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(54) **System for fast localized cooling of food in a refrigeration appliance**

(57) There is described a system (26) for fast localized cooling of food in a refrigeration appliance (1) having a refrigeration compartment (3) with a number of sections (6, 7); and a cooling unit (11) for emitting a stream of low-temperature air into the refrigeration compartment (3); the system has a choking member (22) which, on command, divides the air stream emitted by the cooling unit (11) so as to regulate, between a first and second pre-determined flow value, the air flow to a specific fast-cooling section (6) in the refrigeration compartment (3).

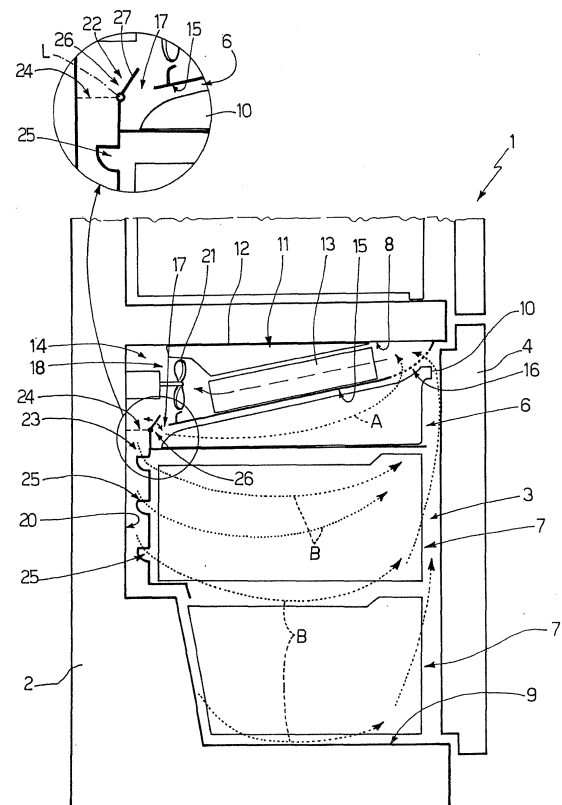


Fig.1

Description

[0001] The present invention relates to a system for fast localized cooling of food in a refrigeration appliance.

[0002] More specifically, the present invention relates to a system for fast-cooling food inside a specific compartment of a refrigeration appliance, such as a frozen-food compartment or fresh-food compartment of an electric household appliance, such as a freezer or refrigerator; to which the following description refers purely by way of example.

[0003] It should be pointed out that the term "cooling" is used herein to indicate a reduction in temperature to a temperature preferably ranging between approximately -24°C and -18°C to preserve frozen food in a freezer compartment; or a reduction in temperature to a temperature ranging between approximately -3°C and +5°C to preserve fresh food in a refrigerator compartment.

[0004] As is known, there is increasing demand, among users of refrigeration appliances with a freezer compartment, for fast, specific freezing of non-frozen food placed inside one of the freezer compartment sections.

[0005] The reason for this lies in the fact that, to preserve the nutritional properties of non-frozen food, it must be frozen extremely quickly.

[0006] Accordingly, some last-generation refrigeration appliances, in particular certain refrigerators, are equipped with a special freezer compartment cooling system that is activated by the user when non-frozen food is placed inside the sections of the freezer compartment, which, in normal operating conditions, maintains the food at a predetermined steady freezing temperature of normally -18°C.

[0007] During fast-freezing, the temperature inside the whole volume of the freezer compartment is rapidly lowered temporarily to below -18°C to rapidly lower the temperature of the non-frozen food; and, after a predetermined time interval, the fast-cooling system is deactivated, and the compartment is restored to its previous steady-operating temperature.

[0008] Refrigeration appliances equipped with fast-cooling systems of the above type have the major drawback of being inefficient, both as regards energy consumption and the speed with which the non-frozen food inserted into the compartment is frozen. The system, in fact, provides for indiscriminately lowering the temperature of the whole volume of the freezer compartment, regardless of the section containing the non-frozen food. As a result, on the one hand, the temperature of the frozen food in the other sections, which requires no additional freezing, is also lowered unnecessarily, and, on the other, considerable electrical energy is wasted in further lowering the temperature during fast-freezing.

[0009] Moreover, cooling the whole volume of the freezer compartment has the major drawback of only enabling a sufficiently low temperature of the non-frozen food to be achieved quickly at the expense of excessive

energy consumption.

[0010] It is an object of the present invention to provide a system for fast localized cooling of food in a refrigeration appliance, designed to lower the temperature inside a section of the refrigeration appliance quickly, simply, and effectively, which improves the energy efficiency of the appliance.

[0011] According to the present invention, there is provided a system for fast localized cooling in a refrigeration appliance, as claimed in the accompanying Claims.

[0012] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic of a refrigeration appliance featuring a cooling system in accordance with the teachings of the present invention;

Figure 2 shows a schematic of the cooling system in a first operating configuration;

Figure 3 shows a schematic of the cooling system in a second operating configuration;

Figure 4 shows a detail of a variation of the cooling system;

Figure 5 shows a schematic of one possible embodiment of the cooling system.

