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(54) **Power supply unit for microwave ovens**

Stromversorgungseinheit eines Mikrowellenherdes

Ensemble d'alimentation pour un four à micro-ondes

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(56) References cited:
EP-A- 0 449 275 **US-A- 4 835 353**

- **PATENT ABSTRACTS OF JAPAN vol. 13, no. 429 (E-823)25 September 1989**
- **PATENT ABSTRACTS OF JAPAN vol. 14, no. 79 (E-888)14 February 1990**
- **PATENT ABSTRACTS OF JAPAN vol. 3, no. 85 (E-124)21 July 1979**
- **PATENT ABSTRACTS OF JAPAN vol. 15, no. 438 (E-1130)8 November 1991**
- **PATENT ABSTRACTS OF JAPAN vol. 13, no. 594 (E-867)27 December 1989**
- **PATENT ABSTRACTS OF JAPAN vol. 13, no. 429 (E-823)25 September 1989**
- **PATENT ABSTRACTS OF JAPAN vol. 15, no. 106 (E-1044)13 March 1991**
- **DATABASE WPI Week 7641, Derwent Publications Ltd., London, GB; AN 76-K0246X**

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Description

This invention relates to a power supply unit for a microwave oven which is provided with a step-up transformer having a gap in its iron core and wherein a secondary side voltage of the step-up transformer is applied to a filament of the magnetron.

Conventional microwave ovens are provided with a step-up transformer having at least a secondary winding from which a voltage is applied across an anode and a cathode of a magnetron via a voltage doubler rectifier circuit comprising a capacitor and a diode and a tertiary winding from which a voltage is applied across ends of a filament serving as the cathode.

A large current flows in the anode of the magnetron during drive of the magnetron for the cooking. This large current causes the magnetron to generate heat. The inventors have found that a filament voltage of the magnetron drops with increase in the temperature of a magnet of the magnetron and that the drop of the filament voltage renders the operation of the magnetron unstable. The reason for this is considered to be as follows: a magnetic force of the magnet of the magnetron is reduced with increase in the temperature of the magnet comprising a permanent magnet. The reduction of the magnetic force of each magnet lowers an anode voltage necessary for an anode current to flow in the magnetron. Consequently, the anode current begins to flow before its sufficient rise at every time of start of an intermittent operation of the magnetron, which results in insufficient charge of the capacitor of the voltage doubler rectifier circuit. Accordingly, the filament voltage is not raised to a rated value since a terminal voltage of the secondary winding is not sufficiently raised and an induced voltage of the tertiary winding magnetically coupled to the secondary strongly is not sufficiently raised, either.

In the prior art, however, no measure has been taken against the drop of the filament voltage. Accordingly, the operation of the magnetron is rendered unstable depending upon the degree of drop of the filament voltage.

The filament voltage tends to be lowered as the heating output is lowered as far as the inventors has found, as shown in FIG. 10. Consequently, when the temperature of the magnetron is increased in the condition that the heating output is low, the filament voltage drops below a lower limit operating voltage, which results in interruption of the operation of the magnetron.

JP-A-1-159935 discloses a magnetron driver device in which a gap is formed between a core on which primary and secondary windings of a high-frequency transformer driving a magnetron are wound and a core on which a tertiary winding is wound so that a magnetic coupling force is weakened between the primary and tertiary windings, whereby an electromotive force induced in the tertiary winding is maintained at approximately a constant value irrespective of variations of a primary winding voltage.

EP-A-0 449 275 discloses a microwave oven with an invertor control power source which produces a microwave by the use of the magnetron in relation to the high frequency power generated by the invertor control power source. Heat sensitive ferreit beads provided on the lead wire for transmitting the high frequency power to the magnetron change the inductance of the wire from the high level to the low level at around a threshold temperature lower than the working equilibrium temperature of the magnetron. The cathode filament current remains within the allowable range and moding of the magnetron is prevented.

JP-A-3-183361 discloses a switching regulator for a high-frequency transformer having a primary winding receiving an oscillating current from a switching circuit and first and second secondary windings applying a voltage to a load. The high-frequency transformer is formed with a gap in a core on which the second secondary winding is wound. The gap is automatically varied by an adjusting device. The degree of magnetic coupling between the primary and second secondary windings can be controlled by varying the gap, whereupon the degree of variation in an output voltage of the second secondary winding is suppressed by adjustment of the gap even when a voltage applied to the primary winding is varied to a large extent so that an output voltage of the first secondary winding is maintained at a constant value.

Therefore, an object of the present invention is to provide a power supply unit for microwave ovens wherein the drop of the filament voltage can be prevented so that the magnetron can be normally operated even when the temperature of the magnetron is increased by execution of the heating for the cooking.

The present invention provides a power supply unit for a microwave oven provided with a magnetron generating high frequency waves for heating food, the power supply unit comprising an inverter converting an AC voltage to a DC voltage and further converting the DC voltage to a high frequency voltage, a step-up transformer stepping up the high frequency voltage delivered from the inverter, the step-up transformer having an iron core and a gap formed to extend across a magnetic path of the iron core, and a rectifier circuit converting an AC voltage delivered from the step-up transformer to a DC voltage, which DC voltage is applied to the magnetron, characterized by gap adjusting means for adjusting the length of the gap with increase in the temperature thereof in accordance with variations in an ambient temperature such that the length of the gap is reduced.

