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Heating apparatus enclosed in a cabinet during its use.

A cabinet (24) for enclosing a heating apparatus such as a microwave oven is disclosed. The cabinet (24) encloses the body (11) of the heating apparatus and is held on a room wall. An air flow path (30) is formed between the apparatus body (11) and the cabinet (24). The cabinet (24) has an inlet (33) in its lower front and an outlet (34) in its upper front. A transverse fan (35) is disposed in the air flow path (30). Side plates (24d, 24e) of the cabinet (24) are protruded rearwards such that a space (S) is defined between the rear wall (24b) and the room wall. A suction opening (36) is formed in the rear wall (24b) of the cabinet (24) to correspond to suction apertures (21) of the component chamber (13). When a cooling fan (20) and the fan (35) are driven, outside air is drawn in through the inlet (33) and the suction opening (36) so that electrical components in the component chamber (13) are sufficiently cooled by the air.

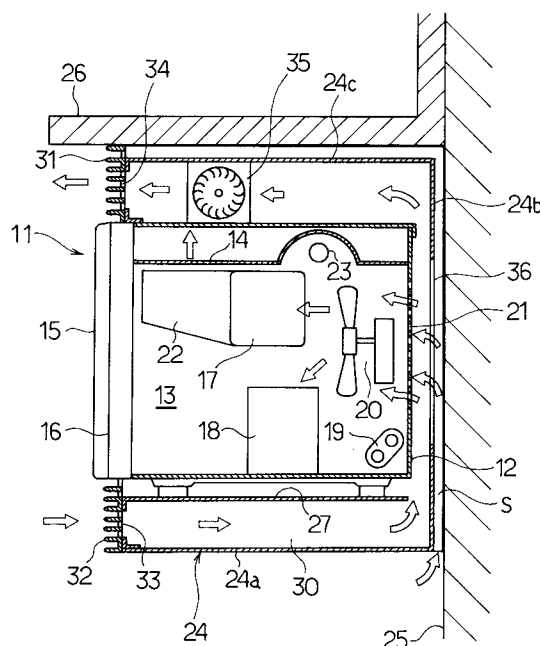


FIG.1

This invention relates to a heating apparatus such as microwave ovens, and more particularly to such a heating apparatus which is enclosed, in its use, in a cabinet mounted so that its rear is abutted against a wall of the kitchen or the like.

A microwave oven with an oven function, for example, is sometimes mounted, in its use, on the outer bottom of a cupboard hung on a room wall as well as placed on a stand. When the microwave oven is conventionally mounted on the outer bottom of the cupboard, a body 1 of the microwave oven is enclosed in a cabinet 2 having the height and depth larger than the microwave oven body 1 and the top of the cabinet 2 is fixed to the outer bottom of the cupboard 4 with its rear abutted against the room wall 3, as shown in FIG. 9.

A fan disposed in a component chamber defined in the body 1 is driven for the cooling of electrical components such as a magnetron during operation of the microwave oven, so that cooling air is drawn in through suction apertures formed in the rear of the microwave oven. After the electrical components have been cooled, the air is discharged through an exhaust aperture formed in the top of the microwave oven body 1. Further, the interior of the cabinet 2 needs to be cooled during the heating operation and in particular, during the oven mode since the air in the cooking chamber 4 is heated to a high temperature.

In view of the foregoing, an air flow path 5 is defined to extend through the upper, lower and rear spaces between the cabinet 2 and the microwave oven body 1. Further, another fan 6 is provided in the air flow path 5 so that air is drawn in through lower louvers 7 and exhausted through upper louvers 8.

In the above conventional construction, however, a sectional area of the air flow path 5 is increased so that a volume of air necessary for the cooling of the electrical components such as the magnetron is ensured. As a result, the depth of the cabinet 2 is increased. Further, the rear of the cabinet 2 is abutted against the room wall 3, high temperature heat induced in the cabinet 2 is transmitted to the room wall 3 during the oven mode, particularly, resulting in increase in the atmospheric temperature of the room wall 3.

Therefore, an object of the present invention is to provide a heating apparatus which is enclosed, in its use, in a cabinet having a reduced depth and wherein a sufficient cooling capacity can be ensured and the temperature of the room wall can be prevented from being increased.

The present invention provides a heating apparatus comprising an apparatus body having therein a heating chamber in which food is heated and a component chamber in which electrical components are disposed, the apparatus body being

enclosed, in use, in a cabinet mounted so as to be abutted against a room wall, characterized by an air flow path continuously extending along a bottom, rear and ceiling of the apparatus body between the cabinet and the apparatus body enclosed in the cabinet, an inlet formed in the lower front of the cabinet and communicating with the air flow path, an outlet formed in the upper front of the cabinet and communicating with the the air flow path, a fan disposed in the air flow path for circulating air, and means for defining a space between the room wall and the rear wall of the cabinet when abutted against the room wall.

According to the above-described construction, the space is defined between the room wall and the rear wall of the cabinet by the space defining means provided on the side walls of the cabinet. Consequently, the temperature of the room wall can be prevented from being increased even if the air flow path between the rear of the apparatus body and the inner rear wall of the cabinet is narrowed.

In the above-described construction, the cabinet may have in the rear wall a suction opening communicating with the air flow path. The cooling air is drawn in both from the inlet formed in the lower front of the cabinet and from the suction opening. A sufficient air volume is thus provided for the cooling. Consequently, a sufficient cooling capacity can be ensured even if the air flow path between the rear of the apparatus body and the inner rear wall of the cabinet is narrowed.

