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(54) Heating apparatus.

(57) A heating apparatus with both a microwave heating function and a heater heating function includes an inner casing (3) forming a heating chamber (4), an outer casing (2) enclosing the inner casing (3), a component chamber (5) defined between the outer and inner casings (2,3), a first fan (7) cooling electrical components such as a magnetron (6) in the component chamber (5), and a second fan (23) introducing outside air into a duct (19) and sending the outside air to a glass window (13) of the heating chamber (4) for defogging it. The duct (19) has a small vent (32) through which a small part of air delivered by the first fan (7) is introduced into the duct (19) so that the pressure in the duct (19) is increased above the pressure in the heating chamber (4).

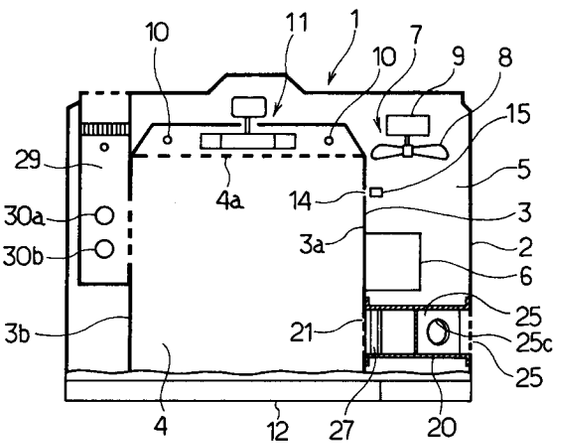

FIG.2

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This invention relates to a heating apparatus, such as microwave ovens, having a microwave heating function in which food placed in a heating chamber is heated by way of microwaves and a heater heating function in which the food is heated by an electric heater, and more particularly to such a heating apparatus provided with defogging means for defogging a window formed in a door opening and closing a front opening of the heating chamber.

The prior art has provided a heating apparatus comprising an outer casing, an inner casing provided in the outer casing for defining a heating chamber therein, a magnetron provided in a component chamber defined outside the inner casing in the outer casing, a door opening and closing a front opening of the heating chamber, the door having a glass window, an electric heater provided in the heating chamber for heating food placed in the heating chamber, and a cooling fan delivering cooling air to the magnetron in the component chamber. In a microwave heating mode, the magnetron is operated for heating food placed in the heating chamber, by way of microwaves. In a heater heating mode including an oven mode and a grill mode, the electric heater is energized to heat the food.

The cooling fan is driven during the microwave heating mode for cooling the magnetron which becomes very hot for generation of heat. The cooling fan is further driven during heater heating mode so that the magnetron and other electrical parts are prevented from being heated by high temperature atmosphere in the heating chamber.

The above-described heating apparatus further includes defogging means for defogging the glass window of the door which is subjected to steam produced from the food during the microwave heating operation. The defogging means includes an air-path forming member guiding a part of the air delivered by the cooling fan so that the air is blown along an inner face of the glass window of the door. The air-path forming member is provided with a shutter closing the air-path forming member so that the defogging air is prevented from being discharged into the heating chamber in the heater heating mode. However, the pressure in the component chamber is high as the result of operation of the cooling fan. Accordingly, even if the shutter is switched to the closing state in the heater cooking mode, the pressure difference causes the cooling air to inevitably leak into the heating chamber, which prevents rise of the temperature in the heating chamber.

Therefore, an object of the present invention is to provide a heating apparatus wherein the window of the door formed of a transparent material can be prevented from being fogged in the microwave heating mode.

Another object of the present invention is to provide a heating apparatus wherein the cooling air delivered from the cooling fan can be prevented from leaking out into the heating chamber in the microwave heating mode, thereby preventing drop of the temperature in the heating chamber by the leaking cooling air.

