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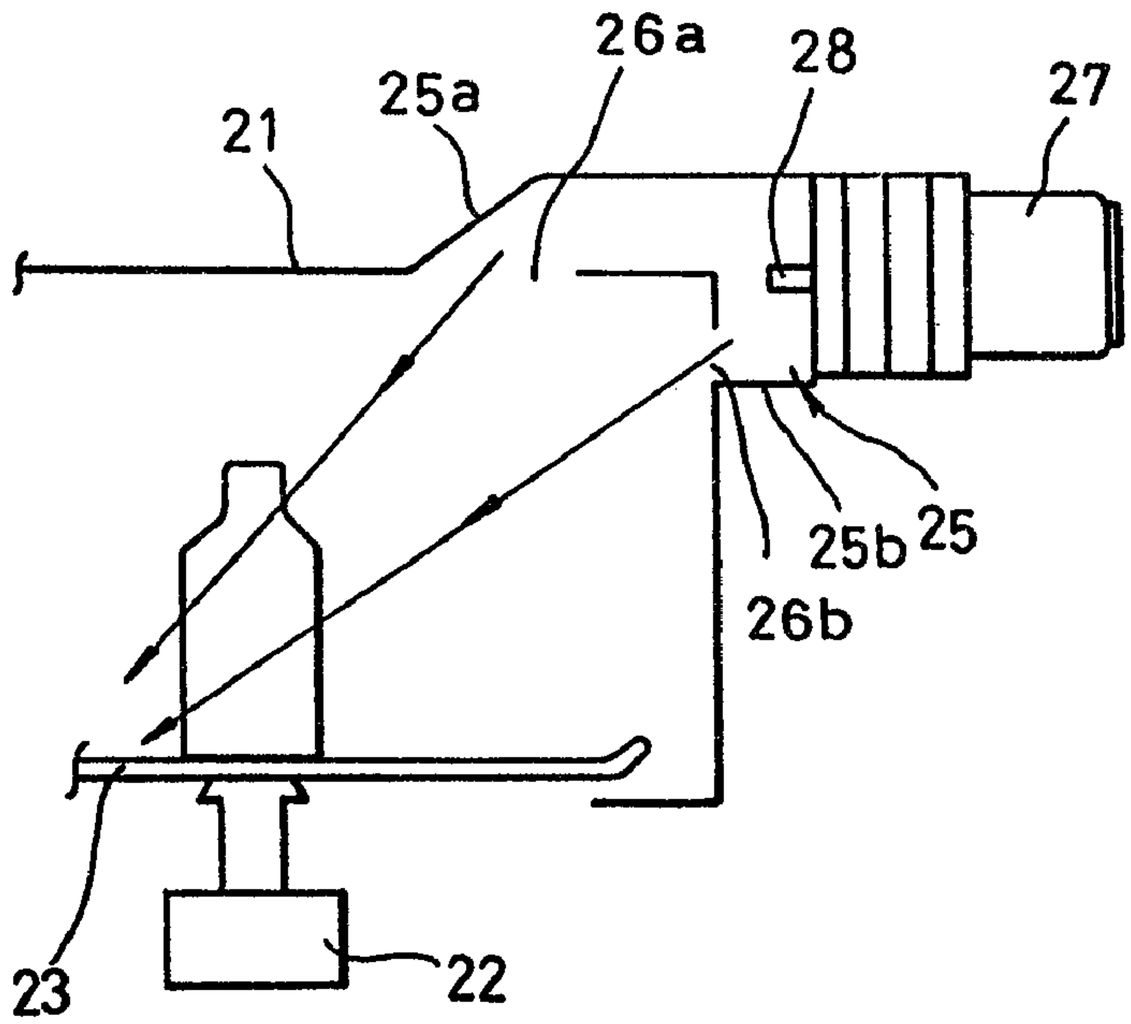
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(72) Joo, Pil Don, KR
(72) Lim, Kyung Sam, KR
(72) Lee, Kwan Ho, KR
(73) GOLDSTAR CO., LTD., KR

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(54) **GUIDE D'ONDES POUR FOUR A MICRO-ONDES**
(54) **WAVE GUIDE SYSTEM OF A MICROWAVE OVEN**




(57) The present invention provides a waveguide system for a microwave oven comprising a cavity for holding food to be cooked and having a plurality of microwave feed openings formed in one wall thereof; a magnetron having an antenna and positioned between the microwave feed openings in spaced apart relation to the wall having the feed openings, to generate microwaves having a wavelength of $\lambda_g$; and a waveguide to cover the feed openings, support thereon the magnetron and guide the microwave through the feed openings into the cavity and having a short circuited surface which is spaced apart from the antenna by a distance of approximately $\lambda_g/4$ and is parallel to the antenna. With this arrangement, the microwaves generated in the magnetron produce standing waves in the waveguide, and then are emitted into the cavity through the microwave feed openings of the cavity, thereby uniformly heating a food in the cavity.

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## ABSTRACT

The present invention provides a waveguide system for a microwave oven comprising a cavity for holding food to be cooked and having a plurality of microwave feed openings formed in one wall thereof; a magnetron having an antenna and positioned between the microwave feed openings in spaced apart relation to the wall having the feed openings, to generate microwaves having a wavelength of $\lambda_g$; and a waveguide to cover the feed openings, support thereon the magnetron and guide the microwave through the feed openings into the cavity and having a short circuited surface which is spaced apart from the antenna by a distance of approximately $\lambda_g/4$ and is parallel to the antenna. With this arrangement, the microwaves generated in the magnetron produce standing waves in the waveguide, and then are emitted into the cavity through the microwave feed openings of the cavity, thereby uniformly heating a food in the cavity.

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# WAVE GUIDE SYSTEM OF A MICROWAVE OVEN

## BACKGOUND OF THE INVENTION

### 1. Field of the Invention

This invention generally relates to microwave ovens, and more particularly a wave guide system for microwave ovens, which guide microwaves generated by a magnetron into the cavity of the oven through microwave feed openings in the wall of the cavity to heat food products located in the cavity.

### 2. Description of the Prior Art

Generally, a microwave oven is a cooker for dielectrically heating food products located in the cavity by use of microwaves which are generated by a magnetron and are directed by a waveguide into the cavity where they impinge upon the food products. Microwave ovens are classified into a single feed type, a dual feed type and a multiple feed type, depending upon the number of microwave feed openings in the oven for conducting microwaves into the cavity.

A conventional microwave oven of the single feed type is shown in Figs. 1a and 1b of the accompanying drawings. The oven comprises a cavity 301 having an internal space and a microwave feed opening 302 formed through one side wall thereof to conduct microwaves into the cavity; a tray 305 disposed centrally of the bottom of the cavity 301 to support a bed thereon, i.e. a food product and rotatably driven by a motor 306; a waveguide 303 disposed externally of the cavity 301 to surround the microwave feed opening 302 and be in communication with the feed opening; and a magnetron 304 mounted on the back of the waveguide 303.

With this construction, when electric power is applied to the microwave oven, the magnetron 304 generates microwaves, which are in turn introduced into the waveguide 303, and then emitted into the cavity 301 through the single microwave feed opening 302 of the side wall of the cavity to be incident upon the food on the rotating tray 305, thereby effecting cooking of the food through dielectrical heating action.

This prior microwave oven having the single microwave feed opening through which the microwaves pass to be directed to a food product in the cavity however has drawbacks as follows:

First, in cooking of planar food products such as a laver, a squid, a pizza and the like, uniform heating may not be achieved, so that the central portion of the food may be over-heated and burned. Second, when heating food products in relatively higher containers such as milk bottles, cups and the like, there may occur a phenomenon in which the upper portion of the container is heated more than the lower portion so that there occurs a heating temperature difference between the upper and lower portions of the container. As a result, heated liquid beverages such as milk, Chinese medicine or the like can cause discomfort to the consumer because of the temperature difference between the upper and lower areas of the liquid beverage in the container. Third, since food products are not heated uniformly, it is necessary to extend the cooking time in order to fully cook the portion receiving the heating, resulting in increased power consumption.

In order to overcome the problems of single feed type microwave ovens as described above, there has been proposed dual

feed type microwave ovens having two microwave feed openings formed in a side wall of the cavity, typical examples of which are disclosed in U. S. Patent No. 5,057,660 and European Patent Publication No. 0,478,053.

The prior art dual feed type microwave ovens as disclosed in the above patents will now be briefly described with reference to Figs. 2a, 2b, 3a and 3b of the accompanying drawings.

First, referring to Figs. 2a and 2b showing longitudinal cross-sectional and exploded fragmentary perspective views of the dual feed type microwave oven as disclosed in U. S. Patent No. 5,057,660, the oven comprises a cavity 201 having a pair of upper and lower microwave feed openings 206a, 206b formed in one side wall thereof; a pair of upper and lower heaters 202, 202 disposed in the cavity 201; a plurality of pairs of racks 204 formed at different spacings on the opposite side wall surfaces of the cavity 201 to allow a shelf 203 to be adjustable supported at selected heights depending upon the size of the loading placed on the shelf; and a planar cover plate 209 attached to the outer wall surface of the cavity 201 opposite to the racks 204 between the upper and lower feed openings 206a, 206b to facilitate production of standing waves in the waveguide 205.

The waveguide 205 for guiding microwaves generated by a magnetron 207 is mounted on the outer wall surface of the cavity 201 to cover all of the microwave feed openings 206a, 206b and cover plate 209. The magnetron 207 is mounted on the outer

surface of one wall of the waveguide 205 with a protruding antenna 208 thereof positioned within the waveguide. This microwave oven is usually referred to as a multifunctional microwave oven having both an electric heater heating function and a microwave heating function.

In operation of this microwave oven when it is desired to cook a food product by using the heaters, a heater mode is selected, and electric power is applied to the oven in which the food product has been placed on the shelf 203 supported by the racks 204. As a result, the upper and lower heaters 202, 202 positioned in the cavity 201 are energized to heat the food product.

When it is desired to cook a food product by using microwaves, a microwave mode is selected, and electric power is applied to the oven. As a result, the magnetron 207 generates microwaves, which in turn are emitted through the upper and lower microwave feed openings 206a, 206b to dielectrically heat the food.