The suction opening may be located so as to correspond to suction apertures formed in the rear of the apparatus body so that air is introduced into the component chamber of the heating apparatus. The suction of the cooling air into the component chamber can be efficiently performed through the suction opening. Consequently, the electrical components in the component chamber can be cooled efficiently.

The body of the heating apparatus may have in the ceiling an exhaust aperture through which air in the component chamber is exhausted to the air flow path side. In this case, the air can be exhausted from the component chamber by effective use of the air flow path. Consequently, the cooling of the electrical components in the component chamber can be improved. In this regard, the fan may be disposed on the ceiling of the apparatus body and two exhaust apertures may be formed to be located at opposite sides of the fan respectively. The cooling operation can be performed uniformly in the right-hand and left-hand sides of the apparatus body. As a result, the air flow path at each side of the apparatus body can be narrowed or eliminated.

The apparatus body may include an exhaust duct provided for introducing air in the heating chamber to the air flow path. The air in the heating chamber can be exhausted simultaneously with exhaustion of the cooling air from the component chamber. Furthermore, a partition plate may be provided in the air flow path for preventing back flow of the air exhausted from an outlet of the exhaust duct to the exhaust aperture. Even when steam is contained in the air exhausted from the heating chamber into the air flow path through the exhaust duct, the steam can be prevented from flowing back into the component chamber. Consequently, deterioration of the electrical components in the component chamber due to the steam can be prevented.

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

FIG. 1 is a longitudinally sectional side view of a cabinet and a heating apparatus enclosed in the cabinet in accordance with an embodiment of the invention;

FIG. 2 is an exploded view of the cabinet and the heating apparatus;

FIG. 3 is a plan view of the cabinet enclosing the heating apparatus;

FIG. 4 is a perspective view of the cabinet enclosing the heating apparatus, for the purpose of showing the mounting of the cabinet on a cupboard;

FIG. 5 is a view similar to FIG. 1 showing another embodiment of the invention;

FIG. 6 is a perspective view of the upper portion of the heating apparatus;

FIG. 7 is a partially broken perspective view of the upper portion of the heating apparatus as taken from its rear;

FIG. 8 is a front view of the cabinet enclosing the heating apparatus; and

FIG. 9 is a longitudinally sectional view of a cabinet enclosing a heating apparatus in accordance with the prior art.

A first embodiment of the present invention will be described with reference to FIGS. 1 to 4. The invention has been applied to a high mount type microwave oven having oven and grill functions in the embodiment.

A body 11 of the microwave oven will be first described in brief. The body 11 comprises a rectangular outer casing 12 defining an outer wall of the body 11, a heating chamber (not shown) and a component chamber 13 both defined in the outer casing 12 to be disposed transversely. A ceiling 14 serves as those of both the heating chamber and the component chamber 13, as shown in FIG. 1. A door 15 is mounted on the front of the heating chamber to be openable for placing food in and

taking it out of the heating chamber, as shown in FIG. 4. An operation panel 16 including various switches is disposed on the front of the component chamber 13.

In the component chamber 13 are provided a magnetron 17 for supplying microwaves into the heating chamber, a high voltage transformer 18, a high voltage capacitor 19 and the like. A cooling fan 20 is provided at the rear interior of the component chamber 13 for cooling the electrical components such as the magnetron 17. The cooling fan 20 comprises a fan blade and an electric motor. Suction apertures 21 are formed in the rear of the outer casing 12 of the body 11 so as to be positioned behind the cooling fan 20, as shown in FIG. 2. The cooling fan 20 is driven so that a cooling air outside the body 11 is drawn in through the suction apertures 21 to be used for the cooling of the electrical components such as the magnetron 17. The cooling air, after having passed the magnetron 17, flows through a duct 22 to be exhausted from an opening (not shown) of the ceiling 14 upwardly or into a space between the ceiling 14 and the outer casing 12. A part of the cooling air is supplied into the heating chamber through the duct 22 in the range mode.

A grill heater 23 having an outer pipe formed from ceramic is disposed near the ceiling 14 in the heating chamber, as shown in FIG. 1. An oven heater (not shown) is disposed in the rear interior of the heating chamber.

The microwave oven body 11 constructed as described above is enclosed in a cabinet 24 and then, the cabinet 24 is mounted on the outer bottom of a cupboard 26 hung on a room wall 25 of the kitchen, for example.

The cabinet 24 has the height and width slightly larger than the microwave oven body 11 and a front opening and is formed into the shape of a rectangular box. A mounting plate 27 is provided at the lower interior of the cabinet 24 so that the microwave oven body 11 is placed on the mounting plate 27. Two movable rail members 29 are mounted on the top of the cabinet 24 so as to be engaged with respective fixed rail members 28 mounted on the outer bottom of the cupboard 26, as shown in FIGS. 3 and 4.

An air flow path 30 is defined between the microwave oven body 11 and the cabinet 24 in the condition that the body 11 is enclosed in the cabinet 24, as is shown in FIG. 1. The air flow path 30 extends from under the bottom of the body 11 and the rear of the body 11 to the space over the top of the body 11. Decorative panels 31 and 32 are mounted on the upper and lower front portions of the cabinet 24 respectively. Each decorative panel 31, 32 includes a plurality of louvers and slits extending transversely substantially a full width of

the apparatus body 11. The slits of the lower decorative panel 32 serves as an inlet 33 communicating with the air flow path 30 and the slits of the upper decorative panel 31 serves as an outlet 34 communicating with the air flow path 30.

