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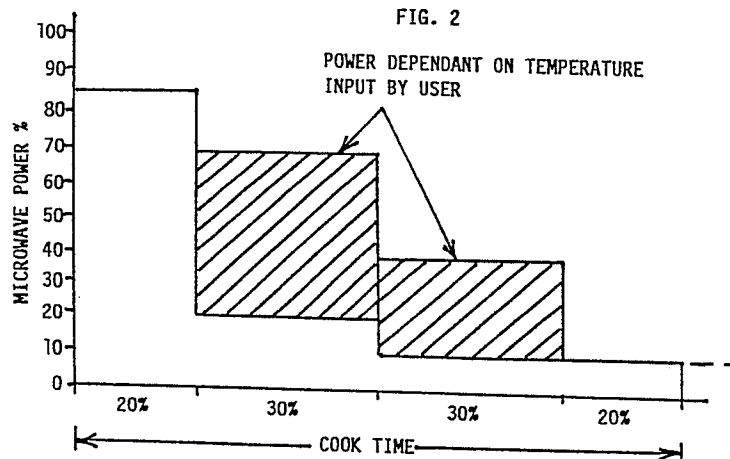
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54 **Microwave ovens.**

57 A gas microwave combination oven is described having an oven cavity which includes a microwave energy source, a gas burner located in the rear of the floor of the oven cavity, and a circulating fan located in the rear wall of the oven cavity. A gas mark control is provided for controlling the operation of the gas burner, and a microprocessor arrangement is provided for controlling the operation of the microwave energy source in dependence upon the setting of the gas mark control and also a preset 'cook time' that is set into the oven.

FIG. 2



Microwave Ovens

This invention relates to microwave ovens and more particularly to so-called combination microwave ovens which incorporate a source of convection hot air in addition to the source of microwave energy.

Combination microwave ovens are known in which hot air derived either from an electrical heater or from a gas burner is used in conjunction with the microwave energy in order to cook food placed in the oven. The hot air is conveniently circulated in the oven by means of a fan therein. Such combination microwave ovens are claimed to cook food better than straightforward microwave ovens. However, in use of such a combination microwave oven, it is necessary for any particular food item being cooked to preset the level of the microwave energy to be used, to preset the temperature or the gas mark setting of the hot air source and also to preset the time the cooking operation is to take. When it is realised that these settings will vary dependent upon the type of food being cooked then it will be appreciated that the initial setting up of a combination microwave oven can be very complex and it is virtually impossible to relate the required settings to the instructions that are normally given in recipes designed for use with conventional (non-microwave) ovens.

It is an object of the present invention to provide a combination microwave oven which is easier to set up and in which in a preferred form the set-up procedure can be more easily related to conventional food recipes.

According to the present invention there is provided a microwave oven comprising a source of microwave energy, a source of hot air, and control means for setting the effective temperature of said source of hot air, means being provided for automatically setting the level of the microwave energy in dependence upon the setting of said control means.

Advantageously, timer means will be provided for pre-setting the cook time of a cooking operation, the means for automatically setting the level of microwave energy being arranged to vary the setting of the microwave energy during said cook time in dependence upon the setting of said control means.

In a preferred form of microwave oven according to the present invention, means is provided for subdividing the preset cook time into a plurality of time periods, and in which the means for automatically setting the level of microwave energy is arranged to automatically set the level of microwave energy in each of said time periods, the level of microwave energy in at least one of said time

periods being dependent upon the setting of said control means.

Advantageously, the cook time will be subdivided into four time periods, a first time period corresponding to the first 20% of the preset cook time, a second time period corresponding to the next 30% of the preset cook time, a third time period corresponding to the next 30% of the preset cook time and a fourth time period corresponding to the next 20% of the preset cook time.

Conveniently it may be arranged that in some of said time periods the level of microwave energy is set independent of the setting of said control means, and in the other of said time periods the level of microwave energy is set in dependence upon the setting of said control means.