This dual feed type microwave oven however has the disadvantage in that the waveguide 205 is longer and a separate cover plate 209 must be attached to the outer surface of the wall of the cavity 201 to permit the production of the standing waves in the waveguide 205. As a result, material costs and the number of manufacturing processes are increased, resulting in higher manufacturing costs. In addition, since a short circuited surface is not provided between the antenna 208 of the magnetron 207 and one side surface of the waveguide 205, standing waves are not

sufficiently produced in the waveguide, so that the output and uniform heating performance of the oven may be lowered.

Referring now to Figs. 3a and 3b which show longitudinal cross-sectional and schematic perspective views of the microwave oven as disclosed in European Patent Publication No. 0,478,053. The oven comprises a vertically extending waveguide 105 formed integrally with one side wall of cavity 101 and having a protruding portion 104 formed at the upper portion of its outer wall and upper and lower microwave feed openings 106a, 106b formed in the upper and lower portions of its inner wall to be in communication with the interior of the cavity; and a magnetron 107 having an antenna 108 and mounted on the protruding portion 104 of the waveguide 105 with the antenna inserted into the protruding portion in spaced apart relation to the portion to form therebetween a short circuited surface. The width of the protruding portion 104 of the waveguide is chosen to be substantially equal to the length of the antenna 108, and the waveguide 105 is provided with a horizontal top wall 105a and an inclined lower wall 105b. Further, the distance between the upper and lower microwave feed openings 106a, 106b is chosen to be as great as possible so that the upper and lower feed openings are located near to the upper and lower ends of the waveguide 105, respectively.

With this construction, microwaves generated by the magnetron 107 and emitted through the antenna 108 produce standing waves in the waveguide 105 through the protruding portion 104 of the waveguide short circuited with the antenna. The microwaves

are then in part emitted directly into the cavity 101 through the upper microwave feed opening 106a of the waveguide, while the remainder are reflected from the inclined lower wall 105b of the waveguide, and then emitted into the cavity through the lower microwave feed opening 106b. As a result, an interference field is formed in the cavity so that the food in the cavity can be heated uniformly.

However, this prior art microwave oven also has drawbacks in that the waveguide 105 is longer in order to provide the required distance between the upper and lower microwave feed openings 106a, 106b, the protruding portion 104 must be additionally provided on the outer wall of the waveguide to form the short circuited surface for producing the standing waves in the waveguide and the waveguide is relatively complex in construction, resulting in increasing the number of manufacturing processes, and hence manufacturing cost. Further, the long waveguide leads to difficulty in arranging the parts of the electric apparatus in a space below the waveguide adjacent one side wall of the cavity during assembling operation.

## SUMMARY OF THE INVENTION

With the foregoing drawbacks of the prior art microwave ovens in view, it is an object of the present invention to provide a wave guide system of a microwave oven, which provides improved heating performance to allow a food in a cavity of the oven to be heated more uniformly and which is provided with a shortened waveguide to permit easy arrangement of the parts of the electric components of the oven.

To achieve the above object, there is provided according to one form of the present invention a waveguide system for a microwave oven comprising: a cavity for containing food to be cooked and having a plurality of microwave feed openings formed in one wall thereof; a magnetron having an antenna positioned between said microwave feed openings in spaced apart relation to said wall having said microwave feed openings, said magnetron being adapted to generate microwaves having a wavelength of $\lambda_g$; and a waveguide for covering said microwave feed openings and supporting thereon said magnetron, said waveguide being adapted to guide microwaves through said microwave feed openings into said cavity and having a short circuited surface which is spaced from said antenna a distance of approximately $\lambda_g/4$ and is parallel to said antenna.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Figs. 1a and 1b are schematic perspective and longitudinal cross-sectional views of a prior art microwave oven of a single feed type;

Figs. 2a and 2b are longitudinal cross-sectional and exploded fragmentary perspective views showing one example of a prior art microwave oven of a dual feed type;

Figs. 3a and 3b are longitudinal cross-sectional and schematic perspective views showing another example of a prior art microwave oven of a dual feed type;

Fig. 4 is a perspective view of the microwave oven of a dual feed type according to one embodiment of the present invention;

Fig. 5 is a longitudinal cross-sectional view of the oven of Fig. 4;

Fig. 6 is a cross-sectional view taken along line A-A of Fig. 5;

Fig. 7a is a longitudinal cross-sectional view of a microwave oven of a dual feed type according to another embodiment of the present invention;

Fig. 8 is a longitudinal cross-sectional view of a microwave oven of a dual feed type according to another embodiment of the present invention;

Figs. 9a and 9b are diagrams showing temperature distributions when experimentally heating biscuits using a prior art microwave oven of a single feed type and a microwave oven of the present invention of a dual feed type, respectively; and

Figs. 10a and 10b are graphs showing temperature distributions when experimentally heating bottled milk using a prior art microwave oven of a single feed type and a microwave oven of the present invention of a dual feed type.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described in detail, by way of example, with reference to Figs. 4 to 10 of the accompanying drawings.

### First Embodiment

Referring to Figs. 4 to 6 showing in perspective and cross-section a dual feed type microwave oven according to the first embodiment of the present invention. The wave guide system of the microwave oven according to this embodiment comprises

a cavity for holding food to be cooked and having a pair of upper and lower microwave feed openings 6a, 6b formed in one side wall thereof. A magnetron 7 having an antenna 8 is positioned between the microwave feed openings 6a, 6b in spaced apart relation to the side wall having the feed openings, to generate microwaves having a wavelength of $\lambda_g$. A waveguide 5 on the side wall of the cavity 1 covers the feed openings 6a, 6b, supports a magnetron 7 and guides the microwaves through the feed openings into the cavity. The waveguide has a short circuited surface which is spaced apart from the antenna 8 by a distance of $\lambda_g/4$ and is parallel to the antenna.

The upper microwave feed opening 6a is formed in the upper portion of the side wall of the cavity 1, and the lower microwave feed opening 6b is formed in the middle portion of the same side wall. Although the microwave feed openings are preferably of a rectangular shape, they may be polygonal or any other suitable shapes.

In addition, as shown in Figs. 5 and 6, the upper and lower microwave feed openings 6a, 6b of the side wall of the cavity 1 are formed such that the upper feed opening 6a is positioned adjacent the antenna 8 of the magnetron 7 closer than the lower feed opening 6b and has an opening area smaller than that of the lower feed opening. The purpose of forming the feed openings 6a, 6b to have different sizes is to cause the microwaves emitted into the openings to form an electric field of uniform intensity. More specifically, in an oven in which the two microwave feed openings are formed in the cavity 1 at opposite sides

of the waveguide 5, the distances from the antenna 8 of the magnetron to the opposite sides of the waveguide are different from each other and the microwave feed openings must have different opening areas in order to provide an electric field of uniform intensity. In other words, in order to obtain uniform intensity of electric field by means of microwaves conducted by two microwave feed openings formed in different portions of the cavity, the upper feed opening 6a positioned in close proximity to the antenna 8 of the magnetron 7 must have a smaller area, while the lower feed opening 6b positioned further from the antenna must have a larger area.

At least one additional microwave feed opening may be formed in the cavity wall between the pair of the microwave feed openings 6a, 6b according to open area ratio of the upper and lower feed openings.

The waveguide 5 for guiding the microwaves is mounted externally of the upper portion of the side wall of the cavity 1 and encompasses both the upper and lower microwave feed openings 6a, 6b. The wave guide 5 is a rectangular prismatic body having a rectangular cross-section and is of a hexahedral shape having an inclined lower wall 5b opposite to a horizontal upper wall 5a, the short circuited surface. With this waveguide construction, the microwaves emitted into the cavity through the upper microwave feed opening are indirectly incident upon the food placed on a rotary tray 3 which is disposed on the bottom of the cavity to be rotatably driven by a motor 2 while the microwaves emitted into

the cavity through the lower microwave feed opening are directly incident upon the food on the tray 3 through reflection from the inclined lower wall 5b of the waveguide.

The magnetron 7 for generating the microwaves and emitting them through the antenna 8 is mounted on the back of the waveguide 5 with the antenna positioned within the waveguide. As shown in Fig. 5, the antenna 8 of the magnetron is positioned so that the distance (l) between the antenna and the horizontal upper wall 5a of the waveguide this equal to the value of $\lambda_g/4$. As a result, a short circuited surface is provided to produce standing waves in the waveguide during oscillation of the magnetron. When the distance (l) from the antenna of the magnetron to one side of the waveguide has the value of $\lambda_g/4$ such that the side of the waveguide forms a horizontal, short circuited surface, the distance between the antenna and the other side of the waveguide usually has a value of more than $\lambda_g/4$. Therefore, according to the present invention, the minimum height of the waveguide is $\lambda_g/2$, and the maximum length of the waveguide may be up to the height of the cavity less the height required to accommodate the electric components, such as a high voltage transformer (HVT), a high voltage capacitor (HVC) and the like (not shown). That is, the length of the waveguide of the present invention ranges from a minium of $\lambda_g/2$ to a maximum determined by subtracting the height of the electrical components from the height of the side wall of the cavity. Here, $\lambda_g$ is the wavelength of the microwaves generated in the waveguide by the magnetron.

Meanwhile, in this embodiment, it is explained that

a distance from one end of the waveguide 5, i.e., an upper horizontal surface (short circuited surface 5a) to the antenna 8 is $\lambda_g/4$ for generating a standing wave within the waveguide 5.

However, in the present invention, the distance from the short circuited surface 5a to the antenna 8 is not limited to $\lambda_g/4$, but may be longer or shorter. Because, though theoretically the antenna 8 should be located at the distance of $\lambda_g/4$ from the short circuited surface 5a for generating a standing wave, the antenna 8 is actually located at a place longer or shorter than $\lambda_g/4$ for an optimal position in view of a uniform heating of food or impedance matching and so on. Further, since an intensity of the electric field from the antenna is substantially sinusoidal, there will be no significant reduction of the field intensity even if the antenna 8 is located at a place longer or shorter than $\lambda_g/4$ to some extent.

As explained, the distance from the short circuited surface 5a to the antenna 8 may be determined longer or shorter than $\lambda_g/4$. Further, it is preferable that the distance from the short circuited surface 5a to the antenna 8 is shorter than $\lambda_g/4$, since the antenna displaced toward the short circuited surface is favorable for making a short waveguide.

In conclusion, the distance from the short circuited surface to the antenna 8 may be shorter than $\lambda_g/4$, and preferably $\lambda_g/8 \sim \lambda_g/4$. Accordingly, a minium length of the waveguide may be shorter than $\lambda_g/2$, while a maximum length of the waveguide 5 is preferably approximately 1/2 of a height of

the wall of the cavity 1, considering both easy installation of electrical components and a reduction of the waveguide.