A fan 35 is provided in the air flow path 30 as shown in FIG. 1. The fan 35 may be a transverse fan, for example, and is mounted on the top of the body 11 to be arranged transversely. Upon drive of the fan 35, air is drawn in from the inlet 33 and flows through the air flow path 30 toward the outlet 34. Two exhaust apertures 38 and 39 are formed in the top of the body 11 to be located at opposite sides of the fan 35 respectively, as is shown in FIG. 2. The air in the body 11 is exhausted through the exhaust apertures 38, 39 into the air flow path 30.

The cabinet 24 comprises a bottom plate 24a, a rear plate 24b, a top plate 24c and two side plates 24d and 24e. In the embodiment, the side plates 24d, 24e extend beyond the rear plate 24b, as shown in FIGS. 2 and 3 such that portions 24f, 24g of the side plates 24d, 24e protruding beyond the rear plate 24b serve as space defining means.

The rear plate 24b has a generally rectangular suction opening 36, as shown in FIG. 2. The position of the suction opening 36 corresponds to that of the suction apertures 21 of the body 11. In the embodiment, the side plates 24d, 24e of the cabinet 24 serves as side plates of the outer casing 12 of the microwave oven body 11.

In mounting the cabinet 24 enclosing the body 11 on the cupboard 26 hung on the room wall 25, the movable rail members 29 are inserted into the fixed rail members 28 secured on the outer bottom of the cupboard 26 and moved rearwardly until it abuts against the room wall 25, as is shown in FIG. 4. A space S is defined between the rear plate 24b of the cabinet 24 and the room wall 25 by the space defining means 24f, 24g when the rear edges of the side plates 24d, 24e abut against the room wall 25, as shown in FIGS. 1 and 3.

In operation, the cooling fan 20 in the component chamber 13 of the body 11 and the fan 35 disposed in the air flow path 30 are driven during execution of the heating. An outside air is drawn into the air flow path 30 through the inlet 33 of the decorative panel 32 to serve as the cooling air, as shown by void arrows in FIG. 1. The cooling air flows through the air flow path 30 to serve to cool the components such as the magnetron 17 in the component chamber 13, the outer casing 12 of the body 11 and the cabinet 24. Thereafter, the cooling air is exhausted outwards from the outlet 34. Simultaneously, the outside air is also drawn in through the space S defined between the rear plate 24b and the room wall 25, the suction opening 36 formed in the rear plate 24b and the suction ap-

ertures 21 in turn to serve as the cooling air. Accordingly, a sufficient volume of cooling air is ensured since the cooling air is thus drawn in both from the inlet 33 and from the suction opening 36.

In particular, since the suction opening 36 is positioned immediately behind the suction apertures 21, the air is efficiently drawn in from the suction opening 36. Consequently, the cooling effect for the components such as the magnetron 17 in the component chamber 13 can be improved.

The inventors made an experiment to study the difference in the temperature of the magnetron 17 between the cabinet having the suction opening 36 and that without the suction opening 36. According to the experiment, the temperature of the magnetron 17 is 210 °C (efficiency of 50% or above) in the case of the microwave oven with the suction opening 36 while it is 240 °C (efficiency of 48%) in the case of the microwave oven without the suction opening 36.

According to the above-described embodiment, the outside air is drawn in from the suction opening 36 through the space S as well as from the inlet 33. Consequently, a sufficient volume of air can be ensured for the cooling of the components in the component chamber 13, the cabinet 24 and the like. Although a large air flow path is necessitated behind the body of the microwave oven in the prior art, a sufficient cooling capacity can be ensured in the embodiment even when the air flow path 30 is narrowed behind the body 11. Consequently, the depth of the cabinet 24 can be reduced.

Further, as the result of provision of the space S between the rear plate 24b and the room wall 25, an amount of heat transferred to the room wall 25 can be reduced as compared with the prior art wherein an overall rear of the cabinet is in close contact with the room wall. Consequently, the increase in the temperature of the room wall can be restrained.

Although the suction opening 36 is positioned behind the suction apertures 21 in the foregoing embodiment, the same effect can be achieved as in the foregoing embodiment, even when the suction opening 36 is formed in any portion of the rear plate 24b. Further, although the space defining means 24f, 24g extend rearwardly from the side plates 24d, 24e of the cabinet respectively, such space defining means may be provided at four corners of a flat rear plate respectively.

FIGS. 5 through 8 illustrate a second embodiment of the invention. A temperature sensor 44 for the temperature control is provided on the ceiling 14a of the heating chamber. The temperature sensor 44 is inserted into the ceiling 14a to be mounted in position. A partition plate 45 is mounted on the upper side of the ceiling 14a so as to squarely surround the temperature sensor 44. Referring fur-

ther to FIG. 7, an exhaust duct 46 is mounted on the right-hand side wall of the heating chamber for the purpose of exhausting the air from the heating chamber outside the body 11. The duct 46 has air outlets 46a open to the outside at the upper rear of the body 11.

