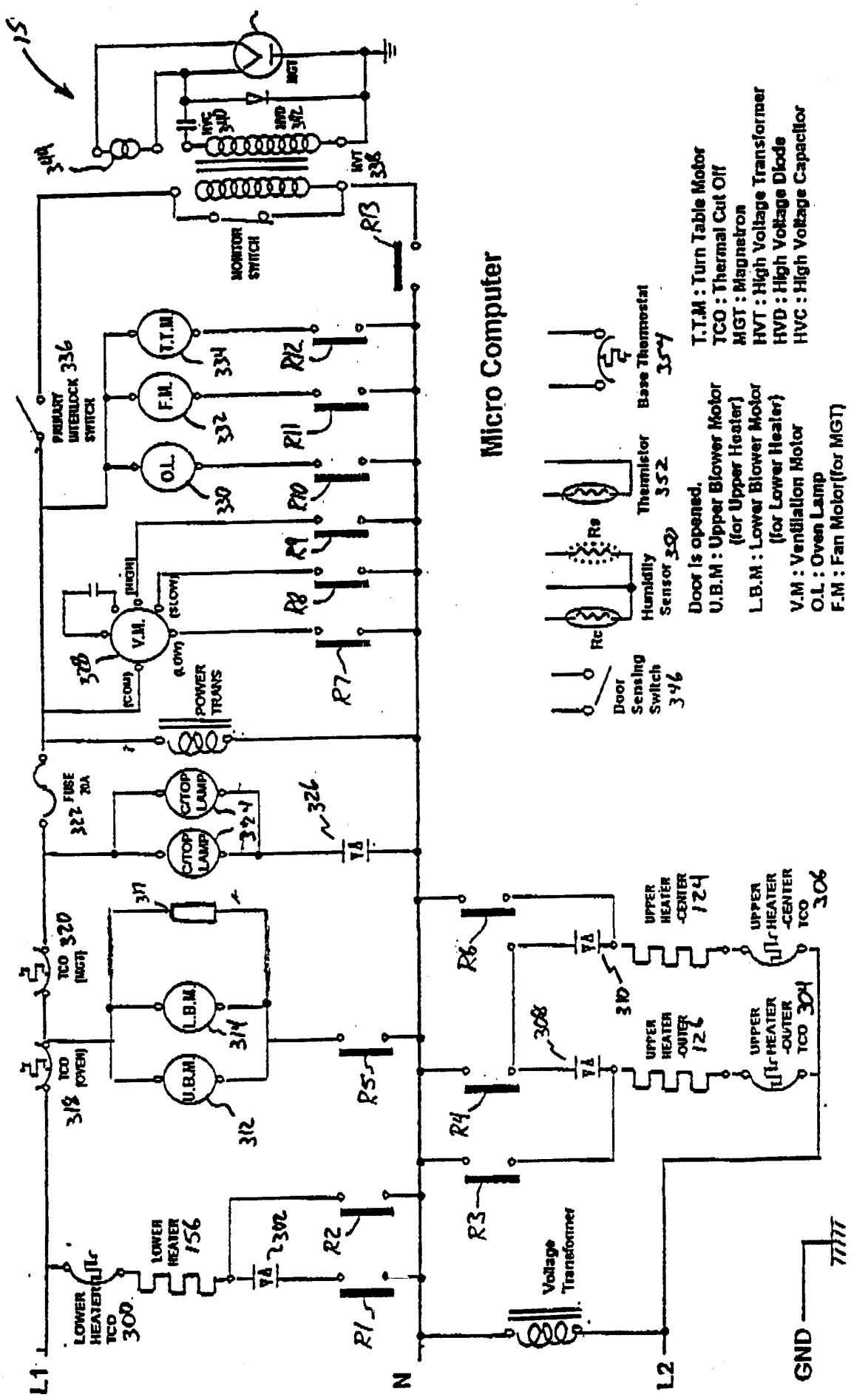


FIG. 7





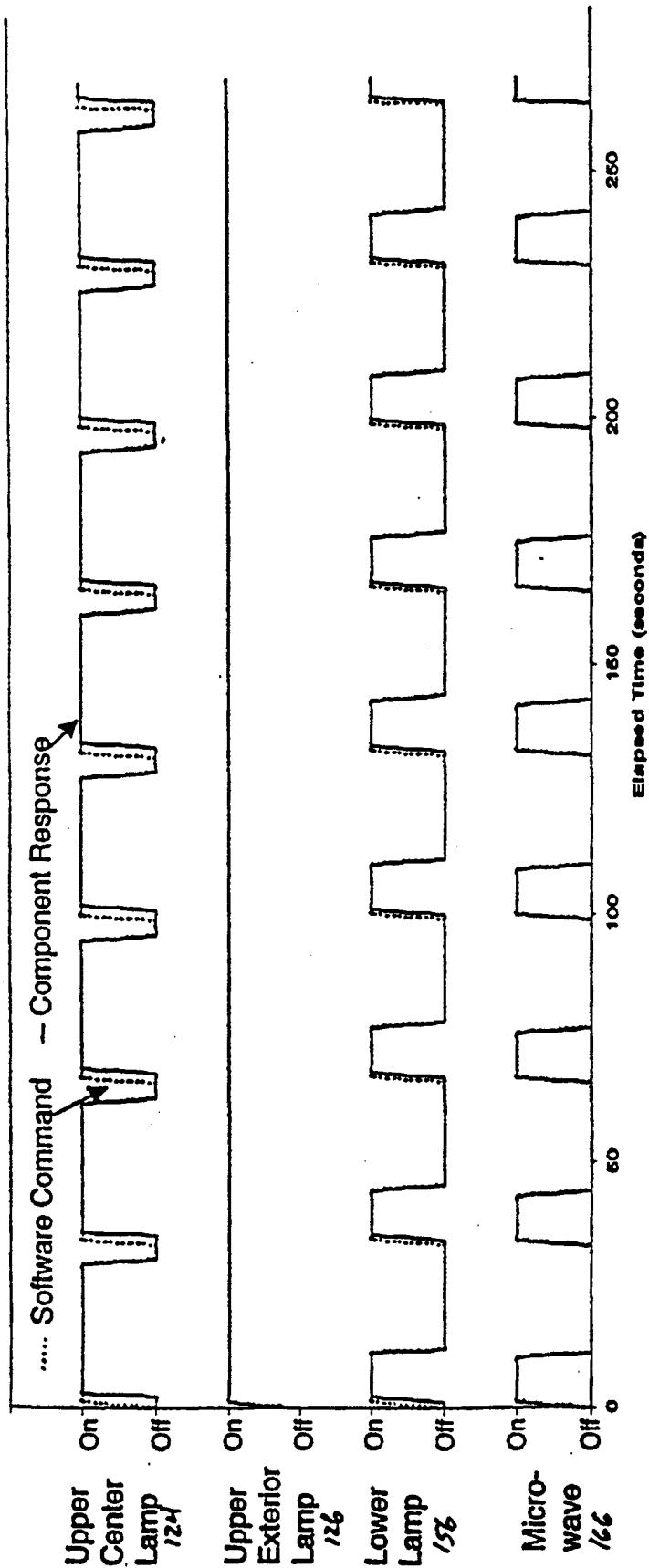