Operation of the thus constructed microwave oven of the present invention will now be described with reference to Figs. 4 and 5.

When electric power is applied to the oven to operate it, the microwaves generated by the magnetron 7 are emitted into the waveguide 5 from the antenna 8, and are then guided along the waveguide. Then, the microwaves in part pass through the

upper microwave feed opening 6a, are reflected from the inner wall surfaces of the cavity 1, and then impinge upon the food on the rotating tray 3. The remainder of the microwaves are reflected from the inclined lower surface 5b of the waveguide, pass through the lower microwave feed opening 6b, and directly impinge upon the food. As a result, an interference field is formed in the cavity thereby dielectrically heating the food.

The short circuited surface formed between one side wall of the waveguide 5 and the antenna 8 of the magnetron 7 permits easy production standing waves to enhance the output and the uniform heating performance of the oven and the shortened height of the waveguide 5 mounted on the upper portion of one side wall of the cavity 1 permits easy arrangement of the parts of the electric apparatus below the waveguide. Further, since the waveguide can be formed to have a height equal to the height of waveguides for prior art microwave ovens of the single feed type having a single microwave feed opening, the waveguide can be used both in ovens of the prior art and the present invention.

Furthermore, since the oven of the present invention does not require a separate planar cover plate positioned on the outer surface of one side wall of the cavity, or a protruding portion provided at the waveguide to produce the standing waves as disclosed in U. S. Patent No. 5,057,660 and European Patent Publication No. 0,478,053 set forth above, material costs and the number of manufacturing steps can be reduced, resulting in a lowering of manufacturing cost.

In addition, since the microwaves passed through the upper and lower microwave feed openings 6a, 6b are evenly incident upon the food in the cavity, and at the same time form the interference field in the cavity, thereby dielectrically heating the food uniformly, the oven of the present invention overcomes the problems of prior art microwave ovens of a single feed type. That is, the microwave oven of the present invention can not only achieve uniform heating of thin, planar food products, but can also eliminate heating temperature differences between the upper and lower areas of food in a relatively high container. Therefore, since it is not necessary to further heat the portions of food which due to non-uniform heating have not been cooked, the invention avoids the need for extended cooking times and the accompanying increase in power consumption.

To ascertain the effects of the present invention as set forth above, experiments have been carried out on uniform heating performance of the microwave oven. The results will now be discussed with reference to Figs. 9a, 9b, 10a and 10b.

Reference is first made to Figs. 9a and 9b which are diagrams showing temperature distributions in biscuits heated for a same period of time using a prior art microwave oven of a single feed type and a microwave oven of a dual feed type according to the first embodiment of the present invention, respectively. When the biscuit was heated using the prior art microwave oven, as shown in Fig. 9a, there occurred a phenomenon in which the temperatures of the respective areas of the biscuit were not uniform. In particular the central area had the highest

temperature, and as a result has burned. This phenomenon indicates that the microwaves are concentrated in the central area so that the biscuit as a whole is not heated uniformly. On the other hand, when the biscuit was heated using the microwave oven of the present invention, as shown in Fig. 9b, the temperature distribution in the entire biscuit was substantially uniform so that the central area of the biscuit was not burnt. This indicates that the microwaves are evenly incident upon the biscuit.

Referring to Figs. 10a and 10b which are graphs showing temperature changes with time of respective areas of milk bottles when heated using a prior art microwave oven of a single feed type and a microwave oven of a dual feed type according to the first embodiment of the present invention, respectively. The prior art microwave oven exhibits a heating pattern in which the rate of a temperature rise with time in the upper portion of the milk bottle increases more steeply than those in the middle and lower portions, as shown in Fig. 10a. As will be appreciated by those skilled in the art, this indicates that the microwaves are not evenly incident upon all of the upper, middle and lower portions of the milk bottle, so that uniform heating is not achieved.

On the other hand, according to the present invention, as shown in Fig. 10b, the rates of a temperature rise in the upper, middle and lower portions of the milk bottle are substantially equal to one another. This shows that the microwaves are evenly incident upon all of the portions.

Second Embodiment

Figs. 7a and 7b illustrate in section the second embodiment of the present invention. This embodiment is substantially identical in general construction and operation with the previous embodiment in that the oven of this embodiment also comprises a cavity containing for holding food to be cooked and having a pair of microwave feed openings formed in one wall thereof. A magnetron having an antenna is positioned between the microwave feed openings in spaced apart relation to the wall having the feed openings, to generate microwaves having a wavelength of $\lambda_g$. A waveguide is provided covering the microwave feed openings and supporting thereon a magnetron. The waveguide guides the microwaves through the feed openings into the cavity which has a short circuited surface which is spaced apart from the antenna by a distance of $\lambda_g/4$ and is parallel to the antenna. Therefore, a further detailed explanation is not required.

However, this embodiment is different from the first embodiment in that the upper and lower microwave feed openings 16a, 16b of the cavity 11 are formed so that the upper feed opening 16a has an opening area larger than that of the lower feed opening 16b, and that the waveguide 15 has an inclined upper wall 15a and a horizontal lower wall 15b forming a short circuited surface which is spaced apart from the antenna 18 of the magnetron 17 by a distance of $L = \lambda_g/4$ and is parallel to the antenna. Briefly stated, the differences between this embodiment and the first embodiment are that in the second embodiment the waveguide 15

is positioned upside down relative to the first embodiment, and the lower feed opening 16b is formed smaller than the upper feed opening 16a and disposed adjacent the antenna 18 of the magnetron 17 in contrast to the first embodiment.

With this construction, as shown in Fig. 7a, the microwaves introduced into the waveguide 16 during oscillation of the magnetron 17 pass in part through the lower feed opening 16b, and then are directly incident upon food on the rotary tray 13 positioned in the cavity 11 and is adapted to be rotatably driven. The remainder of the microwaves are reflected from the inclined wall 15a of the waveguide, pass through the upper feed opening 16a and are then indirectly incident upon the food.

Third Embodiment

In Fig. 8, there is shown in longitudinal section a microwave oven of a dual feed type according to the third embodiment of the present invention. This embodiment is substantially identical with the previous embodiments in that the oven of this embodiment comprises a cavity having a pair of microwave feed openings, a magnetron for generating microwaves, and a waveguide disposed to interconnect the cavity and the magnetron and be in communication with the microwave feed openings. Therefore, its detailed description will be omitted to avoid duplication of description.

However, this embodiment is different from the first and second embodiments in that one of the microwave feed openings, 26a, is formed in a side portion of the upper wall of the cavity 21, while the other 26b is formed in the upper end portion of one wall of the cavity adjacent the feed opening 26a

of the upper wall. Moreover the waveguide 25 has an inverted L-shape configuration in longitudinal cross-section and is joined to the cavity 21 so as to cover both of the microwave feed openings 26a, 26b formed in the upper and side walls of the cavity.

This embodiment further differs from the first and second embodiments in that the waveguide 25 of this embodiment has an inclined wall portion 25a at the end joined to the upper wall of the cavity 21, and a horizontal lower wall 25b joined to the side wall of the cavity and providing a short circuited surface which is spaced from the antenna 28 of the magnetron 27 by a distance of $\lambda_g/4$ and is parallel to the antenna.

Reference numerals 22 and 23 in the various embodiments thereof denote a motor and a tray, respectively. Meanwhile, a waveguide system having two microwave feed openings, i.e., the upper and lower microwave openings are explained in the above described embodiments.

However, this invention is not limited to a waveguide system having two microwave feed openings. That is, it is possible that a waveguide system further has at least one microwave feed opening between the pair of microwave feed openings. It will be understood that variations and modifications in form and detail may be made therein without departing from the spirit and scope of the invention as defined in the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A waveguide system for a microwave oven comprising:

a cavity for containing food to be cooked and having a plurality of microwave feed openings formed in one wall thereof;

a magnetron having an antenna positioned between said microwave feed openings in spaced apart relation to said wall having said microwave feed openings, said magnetron being adapted to generate microwaves having a wavelength of $\lambda_g$; and

a waveguide for covering said microwave feed openings and supporting thereon and magnetron, said waveguide being adapted to guide microwaves through said microwave feed openings into said cavity and having a short circuited surface which is spaced from said antenna a distance of approximately $\lambda_g/4$ and is parallel to said antenna.

2. A waveguide system for a microwave oven as claimed in claim 1, wherein the length of said waveguide ranges from a minimum of $\lambda_g/2$ to a maximum of approximately a half of the height of the wall of the cavity.

3. A waveguide system for a microwave oven as claimed in claim 1, wherein said microwave feed openings are of different sizes in proportion to the distances between said antenna and the centers of said microwave feed openings, the size of said microwave feed opening with long distance being longer than the size of said microwave feed opening with short

distance.



4. A waveguide system for a microwave oven as claimed in claim 1, wherein said waveguide is of a hexahedral shape having an inclined surface opposite to said short circuited surface.

5. A waveguide system of a microwave oven comprising:

a cavity for containing a food to be cooked and having a plurality of microwave feed openings which are formed with one in each of two neighboring walls thereof;

a magnetron having an antenna and positioned between said microwave feed openings in spaced apart relation to said walls having said microwave feed openings, to generate microwaves having a wavelength of $\lambda_g$; and

a waveguide for covering said microwave feed openings, said waveguide supporting thereon said magnetron and being adapted to guide the microwaves through said microwave feed openings into said cavity and said waveguide having a short circuited surface which is spaced apart from said antenna a distance of approximately $\lambda_g/4$ and is parallel to said antenna.

6. A waveguide system of a microwave oven as claimed in claim 5, wherein the height of said waveguide ranges from a minimum of $\lambda_g/2$ to a maximum of approximately a half of the height of the wall of the cavity.