Two exhaust apertures 38, 39 are formed in the top of the body 11 or in the top 12a of the outer casing 12 to be located at opposite sides of the fan 35 respectively, as shown in FIGS. 6 and 7. The air in the body 11 or in the space between the ceiling 14a and the top 12a is exhausted through the exhaust apertures 38, 39 into the air flow path 30. A partition plate 40 is mounted between the air outlets 46a and the exhaust aperture 38 on the top 12a.

In operation, the cooling fan 20 in the component chamber 13 of the body 11 and the fan 35 disposed in the air flow path 30 are driven during execution of the heating. The outside air is drawn into the air flow path 30 through the inlet 33 of the decorative panel 32 and further introduced into the component chamber 13 through the suction apertures 21 formed in the rear wall of the body 11, as shown by void arrows in FIG. 5. The air serves to cool the components such as the magnetron 17 in the component chamber 13 and thereafter, the air is exhausted into the space between the ceiling 14a and the top 12a of the outer casing 12 through the duct 22 and an opening 14b (FIG. 6) formed in the ceiling 14. Accordingly, the outer and inner casings 12, 14 and the like are also cooled by the cooling air. The air exhausted into the space between between the ceiling 14a and the top 12a is further exhausted into the upper portion of the air flow path 30 to be finally exhausted outside through the outlet 34.

In the above-described embodiment, the efficient cooling can be performed by the fan 35. The cooling can be performed uniformly in the right-hand and left-hand sides of the body 11 or the cabinet 24 since the exhaust apertures 38, 39 are positioned at opposite sides of the fan 35 respectively. Although the temperature sensor 44 is disposed in the space between the ceiling 14a and the top 12a of the outer casing 12, it is not influenced by the air flowing through the space since it is surrounded by the partition plate 45. Consequently, the temperature of the atmosphere in the heating chamber can be accurately detected by the temperature sensor 44.

A part of the cooling air is supplied into the heating chamber through the duct 22 and exhausted outside the body 11 through the exhaust duct 46 in the range mode, for example. The air exhausted from the heating chamber contains steam or the like induced in it. Accordingly, the electrical components may be damaged when the air con-

taining steam flows back into the component chamber 13. In the embodiment, however, the partition plate 40 is mounted between the air outlets 46a and the exhaust aperture 38 on the top 12a. The partition plate 40 prevents the air containing steam or the like from flowing back into the component chamber when the air is exhausted from the exhaust duct 46 to the air flow path 30 through the exhaust aperture 38.

According to the above-described embodiment, high cooling efficiency can be achieved by the fan 35 disposed in the air flow path 30. Further, the cooling can be performed uniformly in the right-hand and left-hand sides of the body 11 or the cabinet 24. Accordingly, although the air flow path is necessitated at the right-hand and left-hand sides of the body of the microwave oven in the prior art, the increase in the temperature of each side wall can be restrained without the air flow path at the right-hand and left-hand sides of the body in the embodiment. Consequently, the width of the cabinet can be reduced and space saving can be enhanced.

Furthermore, the partition plate 40 is mounted between the air outlets 46a and the exhaust aperture 38 on the top 12a. Accordingly, even when the steam is exhausted with the air from the heating chamber through the exhaust duct 26, the steam can be prevented from flowing back into the body 11 through the exhaust aperture 38, which prevents a bad influence of the steam upon the electrical components in the component chamber.

The partition plate 40 may or may not be provided. The above-described object can be achieved without provision of the partition plate 40. Further, although the invention is applied to the microwave oven with oven and grill functions in the embodiments, it may be applied to the other heating apparatuses.

The foregoing disclosure and drawings are merely illustrative of the principle 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 heating apparatus comprising an apparatus body (11) having therein a heating chamber in which food is heated and a component chamber (13) in which electrical components are disposed, the apparatus body (11) being enclosed, in use, in a cabinet (24) mounted so as to be abutted against a room wall (25), characterized by an air flow path (30) continuously extending along a bottom, rear and ceiling of the apparatus body (11) between the cabinet (24) and the apparatus body (11) enclosed in

the cabinet (24), an inlet (33) formed in the lower front of the cabinet (24) and communicating with the air flow path (30), an outlet (34) formed in the upper front of the cabinet (24) and communicating with the the air flow path (30), a fan (35) disposed in the air flow path (30) for circulating air, and means (24f, 24g) for defining a space (S) between the room wall and the rear wall of the cabinet (24) when abutted against the room wall (25). 5 10

2. A heating apparatus according to claim 1, characterized in that the space defining means (24f, 24g) are formed by rearwardly protruding the opposite side walls of the cabinet (24). 15
3. A heating apparatus according to claim 1 or 2, characterized in that the cabinet (24) has at the rear wall a suction opening (36) communicating with the air flow path (30). 20
4. A heating apparatus according to claim 3, characterized in that the suction opening (36) is located so as to correspond to suction apertures (21) formed in the rear of the apparatus body (11) so that air is drawn into the component chamber (13). 25
5. A heating apparatus according to claim 3 or 4, characterized in that the fan (35) is disposed nearer to the outlet (34) than to the inlet (33). 30
6. A heating apparatus according to any of claims 1 to 5, characterized in that the apparatus body (11) has in the ceiling an exhaust aperture (38) through which air in the component chamber (13) is exhausted to the air flow path side. 35
7. A heating apparatus according to claim 6, characterized in that the fan (35) is disposed on the ceiling of the apparatus body (11) and two exhaust apertures (38, 39) are formed to be located at opposite sides of the fan (35) respectively. 40 45
8. A heating apparatus according to claim 7, characterized in that the apparatus body (11) includes an exhaust duct (46) provided for introducing air in the heating chamber to the air flow path (30) and a partition plate (40) is provided in the air flow path (30) for preventing back flow of the air from an outlet (46a) of the exhaust duct (46) to the exhaust aperture (38). 50 55