[0013] The present invention is substantially based on the principle of generating, by means of a cooling unit, a stream of low-temperature air inside a food compartment of a refrigeration appliance, and choking the air flow to a specific section of the compartment to increase air flow through the section and obtain, inside the section, a cooling temperature below a predetermined refrigeration temperature in the compartment outside the section.

[0014] In other words, the present invention is substantially based on the idea of "dividing" the stream of low-temperature air emitted by the cooling unit, so as to increase air flow through a fast food-cooling section to "force", i.e. enhance, heat exchange between the food in the fast-cooling section and the air flowing over the food; and simultaneously feeding the rest of the air flow into the compartment space outside the section, so as to maintain the refrigeration temperature outside the cooling section at a predetermined value higher than the temperature inside the fast-cooling section.

[0015] With reference to Figure 1, number 1 indicates as a whole a food refrigeration appliance comprising a preferably, though not necessarily, parallelepiped-shaped outer casing 2, and at least one refrigeration compartment 3 formed inside casing 2 and for housing food for refrigeration.

[0016] Refrigeration appliance 1 also comprises a door 4 for closing refrigeration compartment 3, and which is hinged to a lateral wall (not shown) of casing 2, to the side of the access opening to compartment 3, to rotate about a vertical axis to and from a closed position closing compartment 3.

[0017] It should be pointed out that refrigeration com-

partment 3 is preferably parallelepiped-shaped, and may be a refrigerator compartment for maintaining food at a refrigeration temperature of preferably about +5°C, or a freezer compartment for freezing food at a freezing temperature of preferably about -18°C.

[0018] Refrigeration compartment 3 is divided into a number of food-containing sections arranged one over the other.

[0019] More specifically, a top section 6 is for fast-cooling food, and, in use, has an internal temperature varying, on command, between a predetermined refrigeration temperature t_C and a cooling temperature t_R lower than refrigeration temperature t_C , whereas the other bottom sections 7, i.e. underneath top section 6, are food-refrigeration sections with a permanent temperature equal to refrigeration temperature t_C .

[0020] More specifically, top section 6 is located next to the top wall 8, opposite the bottom wall 9, of compartment 3, and is shaped to house a box-shaped, preferably, though not necessarily, pull-out container 10 having a top opening and for containing food for fast cooling.

[0021] Refrigeration appliance 1 also comprises a cooling unit 11 for generating the low-temperature air stream inside sections 6 and 7 of compartment 3. More specifically, cooling unit 11 comprises a box-shaped housing 12 fixed firmly to top wall 8, directly over section 6, and housing an evaporator module 13 and a ventilator module 14.

[0022] In the example shown in Figures 1-3, box-shaped housing 12 is substantially triangular-shaped, and comprises a bottom wall 15 defining the top inner wall of section 6, on which the two lateral walls of box-shaped container 10 rest; and two openings respectively defining the inlet and outlet of the low-temperature air from cooling unit 11.

[0023] In the example shown, an opening, defining an air inlet 16 into cooling unit 11, is formed in bottom wall 15, facing door 4 and section 6; and an opening, defining the air outlet 18 from cooling unit 11, is formed in an inner wall of box-shaped housing 12 facing an inner wall 20 corresponding to the back of compartment 3 opposite door 4.

[0024] More specifically, the opening defining inlet 16 is shaped to communicate with both the space in compartment 3 outside section 6, and the space inside section 6 and relative container 10, when container 10 is inserted inside section 6.

[0025] Section 6 also communicates with cooling unit 11 through a rear opening formed in a downward extension of bottom wall 15 of box-shaped housing 12, and defining an air inlet 17 into section 6 and/or relative box-shaped container 10.

[0026] Evaporator module 13 and ventilator module 14 are housed inside box-shaped housing 12 to cool and circulate the air through box-shaped housing 12 and compartment 3.

[0027] More specifically, evaporator module 13 comprises an evaporator circuit for appropriately cooling the

air flowing through housing 12 between inlet 16 and outlet 18; and ventilator module 14 comprises a fan 21 facing outlet 18, and an electric unit, e.g. an electric motor, connected to fan 21 to rotate it about a preferably horizontal axis.

[0028] When operated, fan 21 produces an air stream of given flow and temperature, which flows inside housing 12 in a substantially horizontal direction between inlet 16 and outlet 18, and links up, outside cooling unit 11, with a preferential cooling path A through section 6 and relative container 10, and with a number of secondary cooling paths B through sections 7 beneath section 6 in compartment 3.

[0029] Preferably, though not necessarily, refrigeration appliance 1 also comprises an internal air distribution conduit 23, which extends inside compartment 3, from outlet 18 along inner wall 20 towards bottom wall 9, and which in turn comprises an inlet 24 for receiving the air fed to outlet 18 by cooling unit 11, and a number of outlets 25 appropriately arranged inside compartment 3, beneath section 6, to appropriately feed the low-temperature air stream into sections 7.