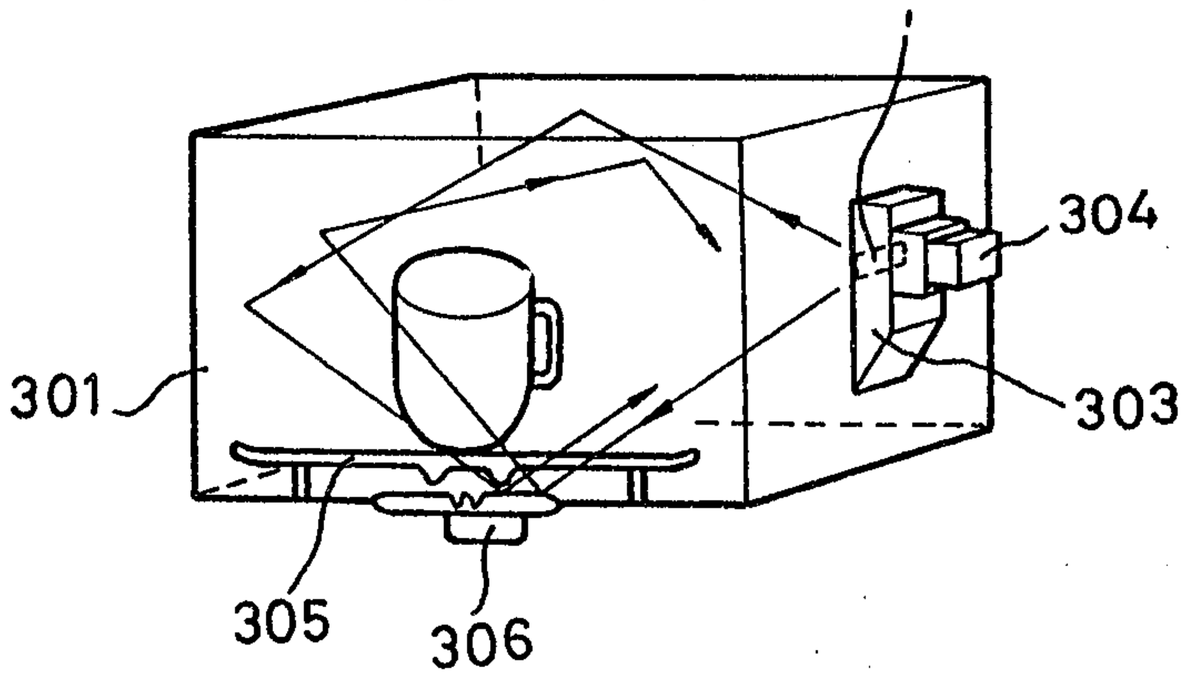
7. A waveguide system of a microwave oven as claimed in claim 5, wherein said microwave feed openings are of different sizes in proportion to the distances between said antenna and the centers of said microwave feed openings, the size of said microwave feed opening with long distance being larger than the size of said microwave feed opening with short distance.

8. A waveguide system of a microwave oven as claimed in claim 5, wherein said waveguide is a hexahedral shape having an inclined surface opposite to said short circuited surface.

SMART & BIGGAR
OTTAWA, CANADA

PATENT AGENTS

F I G. 1a
PRIOR ART




F I G. 1b
PRIOR ART

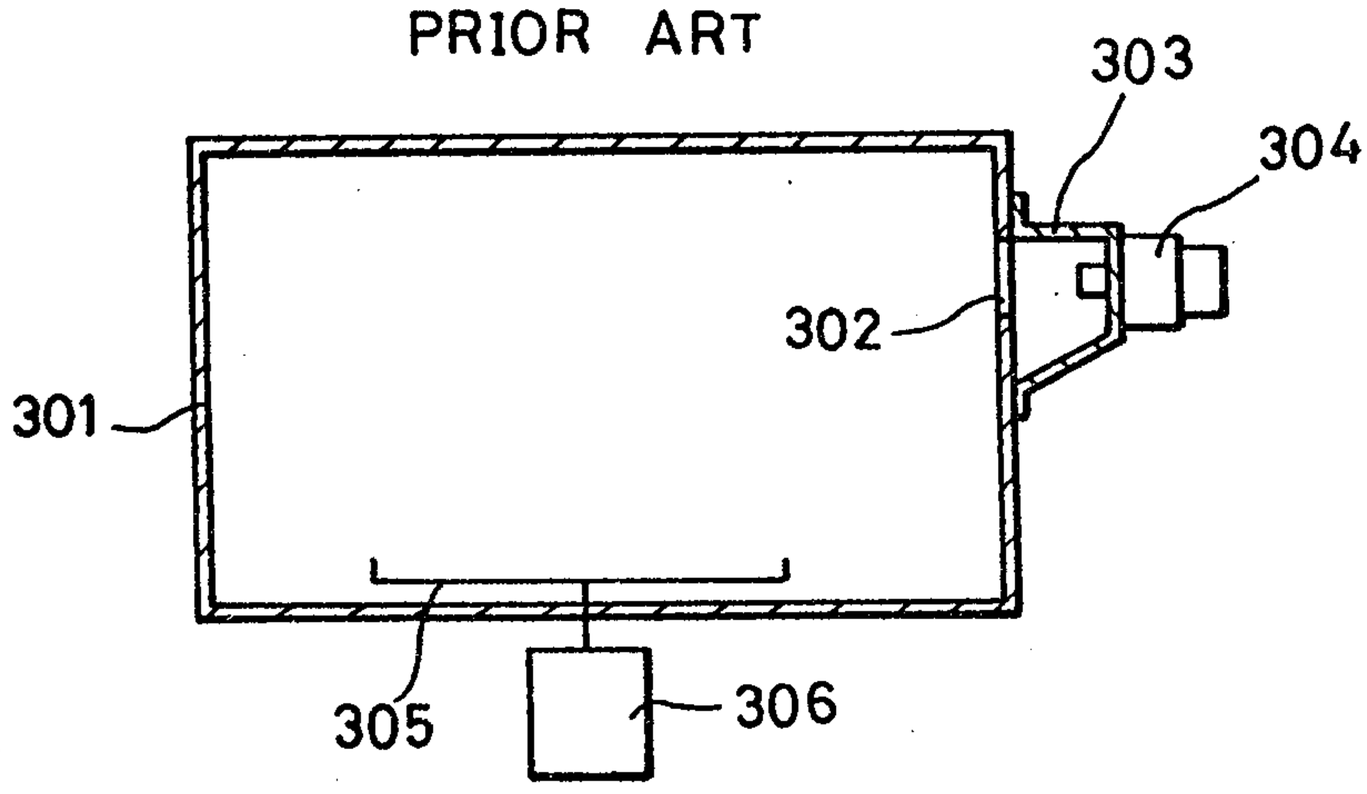


FIG. 2a
PRIOR ART

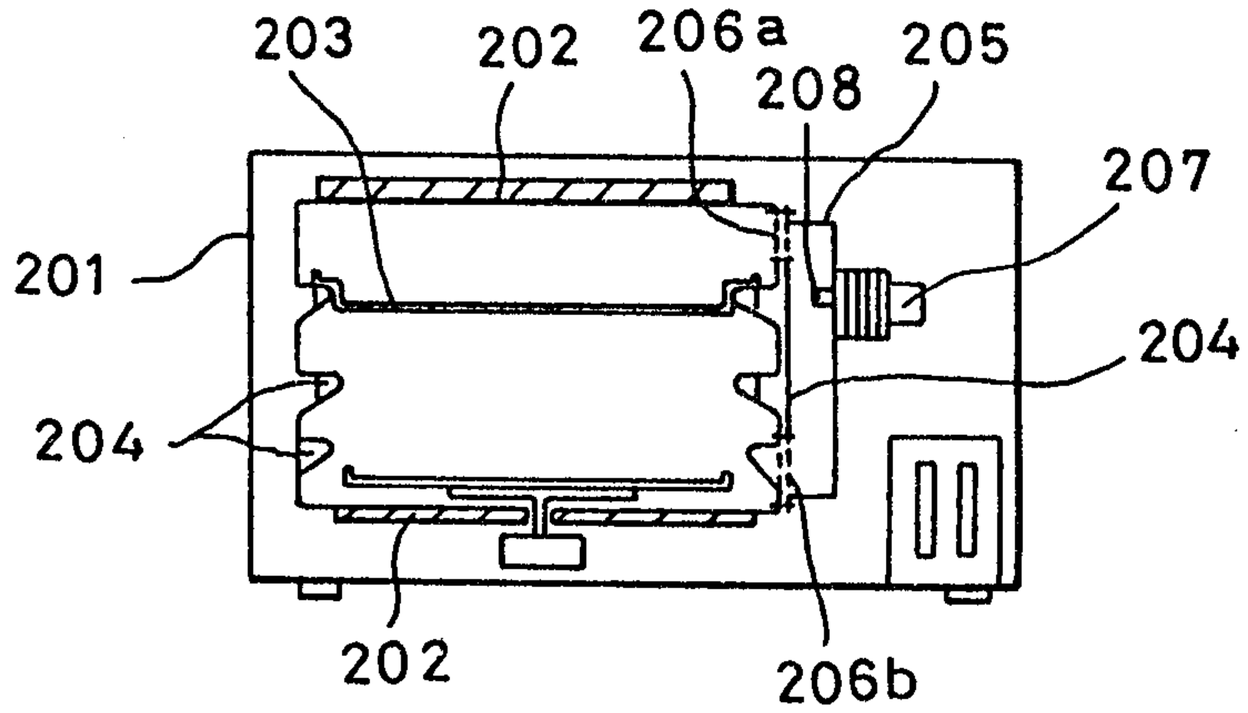
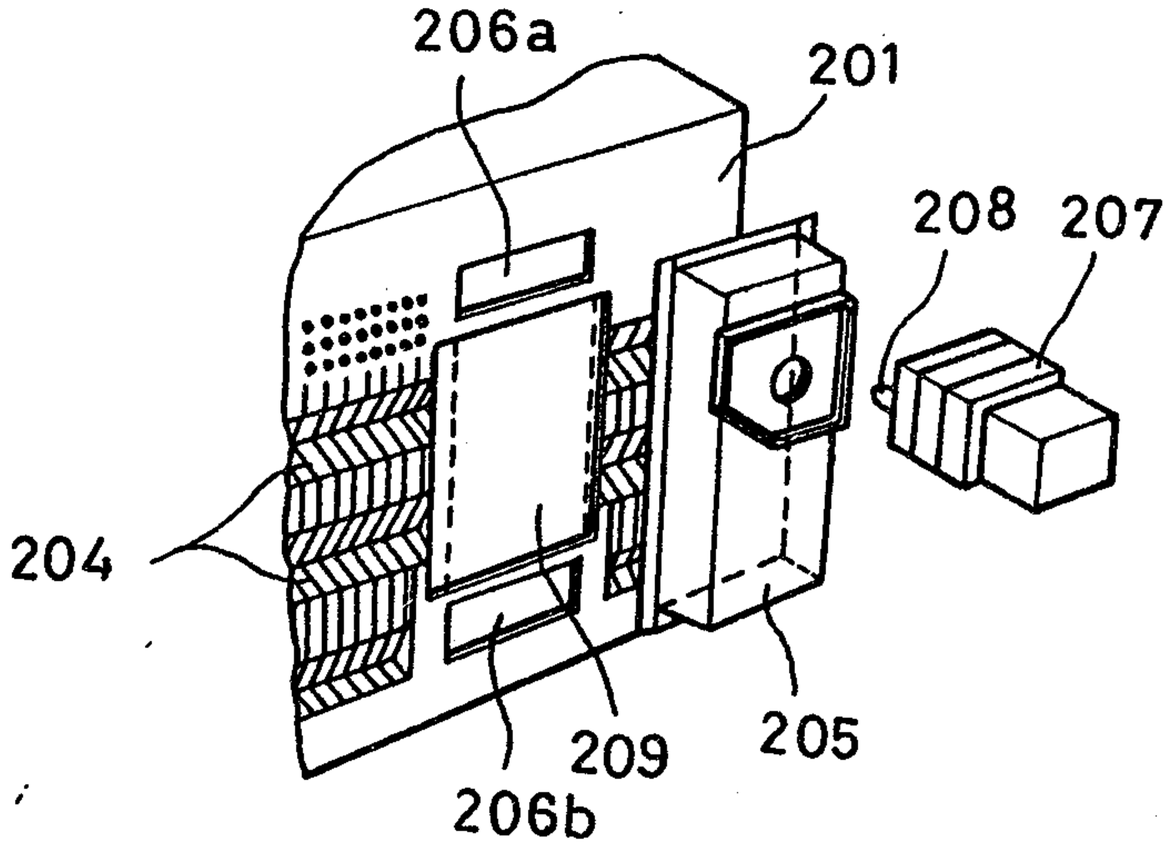



