

Description

[0001] The present invention relates to a microwave oven that is capable of preventing the outbreak of fire due to an erroneous operation of the microwave oven caused by a surge current.

[0002] When startup power is applied to general household electrical appliances including a microwave oven, a surge current much larger than a common current may flow and cause damage to the electrical appliances.

[0003] In conventional microwave ovens, current limiting resistors are used to prevent the surge current, which will be described below in conjunction with Figure 1.

[0004] Figure 1 shows a circuit diagram of a conventional microwave oven in which cooking time and power levels are manually set by a user.

[0005] First and second power lines L1 and L2 for inputting a common Alternating Current (AC) are connected to both ends of a primary coil 7a of a High Voltage Transformer (HVT) via a noise filter 1. The noise filter 1 suitably comprises a main fuse FUSE1, condensers C1-C3, an inductor L, and a resistor R1.

[0006] The first power line L1 is connected in series with a magnetron temperature sensor TCO1 which is turned on/off depending on the temperature of a magnetron MGT so as to prevent the overheating of the magnetron MGT, a first door switch SW1 which is turned on/off depending on the opened/closed state of a door, an output control switch SW_{VP} which controls output of the microwave oven, and a monitor switch which monitors the opened/closed state of the door.

[0007] In addition, the second power line L2 is connected in series with a cooking chamber temperature sensor TCO2 which is turned on/off depending on the temperature of the cooking chamber to prevent the overheating of a cooking chamber, a timer switch SW_{TM} which controls heating time during cooking, a relay switch SW_{IR} which prevents a surge current, and a second door switch SW2 which is turned on/off depending on the opened/closed state of a door.

[0008] Further, a lamp 2, a fan motor 3, a driving motor 4 and a timer motor 5 are connected between the first power line L1 and the second power line L2. Here, the lamp 2, the fan motor 2 and the timer motor 5 are driven by a power voltage (AC 200V), while the driving motor 4 is driven by a low voltage (AC 21V) drawn from one side of a coil of the fan motor 4.

[0009] Suitably, the timer switch SW_{TM}, the output control switch SW_{VP} and the timer motor 5 are integrally formed within a cooking timer 8. The timer motor 5 has a plurality of rotating gears. Users can set cooking time and output by manipulating time control and output control knobs (not shown) formed on a body. After the setting of cooking time and output is completed, the timer switch SW_{TM} and the output control switch SW_{VP} are automatically actuated during a preset time. According-

ly, when the preset time elapses after the timer switch SW_{TM} connected between the cooking chamber temperature sensor TCO2 and the second door switch SW2 is turned on by the actuation of the timer motor 5 having a plurality of gears, the timer switch SW_{TM} is turned off, thus allowing a power source to be connected to or isolated from the lamp 2, the fan motor 3, the driving motor 4, etc.

[0010] An output control switch SW_{VP}, which is connected between the first door switch SW1 and the monitor switch SW_{MT}, controls the output of the microwave oven by being periodically turned on/off by the actuation of the timer motor, like the timer switch SW_{TM}. Accordingly, when the output control switch SW_{VP} is turned off, power is induced to the lamp 2, the driving motor 44, the fan motor 3, etc. On the other hand, when the output control switch SW_{VP} is turned on, power is induced to the high voltage transformer HVT so that the magnetron MGT generates a high frequency signal to cook food.

[0011] One side of the monitor switch SW_{MT} is connected to the primary coil 7a of the high voltage transformer HVT, while the other side of the monitor switch SW_{MT} is connected to the relay switch SW_{IR} via a monitor fuse FUSE2. The monitor switch SW_{MT} is connected in parallel to a relay coil 6a so as to turn on/off the relay switch SW_{IR}. The relay switch SW_{IR} and the relay coil 6a are implemented as a single relay 6, and are characterized by being operated after a preset time, for example, 20 - 40ms, elapses without an immediate operation when an external voltage is applied. In addition, the relay switch SW_{IR} is connected in parallel to a current limiting resistor R2.