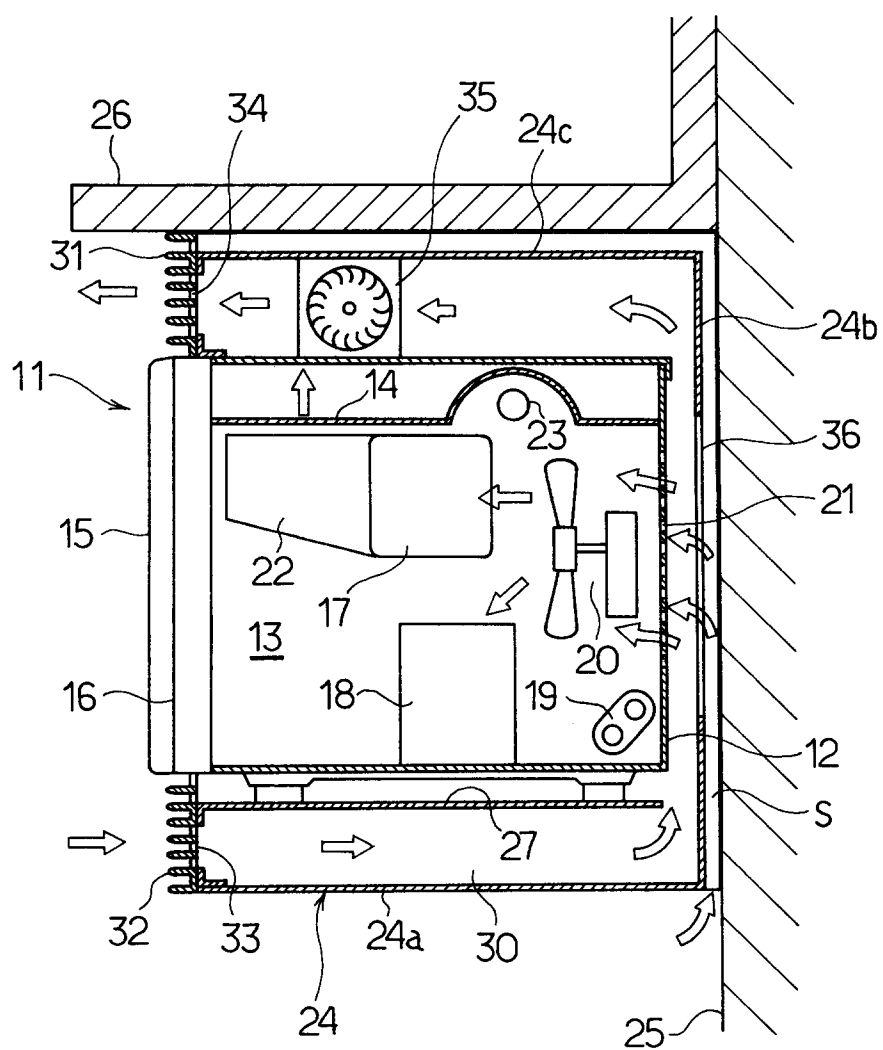


FIG.1

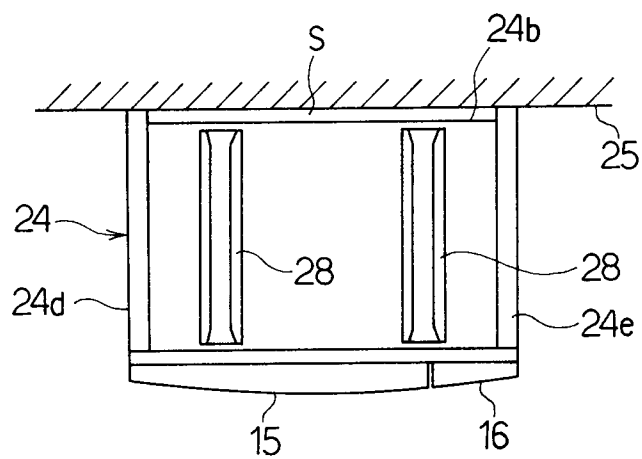
