

**METHOD FOR CONTROLLING A MICROWAVE OVEN AND
MICROWAVE OVEN EMPLOYING THIS METHOD**

The present invention relates to a method of controlling a microwave oven and to a microwave oven
5 employing this method.

A microwave oven is usually intended for heating diverse articles of various kinds. In one of its applications, this oven is used to thaw, reheat and cook foods and drinks. A microwave oven generally includes a micro-
10 wave-production system and a compartment which receives these microwaves and serves as resonance box and as enclosure for treating these foods and drinks. A microwave-production system in a microwave oven frequently comprises a magnetron which provides microwaves and
15 electrical and/or electronic accessories for powering and controlling this magnetron and for cooling this microwave-production system. The accessories for powering and controlling the magnetron are for example transformers, switches, capacitors, diodes and drive motors,
20 and the accessories for cooling the system are often electric fans. During operation of the oven, the components and accessories making up the microwave-production system come into action and heat up both singly and influentially under the effect of thermal conduction or
25 convection. To enable them to preserve a good lifetime and good operation, these components and accessories must function at individual temperatures which do not exceed acceptable limits. In an improvement to the performance of the oven via an increase in the power of the
30 magnetron, known solutions have proposed overdimensioning the power supply and control accessories or cooling them further, for example through the use of a larger number of fans. These known solutions entail not only the raising of the price of the oven but also the expansion
35 of the volume occupied by these components and accessories in this oven at the expense of their foods and drinks treatment compartment for a given dimension of this oven.

Furthermore, European Patent Application

EP-A-0 301 805 describes another solution for optimizing the performance levels and costs of a microwave oven, consisting in operating the magnetron, at the start of a cooking operation, at a power greater than the normal operating power for a period during which the temperature of the various components does not exceed a limit temperature. To do this, the microwave oven described uses an electric power-converter semiconductor element, the operation of which is controlled via a monitoring section.

Furthermore, European Patent Application EP-A-0 192 771 describes a microwave oven equipped with a device for automatic weighing of the items and which controls a circuit for monitoring the output power of a magnetron. More precisely, the automatic weighing device controls a switch which establishes a series electrical connection between the magnetron and the secondary of a transformer across one or two capacitors placed in parallel, in such a way that the magnetron delivers a first or a second power with values specified through the capacitive values of the capacitors used.

The present invention, aimed at avoiding the aforesaid drawbacks, proposes an effective and economical method of controlling a microwave oven, enabling the performance of this oven to be improved, consisting:

- at the start of a food or drink treatment cycle, in operating this microwave-production tube at its maximum power P_n for a time at most equal to a reheating time of this microwave-production tube or of one or more of the accessories such as a power-supply transformer for this tube, taken as reference, that is to say the time for the temperature to rise, from its or their idle temperature, to its or their prespecified limit operating temperature, and
- in the remainder of this treatment cycle, in making the microwave-production tube function at a predetermined normal running power which is less than the maximum power P_n .

The subject of the invention is therefore a

microwave oven as defined in Claims 1 to 3.

To provide a better understanding of the invention, an example implementation thereof is described below and illustrated by the attached drawings which represent in:

- 5 - Figure 1, a schematic and partial front view of a microwave oven according to the oven,
- Figure 2, schematically and partially, an electrical circuit of a control and microwave-production system for the oven of Figure 1, and
- 10 - Figure 3, schematically and partially, an electrical circuit of a control and microwave-production system for a known microwave oven.

A microwave oven 1, illustrated schematically and partially in Figures 1 and 2, comprises a casing 2 in which are formed a compartment 3 for housing a control and microwave-production system 5 for the microwave oven 1 and a compartment 6 serving as resonance box and as food and drink treatment enclosure. The compartment 6 is closed by a door 7.

During operation of the oven 1, the foods or drinks accommodated in the compartment 6 and subjected to a thawing, reheating or cooking treatment are flooded with a microwave flux, produced by the control and microwave-production system 5, and conveyed into the compartment 6 through a waveguide of a known type and not represented.

The control and microwave-production system 5 which is partially and schematically represented in Figure 2 comprises a magnetron 10 having a prespecified power P_n lying within a power range of from 600 watts to 1500 watts approximately for domestic microwave ovens.

In a known microwave oven 12 whose electrical circuit is schematically and partially represented in Figure 3, a magnetron 14 is supplied with electric current across a transformer 15 and a programmer 17 via an AC current source 18. In this electrical circuit, the magnetron 14 is connected across a capacitor 19 in series to the secondary of the transformer 15 and comprises a

rectifying diode 20 wired in parallel in such a way that the cathode of the diode 20 is joined to the anode of this magnetron 14 which is earthed and the anode of the diode 20 is connected to the cathode of the magnetron 14.

5 During a first negative alternation of the voltage at the secondary of the transformer 15, the diode 20 conducts and charges the capacitor 19. During a subsequent positive alternation of the voltage at the secondary of this transformer 15, the diode 20 is off and
10 the magnetron 14 becomes conducting in the opposite direction, discharging the capacitor 19 at least partly.