[0030] Finally, refrigeration appliance 1 comprises a fast food-cooling system 26, which, on command, divides the air stream fed through outlet 18 by cooling unit 11 into two separate air streams, a first of which is fed to section 6 and relative container 10, and has a first flow to lower the temperature inside section 6 to below the predetermined refrigeration temperature t_C . The second air stream is fed to the other sections 7 at a second flow, lower than the first, to maintain the refrigeration temperature t_C inside sections 7 substantially constant.

[0031] More specifically, cooling system 26 comprises a flow choking member 22 located at outlet 18 of cooling unit 11 to intercept and divide the air stream from cooling unit 11 into the two air streams, the first of which is fed through inlet 17 to section 6 and relative container 10, and the second of which is fed through inlet 24 and conduit 23 to sections 7.

[0032] In the Figure 1 example, choking member 22 comprises a flap or baffle 27, preferably, though not necessarily, located at inlet 17 of section 6, and which rotates, about a horizontal axis L, between a rest position and a fast-cooling position.

[0033] With reference to Figure 2, in the example shown, baffle 27 in the rest position divides the air stream fed through outlet 18 by cooling unit 11 into the two streams, so that the flow of the first air stream fed through inlet 17 to section 6 maintains the temperature inside section 6 at a value corresponding to refrigeration temperature t_C , and the flow of the second air stream fed to the other sections 7 along conduit 23 maintains the temperature inside sections 7 at a value substantially equal to refrigeration temperature t_C .

[0034] With reference to Figure 3, the flap or baffle 27 in the fast-cooling position divides the air stream fed through outlet 18 by cooling unit 11 into the two streams, so that the flow of the first air stream fed through inlet 16

to section 6 reduces the temperature inside section 6 and relative container 10 to a cooling temperature t_R lower than refrigeration temperature t_C , and the flow of the second air stream fed to the other sections 7 along conduit 23 maintains the temperature inside sections 7 at a value substantially equal to refrigeration temperature t_C .

[0035] It should be pointed out that, in the event compartment 3 is a "frozen" food compartment, i.e. a "freezer compartment", refrigeration temperature t_C may be approximately -18°C , and section 6 may reach a cooling temperature t_R of approximately -24°C or lower; whereas, in the event compartment 3 is a "fresh" food compartment, i.e. a "refrigerator compartment", refrigeration temperature t_C may be approximately $+5^\circ\text{C}$, and section 6 may reach a cooling temperature t_R of approximately 0°C or lower, and preferably, though not necessarily, of approximately -3°C .

[0036] In the example shown in Figures 1-3, baffle 27 is located at the end of the extension of bottom wall 15 of box-shaped housing 12, at inlet 17 of section 6, adjacent to inlet 24 of conduit 23, and facing outlet 18. In the example shown, rotation of baffle 27 about axis L regulates closing/opening of inlet 17 of section 6.

[0037] In an alternative embodiment shown schematically in Figure 4, baffle 27 is connected to inner wall 20 inside conduit 23 at inlet 24, so that rotation of baffle 27 about axis L regulates closing/opening of inlet 24. Obviously, in this case, rotation of baffle 27 into the fast-cooling position partly closes inlet 24, thus resulting, on the one hand, in a reduction in air flow along conduit 23, and, on the other, in an increase in air flow to inlet 17 of section 6.

[0038] Conversely, rotation of baffle 27 into the rest position (shown by the dash line) opens inlet 24, thus resulting, on the one hand, in an increase in air flow along conduit 23, and, on the other, in a reduction in air flow to inlet 17 of section 6.

[0039] It should be pointed out that, in this case, inlets 17 and 24 are shaped so that the respective air flows to section 6 and conduit 23 are such as to ensure cooling temperature t_R in section 6, when baffle 27 is in the fast-cooling position (shown by the bold line), and a refrigeration temperature in the whole of compartment 3 when baffle 27 is in the rest position (shown by the dash line).

[0040] Baffle 27 may be operated manually and therefore connected to a mechanical member (not shown) by which to rotate baffle 27, about axis L, between two distinct angular positions, a first corresponding to the rest position, and a second to the fast-cooling position.

[0041] In actual use, to fast-cool food inside section 6 or relative box-shaped container 10, the user rotates baffle 27 manually about axis L from the rest position to the fast-cooling position. Once fast cooling of the food in section 6 is completed, the user may obviously rotate baffle 27 manually from the fast-cooling position back to the rest position to maintain refrigeration of the cooled food.

[0042] In an alternative embodiment of the invention, shown in Figure 5, cooling system 26 comprises an ac-

tuating unit 28 for rotating baffle 27, about axis L, between the rest position and the fast-cooling position.

