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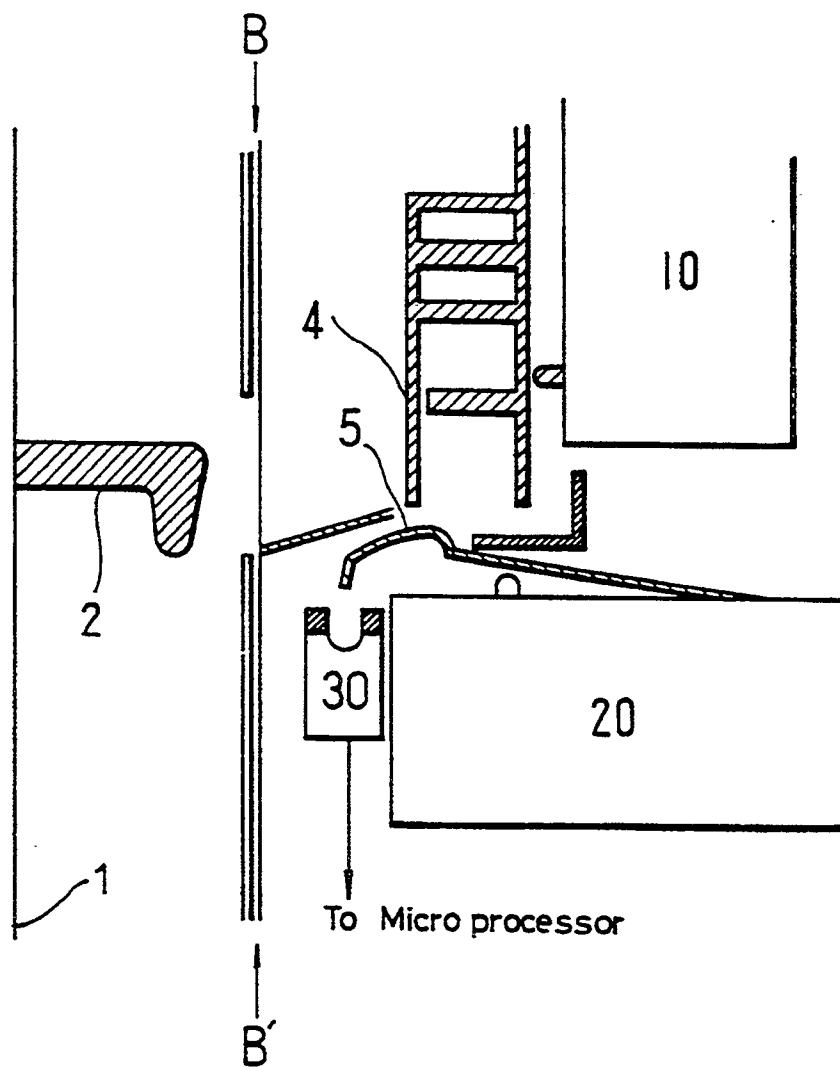
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(54) **Microwave oven's door opening and closing detection apparatus using photo-detecting sensor.**

(57) The invention relates to a microwave oven's door opening and closing detection apparatus using a photo-detecting sensor in order to detect a defect of a mechanical switch. It comprises a mechanical switch (20) for controlling a magnetron, a lever (5) actuated by a hook (2) attached to the door of the oven, a photo-detecting sensor (30) operating according to the lever (5) and a microprocessor receiving the output signals of the photo-detecting sensor (30) as well as the mechanical switch (20) and processing them for controlling the microwave oven by applying power to a transformer. It detects the state of the door by using the photo-detecting sensor (30) as well as the mechanical switch (20) and controls the microwave oven according to the state of the door by using the mounted microprocessor.

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F I G. 1



MICROWAVE OVEN'S DOOR OPENING AND CLOSING DETECTION APPARATUS USING PHOTO-DETECTING SENSOR

The invention relates to an apparatus for detecting whether microwave oven's door is open or closed, particularly to an apparatus for detecting a defect of a mechanical switch by using a photo-detecting sensor.