 The power of the magnetron 14 is, according to a known regulation, alternately emitted for a given time interval and then interrupted for another given time
15 interval throughout an operating cycle. In an operating cycle, the ratio of all the running-time intervals to all the idle-time intervals plus all the running-time intervals gives the mean running factor for the oven which comes into the determination of the treatment time.

20 Each one of the treatments, thawing, reheating or cooking, has a particular treatment time prespecified for each of the varieties or groups of varieties of foods or drinks.

 In the known microwave oven 12, the programmer 17
25 is preprogrammed and allows both the setting of the running factor or a power setting suitable for a thawing, reheating or cooking treatment, and a setting of the treatment time for each of the varieties or groups of varieties of foods or drinks.

30 In the known microwave oven 12 having a magnetron 14 of given power P_n , the control and power-supply accessories such as the transformer 15, the capacitor 19, the diode 20, the programmer 17 and the cooling accessories such as a fan, not represented, are usually
35 prespecified as regards their characteristics in accordance with a compromise which makes it possible to obtain an oven having an attractive retail price, restricted size, correct operation and correct efficiency and a reasonable lifetime.

Owing to their reheating during operation, the power-supply, control and cooling accessories associated with the magnetron 14 are chosen for their durability at acceptable limit temperatures which are specific to them under continuous operation. The frequent result of this compromise is that the magnetron 14 does not function at its maximum power P_n at any moment in the operation of the oven 12. The magnetron 14 functions only at a lower power which is a predetermined normal running power. This constitutes wastage and a weak point in terms of the performance of the known oven 12.

The present invention makes it possible to avoid these disadvantages.

According to the invention, a method for controlling a microwave oven with microwave-production tube such as a magnetron consists at the start of a food or drink treatment cycle in operating this microwave-production tube at its maximum power P_n for a time at most equal to a reheating time of this microwave-production tube or of one or more power-supply and cooling accessories for this microwave-production tube taken as reference, such as a transformer, that is to say the time for the temperature to rise, from its or their idle temperature, to its or their prespecified limit operating temperature, and, in the remainder of this treatment cycle, in making the microwave-production tube function at a predetermined normal running power which is less than its maximum power P_n .

In the method for controlling a microwave oven with microwave-production tube such as a magnetron, the time of operation of the microwave-production tube at its maximum power P_n at the start of a treatment cycle for a food or a drink is preferably less than one minute.

In an example implementation of the invention, illustrated in Figures 1 and 2, a microwave oven 1 comprises, in its compartment 3, a control and microwave-production system 5 having a magnetron 10 as microwave-production tube.

In this control and microwave-production system

5, the magnetron 10 is supplied with electric current across a transformer 25 and a control device 28 via an AC current source 30.

According to the invention, in the control and
5 microwave-production system 5 of the microwave oven 1, the magnetron 10 which is furnished at its terminals with a rectifying diode 33 comprises, on the one hand, an anode 35 which, joined to the cathode of this rectifying diode 33, is connected to a first end 36 of a secondary
10 of the transformer 25 across firstly one of the two parallel capacitors 38, 39 of different values, namely a capacitor 38 of lower capacitance, intended for operating the magnetron 10 at a predetermined normal running power which is lower than its maximum power P_n , and a capacitor
15 39 of higher capacitance reserved for operation of the magnetron 10 at its maximum power P_n and next a switch 41 establishing an electrical connection of one 38 or the other 39 of these two capacitors to the secondary of this transformer 25, and, on the other hand, a cathode 37
20 which, joined to the anode of this rectifying diode 33, is connected up to a second end 40 of this secondary of this transformer 25.

The switch 41 is either an electronic switch or an electromechanical switch of a known type. The switch
25 41 comprises three terminals 44, 45, 46. The terminal 44 is joined to the end 36 of the secondary of the transformer 25 whilst the terminals 45 and 46 are joined respectively to the capacitor 38 for operating the magnetron 10 at its normal running power and to the
30 capacitor 39 for operating the magnetron 10 at its maximum power P_n .

The switch 41 comprises an operating button 50, a timer 51 and a latching device 52 controlled by a temperature sensor 53, these allowing either manual
35 disconnection of a normal electrical link 44, 45 and manual connection of a preset-time electrical link 44-46, that is to say the disconnecting of the magnetron 10 from its electrical link, allowing operation at its normal running power and the connecting of the magnetron 10 up

to an electrical link permitting preset-time operation at its maximum power P_n when the temperature of this magnetron 10 or of its power-supply and cooling accessories, taken as reference and picked up by the heat sensor 53, is less than its or their limit operating temperature, or the locking of the operating button 50, that is to say the maintaining of this normal electrical link 44-45 by the latching device 52 when the temperature of this magnetron 10 or of its power-supply and cooling accessories, taken as reference and picked up by the heat sensor 53, is equal to or greater than its or their limit operating temperature. After preset-time operation of the magnetron 10 at its maximum power P_n via the electrical link 44-46, the switch 41 is automatically restored to its normal electrical link 44-45.