In accordance with the above-described power supply unit, the magnetic force of the magnet of the magnetron is reduced with increase in its temperature when the magnetron is repeatedly driven. In this state, the gap adjusting means provided in the gap of the step-up transformer responds to the temperature increase such that the length of the gap is reduced. Consequently, an average magnetic permeability of the iron core of the step-up transformer is increased and accordingly, an induced voltage of the step-up transformer tertiary winding deliv-

ering the filament voltage is raised. Thus, the filament voltage can be prevented from dropping with reduction in the magnetic force of the magnetron magnet, which can provide stable operation of the magnetron.

The gap adjusting means may comprise a thermally responsive member disposed in the gap of the iron core of the step-up transformer and changing dimensions thereof in accordance with the ambient temperature.

The gap adjusting means may further comprise voltage detecting means for detecting an output voltage of the tertiary winding of the step-up transformer, thereby generating a detection signal and an actuator adjusting the length of the gap of the iron core of the step-up transformer in accordance with variations in the output voltage of the tertiary winding in response to the detection signal from the voltage detecting means.

The gap adjusting means may further comprise ambient temperature sensing means for detecting the ambient temperature, thereby generating a temperature signal and an actuator adjusting the length of the gap of the iron core of the step-up transformer in accordance with variations in the ambient temperature in response to the temperature signal from the ambient temperature sensing means.

The invention will be described, merely by way of example, with reference to the accompanying drawings in which:

FIG. 1 is an electrical wiring diagram of a microwave oven incorporating a power supply unit of a first embodiment of the invention;
FIG. 2 is a perspective view of the power supply unit including an inverter;
FIG. 3 is a diagrammatic view of a step-up transformer employed in the power supply unit;
FIG. 4 is a graph showing the relationship between the temperature change of a shape memory plastics and variations in the length of the gap of the step-up transformer core;
FIG. 5 is a graph showing the relationship between the length of the gap of the step-up transformer core and the filament voltage;
FIG. 6 is a graph showing the relationship between the temperature change and variations in the filament voltage;
FIG. 7 is a view similar to FIG. 3 showing a second embodiment of the invention;
FIG. 8 is a schematic side view of the microwave oven showing the arrangement of the machine compartment;
FIG. 9 is a view similar to FIG. 1 showing the second embodiment; and
FIG. 10 is a graph showing the relationship between the heating output and the filament voltage in the prior art.

A first embodiment of the present invention will now be described with reference to FIGS. 1 through 6. Referring to FIG. 2, a power supply unit 1 for a microwave oven comprises a unit of an inverter circuit 3, a unit of a voltage doubler rectifier circuit 4, a step-up transformer 6 and an electronic part 7. These parts are disposed on a substrate 5 mounted on a support frame 2.

Referring to FIG. 1, the inverter circuit 3 is connected to a commercial power supply 8. In the inverter circuit 3, an AC output voltage from the commercial power supply 3 is rectified and then, converted to a high frequency voltage, which voltage is supplied to a primary winding 6a of the step-up transformer 6. A secondary winding 6b of the step-up transformer 6 is connected between an anode 13a and a cathode 13b or filament through the voltage doubler rectifier circuit 4 comprising a high-voltage capacitor 9 and a high-voltage diode 10. The step-up transformer 6 is further provided with a tertiary winding or filament winding 6c magnetically coupled to the secondary winding 6b as well as to the primary winding 6a. The tertiary winding 6c is connected between ends of the cathode 13b (filament) of the magnetron 13.

Referring now to FIG. 3, an iron core 14 of the step-up transformer 6 comprises two generally U-shaped ferrite cores 14a and 14b arranged into an annular shape with a gap 16 therebetween to be opposite to each other. The primary winding 6a is wound on one of legs of the iron core 14 so as to extend over both ferrite cores 14a, 14b. The secondary winding 6b is wound so as to be concentric with the primary winding 6a. The tertiary or filament winding 6c is wound on a leg of the iron core 14 opposed to the leg on which the primary winding 6a is wound.

A non-magnetic, shape memory plastics 15 serving as a thermally responsive member is disposed in the gap 16 formed between the ferrite cores 14a, 14b. A leakage reactance is formed by the gap 16 so that a magnetic field around the iron core 14 is prevented from being saturated for the purpose of improvement of the high frequency characteristics. As shown in FIG. 4, the height of the shape memory plastics 15 disposed in the gap 16 of the iron core 14 and that is, the length of the gap 16 are reduced with increase in the ambient temperature.

In the operation, the high frequency voltage from the inverter circuit 3 is applied to the primary winding 6a of the step-up transformer 6 when the power supply is put to work. A secondary voltage is then developed in the secondary winding 6b. The secondary voltage is applied across the anode 13a and the cathode 13b of the magnetron 13 via the voltage doubler rectifier circuit 4. Simultaneously, another voltage is developed in the tertiary winding 6c and this voltage is applied as the filament voltage across ends of the cathode or filament 13b of the magnetron 13 such that the filament 13b generates heat. Consequently, since an anode current flows across the anode 13a and the cathode 13b, microwaves are radiated from the magnetron 13.