The present invention provides a heating apparatus comprising an outer casing, a partitioning member disposed in the outer casing for defining a heating chamber therein, a magnetron provided in a component chamber defined outside the partitioning member and inside the outer casing, a door provided for opening and closing a front opening of the heating chamber, the door having a window formed from a transparent material, a heater provided for heating food placed in the heating chamber, and a cooling fan disposed to deliver cooling air to the magnetron in the component chamber, characterized by a duct having one of two ends open to the interior of the heating chamber via the partitioning member and the other end open to the outside of the outer casing, thereby communicating between the interior of the heating chamber and the outside of the outer casing, and a defogging fan disposed in the duct to be driven during a microwave heating operation so that air is supplied to the transparent window of the door for defogging the same.

According to the above-described heating apparatus, the interior of the heating chamber is isolated from the cooling air delivered from the cooling fan since the heating chamber communicates with the outside of the outer casing through the duct. The defogging fan is driven during the microwave heating operation so that the outside air is sent to the window of the door through the duct. Since the defogging fan is not driven during the heater heating operation, outside air preventing rise of the temperature in the heating chamber is not introduced into the heating chamber and furthermore, the cooling air is not introduced into the heating chamber during the heater heating operation.

In a preferred form, the location where said one end of the duct communicates with the interior of the heating chamber is high relative to the location of the defogging fan disposed in the duct, so that the hot air in the heating chamber is prevented from flowing to the defogging fan.

In another preferred form, the duct has communication means communicating between the interior of the duct and the interior of the component chamber so that the pressure in the duct is approximately the pressure in the component chamber. Consequently, vapor emitted from the food in the heating chamber can be prevented from dis-

sipating through the duct outside the outer casing since the pressure in the duct is slightly higher than in the heating chamber.

In further another preferred form, the defogging fan comprises an electric motor disposed outside the duct and having a rotational shaft extending upwardly through the bottom of the duct, and an impeller disposed in the duct to be connected to the upper end of the rotational shaft of the motor. Consequently, lubrication oil of the motor 26 can be prevented from leaking out from the shaft end into the duct 19.

In further another preferred form, a plate in the duct has a bank portion formed at said one end of the duct where the duct communicates with the heating chamber via a vent in the partitioning member, the bank portion rising from said one end of the duct inwardly thereof in the vicinity of the lower edge of the vent of the partitioning member. Consequently, liquid adherent to the inner wall of the heating chamber can be prevented from invading the duct.

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

FIG. 1 is a perspective view of a microwave oven embodying the heating apparatus of a first embodiment according to the invention;

FIG. 2 is a transversely sectional view of the microwave oven;

FIG. 3 is a partially enlarged longitudinally sectional view showing the mounting of the duct employed in the microwave oven;

FIG. 4 is a longitudinally sectional side view of a component chamber of the microwave oven;

FIG. 5 is a transversely sectional view taken along line 5-5 in FIG. 1;

FIG. 6 is a view similar to FIG. 2 showing a second embodiment of the invention;

FIG. 7 is a longitudinally sectional view of the duct and its peripheral portion of the microwave oven;

FIG. 8 is an enlarged transversely sectional view of a defogging fan employed in the microwave oven; and

FIG. 9 is a partially enlarged perspective view of the duct.

A first embodiment of the invention will now be described with reference to FIGS. 1-5. Referring first to FIGS. 2 and 3, a body 1 of the microwave oven embodying the invention includes an outer casing 2 and an inner casing 3 enclosed in the outer casing 2 to serve as a partitioning member. The interior of the inner casing 3 serves as a heating chamber 4. A component chamber 5 is defined between the outer and inner casings 2, 3. A magnetron 6, a first fan 7 serving as a cooling fan and other electrical components (not shown) are provided in the component chamber 5. The first fan 7 comprises a blowing blade assembly 8 and an electric motor 9 driving the blade assembly 8.

A heater 10 and an auxiliary fan 11 are provided on the rearside of a rear plate 4a of the heating chamber 4 for the purpose of providing hot air in it. The heating chamber 4 has a front opening and a door 12 is mounted to open and close the front opening. The door 12 has a window 13 formed by a punched metal and a transparent material such as a glass plate.