When a human body is exposed to microwaves generated at a microwave oven, the human body is seriously hurt. For example, if the human eye is exposed to microwaves, they can cause cataract.

In order to eliminate such a danger generated by exposing human body to microwaves, the conventional microwave oven uses a mechanical switch so that the range or oven operates only when its door is completely closed and microwaves do not leak.

However, because of mechanical abrasion due to extended use over a long period of time, the mechanical switch is quite in a state in which malfunction is possible. Therefore, the microwave oven may operate with its door not completely closed, so that it is possible that microwaves leak. Opening and closing of the microwave oven's door is detected by a microprocessor, which controls operation of the microwave oven according to the detected state, to prevent leakage of microwaves.

US-A-4 638 137 discloses such an apparatus as a typical example thereof. In such an apparatus the cooking time is input through keyboard, and, if the microwave oven's door is closed, a door key gives a pushing force to one part of a slide plate. A stop plate which is an integral part of a cooking start button prevents the slide plate from moving. However, if the cooking start button is pushed, the stop plate moves forward, so that the slide plate moves in the door key pushing direction and a heat start switch is closed. At this time, a switch connecting primary winding of a transformer to a power line is closed, and another switch moving together with said switch is closed, so that a signal informing that the heat start switch is closed is sent to a microprocessor. The microprocessor having received said signal energizes relay windings via a converter, such that a relay switch is closed and the primary winding of the transformer is connected with the power line. Therefore, power is applied to the primary winding through a switch moving together with the door, that is to say, when door is closed it is closed and when door is open it is open, thereby a magnetron operates and microwaves are generated.

Although a microprocessor understands opening and closing of the door through the mechanical switch which detects the state of the door and sends a signal corresponding to the state of door to the microprocessor, when the mechanical switch malfunctions, it is possible for the microprocessor to misunderstand the state of door.

Accordingly, it is the object of the invention to pro-

vide an apparatus which can prevent leakage of microwaves in case the mechanical switch is defect.

The invention resides in an apparatus of the kind referred to in claim 1.

5 The invention resides further in an apparatus of the kind referred to in claim 5.

Particular embodiments of the invention are set out in the dependent claims.

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

Fig. 1 shows a microwave oven's door opening and closing detecting apparatus in which a photo-detecting sensor is mounted according to the invention.

15 Fig. 2 shows a flow chart showing method of the invention which controls operation of the microwave oven according to state of its door by using a photo-detecting sensor.

20 Fig. 1 represents a schematic view showing an essential part of the apparatus according to the invention. As shown therein, a door 1 is hinged to the main body of a microwave oven. A door hook 2 is attached to the door 1. The door hook 2 can be moved into the inside of a latch apparatus B-B' through an opening provided in the latch apparatus B-B'. An elastic end of an operating plate 4 is fixed to the latch apparatus B-B' and the other end of the operating plate not fixed to the latch apparatus B-B' is forced to move by the door hook 2, so that a first microswitch 10 is turned on. Because the first microswitch 10 connects power to the primary winding of a transformer, when the door hook 2 pushes the operating plate 4 with the door 1 closed the transformer is connected to power.

35 Also, the distorted end of the door hook 2 pushes downward a lever 5 with the door hook 2 gone into the inside of the latch apparatus. When the lever 5 is pushed downward, the second microswitch 20 connected to the microprocessor is turned on.

40 A photo-detecting sensor 30 is mounted in front of the second microswitch 20. The photo-detecting sensor 30 comprises a light emitting element and a light receiving element. When the lever 5 is pushed downward the end of the lever 5 is inserted into the photo-detecting sensor 30. The photo-detecting sensor 30 is electrically connected to the microprocessor. When the lever 5 is inserted into the photo-detecting sensor 30, it sends an "off"-signal to the microprocessor, and, when the lever 5 is not inserted into the photo-detecting sensor 30, it sends an "on"-signal to the microprocessor.