The control device 28 of the control and microwave-production system 5 of the oven 1 comprises, apart from the switch 41 described above, an electronic or electromechanical programmer of a known type 55. This programmer 55 is preprogrammed, ensures, by way of an operating button 57, the energizing or de-energizing of a primary of the transformer 25, by way of an operating button 58 the selection of a thawing, reheating or cooking treatment according to which a mean running factor for the magnetron has been established, defined in an earlier paragraph, by way of an operating button 59 the choice of a treatment time, and, by way of an electronic circuit of a known type 60, synchronization of operation between the programmer 55 and the switch 41 upon a change of operating power of the magnetron 10.

In the treatment of a food or drink, for example the fast cooking of a dish or the fast reheating of tea, this dish or this tea is accommodated in the compartment 6 of the microwave oven 1 and the button 58 is then set to its "cooking" or "reheating" position, the button 59 is turned to a location of a chosen treatment time, the button 50 is next depressed into its operating position at maximum power P_n of the magnetron 10, and finally the button 57 is flicked into the position for energizing or

running the oven 1. The magnetron 10, then having its
idle temperature, emits microwaves at its maximum power
Pn, these accelerating the cooking of this dish or the
reheating of this tea, and heats up gradually. This slow
5 rise in the temperature of the magnetron is due to the
thermal inertia of its mass.

After a preset time at which the temperature of
the magnetron or of one or more of the power-supply and
cooling accessories, taken as reference, also attains its
10 or their limit operating temperature, the switch 41 which
functions in synchronization with the programmer 55,
automatically changes the operating power of the
magnetron 10 by disconnecting the capacitor 39 for
running the magnetron at its maximum power Pn, immedi-
15 ately connecting the capacitor 38 for operating the
magnetron 10 at its normal running power, and maintains
this normal running power of the magnetron 10 up to the
conclusion of the treatment cycle, that is to say to the
conclusion of the cooking of the dish or the reheating of
20 the tea.

If the chosen fast-treatment time is less than
the time for reheating the magnetron or one or more of
the power-supply and cooling accessories, taken as
reference, to its or their limit operating temperature,
25 the programmer 55 normally stops the operation of the
oven at the conclusion of this chosen treatment time and
simultaneously the switch 41 is automatically restored to
its normal electrical link 44-45, that is to say it is
connected to the capacitor 38 for operating the magnetron
30 10 at its normal running power. In this case, throughout
this chosen fast-treatment time, the magnetron 10
operates at its maximum power Pn.

By virtue of the invention, the microwave oven 1
has thus shortened the treatment time for foods or drinks
35 without compelling the magnetron 10 and the power-supply
and cooling accessories to operate above their limit
working temperature and consequently without curtailing
their lifetime and without compromising the quality of
the treatment.



CLAIMS

1. Microwave oven of the type comprising a control and microwave-production system (5) including a magnetron (10, 14) connected across the terminals of a transformer (25), a rectifying diode (20, 33) wired in parallel with the magnetron so that the cathode of the diode is connected to the anode (35) of the magnetron, a first capacitor (38) connected in series between the magnetron (10) and the secondary of the transformer (25) and allowing operation of the magnetron (10) at a first power, a second capacitor (39) capable of being connected between the magnetron and the said secondary and allowing operation of the magnetron (10) at a second power, and a switch (41) for selecting between operation at the first power and operation at the second power, the oven being characterized in that the second power corresponds to the maximum power P_n of the magnetron and the first power to a predetermined normal running power which is less than the maximum power P_n ,
- 20 in that the said switch includes a first and a second terminal joined respectively to the first and to the second capacitor, and a third terminal joined to the secondary of the transformer in order to establish a series electrical connection between the said secondary and the first or the second capacitor,
- 25 and in that the said switch furthermore includes an operating button (50), a timer (51) and a latching device (52) which is controlled by a temperature sensor (53), which allow:
- 30 - either manual disconnection of a normal electrical link (44, 45) and manual connection of a preset-time electrical link (44-46), that is to say the disconnecting of the magnetron (10) from its electrical link allowing operation at its normal running power and the connecting of this magnetron (10) to an electrical link permitting preset-time operation at its maximum power P_n , when the temperature of this magnetron (10) or of its supply and cooling accessories, taken as reference and picked up by the sensor (53), is less than its or their limit



operating temperature,

- or the locking of the operating button (50), that is to say the maintaining of this normal electrical link (44-45) by the latching device (52) when the temperature
5 of this magnetron (10) or of its supply and cooling accessories, taken as reference and picked up by the sensor (53), is equal to or greater than its or their limit operating temperature.

2. Oven according to Claim 1, characterized in that
10 the switch (41) is, after preset-time operation of the magnetron (10) at the maximum power via the electrical link (44-46), automatically returned to its normal electrical link (44-45).

3. Oven according to one of Claims 1 and 2, having
15 a programmer (55) which allows the energizing or de-energizing of a primary of the transformer (25), the selection of a thawing, reheating or cooking treatment and the choice of a treatment time, characterized in that the control device (28) of the control and microwave-
20 production system (5) includes an electronic circuit which ensures synchronization of operation between the programmer (55) and the switch (41) upon a change of operating power of the magnetron (10).