A side wall 3a of the inner casing 3 at the side of the component chamber 5 has a plurality of apertures 14 formed therein. A plurality of light-emitting elements 15 are mounted on the side wall 3a via base plates 16 and mounting members 17 respectively so that the elements face the respective apertures 14 from the side of the component chamber 5, as shown in FIGS. 4 and 5. Light emitted from the light-emitting elements 15 passes through the respective apertures 14. A plurality of photo detectors (not shown) are mounted on a side wall 3b opposite the side wall 3a. Apertures 18 are also formed in the side wall 3b, as shown in FIG. 1. A photo sensor thus comprises the light-emitting elements 15 and the photo detectors. The photo sensor is provided for detecting presence or absence of food in the heating chamber 4.

Referring to FIGS. 2-4, an air duct 19 is disposed in the component chamber 5. One end of the duct 19 is airtightly connected to the side wall 3a of the inner casing 3 so as to surround an inner vent 21 formed in the side wall 3a and having a number of small apertures. The other end of the duct 19 is airtightly connected to the side wall of the outer casing 2 so as to surround outer vent holes 22. Consequently, the duct 19 communicates between the interior of the heating chamber 4 and the outside of the outer casing 2 and is airtight against the component chamber 5.

A second fan 23 serving as a defogging fan is mounted on the bottom of the duct 19. The second fan 23 comprises a centrifugal vane 24, a partition plate 25 and an electric motor 26 driving the centrifugal vane 24. A generally half interior of the duct 19 at the side of the vent holes 22 is divided by the partition plate 25 into upper and lower portions. The partition plate 25 has a claw 25a engaged with an engagement hole (not shown) formed in the bottom of the duct 19. The partition plate 25 further has a mounting portion 25b formed in the upper end thereof and screwed to the upper wall of the duct 19. The partition plate 25 has a central air inlet 25c. The motor 26 is located below the bottom of the duct 19 in the component chamber 5 and has a rotational shaft 26a extended through the bottom of the duct 19 into the duct 19. The centrifugal vane 24 is mounted on the upper end of the

rotational shaft 26a so as to face the air inlet 25c. The above-described partition plate 25 has a simple construction as compared with a so-called spiral casing but can achieve a necessary air pressure.

A plate 28 is secured at one end to the bottom end of the duct 19 and at the other end thereof to the bottom of the duct 19, as shown in FIG. 3. The plate 28 has a bank portion 27 inclined from the vicinity of the lower edge of the inner vent 21 (the region of the small apertures) upwardly inwardly of the duct 19. An alcohol sensor 30a and a steam sensor 30b are disposed in an exhaust path 29 defined outside the inner casing 3 to communicate with the heating chamber 4, as shown in FIG. 2.

The microwave oven constructed as described above has both a microwave heating function and a heater heating function. In the microwave heating function, the magnetron 6 is operated to generate microwaves which are supplied into the heating chamber to heat the food therein. Both the first and second fans 7, 23 are driven in the microwave heating function. Upon drive of the first fan 7, the magnetron 6, the light-emitting elements 15 and other electrical components in the component chamber 5 are cooled by the cooling air delivered from the first fan 7. Furthermore, the second fan 23 draws outside air into the heating chamber 4 through the duct 19 to cause the air flow along the glass window 13 so that the glass window 13 of the door 12 is defogged.

On the other hand, the heater 10 and the auxiliary fan 11 are driven in the heater heating function so that a circulating hot air flow is produced in the heating chamber 4, which hot air heats the food therein. Only the first fan 7 is driven and the second fan 23 is not driven in the heater heating function.

The electrical components in the component chamber 5 are protected from radiant heat from the side wall 3a of the inner casing 3 during the heating by the heater 10 since they are cooled by the cooling air delivered from the first fan 7. The outside air is not supplied into the heating chamber 4 since the second fan 23 is not driven during the heating by the heater 10. The inner face of the glass window 13 of the door 12 does not collect moisture in the heater heating mode since the flow of hot air is produced in the heating chamber 4.

The cooling air delivered from the first fan 7 does not flow into the heating chamber 4 since the duct 19 is airtightly isolated from the component chamber 5. Consequently, the temperature in the heating chamber 4 is not decreased by the cooling air from the first fan 7.