[0012] In the prior art of Figure 1, a cement resistor having high resistance is commonly used as the current limiting resistor R2.

[0013] Accordingly, when power is applied to the relay coil 6a while the monitor switch SW_{MT} is turned on, the relay 6 turns the relay switch SW_{IR} on due to the operation characteristic after a certain time elapses. Accordingly, the relay switch SW_{IR} is turned on after a surge current is exhausted by the current limiting resistor R2, so the overload of driving circuits and the damage of the microwave oven can be prevented, the surge current having high counter-electromotive force that is generated by the high voltage transformer HVT immediately after startup power is applied.

[0014] However, when the power is applied to the relay coil 6a while the monitor switch SW_{MT} is turned on, abnormal conditions, in which the relay switch SW_{IR} maintains an off-state due to a defect (caused by melting, erroneous operation, etc.), can be generated although the relay switch SW_{IR} should be turned from an off-state to an on-state. When such abnormal conditions are generated, an alternating current is applied to the high voltage transformer HVT via the current limiting resistor R2. At this time, the current limiting resistor R2 is the cement resistor that has high resistance to prevent the surge current, so heat is irradiated due to the resist-

ance of the cement resistor until a certain time (about 30 seconds) elapses. The current limiting resistor R2 is cut off after a certain time elapses.

[0015] Accordingly, if electrical parts mounted on a printed circuit board inside the cooking chamber within which the current limiting resistor R2 is arranged, or signal lines connected to various kinds of sensors are melted by the heat generated by the current limiting resistor R2, there occur problems in that a insulation breakdown as well as an outbreak of fire can occur, resulting in the deterioration of product reliability.

[0016] The present invention has been made keeping in mind the above problems occurring in the prior art. An aim of the present invention is to provide a microwave oven, which can improve its reliability by preventing an insulation breakdown or an outbreak of fire due to the defects of electrical appliances.

[0017] The present invention provides a microwave oven, comprising an alternating power source; a cooking timer for setting cooking time; a relay for supplying the alternating power to a primary coil of a high voltage transformer, the relay comprising a relay coil and a relay switch responding to the operation of the cooking timer; and a current limiting means for attenuating a surge current produced when the alternating power is applied through the relay, the current limiting means being characterized in that its resistance increases in proportion to internal temperature of the current limiting means.

[0018] Preferably, the current limiting means may be a positive temperature coefficient thermistor which is cut off when the internal temperature is higher than a preset temperature, and connected in parallel to the relay switch.

[0019] Preferably, the current limiting means may be configured to attenuate the surge current until the relay coil starts to operate the relay switch in order to provide the alternating power.

[0020] Preferably, the current limiting means may be connected in serial to a power line electrically connecting the cooking timer to the high voltage transformer, and the power line may be arranged in the vicinity of a printed circuit board for supporting electrical parts and a signal line for connecting the electrical parts to the printed circuit board.

[0021] Also according to the present invention there is provided a microwave oven comprising an alternating power source; a cooking timer for setting cooking time; a power supply means for supplying the alternating power to a heating means during the cooking time set by the cooking timer; and a current limiting means for attenuating a surge current produced when the alternating power is applied through the power supply means, the current limiting means being characterized in that its resistance increases in proportion to internal temperature of the current limiting means.

[0022] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of

example, to the accompanying diagrammatic drawings in which:

Figure 1 is a circuit diagram of a conventional microwave oven; and

Figure 2 is a circuit diagram of a microwave oven according to the present invention.

[0023] Figure 2 is a circuit diagram of a microwave oven according to the present invention. Since the constitution of basic parts of the circuit has already been described with reference to the prior art of Figure 1, a detailed description will not be provided here.

[0024] The preferred embodiment of the present invention is characterized in that a Positive Temperature Coefficient (PTC) thermistor is connected in parallel to the relay switch SW_{IR} .