FIG. 2b

PRIOR ART




Patents
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FIG. 3a
PRIOR ART

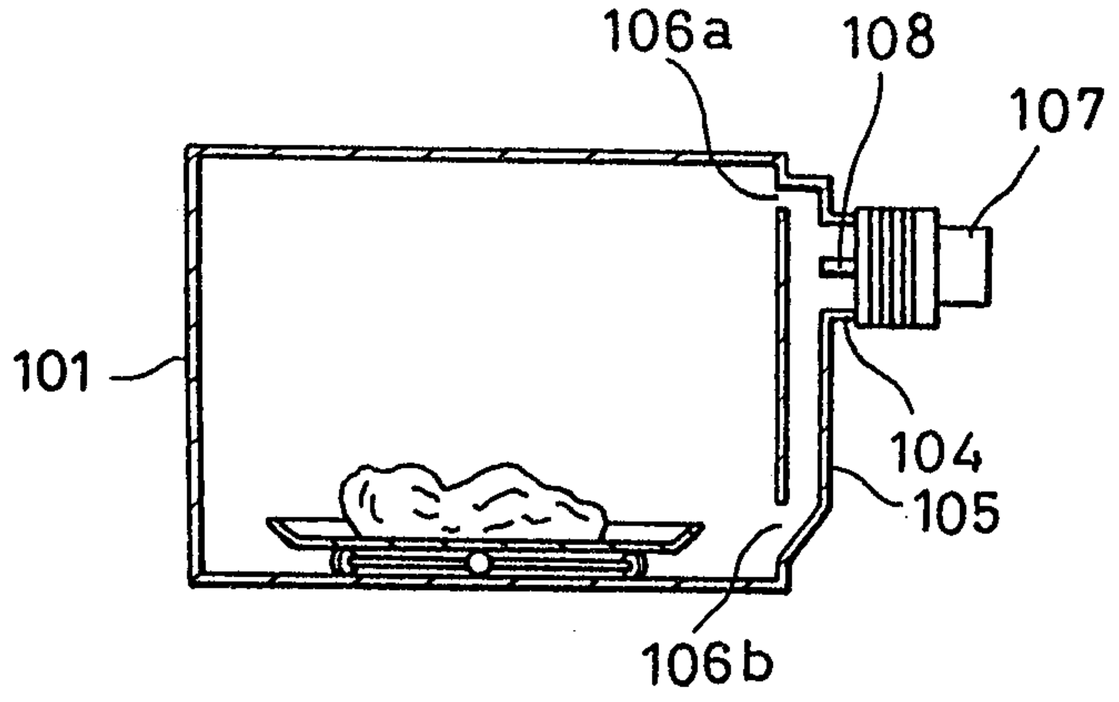



FIG. 3b
PRIOR ART

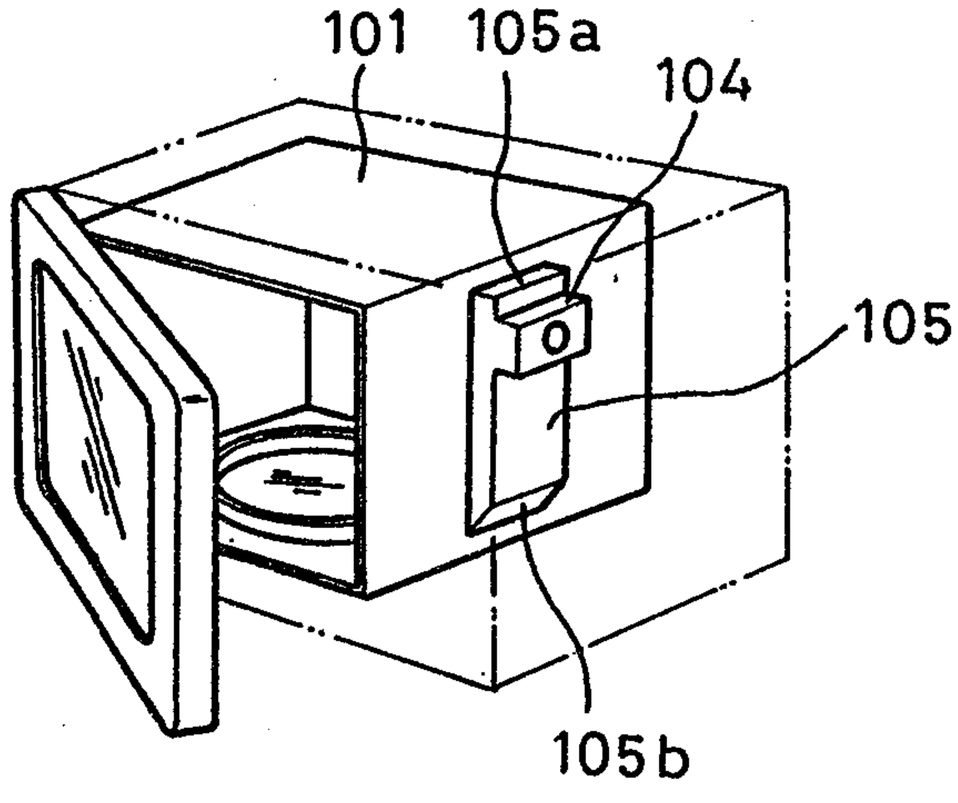


FIG. 4