Furthermore, the hot air in the heating chamber 4 does not flow through the apertures 14 into the component chamber 5 since the pressure in the component chamber 5 is slightly raised as the result of drive of the first fan 7. Consequently, the light-emitting elements 15 are prevented from being subjected to the hot air and accordingly, from being deteriorated.

Air in the component chamber 5 may flow through the apertures 14 into the heating chamber 4. However, the volume of air flowing from the chamber 5 to the chamber 4 through the apertures 14 is so small as not to decrease the temperature in the heating chamber 4 since the pressure difference between the chambers 4, 5 is small and the diameter of each aperture 14 is small.

Furthermore, the motor 26 driving the second fan 23 is disposed below the bottom of the duct 19 so that its shaft 26a extends upwardly. Consequently, lubrication oil of the motor 26 can be prevented from leaking out from the shaft end into the duct 19. Furthermore, the bank portion 27 extends upwardly inwardly of the duct 19 from the lower edge of the inner vent 21. Consequently, when the inner wall of the heating chamber 4 collects moisture or when liquid adheres to the inner wall at the time the food is placed in and taken out of the heating chamber, the bank portion 27 prevents the liquid from invading the duct 19. Consequently, the second fan 23 and the electrical components in the component chamber 5 can be prevented from getting wet with the liquid from the heating chamber 4.

FIGS. 6 through 9 illustrate a second embodiment of the invention. A duct 31 is connected at one end to the inner vent 21 formed in the inner casing 3 and at the other end to the outer vent 22 formed in the outer casing 2, in the same manner as in the duct 19 in the foregoing embodiment. A small vent hole 32 serving as communicating means is formed in the side wall of the duct 31 facing the component chamber 5 in the vicinity of the end connected to the outer vent 22, as shown in FIGS. 6, 8 and 9. A defogging fan 33 is disposed in the vicinity of the outer vent 22 in the duct 31. The defogging fan 33 includes a motor 34 and a propeller-like impeller 35.

In the second embodiment, the defogging fan 33 is driven during the microwave heating mode and not driven during the heater heating mode, as in the foregoing embodiment.

The air in the heating chamber 4 is heated by the heater 10 in the heater heating mode. A small volume of relatively high pressure air delivered from the fan 7 in drive is introduced through the vent hole 32 into the duct 31. Accordingly, the pressure near the vent hole 32 in the duct 31 is slightly higher than that in the heating chamber 4. This difference in the pressure can prevent vapor emitted from the food from passing through the duct 31 toward the outer vent 22.

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 heating apparatus comprising an outer casing (2), a partitioning member (3) disposed in the outer casing (2) for defining a heating chamber (4) therein, a magnetron (6) provided in a component chamber (5) defined outside the partitioning member (3) and inside the outer casing (2), a door (12) provided for opening and closing a front opening of the heating chamber (4), the door (12) having a window (13) formed from a transparent material, a heater (10) provided for heating food placed in the heating chamber (4), and a cooling fan (7) disposed to deliver cooling air to the magnetron (6) in the component chamber (5), characterized by a duct (19) having one of two ends open to the interior of the heating chamber (4) via the partitioning member (3) and the other end open to the outside of the outer casing (2), thereby communicating between the interior of the heating chamber (4) and the outside of the outer casing (2), and a defogging fan (23) disposed in the duct (19) to be driven during a microwave heating operation so that air is supplied to the transparent window (13) of the door (12) for defogging the same.

2. A heating apparatus according to claim 1, characterized in that the location where said one end of the duct (19) communicates with the interior of the heating chamber (4) is high relative to the location of the defogging fan (23) disposed in the duct (19).

3. A heating apparatus according to claim 1, characterized in that the duct (31) has communication (32) communicating between the interior of the duct (31) and the interior of the component chamber (5) so that the pressure in the duct (31) is approximately the pressure in the component chamber (5).

4. A heating apparatus according to claim 1, characterized in that the defogging fan (23) comprises an electric motor (26) disposed outside the duct (19) and having a rotational shaft (26a) extending upwardly through the bottom of the duct (19), and an impeller (24) disposed in the duct (19) and connected to the upper end of the rotational shaft (26a) of the motor (26).