FIG. 10

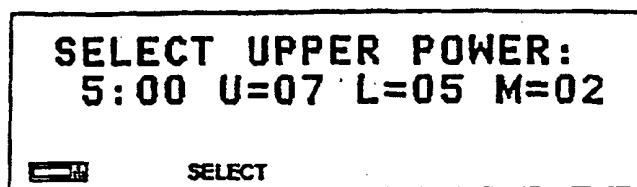


FIG. 11

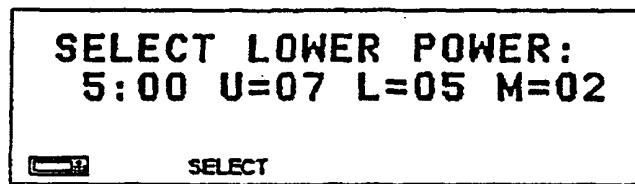


FIG. 12

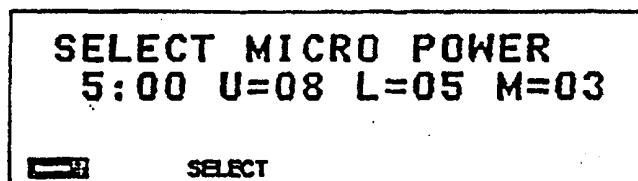