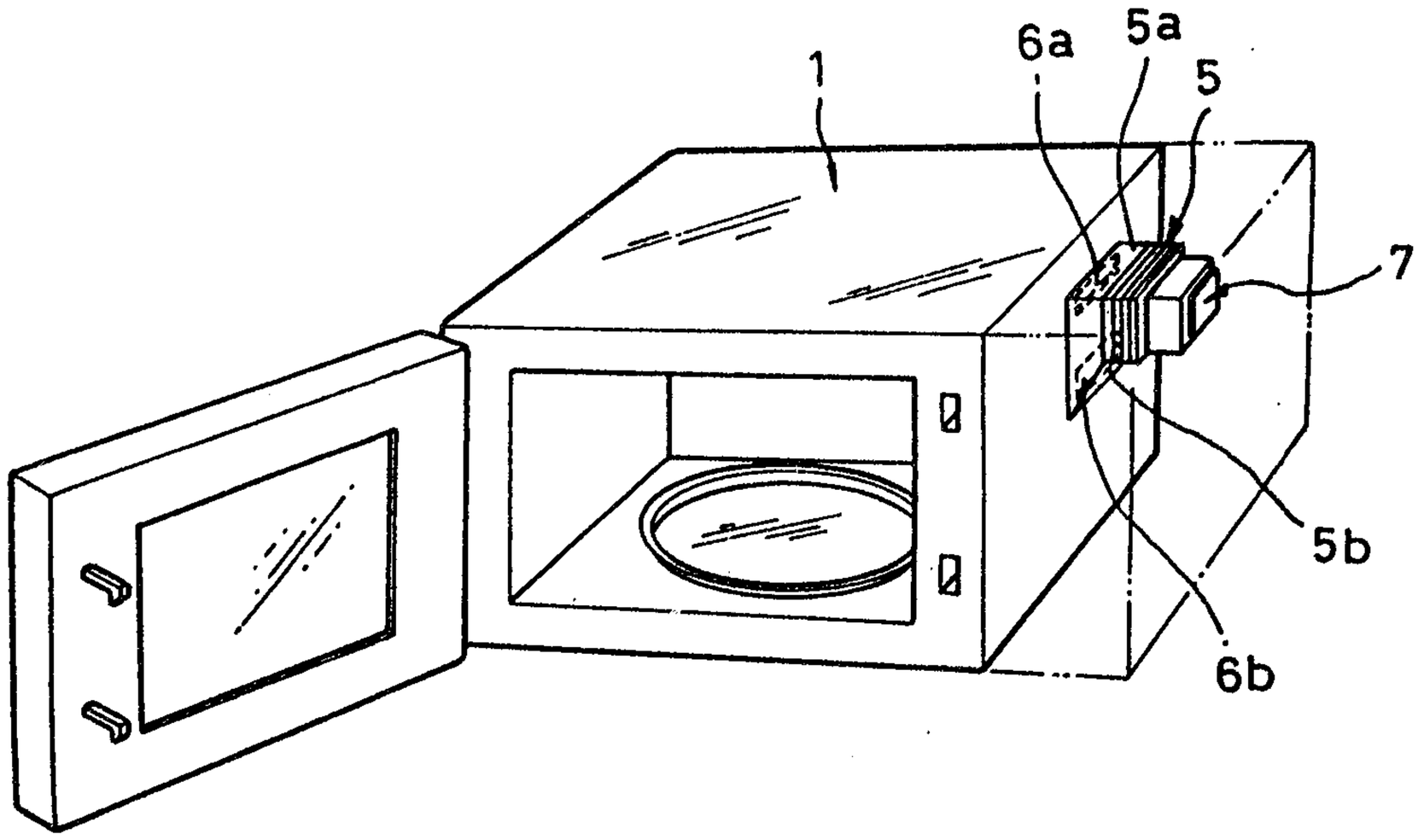
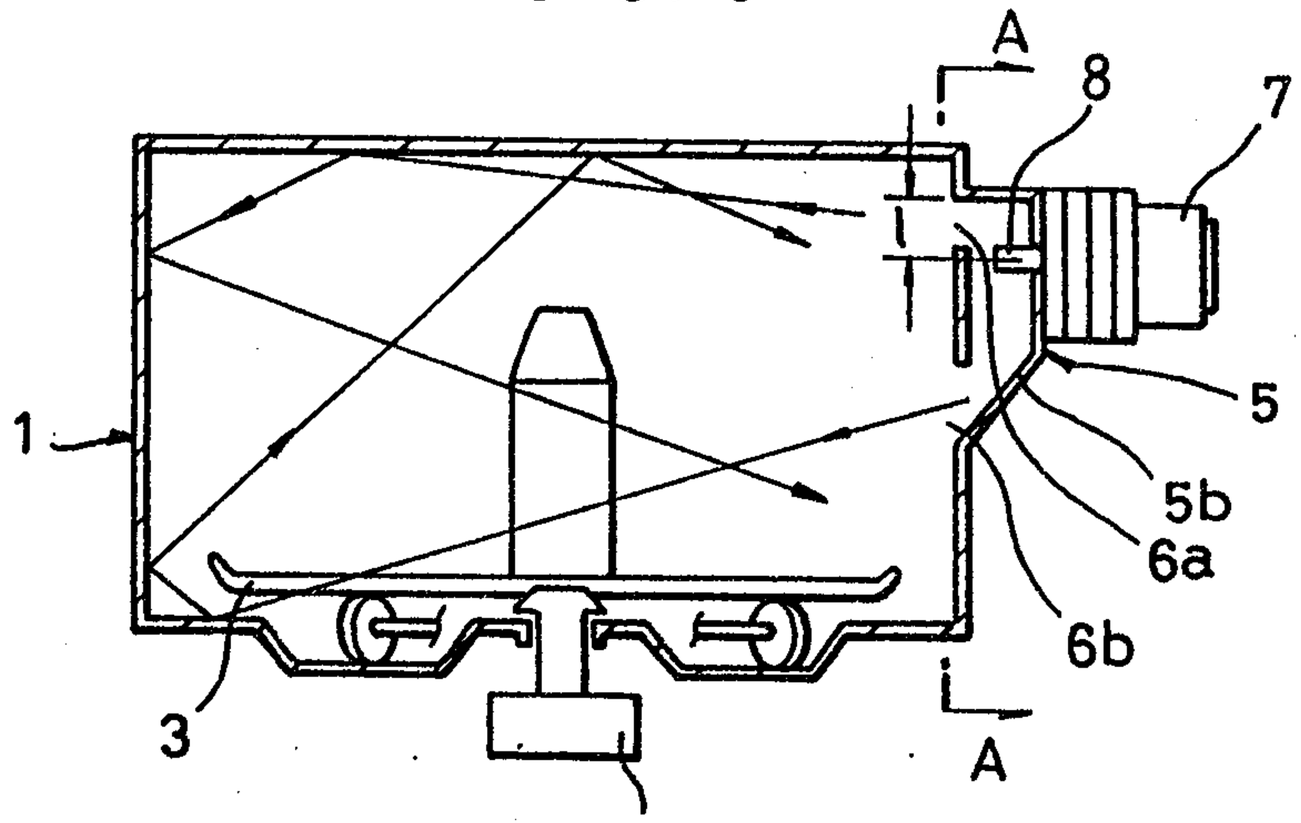



FIG. 5






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FIG. 6

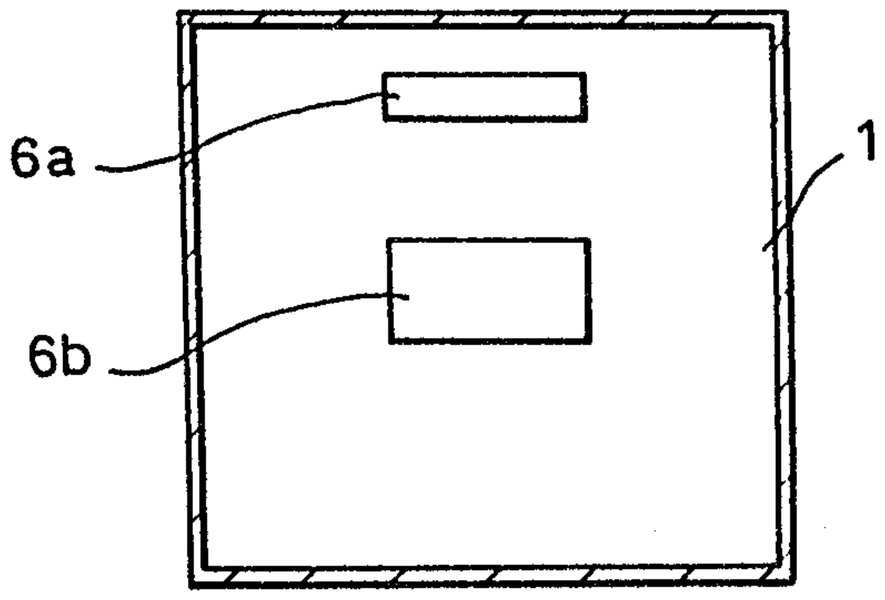
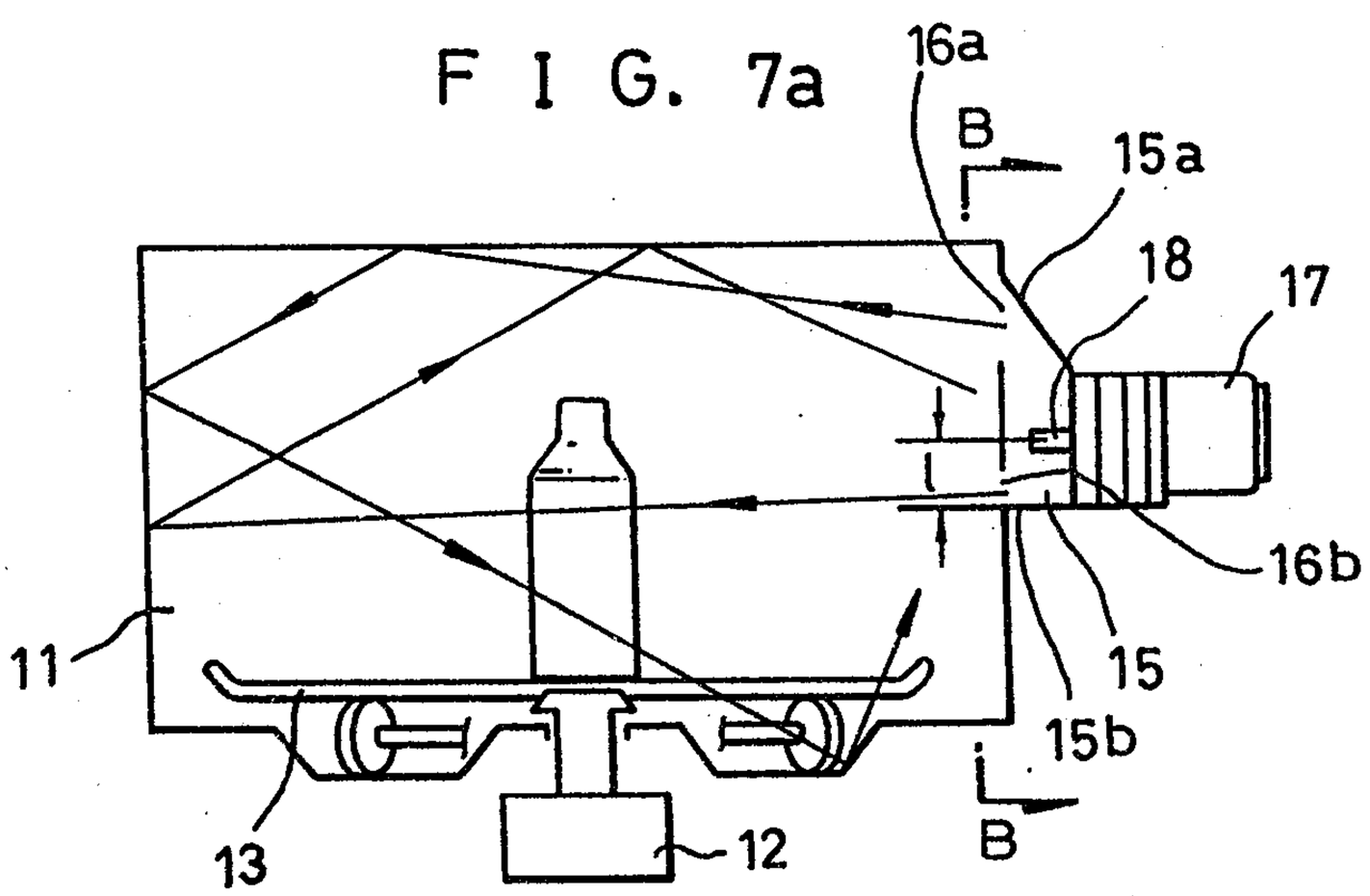