A large amount of power is consumed when the anode current flows in the magnetron 13. Accordingly, the temperature of the magnetron 13 is increased. The tem-

perature of the magnet provided for supplying the magnetic filed to the magnetron 13 is also increased with increase in the temperature of the magnetron 13. Consequently, the magnetic force of the magnet is reduced, which drops the anode voltage necessary for a predetermined current to flow in the magnetron 13. Thus, the voltage developed by the secondary winding 6b cannot be sufficiently raised and the raise of the filament voltage developed by the filament winding 6c is restricted accordingly.

However, the temperature of the shape memory plastics 15 is increased with increase in the ambient temperature due to the heating of the magnetron 13. The height of the shape memory plastics 15 in FIG. 3 is reduced with increase in its temperature and accordingly, the length of the gap 16 is reduced in accordance with the characteristic shown in FIG. 4. Consequently, the average magnetic permeability of the iron core 14 of the step-up transformer 6 is increased with reduction in the height of the gap 16, which raises the induced voltage of the filament winding 6c. The filament voltage is thus raised as shown in FIG. 5.

As described above, even when the filament voltage tends to drop with increase in the temperature of the magnetron 13, the gap 16 of the iron core 14 is reduced by the shape memory plastics 15 such that the filament voltage is raised. Thus, the filament voltage can be prevented from dropping.

FIG. 6 shows the relationship between the filament voltage and the anode temperature of the magnetron 13 or the magnet temperature of the magnetron 13 with lapse of time from the start of drive of the magnetron both in the prior art and in the present invention. As understood from FIG. 6, the increase in the temperature of the magnetron causes the filament voltage to drop below the lower limit operating voltage in the prior art when the temperature of the anode of the magnetron is increased. On the other hand, in the present invention, the filament voltage can be effectively prevented from dropping below the lower limit operating voltage in spite of the increase in the temperature of the magnetron.

Although the shape memory plastics 15 is employed as the thermally responsive member in the foregoing embodiment, a shape memory alloy with a relatively small magnetic permeability may be used instead. Further, one ferrite core 14a may be suspended from a shape memory alloy and the ferrite core 14a may be lowered with increase in the ambient temperature such that the gap 16 is reduced.

FIGS. 7 through 9 show a second embodiment of the invention. Referring to FIG. 7, a filament voltage detecting winding 6d is wound on the iron core 14 in the vicinity of the secondary winding 6b for detecting the filament voltage. Upon detection of the filament voltage, the filament voltage detecting winding 6d delivers a voltage signal in accordance with the magnitude of the detected output voltage of the secondary winding 6b. The shape memory plastics disposed in the gap 16 of the step-up transformer 6 in the first embodiment is eliminated in the second embodiment.

FIG. 8 shows the arrangement of a machine compartment of the microwave oven. A stepping motor 18 serving as an actuator is mounted on a waveguide 17 extending from the magnetron 13. One of two ends of a timing belt 20 is fixed to a pulley 19 mounted on the stepping motor 18. The other end of the timing belt 20 is secured to the upper end of the ferrite core 14a of the step-up transformer 6. Thus, the ferrite core 14a is suspended with the gap 16 of predetermined dimensions between the ferrite cores 14a and 14b.

Referring to FIG. 9, an output of the filament voltage detecting winding 6d is supplied to a control circuit 21 arranged on a printed circuit board. Based on the filament voltage from the filament voltage detecting winding 6d, the control circuit 21 delivers a control signal to a signal circuit 22. Upon receipt of the control signal, the signal circuit 22 drives the stepping motor 18 through a drive circuit 23. In this regard, the control circuit 21 delivers the control signal so that the gap 16 of the iron core 14 is reduced by the stepping motor 18 as the filament voltage drops.

When the filament voltage drops with increase in the temperature of the magnetron 13, the stepping motor 18 is driven to lower the ferrite core 14a so that the length of the gap 16 is reduced. Consequently, the filament voltage can be prevented from dropping as in the first embodiment even when the filament voltage tends to drop because of the heating of the magnetron 13.

Although the stepping motor 18 is driven based on the filament voltage in the foregoing embodiment, a temperature sensor 24 may be provided for sensing the temperature of the magnetron 13 instead of the filament voltage detecting winding 6d. The stepping motor 18 may be driven based on a temperature signal generated by the temperature sensor 24.

The foregoing disclosure and drawings are merely illustrative of the principles of the present invention and are not to be interpreted in a limiting sense. The only limitation is to be determined from the scope of the appended claims.

Claims

1. A power supply unit for a microwave oven provided with a magnetron (13) generating high frequency waves for heating food, the power supply unit comprising an inverter (3) converting an AC voltage to a DC voltage and further converting the DC voltage to a high frequency voltage, a step-up transformer (6) stepping up the high frequency voltage delivered from the inverter (3), the step-up transformer (6) having an iron core (14) and a gap (16) formed to extend across a magnetic path of the iron core (14), a rectifier circuit (4) converting an AC voltage delivered from the step-up transformer (6) to a DC volt-

age, which DC voltage is applied to the magnetron (13), characterized by gap adjusting means for adjusting the length of the gap (16) with increase in the temperature thereof in accordance with variations in an ambient temperature such that the length of the gap (16) is reduced.