5. A heating apparatus according to claim 1 or 4, characterized in that a plate (28) in the duct (19) has a bank portion (27) formed at said one end of the duct (19) where the duct (19) communicates with the heating chamber (4) via a vent (21) in the partitioning member (3), the bank portion (27) rising from said one end of the duct (19) upwardly inwardly thereof in the vicinity of the lower edge of the vent (21) of the partitioning member (3).

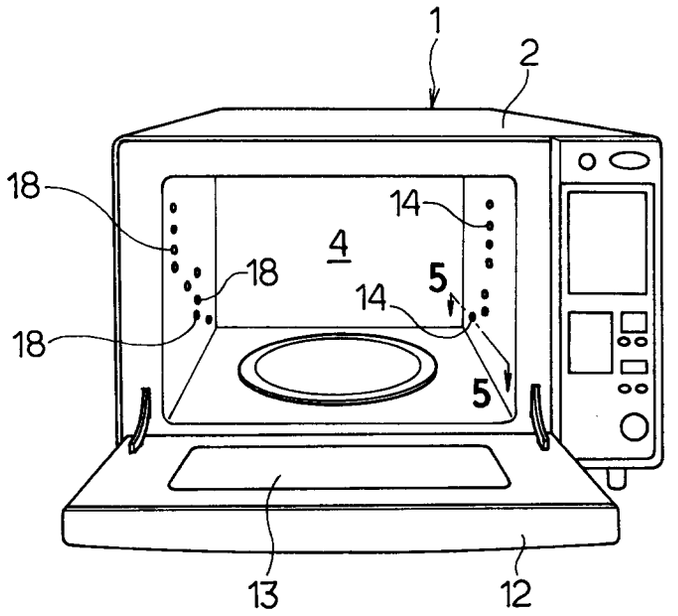
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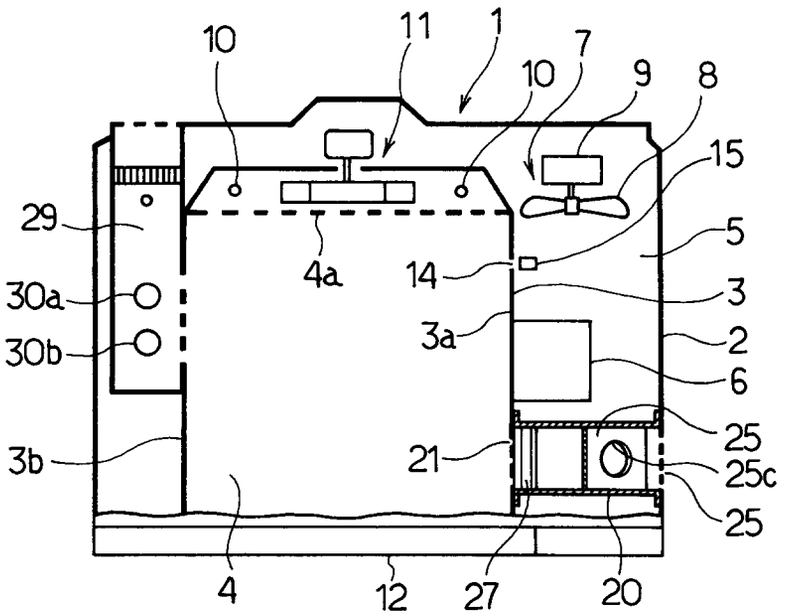
FIG.1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15
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4a
14
30a
3
3a
30b
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3b
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25c
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27
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FIG.2