[0043] More specifically, actuating unit 28 may comprise a control device 29, e.g. a user interface, by which the user controls fast-cooling system 26; an electric drive unit 30, e.g. an electric motor, appropriately connected by its output shaft to baffle 27 to rotate baffle 27, about horizontal axis L, between the rest and fast-cooling positions; and an electric control circuit 31, which receives the user commands entered on control device 29, and accordingly controls electric drive unit 30.

[0044] In actual use, when a fast-cooling command is entered by the user on the user interface, electric control circuit 31 operates electric drive unit 30, which rotates baffle 27 about axis L from the rest position to the fast-cooling position. Conversely, when a food-refrigeration command is selected by the user on the user interface, electric control circuit 31 operates electric drive unit 30, which rotates baffle 27 about axis L from the fast-cooling position to the rest position.

[0045] It should be pointed out that actuating unit 28 may provide for automatically resetting baffle 27 from the fast-cooling position to the rest position after a given time interval, which may be of predetermined length established beforehand to ensure complete cooling of the food in section 6.

[0046] In addition to fast-cooling the food, actuating unit 28 may implement a specific continuous food-cooling function selectable by the user on control device 29, and which keeps baffle 27 permanently in the above fast-cooling position, so that the temperature inside section 6 and relative container 10 corresponds to cooling temperature t_R , which, as stated, is stabilized permanently below refrigeration temperature t_C .

[0047] The continuous-cooling function is particularly advantageous for refrigerating food at a temperature below the refrigeration temperature in the compartment 3 space outside section 6.

[0048] In an alternative embodiment, the time interval TM in which baffle 27 is kept in the fast-cooling position may be regulated automatically by electric control circuit 31 on the basis of a selection command entered by the user on control device 29, and which may comprise a selected food type and/or a number of food temperatures determined before the food is inserted inside section 6.

[0049] In which case, electric control circuit 31 may, for example, comprise a memory module containing a list of food types and/or a number of temperatures, and, for each food type and/or temperature, a corresponding time interval TM in which to keep baffle 27 in the fast-cooling position.

[0050] When a food type or temperature is user-selected on control device 29, electric control circuit 31 therefore determines the corresponding time interval TM in the memory, and controls electric drive unit 30 to keep baffle 27 in the fast-cooling position for the whole determined time interval TM.

[0051] In a further embodiment, cooling system 26 may

comprise a temperature sensor 32 for measuring the temperature in section 6 and/or relative box-shaped container 10; and electric control circuit 31 determines the measured-temperature pattern over a predetermined time interval, so as to accordingly regulate the time interval TM in which baffle 27 is kept in the fast-cooling position.

[0052] For example, electric control circuit 31 may calculate the difference between temperatures measured at two predetermined successive measuring instants, and accordingly calculates the time interval TM in which baffle 27 is kept in the fast-cooling position.

[0053] For example, if a high-temperature food is inserted inside section 6, electric control circuit 31 determines a high temperature difference inside section 6, and accordingly increases the time interval TM in which baffle 27 is kept in the fast-cooling position; and conversely, if a low-temperature food is inserted inside section 6, electric control circuit 31 determines a low temperature difference inside section 6, and accordingly reduces the time interval TM in which baffle 27 is kept in the fast-cooling position.

[0054] Fast-cooling system 26 as described above has numerous advantages.

[0055] In particular, the system can be used to advantage in both "freezer" compartments - thus providing the user with a compartment which, on command, provides for "fast freezing" newly-inserted food, or for conventional refrigeration of frozen food - and "refrigerator" compartments - thus providing the user with a compartment which, on command, provides for "fast cooling" newly-inserted food, or for refrigerating fresh food.

[0056] More specifically, dedicated fast cooling improves the energy efficiency of the refrigeration appliance, because the air stream produced by the cooling unit during fast cooling has the same flow and temperature as in normal, i.e. non-fast-cooling, operating conditions.

[0057] The system is also extremely cheap and easy to produce, especially the embodiment featuring manual operation of baffle 27. Another advantage lies in the system automatically regulating the interval TM in which the baffle is kept in the fast-cooling position. Which function makes fast food cooling easier for the user, while at the same time ensuring optimum cooling, by regulating the interval TM in which the baffle is kept in the fast-cooling position on the basis of parameters, such as type or temperature, characteristic of the food inserted into the compartment section.

[0058] Clearly, changes may be made to the fast localized food-cooling system as described and illustrated herein without, however, departing from the scope of the present invention as defined in the accompanying Claims.