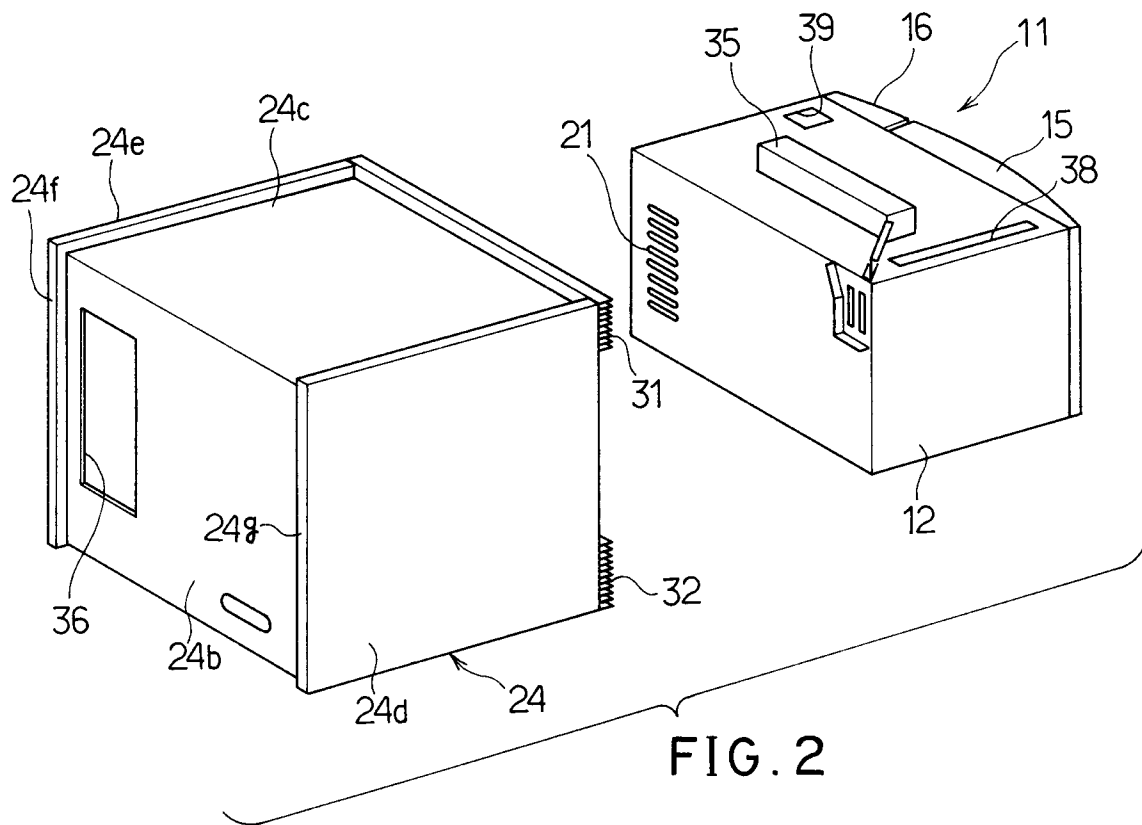
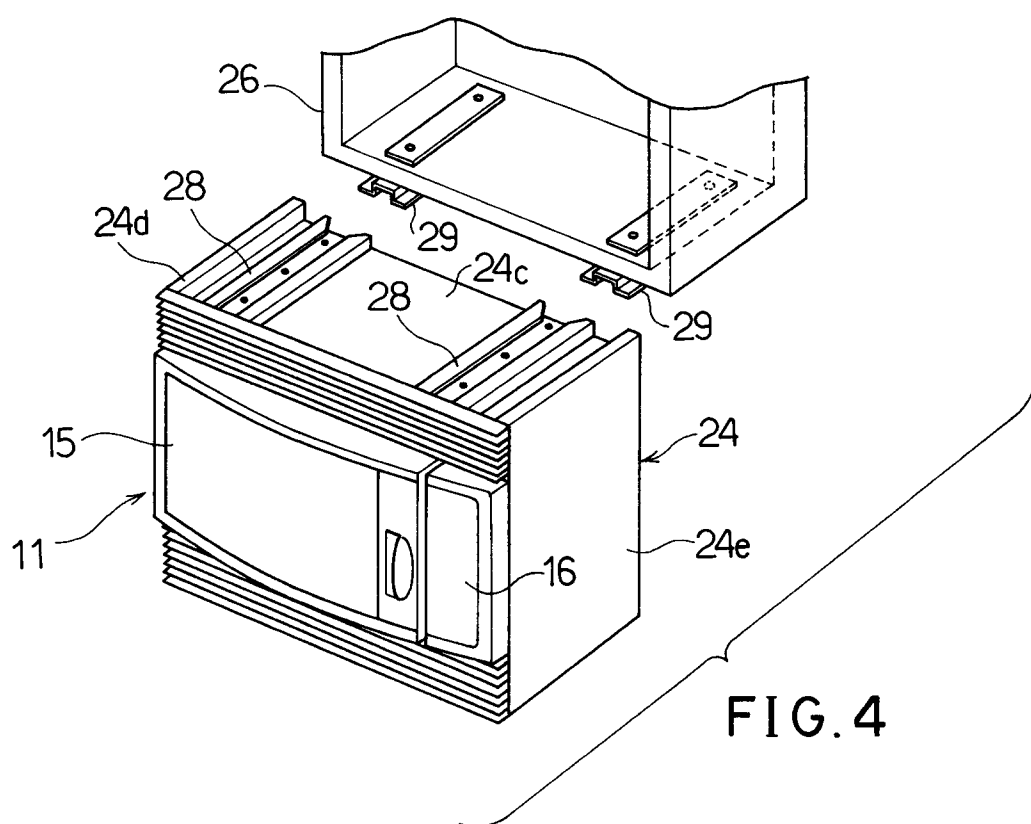