2. A power supply unit according to claim 1, characterized in that the gap adjusting means comprises a thermally responsive member (15) disposed in the gap (16) of the iron core (14) of the step-up transformer (6) and changing dimensions thereof in accordance with the ambient temperature.

3. A power supply unit according to claim 1, characterized in that the step-up transformer (6) comprises a tertiary winding (6c) delivering a voltage applied to a cathode (13b) of the magnetron (13) and the gap adjusting means comprises voltage detecting means (6d) for detecting an output voltage of the tertiary winding (6c) of the step-up transformer (6), thereby generating a detection signal and an actuator (18) adjusting the length of the gap (16) of the iron core (14) of the step-up transformer (6) in accordance with variations in the output voltage of the tertiary winding (6c) in response to the detection signal from the voltage detecting means (6d).

4. A power supply unit according to claim 1, characterized in that the gap adjusting means comprises ambient temperature sensing means (24) for detecting the ambient temperature, thereby generating a temperature signal and an actuator (18) adjusting the length of the gap (16) of the iron core (14) of the step-up transformer (6) in accordance with variations in the ambient temperature in response to the temperature signal from the ambient temperature sensing means (24).

Patentansprüche

1. Stromversorgungseinheit für einen Mikrowellenherd, welche mit einem Magnetron (13) für die Erzeugung von Hochfrequenzwellen zum Erhitzen von Nahrungsmitteln versehen ist, wobei die Stromversorgungseinheit ausgestattet ist mit einem Wechselrichter (3) welcher Wechselspannung in Gleichspannung umwandelt und welcher desweiteren die Gleichspannung in eine Hochfrequenzspannung umwandelt, mit einem Aufwärtstransformator (6) der die von dem Wechselrichter (3) gelieferte Hochfrequenzspannung herauftransformiert, wobei der Aufwärtstransformator (6) einen Eisenkern (14) und einen Spalt (16) hat der so ausgelegt ist, daß er sich über einen magnetischen Pfad des Eisenkerns (14) erstreckt, mit einer Gleichrichterschaltung (4) welche eine von dem Aufwärtstransformator (6) gelieferte Wechselspannung in eine Gleichspannung umwandelt, wobei diese Gleichspannung an das Magnetron (13) angelegt wird, gekennzeichnet durch ein Spalteinstellmittel zum Einstellen der Länge des Spaltes (16) mit einer Zunahme der Temperatur desselben in Übereinstimmung mit den Änderungen in einer Umgebungstemperatur, so daß die Länge des Spaltes (16) verkleinert wird.

2. Stromversorgungseinheit gemäß Anspruch 1, dadurch gekennzeichnet, daß das Spalteinstellmittel ein thermisch reagierendes Glied (15) aufweist, welches in dem Spalt (16) des Eisenkernes (14) des Aufwärtstransformators (6) angeordnet ist und die Dimensionen desselben in Übereinstimmung mit der Umgebungstemperatur verändert.

3. Stromversorgungseinheit gemäß Anspruch 1. dadurch gekennzeichnet, daß der Aufwärtstransformator (6) ausgestattet ist mit einer tertiären Windung (6c). welche eine Spannung abgibt die an die Kathode (13b) des Magnetrons (13) angelegt ist, und daß das Spalteinstellmittel ein Spannungserfassungsmittel (6d) zur Erfassung einer Ausgangsspannung der tertiären Windung (6c) des Aufwärtstransformators (6) aufweist und dadurch ein Erfassungssignal erzeugt, und wobei ein Stellorgan (18) die Länge des Spaltes (16) des Eisenkerns (14) des Aufwärtstransformators (6) in Übereinstimmung mit den Änderungen der Ausgangsspannung der tertiären Windung (6c) als Reaktion auf das Erfassungssignal aus dem Spannungserfassungsmittel (6d) einstellt.

4. Stromversorgungseinheit gemäß Anspruch 1, dadurch gekennzeichnet, daß das Spalteinstellmittel ausgestattet ist mit einem Fühler für die Umgebungstemperatur (24) zwecks Erfassung der Umgebungstemperatur, und dadurch ein Temperatursignal erzeugt wird, und mit einem Stellorgan (18) zur Einstellung der Länge des Spaltes (16) des Eisenkerns (14) des Aufwärtstransformators (6) in Übereinstimmung mit den Änderungen der Umgebungstemperatur als Reaktion auf das Temperatursignal aus dem Fühler für die Umgebungstemperatur (24).