Claims

1. A system (26) for fast localized cooling of food in a refrigeration appliance (1) comprising an outer casing (2); at least one refrigeration compartment (3) housed inside said outer casing (2) and having a number of sections (6, 7) for housing food at a predetermined refrigeration temperature (t_c); and a cooling unit (11) for emitting into the refrigeration compartment (3) a stream of low-temperature air having a predetermined flow and temperature; said system being **characterized by** comprising choke means (22), which choke the air stream emitted by said cooling unit (11) so as to regulate, on command, between a first and second predetermined flow value, the air flow to a specific fast-cooling section (6) in said refrigeration compartment (3); said first flow value maintaining the temperature inside said fast-cooling section (6) at a value substantially equal to said refrigeration temperature (t_c) of the food; said second flow value being greater than said first flow value, and lowering the temperature inside said fast-cooling section (6) to a predetermined cooling temperature (t_R) below said refrigeration temperature (t_c).
2. A system as claimed in Claim 1, wherein said choke means (22) comprise a baffle (27) which rotates, about a given axis (L) of rotation, between a rest position, in which it chokes the air stream from said cooling unit (11) so that the air flow to said fast-cooling section (6) equals said first value; and a fast-cooling position, in which the baffle (27) chokes the air stream from said cooling unit (11) so that the air flow to said fast-cooling section (6) equals said second value.
3. A system as claimed in Claim 2, and comprising electric actuating means (28) to rotate said baffle (27), about said axis (L), between said rest position and said fast-cooling position.
4. A system as claimed in Claim 3, wherein said electric actuating means (28) keep said baffle (27) in said fast-cooling position for a fast-cooling time interval (TM), at the end of which, said electric actuating means (28) reset said baffle (27) to said rest position.
5. A system as claimed in Claim 3, wherein said electric actuating means (28) wherein said electric actuating means (28) keep said baffle (27) permanently in the above fast-cooling position, so that the temperature inside said fast-cooling section (6) corresponds to cooling temperature (t_R) stabilized permanently below refrigeration temperature (t_c).
6. A system as claimed in Claim 4, wherein said electric actuating means (28) comprise user interface means

(29) by which a user generates a control signal containing information relative to a given type of food for cooling and/or a given temperature of the food to be inserted inside said fast-cooling section (6); said electric actuating means (28) comprising control means (31) which regulate said fast-cooling time interval (TM) as a function of the user-selected said information in said control signal.

7. A system as claimed in Claim 6, wherein said electric actuating means (28) comprise temperature sensing means (32) for measuring the temperature in said fast-cooling section (6) at predetermined instants; said control means (31) regulating said fast-cooling time interval (TM) as a function of the variation in temperature measured in said fast-cooling section (6) at said measuring instants.
8. A system as claimed in any one of the foregoing Claims, wherein said refrigeration compartment (3) comprises a refrigerator compartment, and said refrigeration temperature (t_C) corresponds to a fresh-food refrigeration temperature.
9. A system as claimed in Claim 8, wherein said refrigeration temperature (t_C) is approximately +5°C, and said cooling temperature (t_R) is approximately 0°C or lower.
10. A system as claimed in any one of Claims 1 to 7, wherein said refrigeration compartment (3) comprises a freezer compartment, and the refrigeration temperature (t_C) corresponds to a frozen-food refrigeration temperature.
11. A system as claimed in Claim 10, wherein said refrigeration temperature (t_C) is approximately -18°C, and said cooling temperature (t_R) is approximately -24°C or lower.