45 Fig. 2 is a flow chart showing the operation of the microprocessor according to the invention.

When power is applied to the microwave oven

according to the invention, the microprocessor is ready to detect the state of the door (processing block 100). When the door hook 2 is inserted into the inside of the latch apparatus B-B', not only the end of the door hook 2 pushes the operating plate 4 in the direction of advancing the door hook 2 but also the distorted end of the door hook 2 pushes downward the lever 5. At this time, the second microswitch 20 is turned on with the lever 5 pushed downward. The first microswitch 10 is interposed between the primary winding of the transformer and the power line. When the operating plate 4 is pushed with the door 1 closed, the first microswitch 10 is turned on and, therefore, it connects the primary winding of the transformer to the power line. The second microswitch 20 is connected to the microprocessor. When the second microswitch 20 is turned on by the door hook 2, an "on" signal is sent to the microprocessor, so that the microprocessor decides that door 1 is normally closed (processing block 200). When the door 1 is normally closed, the microprocessor inquires whether or not the photo-detecting sensor 30 is turned on and decides the state of the photo-detecting sensor 30 at processing block 300. That is to say, when the lever 5 is inserted into the photo-detecting sensor 30, it sends an "off" signal to the microprocessor and when the lever 5 is not inserted into the photo-detecting sensor 30, it sends an "on" signal to the microprocessor. Therefore, the microprocessor decides the state of the door 1 once more. When the photo-detecting sensor 30 is turned off, the magnetron is driven during a period of time set by means of the keyboard (not shown), so that the microwave oven cooks food in its cooking chamber (processing block 800). When the photo-detecting sensor 30 is turned on, the microprocessor displays an error on a display board (processing block 400), and it performs the next operation (processing block 700). Here, the position of the photo-detecting sensor 30 which is turned on and off by the lever 5 can be adjusted up and down in a range to detect that an alien substance interposes between the door 1 and the opening of the cooking chamber. When the door 1 is abnormally closed, that is to say, when the second microswitch 20 is turned off, the microprocessor inquires whether or not the photo-detecting sensor 30 is turned on and decides the state of it at processing block 500. In case the photo-detecting sensor 30 is turned off, the microprocessor displays an error on the display board at processing block 400 and performs the next operation (processing block 700). In case the photo-detecting sensor 30 is turned on, the microprocessor performs the next operation (for example, stand by) at processing block 600.

In another embodiment of the invention, an apparatus according to the invention comprises a photo-detecting sensor and others without a mechanical switch. In this case, said lever 5 is substituted for a lever mounted in the latch apparatus instead of the

lever of the microswitch. We have the advantage that the number of elements is reduced and the working process is simple.

As described above, the invention detects the state of the door by using the mechanical switch and the photo-detecting sensor in order to prevent leakage of microwaves from the microwave oven, and it detects a defect of the mechanical switch, displays the state of door and gives alarm according to state of door.

Claims

1. An apparatus for detecting the opening or closing state of a door of a microwave oven, comprising:
 - at least one switch means (20) for controlling the magnetron of the microwave oven, said switch means comprising lever means (5) actuated by a hook (2) attached to the door (1) of the oven and
 - a microprocessor receiving an output signal of said switch means (20) and processing it for controlling the microwave oven by applying power to a transformer thereof, characterized by photo-detecting means (30) operating according to said lever means (5) and the output signal of which is additionally received from the microprocessor.
2. The apparatus according to claim 1, wherein said lever means (5) is inserted into said photo-detecting means (30) by the hook (2) and forces said photo-detecting means (30) to be turned on or off when the door (1) is closed.
3. The apparatus according to claim 1 or 2, wherein said photo-detecting means (30) comprises a light emitting element and a light receiving element.
4. The apparatus according to any of the claims 1 to 3, wherein the position of the photo-detecting means (30) is adjustable.
5. An microwave oven's door opening and closing detection apparatus controlling the microwave oven by detecting the state of the door according to the operation of the hook at time the microwave oven's door is closed, comprising :
 - at least one lever means (5) actuated by a hook (2) attached to the door (1) of the oven,
 - at least one photo-detecting means (30) operating according said lever means (5), and
 - a microprocessor receiving an output signal of said photo-detecting means (30) and processing it for controlling the microwave oven

by applying power to a transformer thereof.