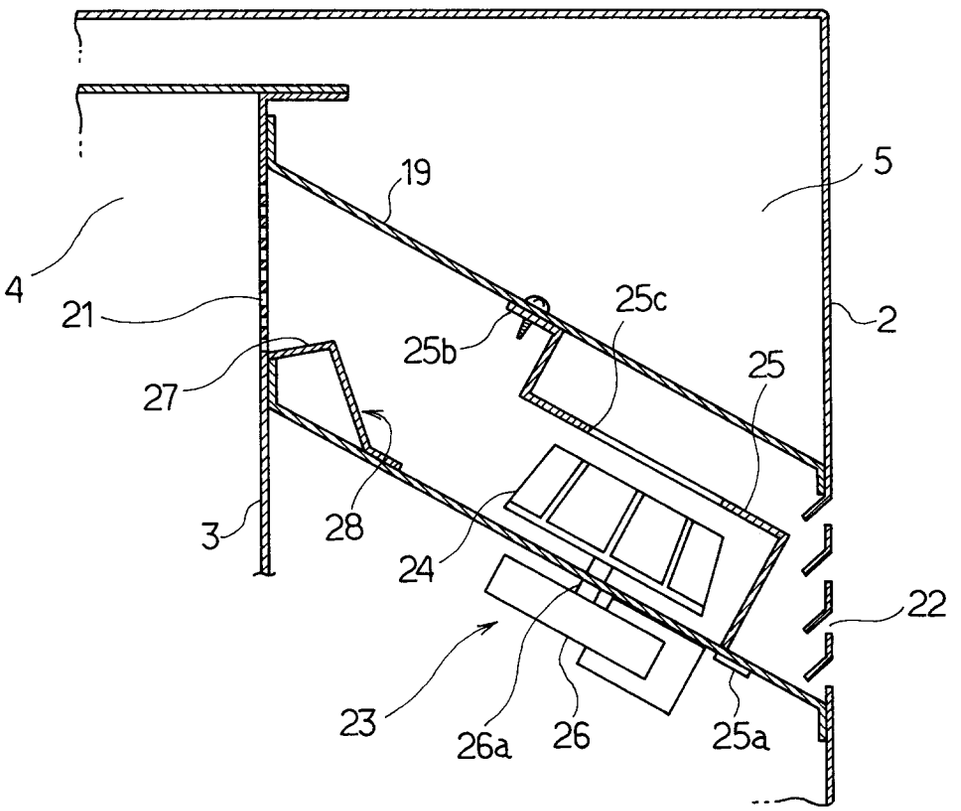

FIG. 3

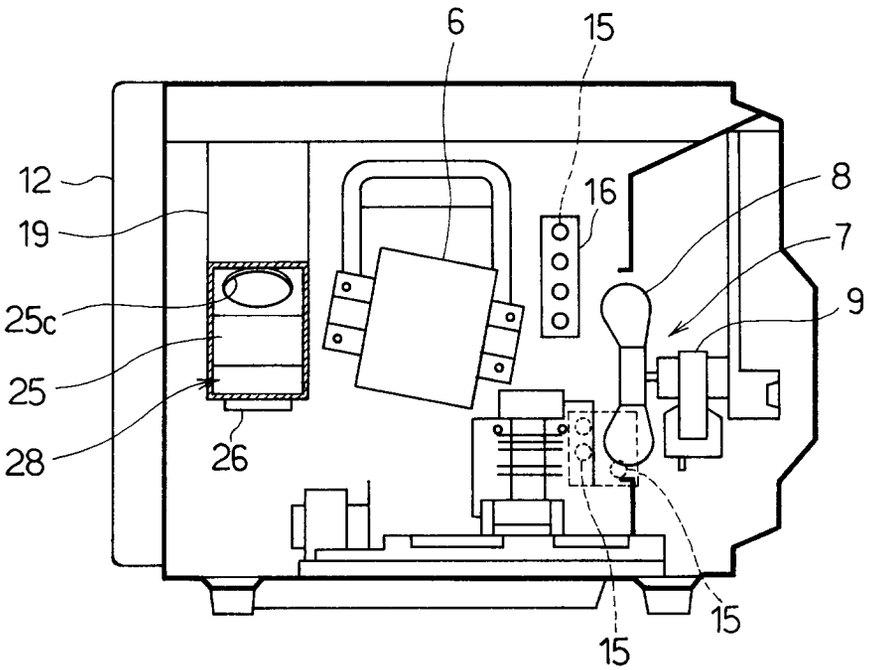

FIG.4

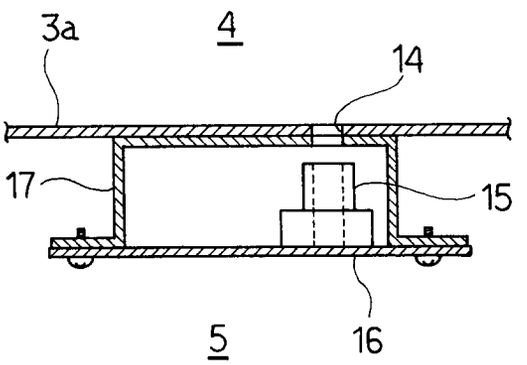

FIG.5

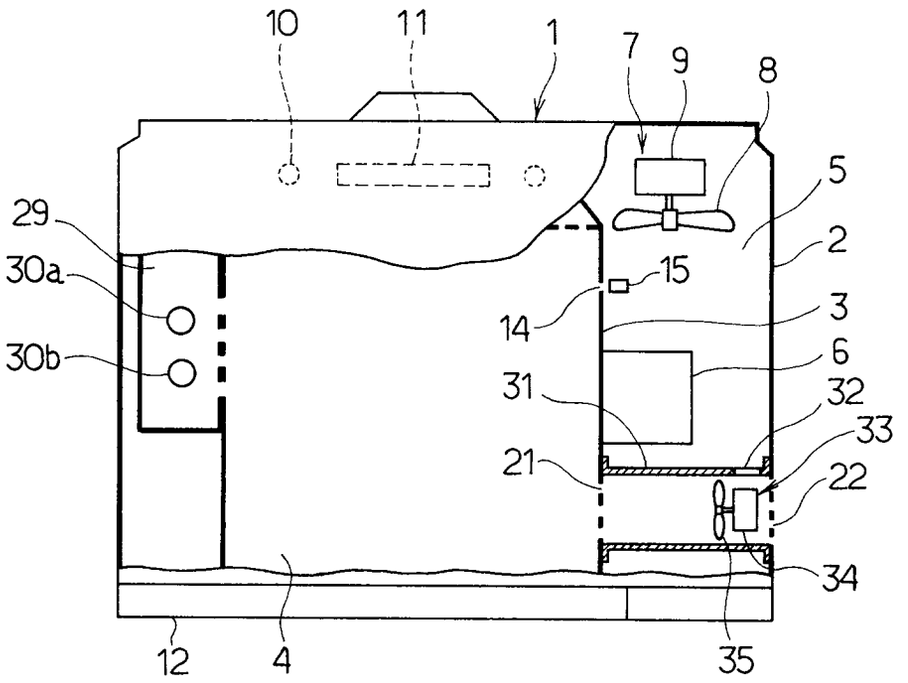
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FIG.6

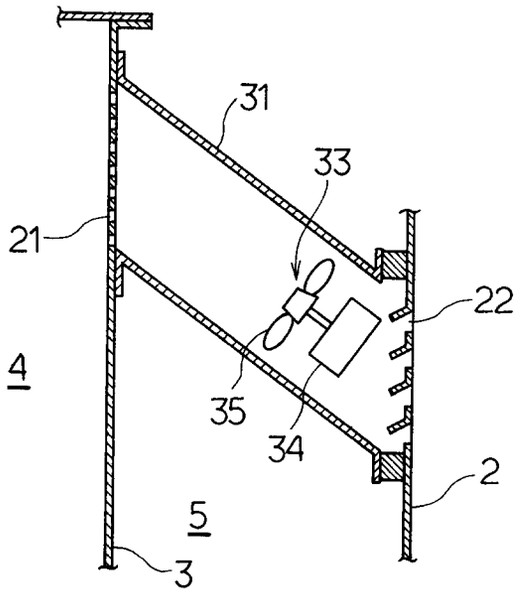
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FIG.7