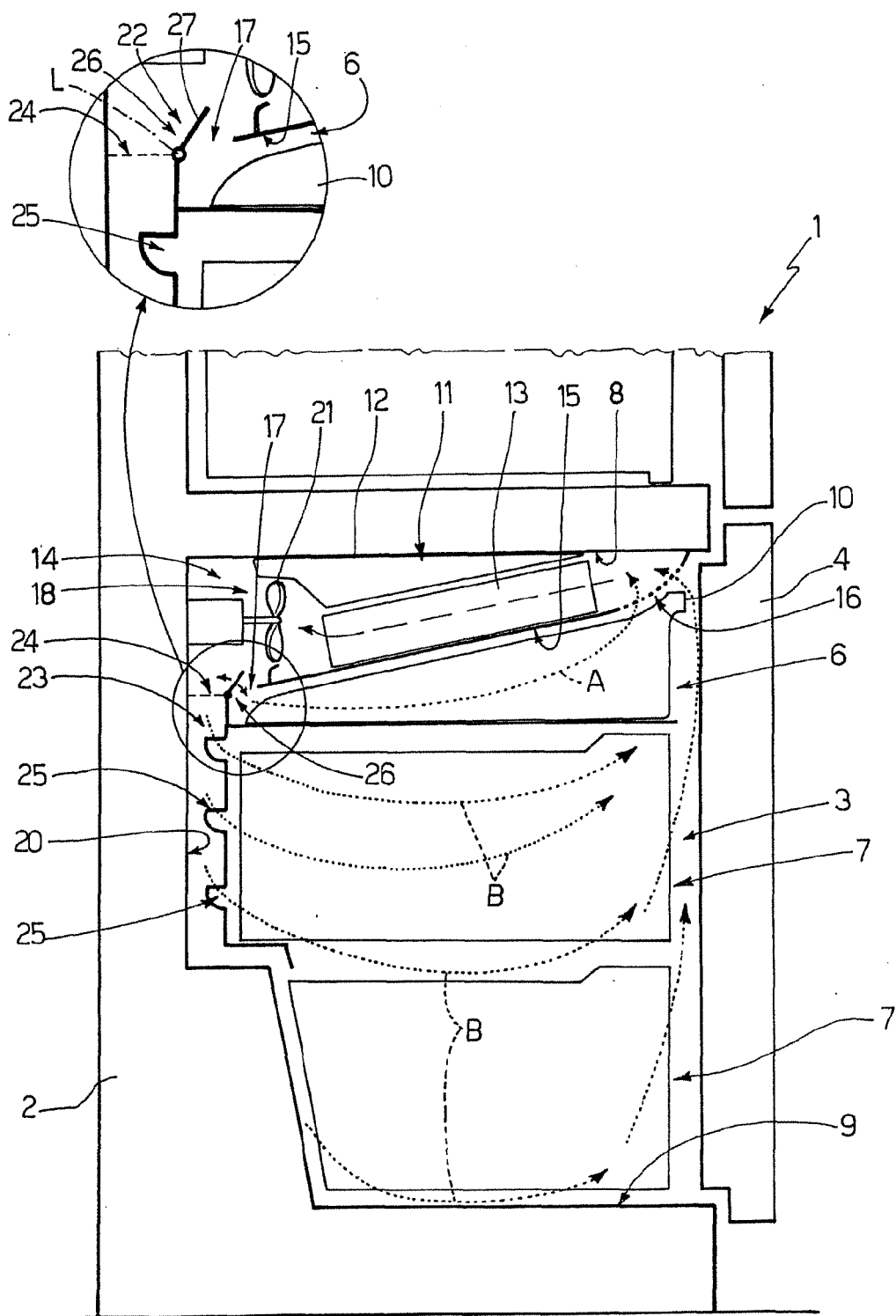


Fig.1

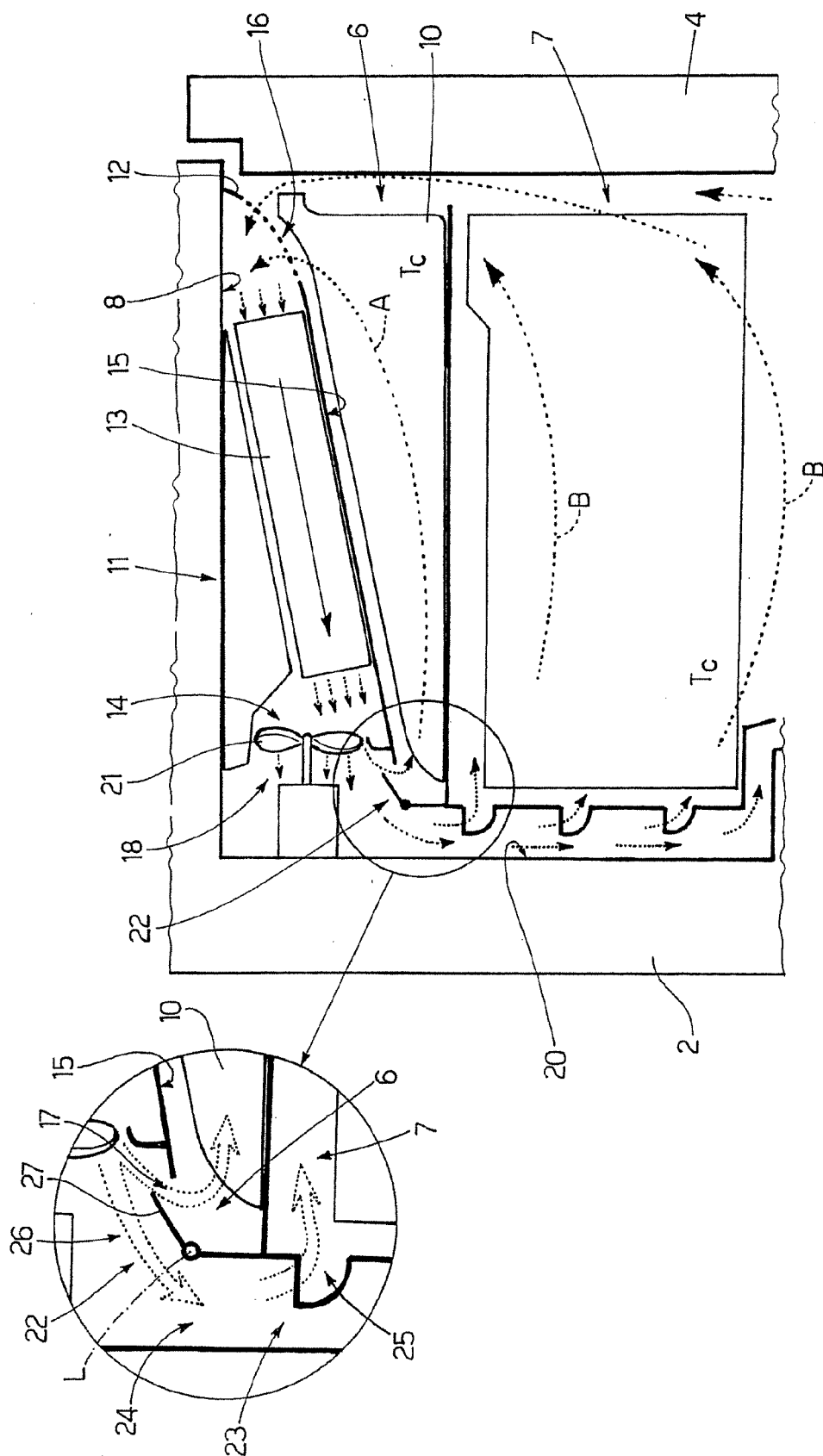


Fig. 2

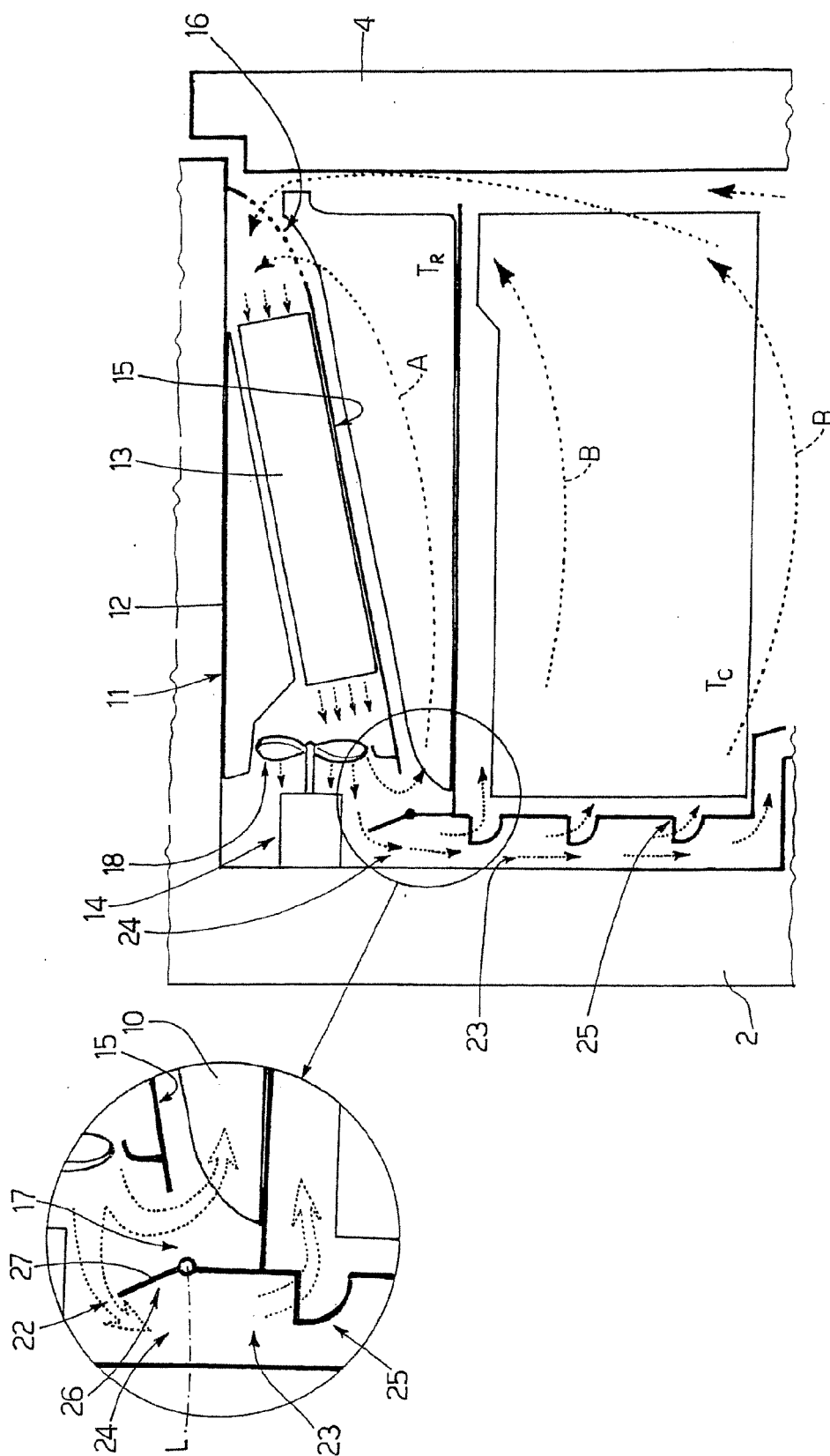
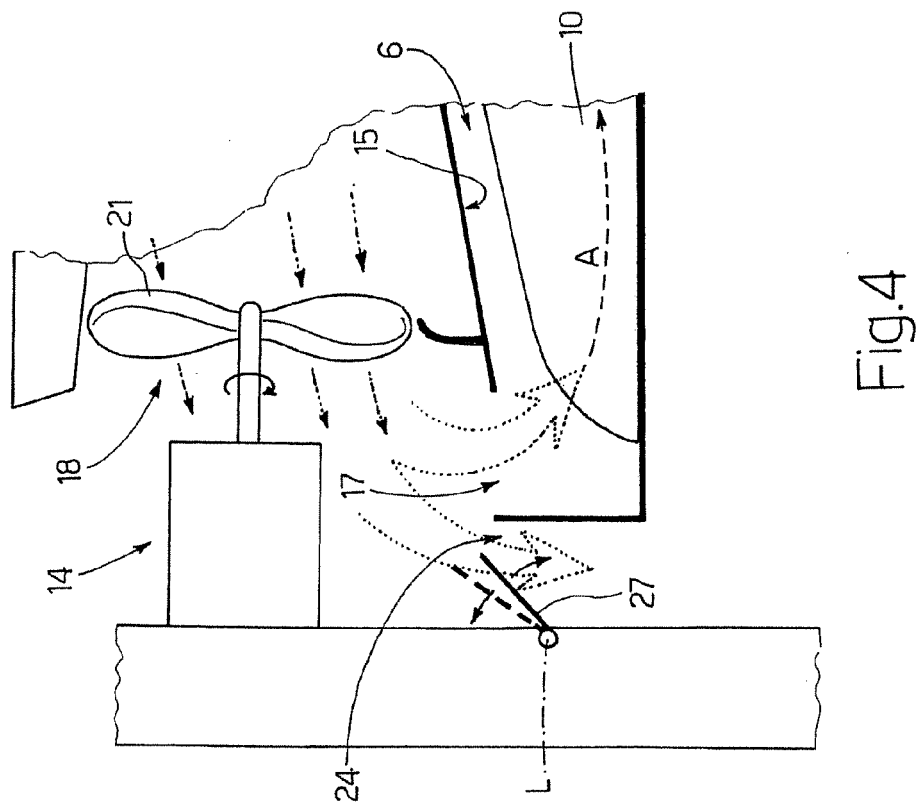