FIG. 7a




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FIG. 7b

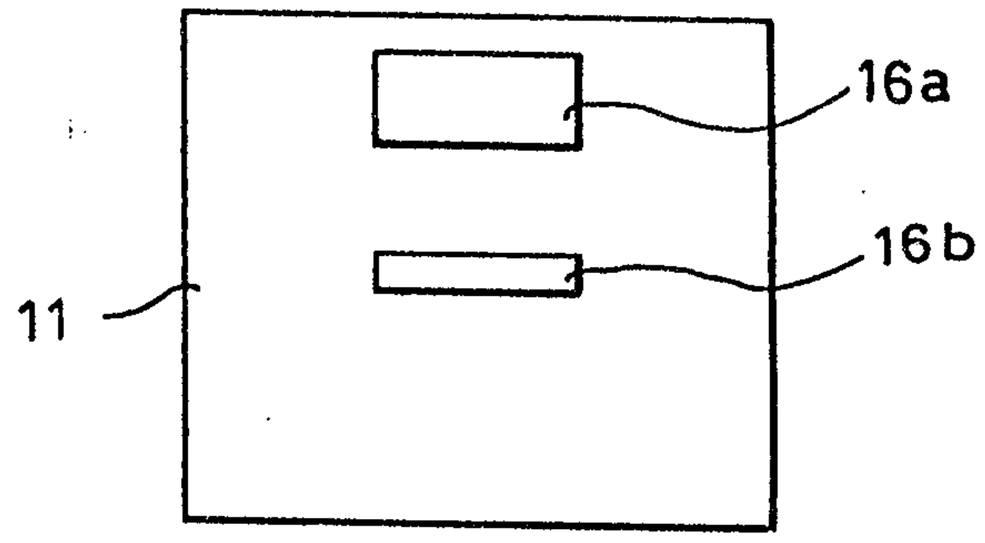
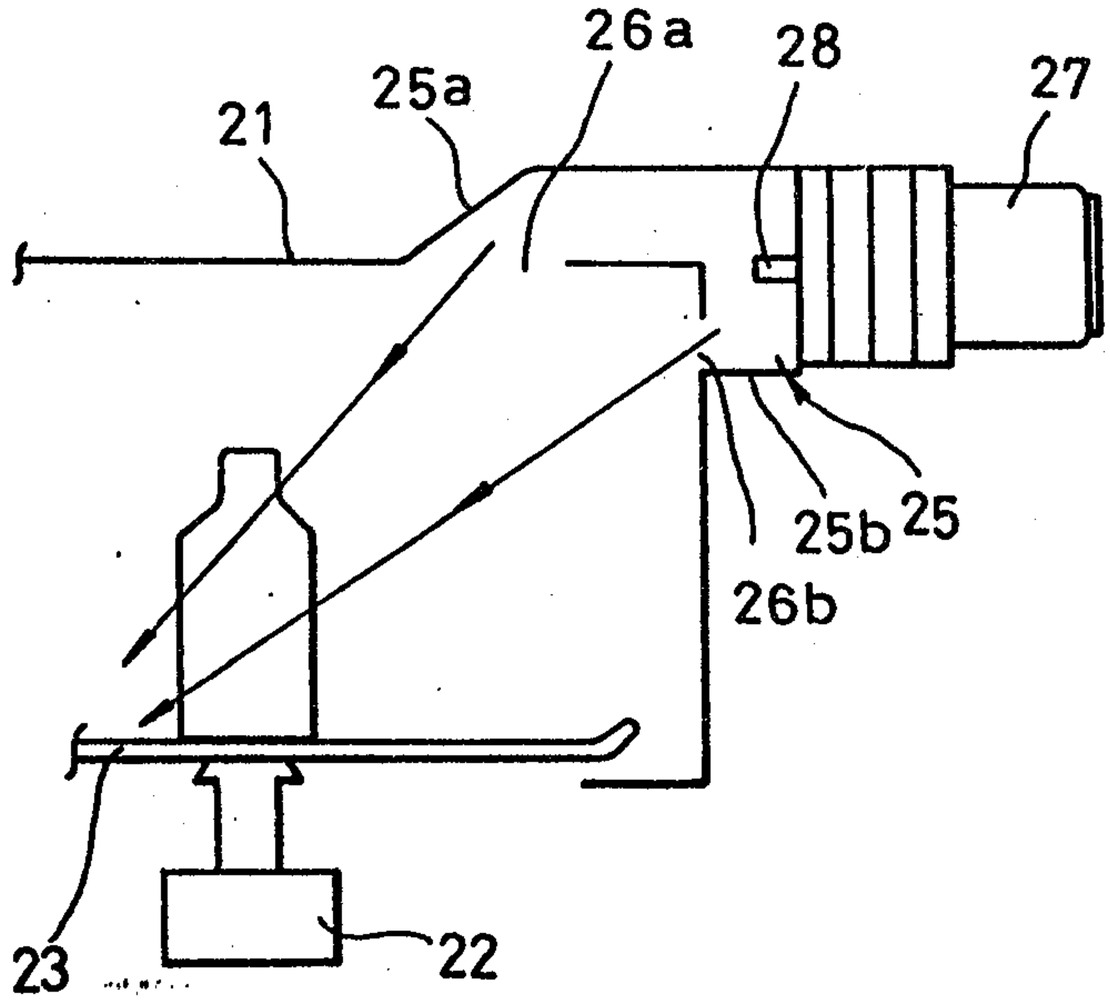
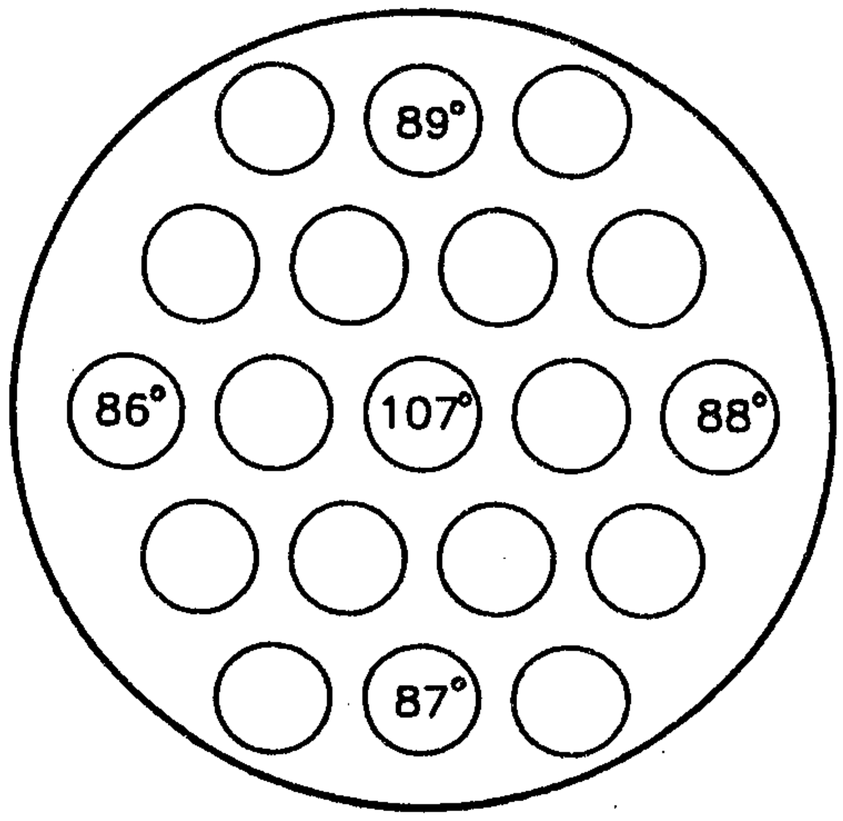