FIG. 13

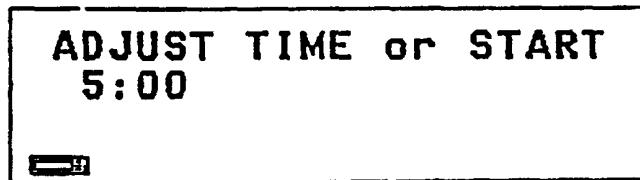


FIG. 14

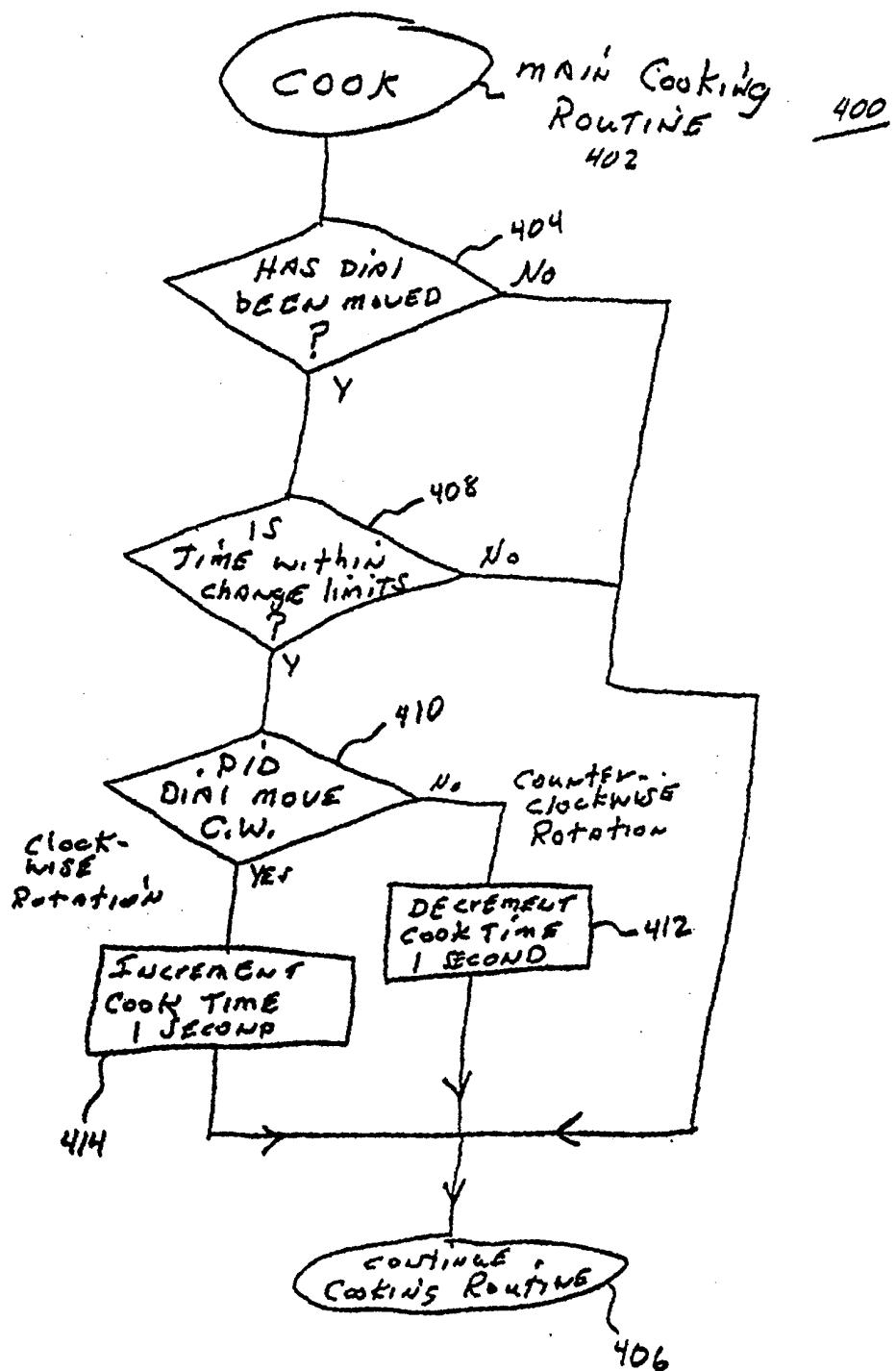


FIG. 15

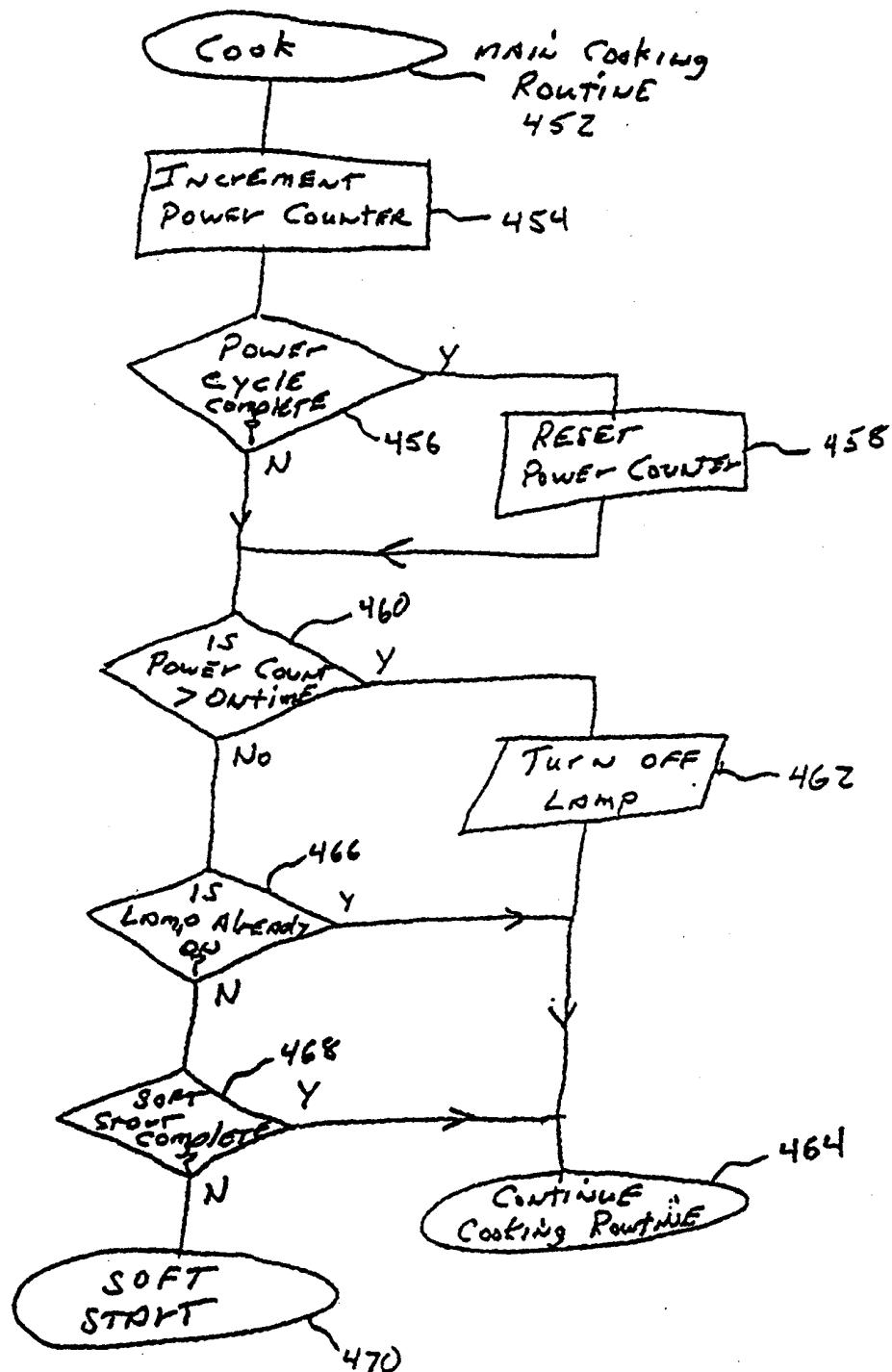


FIG. 16