Revendications

1. Ensemble d'alimentation en énergie pour un four à micro-ondes pourvu d'un magnétron (13) engendrant des ondes à fréquences élevées en vue du chauffage d'aliments, l'ensemble d'alimentation en énergie comprenant un inverseur (3) pour la conversion d'une tension alternée en une tension continue et pour convertir en plus la tension continue en une tension à fréquence élevée, un transformateur élévateur de tension (6) pour augmenter la tension à

fréquence élevée délivrée par l'inverseur (3), le transformateur élévateur de tension (6) ayant un noyau en fer (14) et un entrefer (16) façonné de manière à s'étendre par-dessus le chemin magnétique du noyau de fer (14), un circuit redresseur (4) transformant une tension alternée délivrée par le transformateur élévateur de tension (6) en une tension continue, ladite tension continue étant appliquée au magnétron (13), caractérisé par un moyen d'ajustement de l'entrefer en vue de l'ajustement de la longueur de l'entrefer (16) avec un accroissement de sa température en fonction des variations d'une température ambiante de telle manière que la longueur de l'entrefer (16) est diminuée.

2. Ensemble d'alimentation en énergie selon la revendication 1, caractérisé en ce que le moyen d'ajustement de l'entrefer comprend un membre sensible à la température (15) disposé dans l'entrefer (16) du noyau de fer (14) du transformateur élévateur de tension (6) et modifiant ses dimensions en fonction de la température ambiante.

3. Ensemble d'alimentation en énergie selon la revendication 1, caractérisé en ce que le transformateur élévateur de tension (6) comprend un enroulement tertiaire (6c) fournissant une tension appliquée à une cathode (13a) du magnétron (13) et que le moyen d'ajustement de l'entrefer comprend un moyen de détecteur de tension (6d) pour détecter une tension de sortie de l'enroulement tertiaire (6c) du transformateur élévateur de tension (6), engendrant ainsi un signal de détection, alors qu'un actionneur (18) ajuste la longueur de l'entrefer (16) du noyau de fer (14) du transformateur élévateur de tension (6) en fonction des variations de la tension de sortie de l'enroulement tertiaire (6c) en réaction au signal de détection du moyen de détecteur de tension (6c).

4. Ensemble d'alimentation en énergie selon la revendication 1, caractérisé en ce que le moyen d'ajustement de l'entrefer comprend un moyen de détecteur de la température ambiante (24) pour détecter la température ambiante, engendrant ainsi un signal de température, et un actionneur (18) ajustant la longueur de l'entrefer (16) du noyau de fer (14) du transformateur élévateur de tension (6) en fonction des variations de la température ambiante en réaction au signal de température du moyen de détecteur de la température ambiante (24).