[0025] A PTC thermistor has a resistance that increases suddenly as its internal temperature increases due to a phase transition when its internal temperature reaches a certain temperature.

[0026] The PTC thermistor is a kind of n-type oxide semiconductor that obtains conductivity by adding a very small amount of rare earth elements to $BaTiO_3$. Curie temperature of the n-type oxide semiconductor can be shifted by substituting Sr or Pb for a portion of Ba.

[0027] When power is applied to the relay coil 6a while the monitor switch SW_{MT} is turned on, the relay 6 turns the relay switch SW_{IR} on after a certain time elapses. Accordingly, the relay switch SW_{IR} is turned on after a surge current is attenuated by the PTC thermistor, so the damage of driving circuits due to the surge current can be prevented, the surge current having high counter-electromotive force that is generated by the high voltage transformer HVT immediately after startup power is applied.

[0028] In addition, in the case where abnormal conditions are generated due to defects of the relay switch SW_{IR} , if the relay switch SW_{IR} maintains an off-state even when the power is applied to the relay coil 6a in the state that the monitor switch SW_{MT} turned on, the alternating power is applied to the high voltage transformer HVT via the PTC thermistor.

[0029] Since the PTC thermistor is characterized in that its resistance increases with the increase of its internal temperature, it is cut off automatically when the internal temperature reaches a preset temperature (about 100 °C). According to such a characteristic, the PTC thermistor is cut off within a very short time, for example, about one second, under the abnormal conditions. In other words, no adverse effect is given to the electrical parts mounted on the printed circuit board or any signal line even under the abnormal conditions.

[0030] As described above, the present invention provides a microwave oven which uses a PTC thermistor connected to a relay switch for attenuating a surge current before the operation of the relay switch in the mi-

crowave oven in which users set cooking time and output. Since the PTC thermistor is characterized in that its resistance increases with the increase of its internal temperature, it is cut off within a short time (about one second) when the internal temperature reaches a preset temperature even when it maintains an off-state due to defects of the relay switch, so that an insulation breakdown or an outbreak of fire due to the defects of electrical appliances can be prevented, resulting in improvement of product reliability.

[0031] Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope of the invention as disclosed in the accompanying claims.

[0032] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0033] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0034] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0035] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A microwave oven comprising:

an alternating power source;

a power supply means for supplying the alternating power to a heating means (MGT); and

a current limiting means (PTC) for attenuating a surge current produced when the alternating power is applied through the power supply means;

characterized in that:

the current limiting means has a resistance that increases in proportion to internal temperature of the current limiting means.

2. The microwave oven of claim 1, comprising:

a cooking timer (8) for setting a cooking time;

wherein the power supply means supplies power during the cooking time set by the cooking timer (8).

3. The microwave oven of claim 2, wherein the power supply means comprises a relay for supplying the alternating power to a primary coil (7a) of a high voltage transformer, the relay comprising a relay coil (6a) and a relay switch (SW_{IR}) responding to operation of the cooking timer (8).

4. The microwave oven according to claim 3, wherein the current limiting means is connected in parallel to the relay switch (SW_{IR}).

5. The microwave oven according to claim 4, wherein the current limiting means (PTC) is configured to attenuate the surge current until the relay coil (6a) starts to operate the relay switch (SW_{IR}) in order to provide the alternating power.

6. The microwave oven according to claim 2 or any claim dependent thereon, wherein the current limiting means (PTC) is connected in series to a power line electrically connecting the cooking timer (8) to a high voltage transformer (HVT), and the power line is arranged in the vicinity of a printed circuit board for supporting electrical parts and a signal line for connecting the electrical parts to the printed circuit board.

7. The microwave oven according to any preceding claim, wherein the current limiting means is a PTC thermistor which is cut off when the internal temperature is higher than a preset temperature.