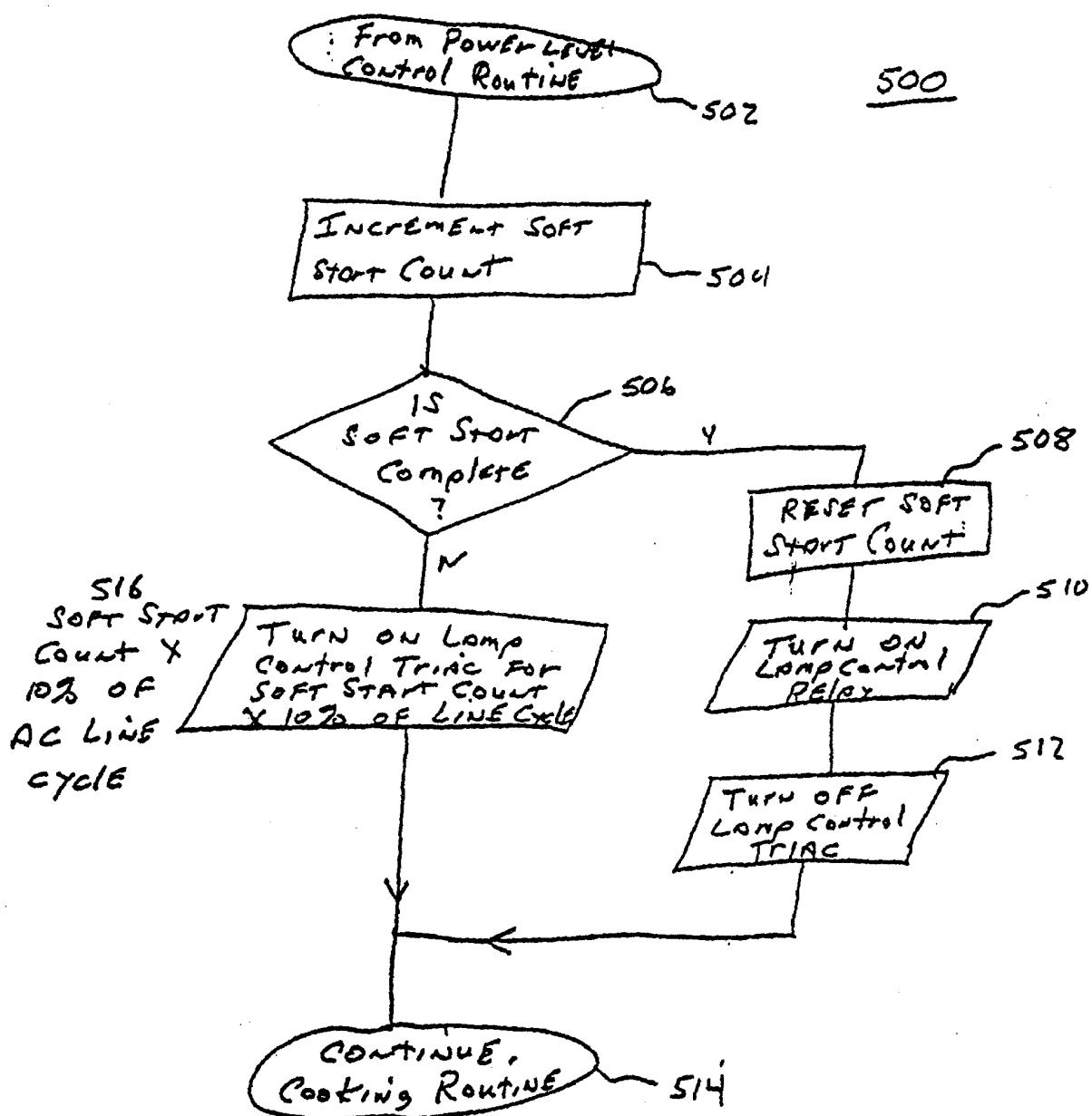
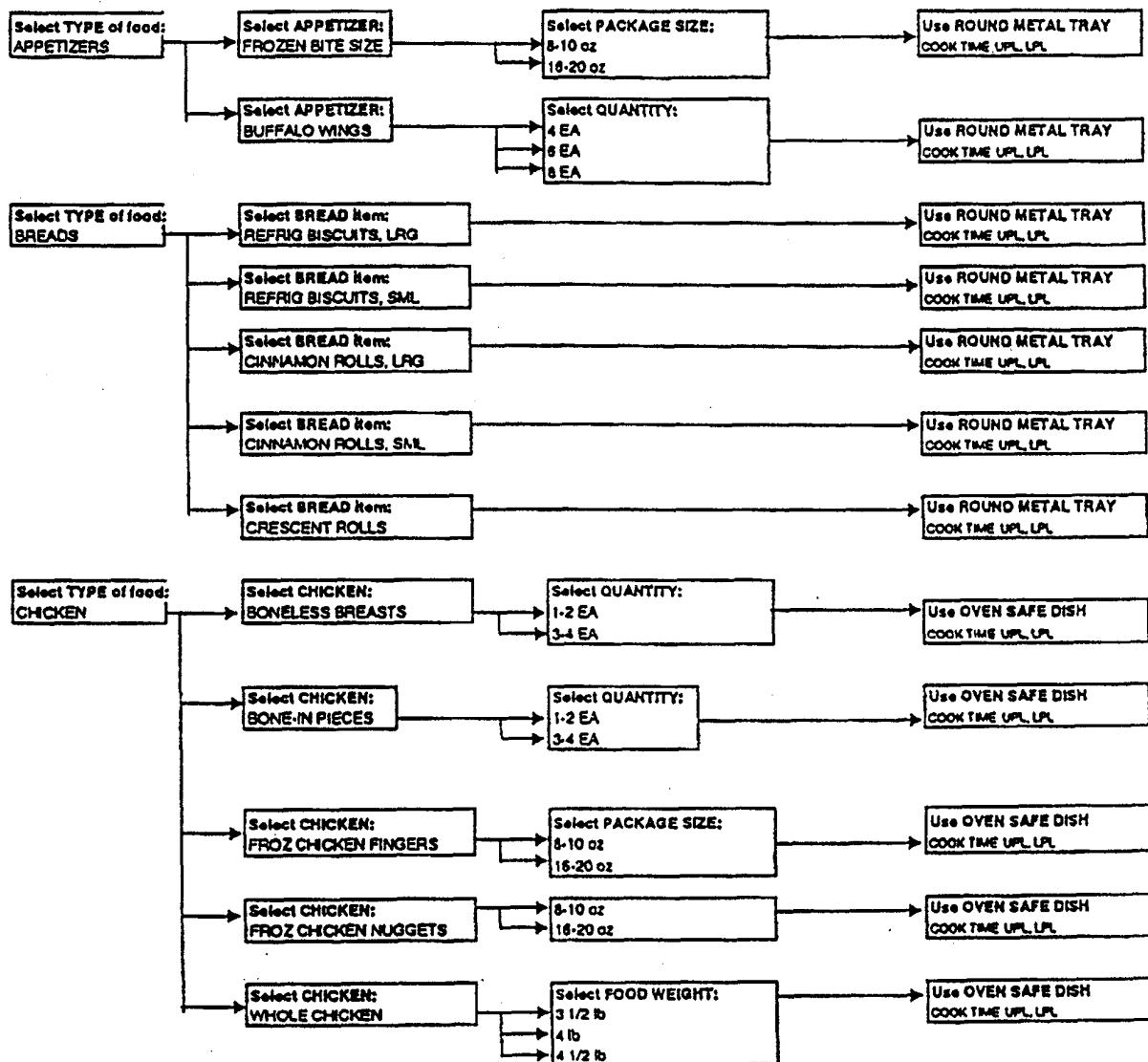