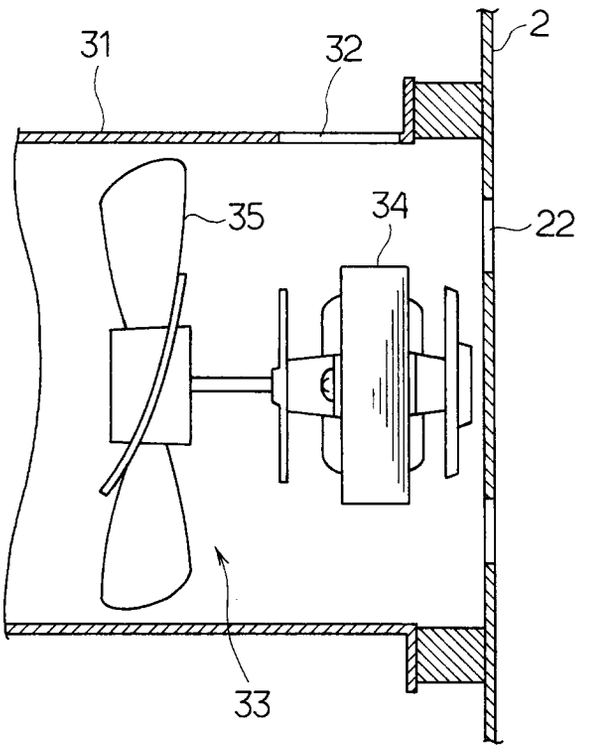

FIG.8

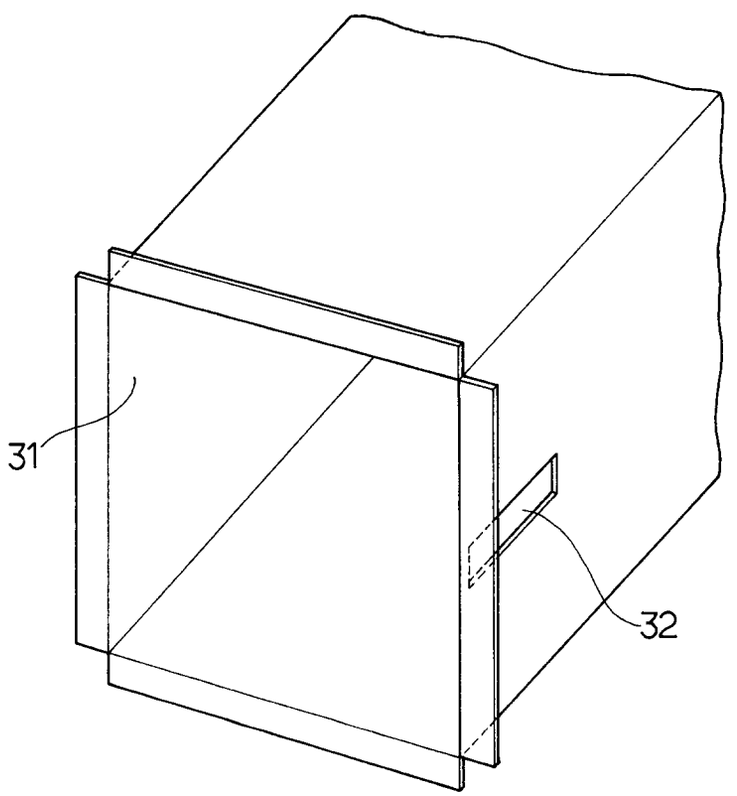

FIG.9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 93305732.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US - A - 3 654 417 (JAUES) * Column 2, lines 58-65; column 3, lines 18-30; claim 1; fig. 1,2 * --	1-4	F 24 C 7/02 H 05 B 6/64
A	DE - A - 3 333 957 (TOKYO SHIBAURA) * Page 10, lines 22-28; fig. 1 * --	1-4	
A	US - A - 3 470 942 (SHUZO) * Column 2, line 68 - column 3, line 17; claim 1; fig. 1 * ----	1-4	

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	Date of completion of the search	Examiner
VIENNA	29-10-1993	TSILIDIS

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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