In an especially preferred microwave oven, during the first time period the level of microwave energy is set to 85% of maximum, during the second time period the level of microwave energy is set to between 20% and 70% of said maximum dependent upon the setting of said control means, during the third time period the level of microwave energy is set to between 10% and 40% of said maximum dependent upon the setting of said control means, and during the fourth time period the level of microwave energy is set to 10% of said maximum.

The source of hot air may comprise an electric heater, in which case the control means may comprise a temperature thermostat control, or it may comprise a gas burner, in which case the control means may comprise a gas mark thermostat control.

A fan may also be provided for circulating the hot air.

An exemplary embodiment of the invention will now be described, reference being made to the accompanying drawing, in which:

Fig. 1, is front view of a combination microwave oven in accordance with the present invention; and

Fig. 2, is graphical representations relating to the operation of the combination microwave oven of Fig. 1.

In Fig. 1 of the drawing there is depicted a front view of a combination microwave oven 1 having a front, side-hung door 2 which is shown in the open position to reveal an oven cavity 3. The microwave oven 1 is provided with a magnetron shown diagrammatically in dashed lines at 4, for transmitting into the oven cavity 3 microwave radiation. The microwave oven 1 is also provided in the floor of the cavity 3 and towards the rear thereof with a gas burner 5, which constitutes a source of

hot air for the cavity 3. Thus, any food placed in the combination microwave oven 1 may be cooked by using a combination of microwave energy from the magnetron 4 and hot air from the gas burner 5. Such an arrangement is advantageous in that the hot air from the gas burner 5 has a browning effect on any food in the oven cavity 3. The cavity 3 is also provided in the rear wall thereof with a fan 6 for providing for forced circulation of the hot air from the gas burner 5.

It should be appreciated that the provision of the fan 6 is optional and also, in place of the gas burner 5, one or more electric heaters, shown in dashed lines at 7, may be provided.

The microwave oven 1 shown in Fig. 1. is provided with a microprocessor controlled timer 8 for controlling the operation thereof, the timer 8 being provided with four push button controls 9 and a digital display 10. Amongst other things, the timer 8 may be used for pre-setting the "cook time" of the microwave oven 1 in the conventional way. The microwave oven is also provided with a gas mark thermostat control 11 for controlling the gas burner 5, the gas mark thermostat control 11 comprising "UP" and "DOWN" push buttons 12 and also a digital display 13 for indicating the actual gas mark setting.

In order to overcome the necessity of individually setting the level of the microwave energy from the magnetron 4, and also the level of the gas mark thermostat control 11, it is arranged that the microprocessor (not shown) of the timer 8 incorporates a software program which takes account of the setting of the gas mark thermostat control 11 and also the preset "cook time" in order to set the level of the microwave energy.

Preferably the microprocessor is programmed to sub-divide the "cook time" into four time periods corresponding to 20%, 30%, 30% and 20% of the cook time, respectively, as shown in Fig. 2 of the accompanying drawing, and is also programmed to set the level of the microwave energy in each of the four time periods as follows:

1st. (20%) Period: set to 85% of maximum;

2nd. (30%) Period: set to between 20% and 70% of maximum dependent upon the setting of the gas mark control;

3rd. (30%) Period: set to between 10% and 40% of maximum dependent upon the setting of the gas mark control;

4th. (20%) Period: set to 10% of maximum.

It will be appreciated that the number of time periods that the "cook time" is sub-divided into and also the microwave energy levels that are set for each of the time periods are exemplary only and other than four time periods and different microwave energy levels may be used as required.

It has been found that by coordinating the hot

air temperature and microwave energy over the "cook time", a foods cooked-finished result can be achieved that is comparable to conventionally cooked methods, but in considerably less time.

This is achieved by arranging that the correct internal and external food temperatures are reached simultaneously, the resultant effect being achieved without undue overheating of the food so that food spatter and smoking is minimised. The coordination of hot air temperature and microwave energy also minimises operator error and confusion in that it can be adapted to conventional food recipes by using a simple time adjustment procedure (e.g. cook in half the time). The final 10% microwave energy time period is used to prevent overcooking, and allows a degree of operator adjustment to compensate for any meal serving delay.