FIG. 1
(PRIOR ART)

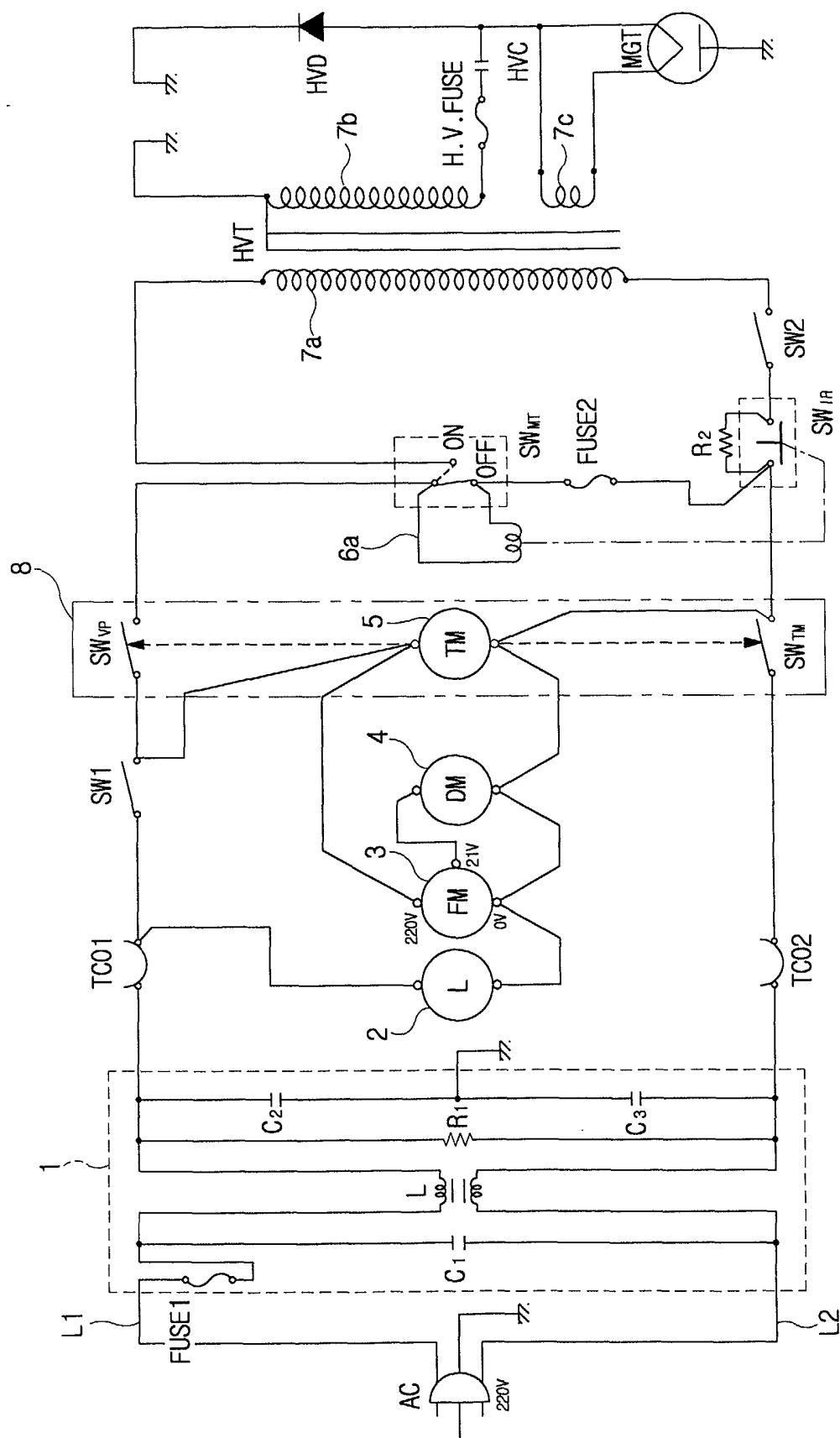


FIG. 2