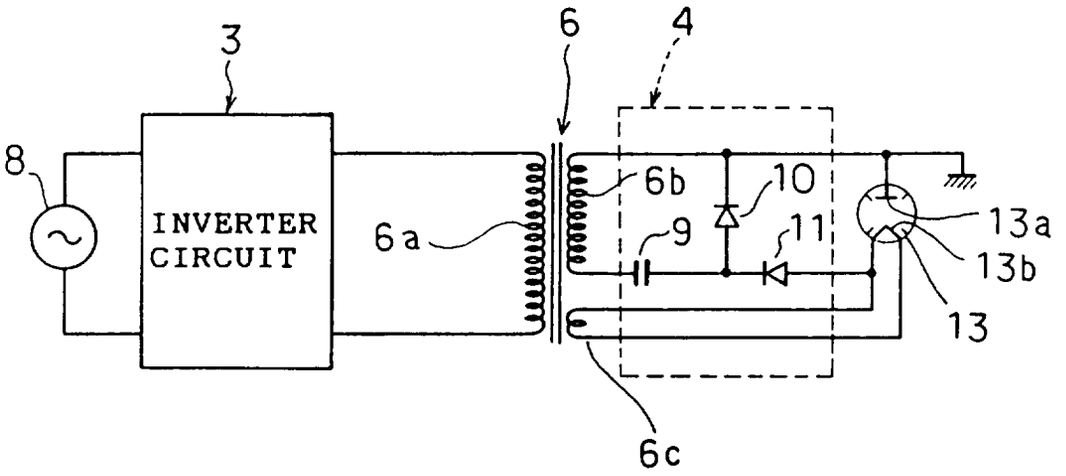


FIG.1

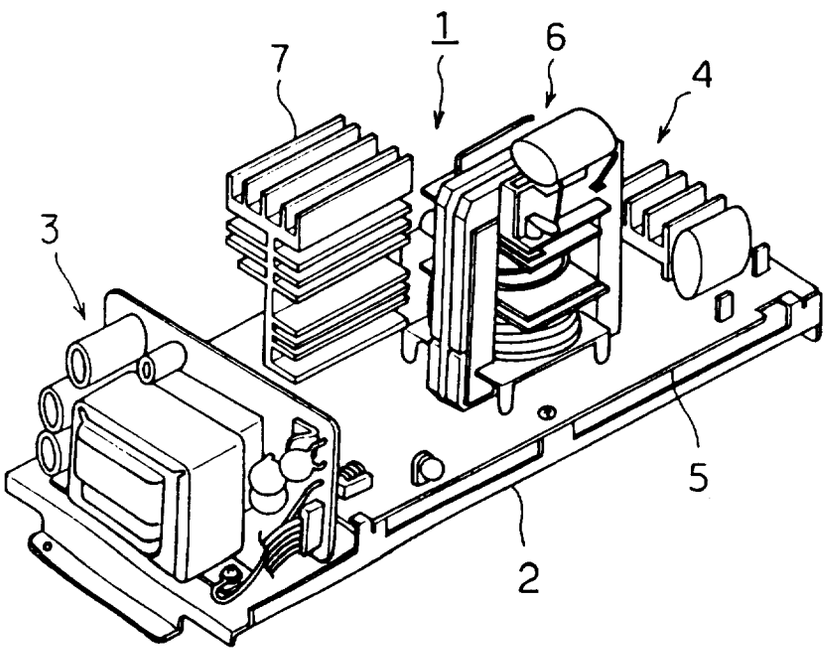


FIG.2

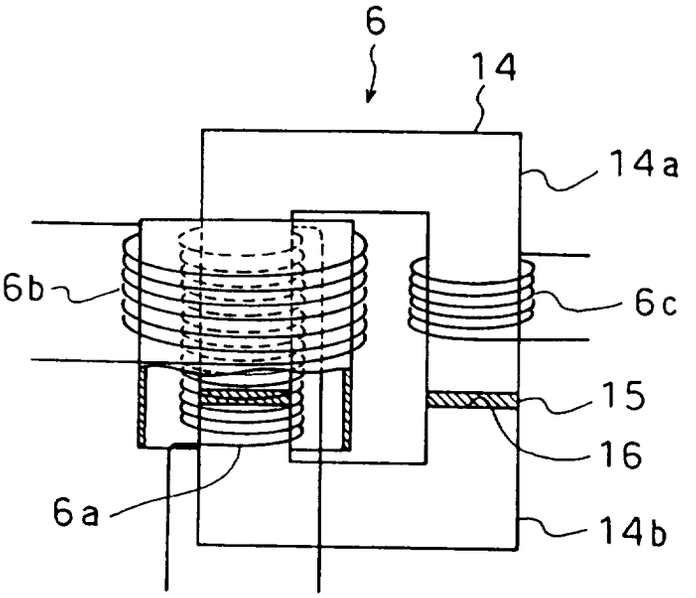

6
14
14a
6b
6c
15
16
6a
14b

FIG.3

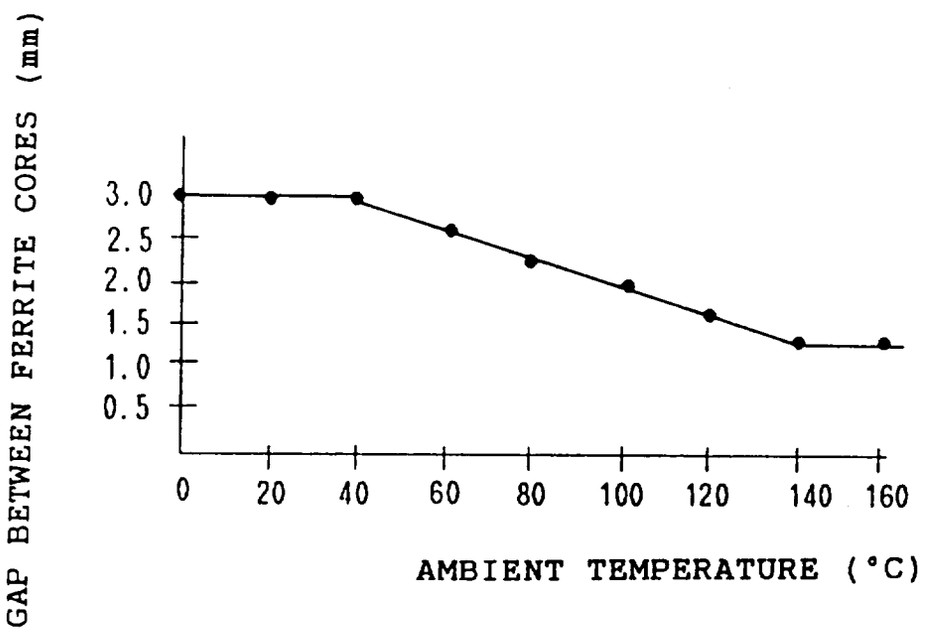

GAP BETWEEN FERRITE CORES (mm)
3.0
2.5
2.0
1.5
1.0
0.5
0
20
40
60
80
100
120
140
160
AMBIENT TEMPERATURE (°C)