It is also envisaged that the microprocessor control will be expanded to introduce "weight-volume-food type" program information into the microprocessor, so that the microwave oven may additionally be provided with "fully automatic cook" and "microwave only defrost" modes.

Claims

1. A microwave oven comprising a source of microwave energy, a source of hot air, and control means for setting the effective temperature of said source of hot air, means being provided for automatically setting the level of the microwave energy in dependence upon the setting of said control means.

2. A microwave oven as claimed in claim 1, comprising timer means for pre-setting the cook time of a cooking operation, in which the means for automatically setting the level of microwave energy is arranged to vary the setting of the level of the microwave energy during said cook time in dependence upon the setting of said control means.

3. A microwave oven as claimed in claim 2, in which means is provided for subdividing the preset cook time into a plurality of time periods, and in which the means for automatically setting the level of microwave energy is arranged to automatically set the level of microwave energy in each of said time periods, the level of microwave energy in at least one of said time periods being dependent upon the setting of said control means.

4. A microwave oven as claimed in claim 3, in which the preset cook time is subdivided into four time periods.

5. A microwave oven as claimed in claim 4, in which a first time period corresponds to the first 20% of the preset cook time, a second time period corresponds to the next 30% of the preset cook time, a third time period corresponds to the next

30% of the preset cook time, and a further time period corresponds to the next 20% of the preset cook time.

6. A microwave oven as claimed in claim 5, in which in some of said time periods the level of microwave energy is set independent of the setting of said control means, and in the other of said time periods the level of microwave energy is set in dependence upon the setting of said control means.

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7. A microwave oven as claimed in claim 6, in which during the first time period the level of microwave energy is set to 85% of maximum, during the second time period the level of microwave energy is set to between 20% and 70% of said maximum dependent upon the setting of said control means, during the third time period the level of microwave energy is set to between 10% and 40% of said maximum dependent upon the setting of said control means, and during the fourth time period the level of microwave energy is set to 10% of said maximum.

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8. A microwave oven as claimed in any preceding claim, in which the source of hot air comprises an electric heater.

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9. A microwave oven as claimed in claim 8 in which the control means comprises a temperature thermostat control.

10. A microwave oven as claimed in any of claims 1 to 7, in which the source of hot air comprises a gas burner.

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11. A microwave oven as claimed in claim 10, in which the control means comprises a gas mark thermostat control.