FIG. 3



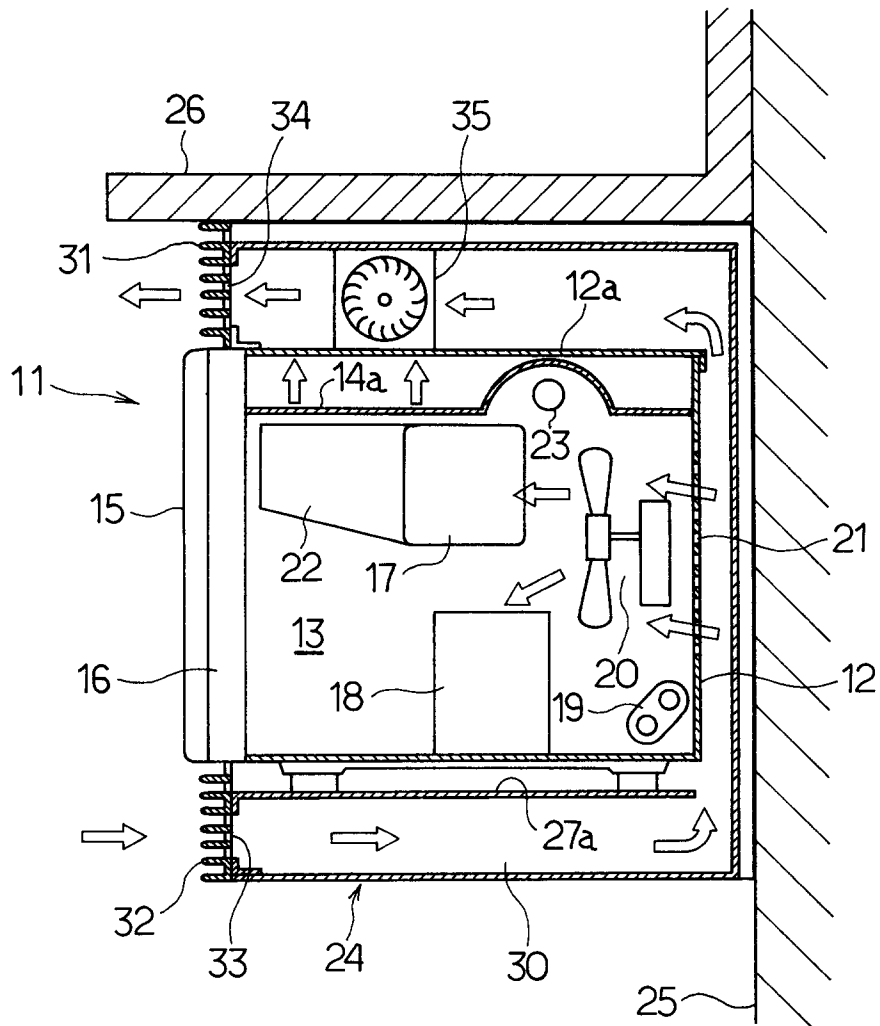


FIG. 5

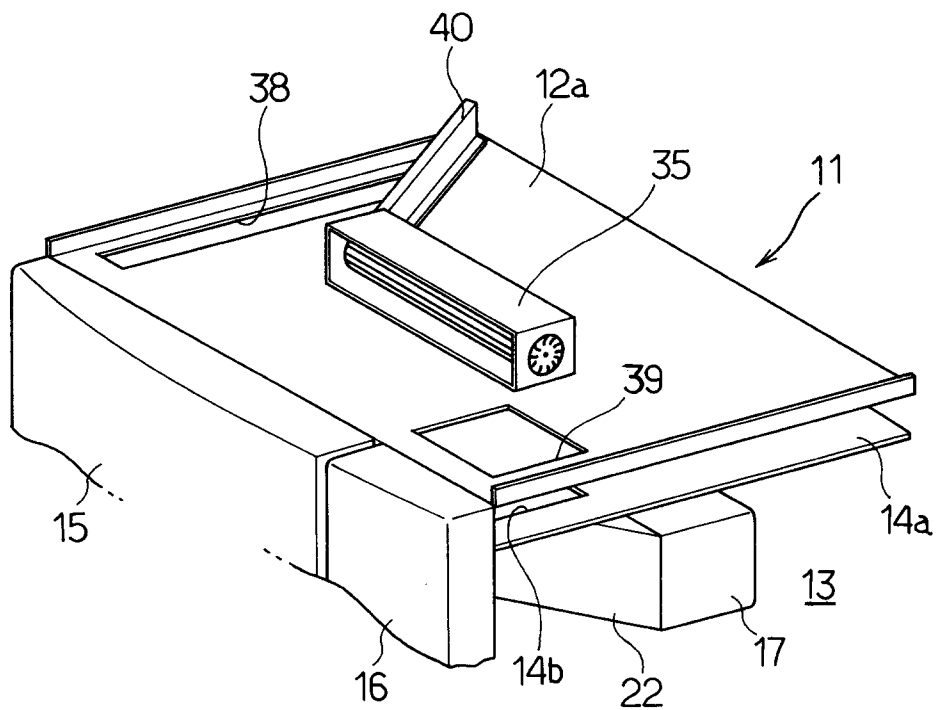


FIG. 6

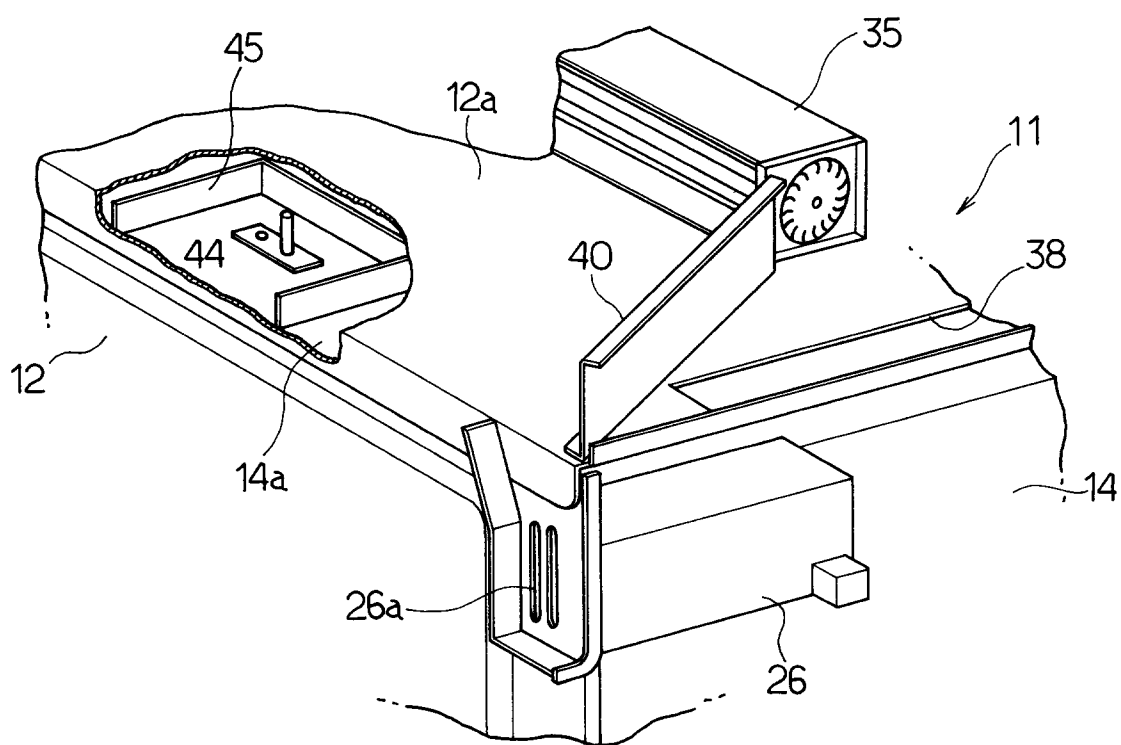


FIG. 7

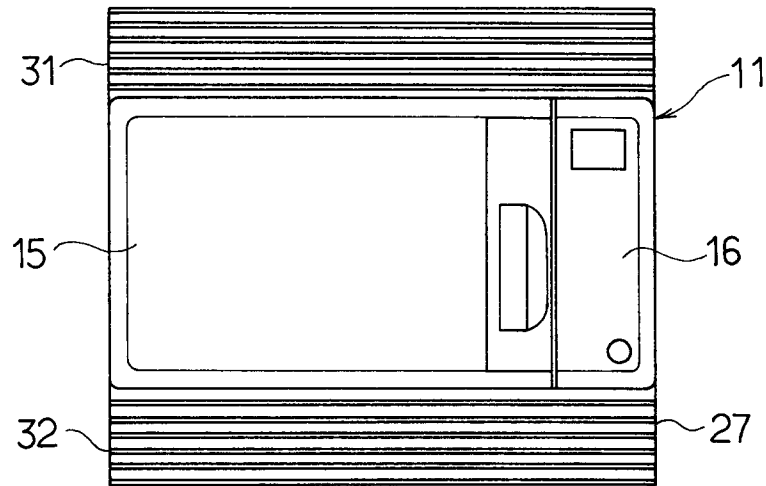


FIG. 8

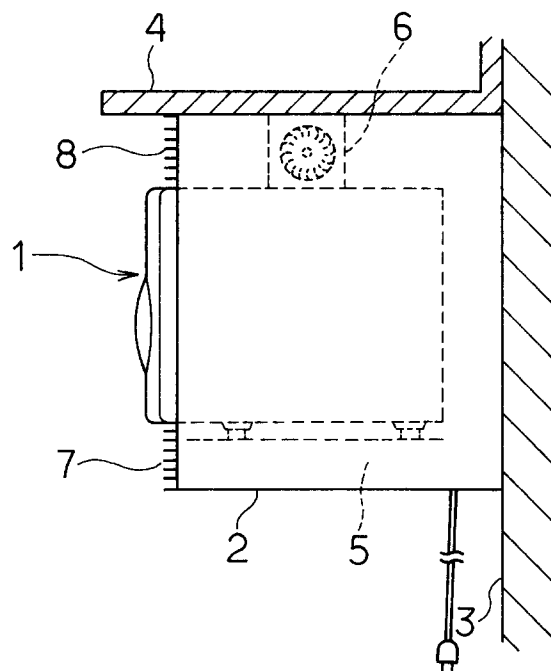


FIG. 9 (PRIOR ART)



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 93305731.7
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	<u>US - A - 3 783 219</u> (TATEDA) * Abstract; column 4, line 55 - column 5, line 5; column 5, lines 16-35, 46-67; claim 1; fig. 1-3 * --	1,3, 5-8	F 24 C 7/02 H 05 B 6/64
A	<u>US - A - 3 878 350</u> (TAKAGI) * Column 3, lines 11-41; claims 1-3; fig. 1,2 * -----	1,3	
			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 29-10-1993	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			