FIG.4

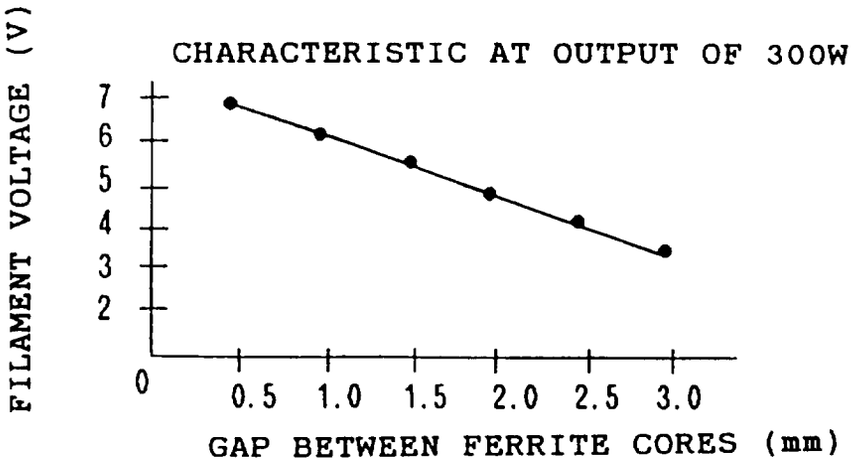

CHARACTERISTIC AT OUTPUT OF 300W
FILAMENT VOLTAGE (V)
7
6
5
4
3
2
0
0.5
1.0
1.5
2.0
2.5
3.0
GAP BETWEEN FERRITE CORES (mm)

FIG.5

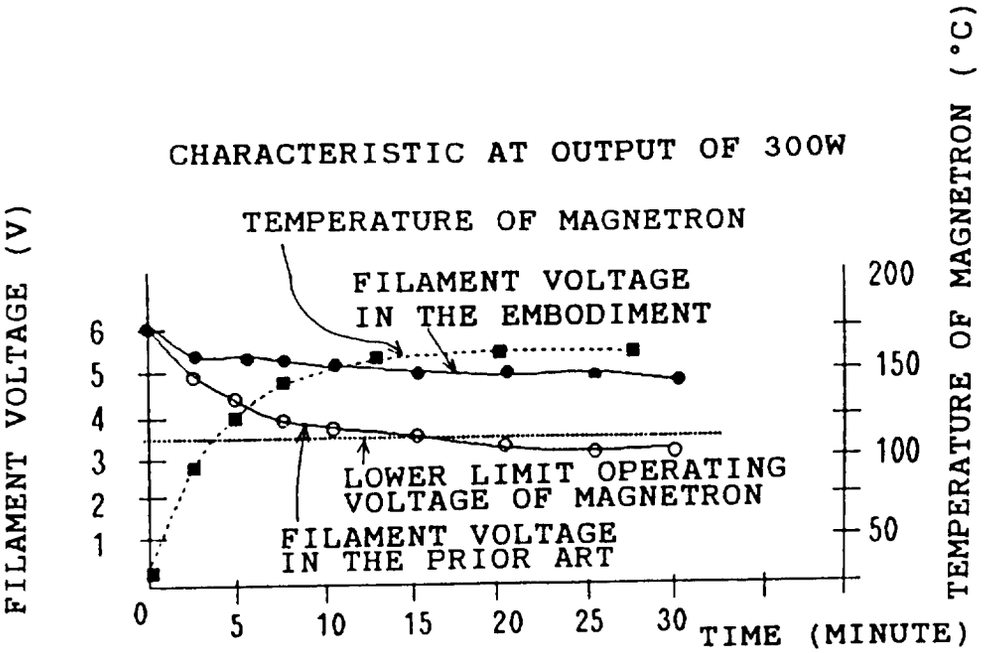

CHARACTERISTIC AT OUTPUT OF 300W
TEMPERATURE OF MAGNETRON
FILAMENT VOLTAGE IN THE EMBODIMENT
FILAMENT VOLTAGE (V)
6
5
4
3
2
1
200
150
100
50
TEMPERATURE OF MAGNETRON (°C)
LOWER LIMIT OPERATING VOLTAGE OF MAGNETRON
FILAMENT VOLTAGE IN THE PRIOR ART
0
5
10
15
20
25
30
TIME (MINUTE)