12. A microwave oven as claimed in any preceding claim, comprising a fan for circulating hot air.

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FIG. 1

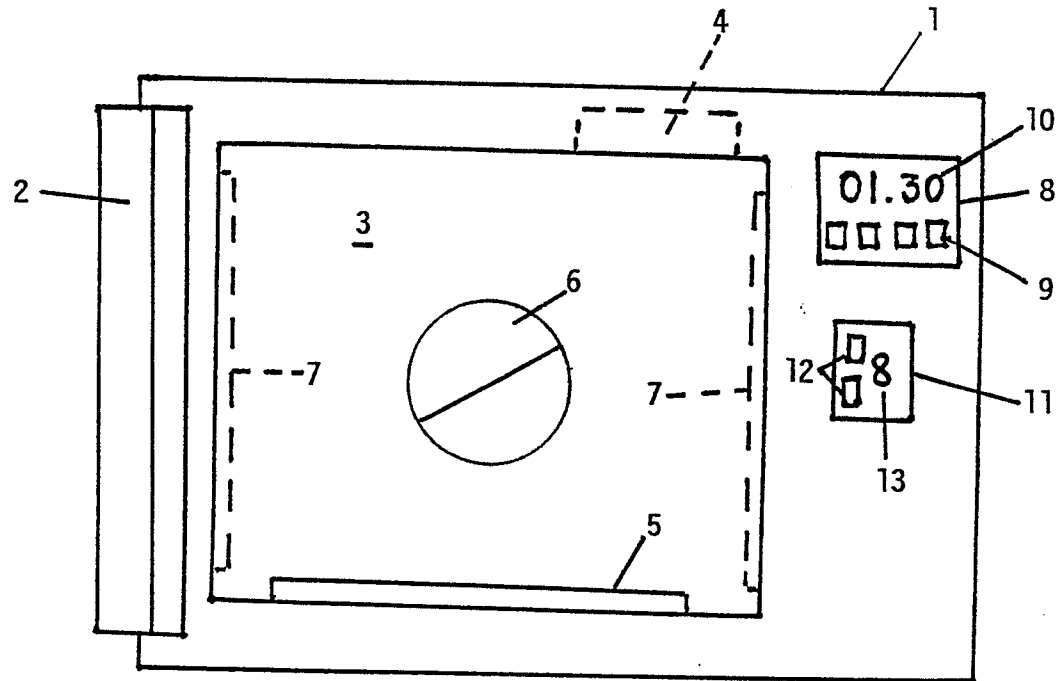
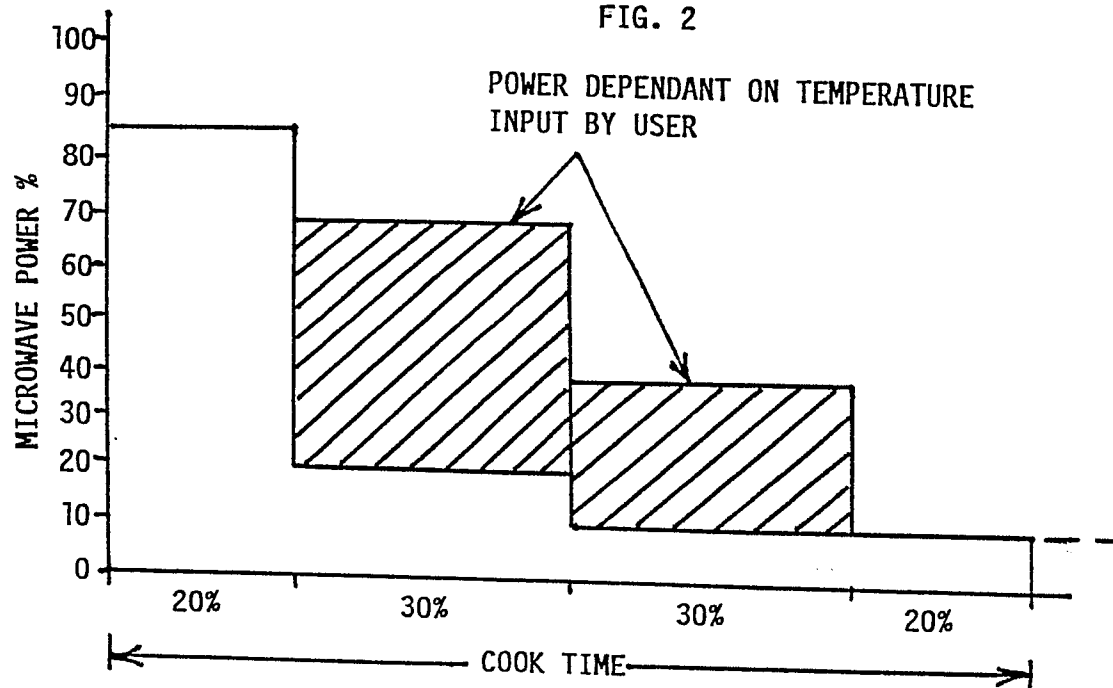


FIG. 2





EP 88 30 1959

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	EP-A-0 187 543 (MICROWAVE OVENS) * Page 7, lines 3-29 * ---	1,4,8,9 ,12	H 05 B 6/68
A	GB-A-2 042 858 (RINNAI K.K.) * Page 1, lines 68-125; figure 1 * ---	1,2,8, 10,12	
A	GB-A-2 168 503 (SHARP K.K.) * Page 1, line 61 - page 2, line 47; figures 1,2 * ---	1,3,4,6	
A	FR-A-2 335 799 (ELEKTROMASCHINEN A.G.) ---		
A	US-A-3 470 942 (FUKADA et al.) ---		
A	UB-A-2 037 100 (MATSUSHITA) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			H 05 B 6/00
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21-06-1988	Examiner RAUSCH R.G.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			