FIG. 8

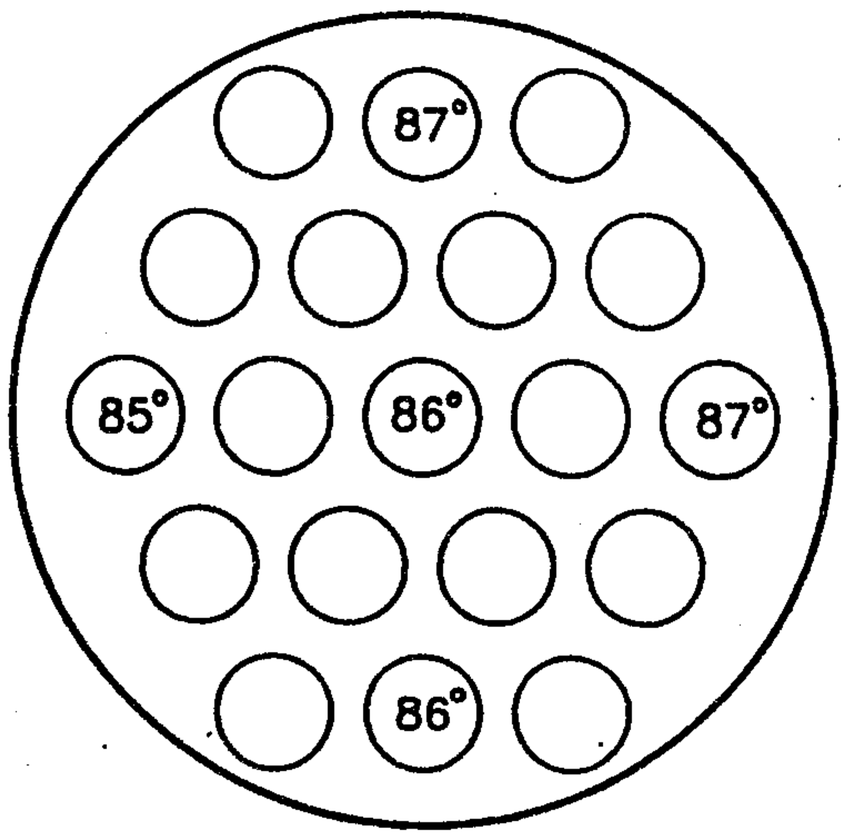



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F I G. 9a




F I G. 9b




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FIG.10a
prior art

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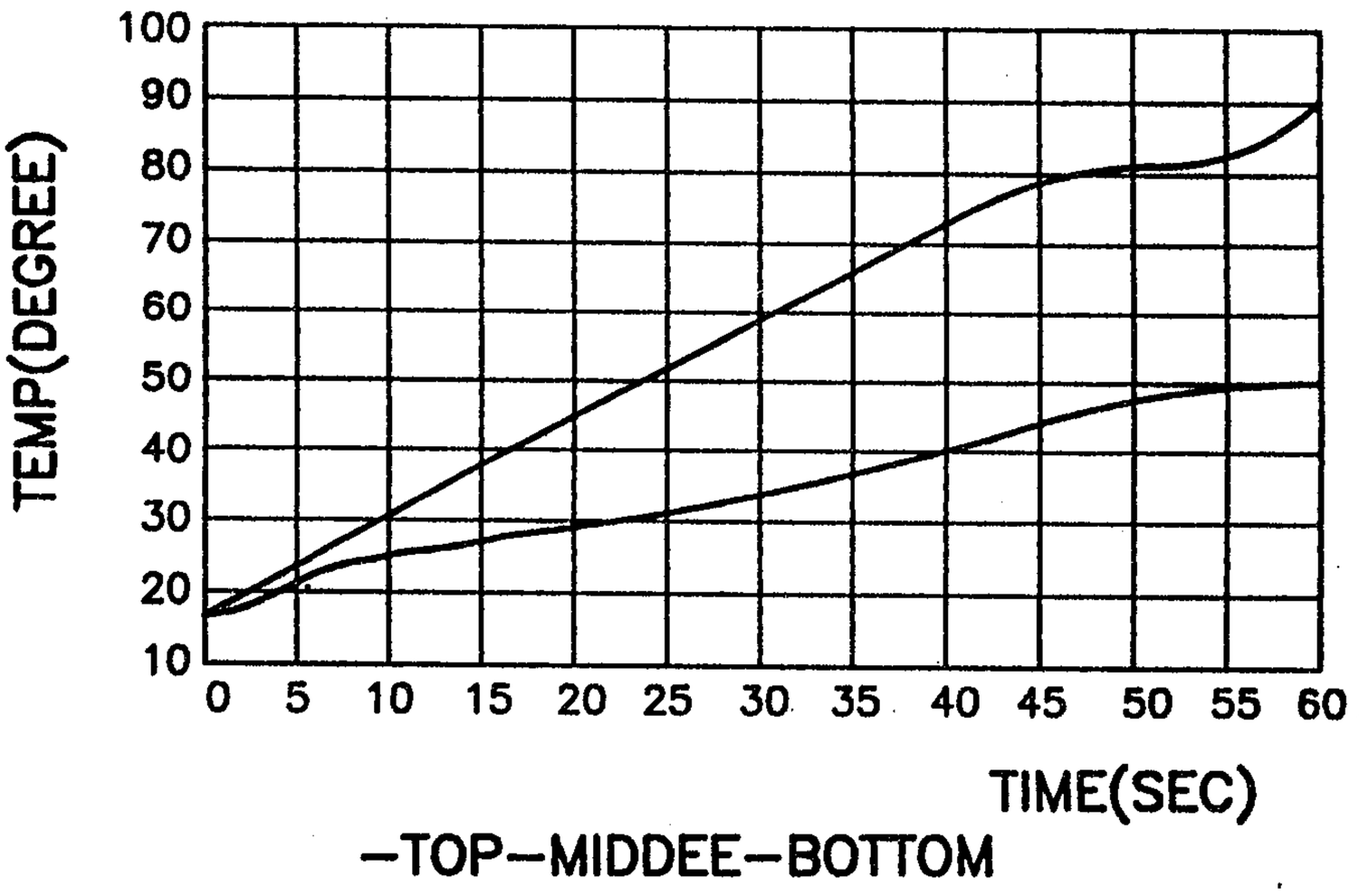
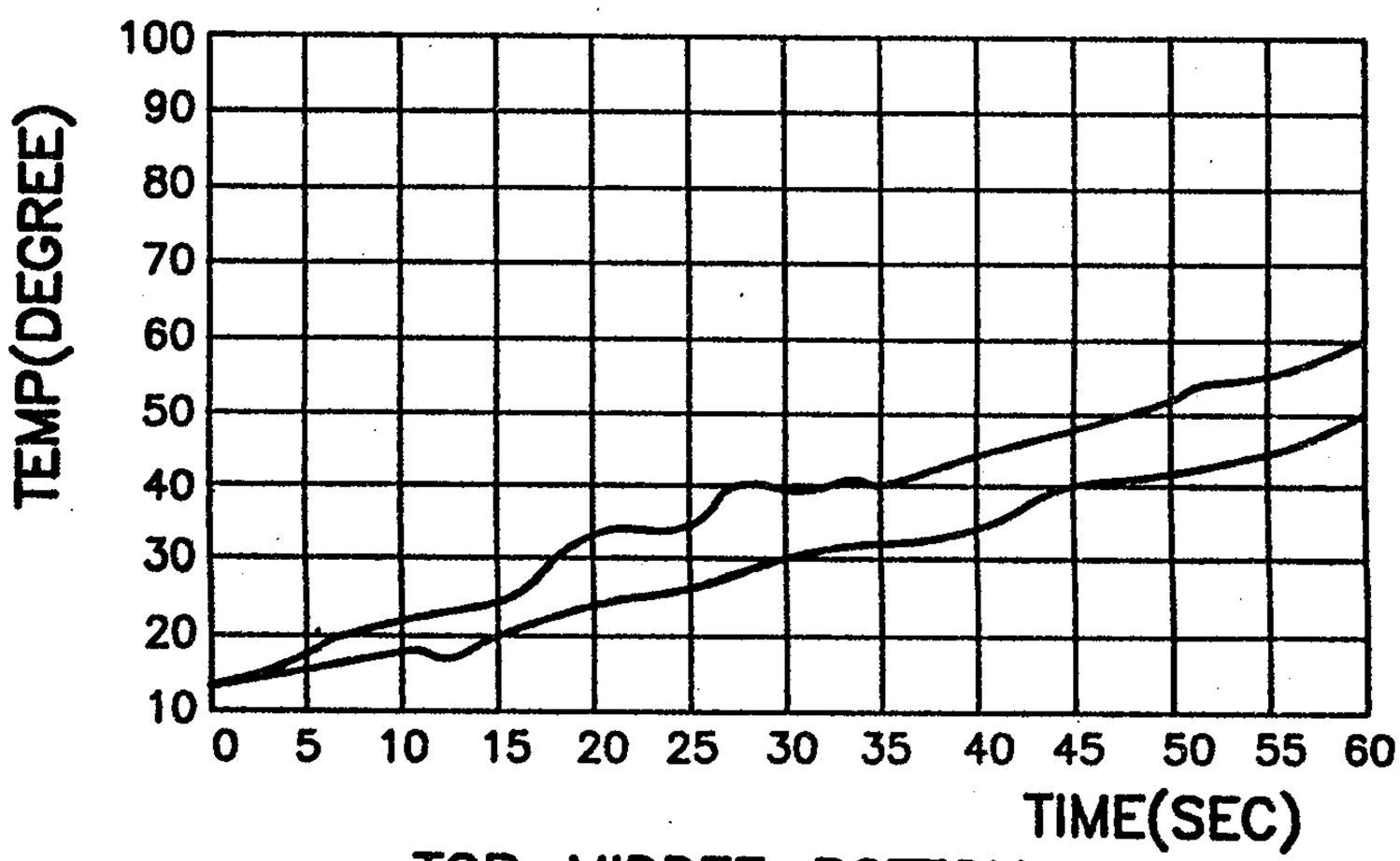
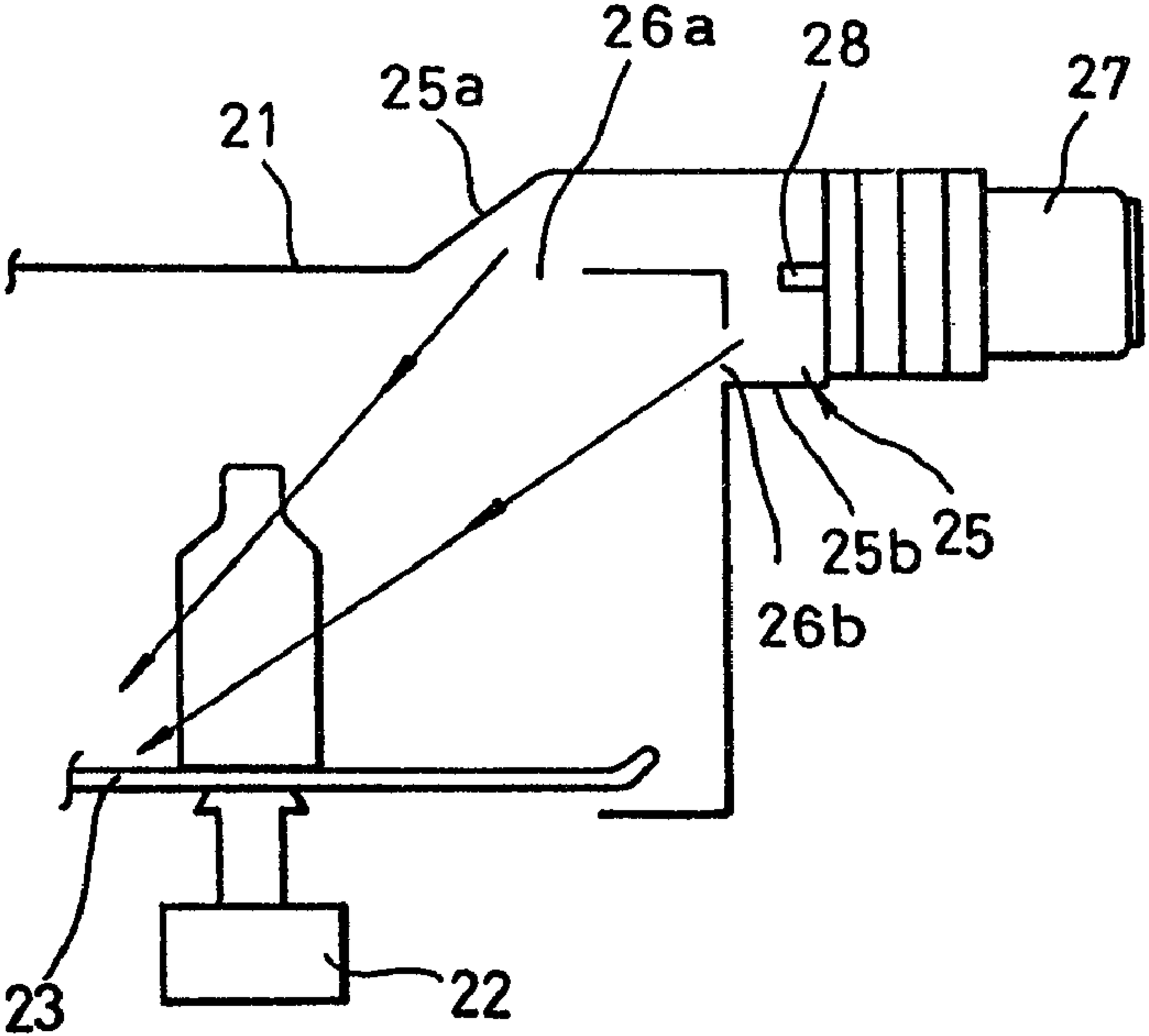



FIG.10b

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26a
28
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25a
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25b
25
26b
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22