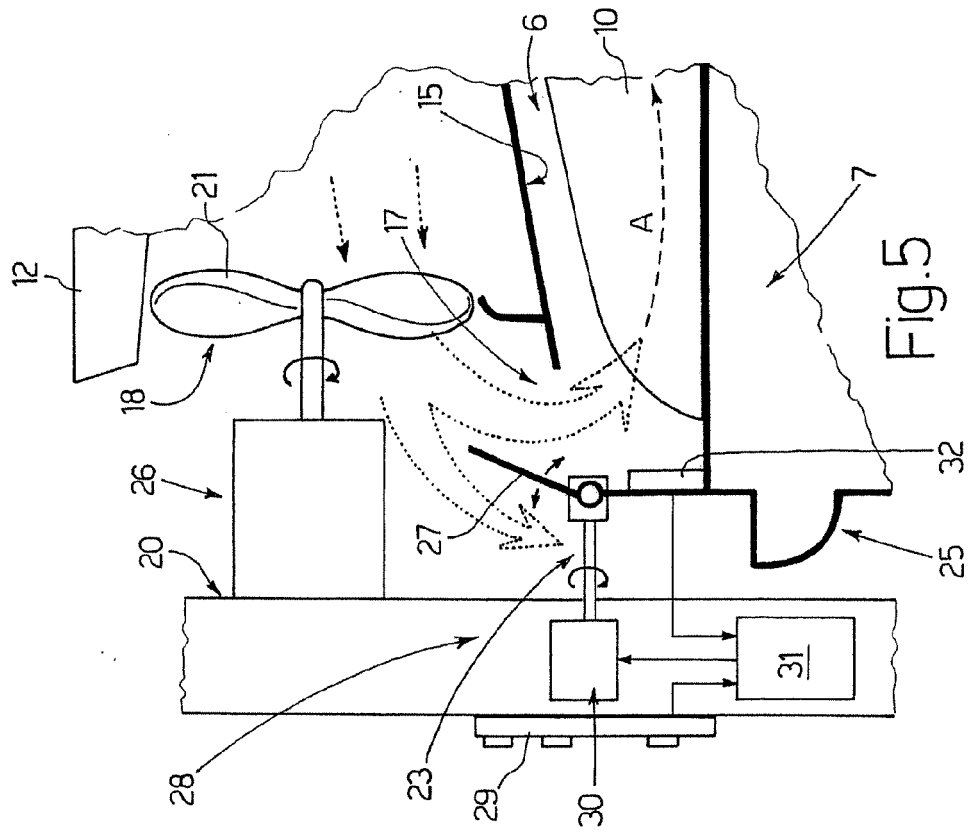


Fig. 3





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
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Place of search Munich		Date of completion of the search 5 July 2007	Examiner Jessen, Flemming
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 06 12 5053

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