6. The apparatus according to claim 5, wherein said lever means (5) is inserted into said photo-detecting means (30) by the hook (2) and forces said photo-detecting means (30) to be turned on or off when the door (1) is closed. 5
7. The apparatus according to claim 5 or 6, wherein said photo-detecting means (30) comprises a light emitting element and a light receiving element. 10

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F I G. 1

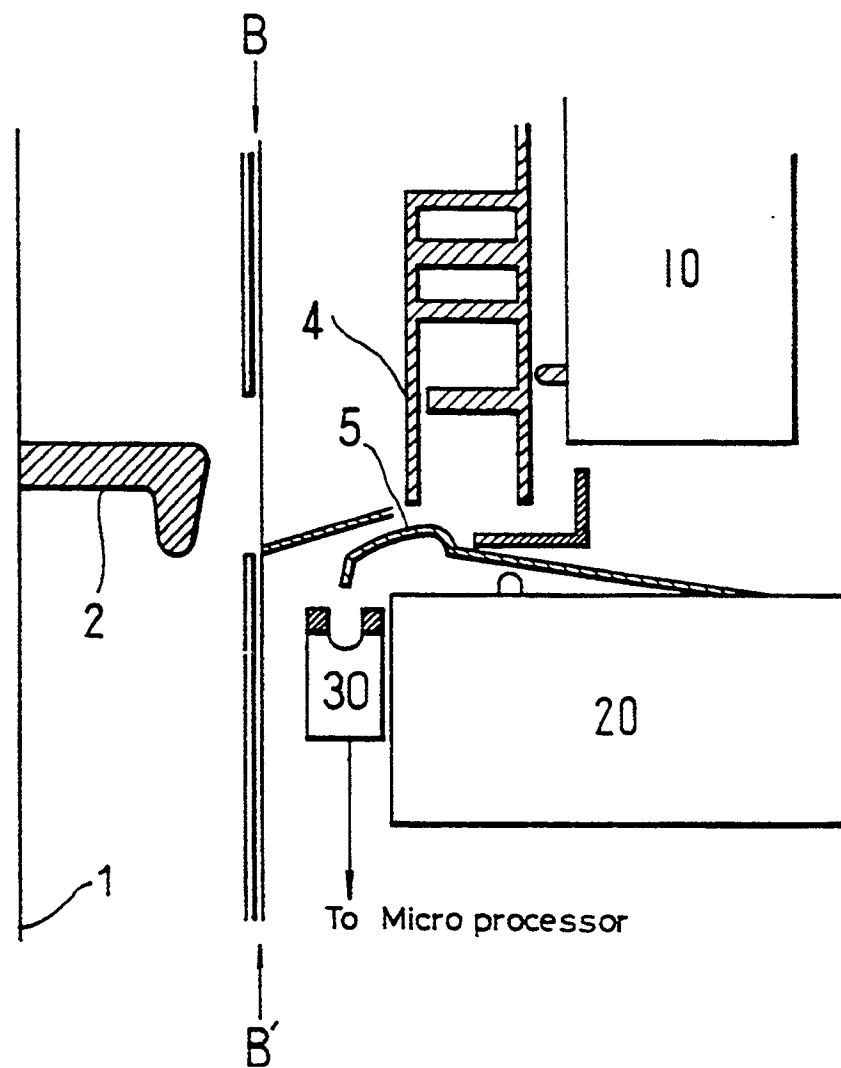
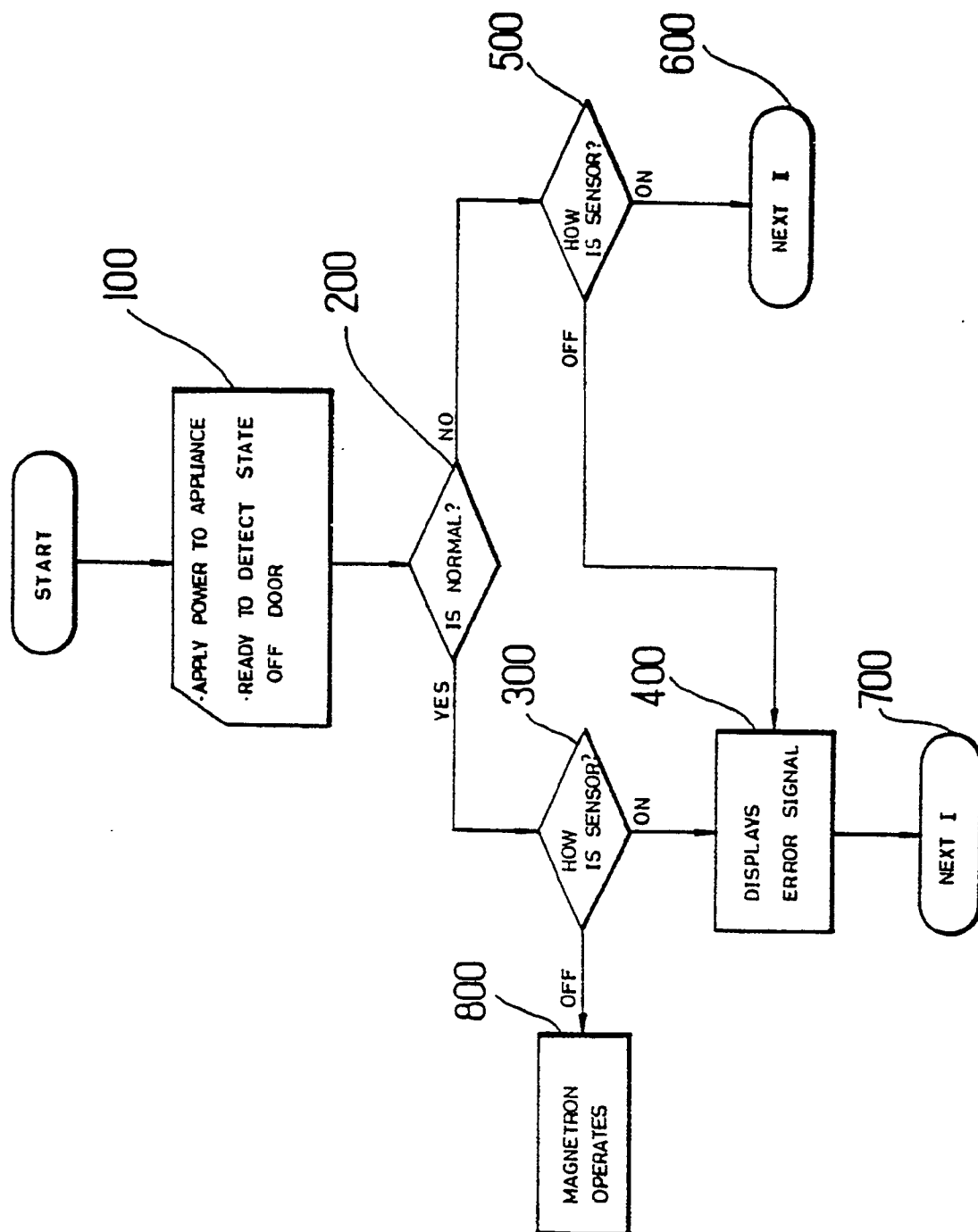


FIG. 2





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EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 91100007.3
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	<u>US - A - 4 638 137</u> (KAZUMI) * Abstract; column 3, line 13 - column 4, line 19; claims; fig. 4,5 * --	1,5	H 05 B 6/76 F 24 C 7/02
A	<u>US - A - 4 504 719</u> (TAYLOR) * Abstract; column 2, line 59 - column 3, line 23; fig. 3- 5 * --	1,5	
A	<u>US - A - 4 511 780</u> (OKAMURA) * Abstract; column 2, line 43 - column 3, line 17; fig. 6- 8 * ----	1,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F 24 C 7/00 H 05 B 6/00
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 28-03-1991	Examiner TSILIDIS
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			

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