FIG.6

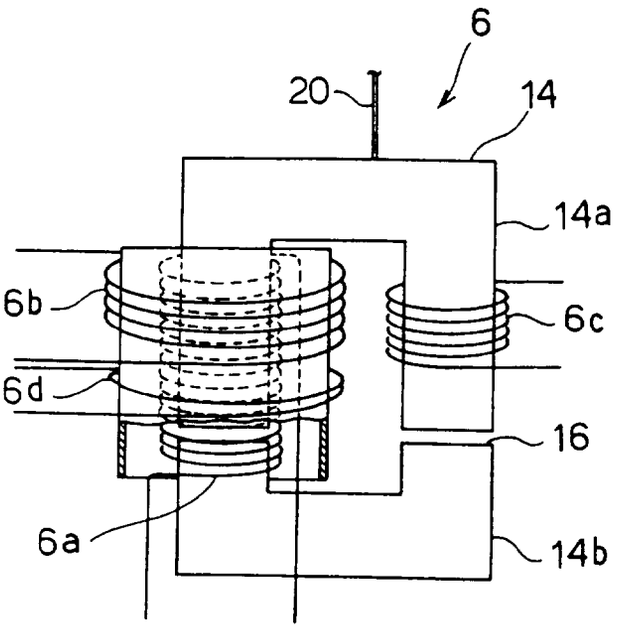


FIG.7

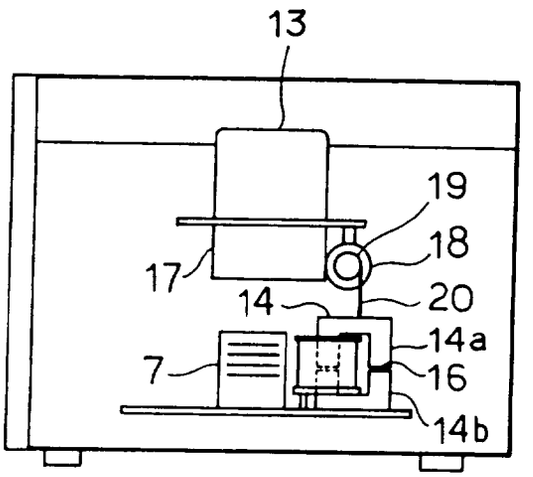


FIG.8

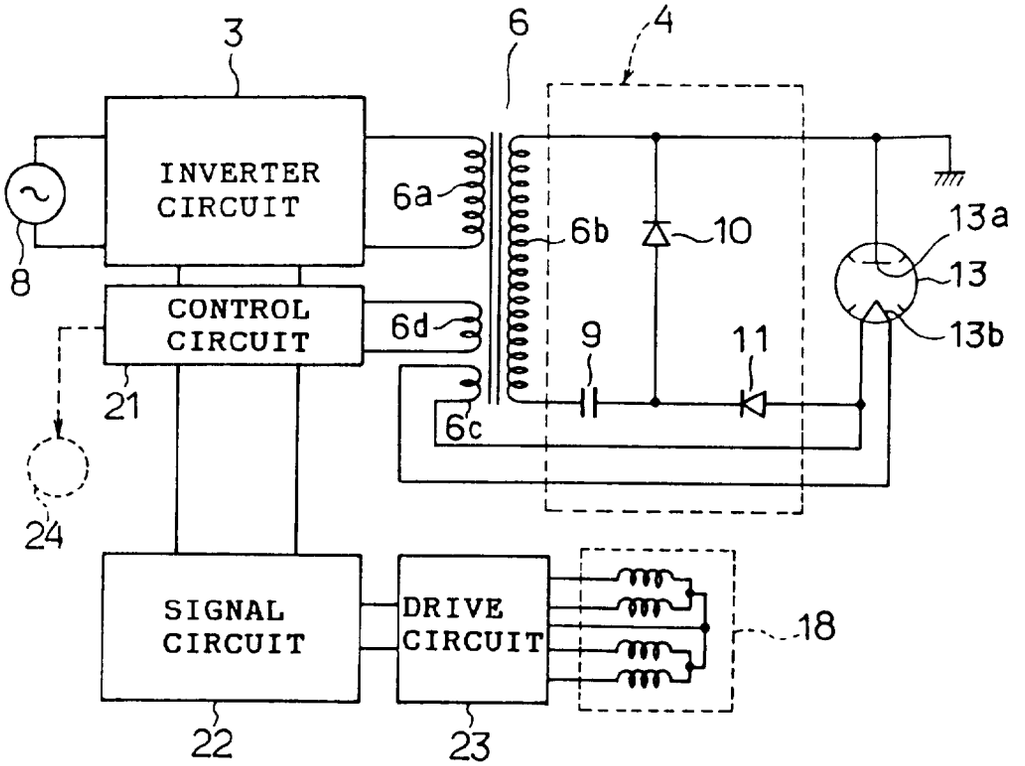


FIG.9

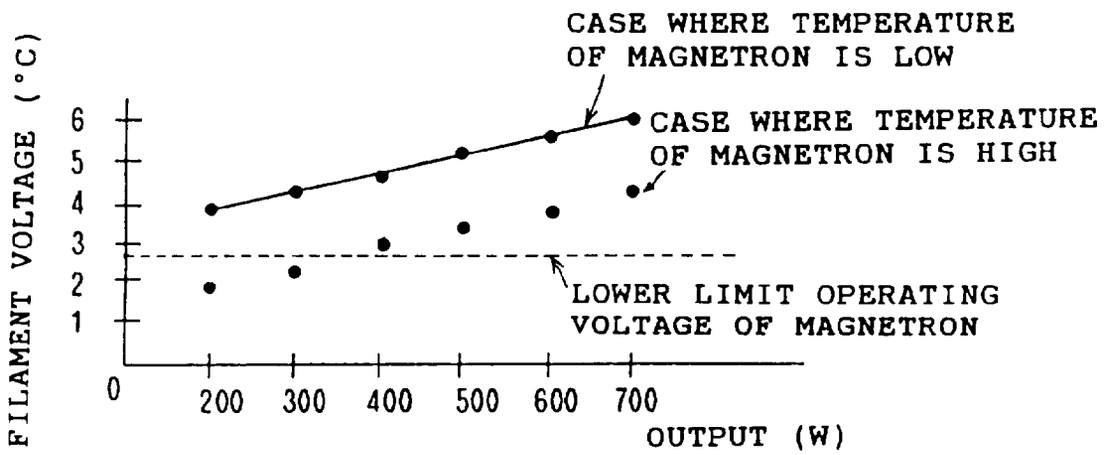


FIG.10 (PRIOR ART)