FIG. 17

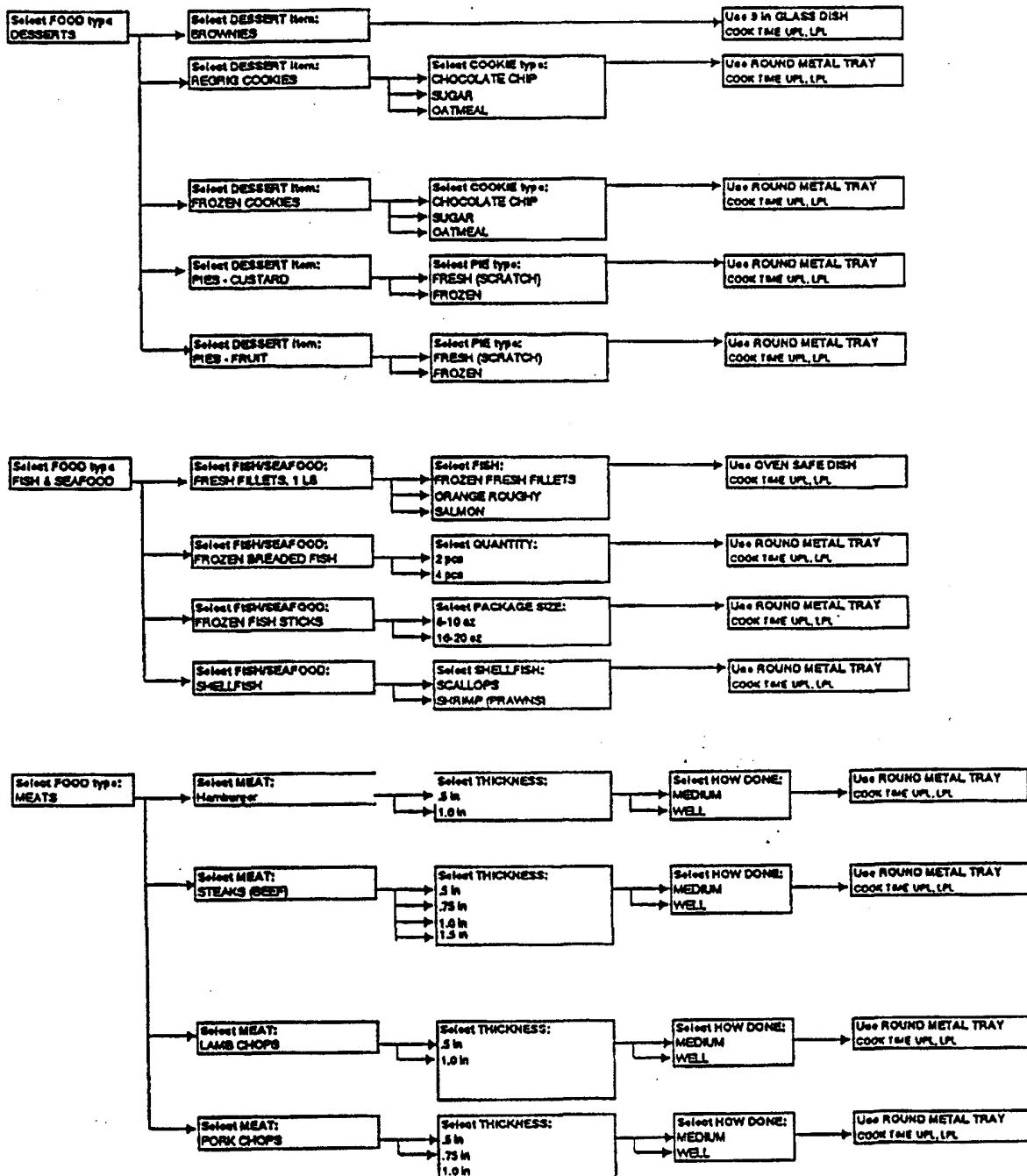
## APPENDIX A

-A1-



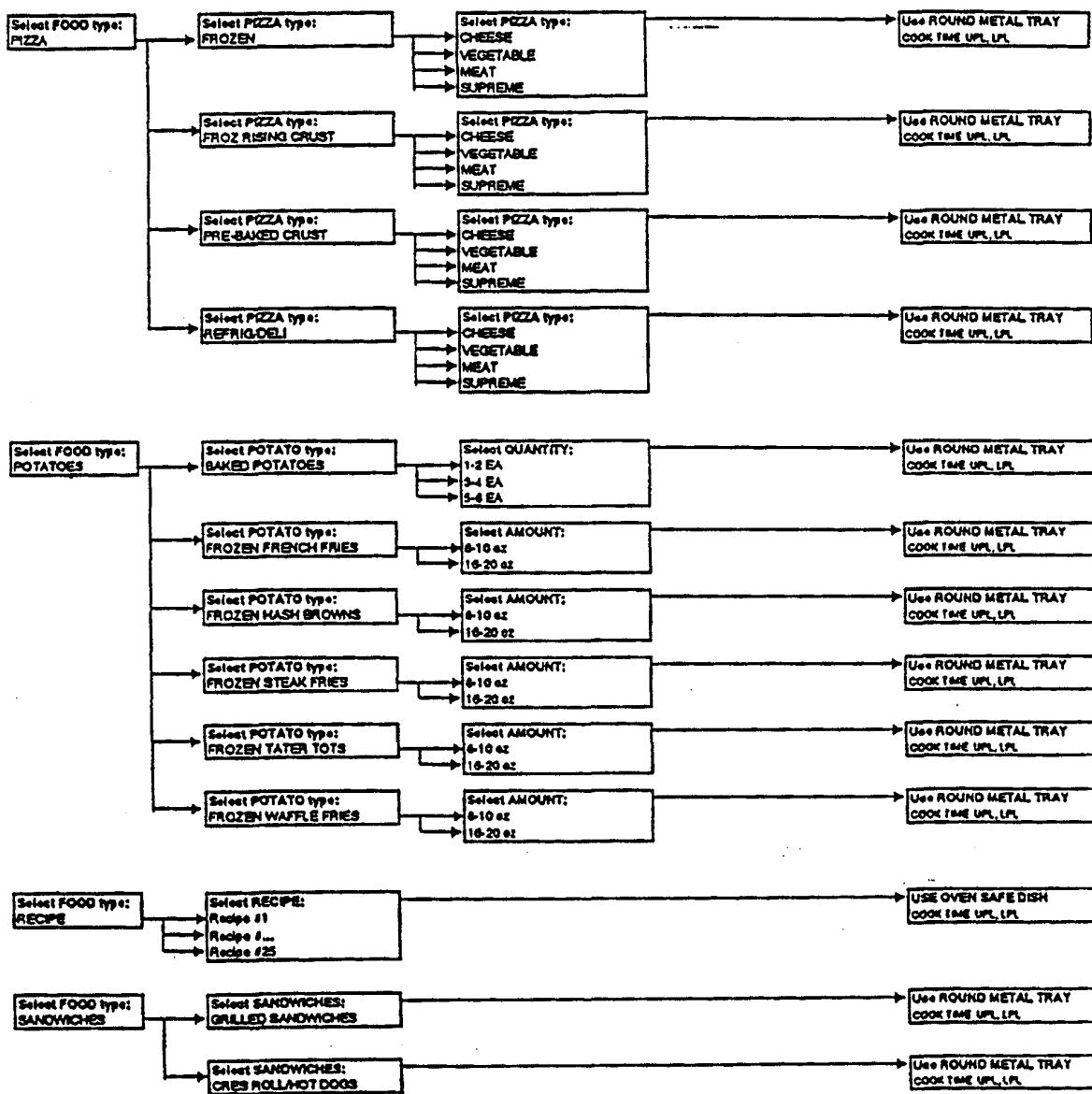
## APPENDIX A

-A2-



## APPENDIX A

-A3-



# INTERNATIONAL SEARCH REPORT

Int'l Application No
PCT/US 00/00594

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B6/68 H05B6/80

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
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Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H05B
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT
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Category <sup>o</sup>	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 213 442 A (BOSCH-SIEMENS) 11 March 1987 (1987-03-11) abstract; claims 1,2 column 2, line 17 - line 31	1,8,12, 13,17,18
A	column 2, line 44 -column 3, line 36 ---	23
A	US 5 747 781 A (KIM) 5 May 1998 (1998-05-05) abstract -----	2,3

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

<sup>o</sup> Special categories of cited documents :

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- "E" earlier document but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2000	04/05/2000
Name and mailing address of the ISA	Authorized officer

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Taccoen, J-F

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Information on patent family members				In: International Application No PCT/US 00/00594	
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