

REFRIGERATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a refrigerator provided with a deodorizing device.

2. Description of the Related Art

As a conventional art, Japanese Utility Model Gazette No. HEI 03-83793 discloses a fridge-freezer which is equipped with a deodorizing device. This fridge-freezer is provided with by-pass channels which are provided in part of or through the circulating air duct in the fridge-freezer and contain deodorizing devices being installed, and characterized by the circulating air duct being divided into the by-pass channels and a main circulating air duct in which air resistance is lower than that in the by-pass channels. The deodorizing device uses a combination of an ozonizer and a deodorizing catalyst. Inside the main circulating air duct, a damper is provided. This damper is closed to enhance a deodorizing effect, and opened to refrigerate by supplying refrigerated air flow to the main circulating air duct. Thus, the main circulating air duct is allowed to receive enough air flowing into for refrigerating. Hence, a problem of

insufficiency in refrigeration may be solved.

Odor given off from food may displease you by the disagreeable smell when you open the door of the fridge-freezer, but on top of it, the smell of odors is transferred to other food stored therein. For that reason, a deodorizing function is one of the vital functions for a fridge-freezer.

However, according to the conventional fridge-freezer introduced in Utility Model Gazette No. Hei3-83793, the damper in the main circulating air duct is to be closed for an effective deodorization. If the damper is closed, then refrigerated air has to pass through the bypass channels, in which the air resistance is incomparably higher, with the deodorizing devices being installed. For that reason, little air for refrigeration is allowed to be supplied to the main circulating air duct, which has posed a problem of causing an extremely insufficient refrigeration in the respective compartments in the fridge-freezer.

Further, a deodorizing operation which is carried out while the compressor is not operating has caused a temperature rise in the respective compartments in the fridge-freezer, which is another problem. This is, in other words, the problem of failing to achieve an enhanced performance of deodorization and a secured performance of

refrigeration at the same time. In addition to that, the deodorizing device uses ozone, which is to be decomposed by a deodorizing catalyst. The deodorizing catalyst, after many years of use, gradually loses its decomposing efficiency, and in the end, ozone may flow back into the refrigerator room. Then, as a result, ozone may give a harmful influence on such as food, which has posed another problem.

Still more, as for the structure of the conventional fridge-freezer, it is required for deodorizing all the compartments of the fridge-freezer to have deodorizing devices installed in all the circulating air ducts for guiding refrigerated air to the respective compartments in the fridge-freezer. Then, if deodorizing devices are installed in all the circulating air ducts for guiding refrigerated air into the respective compartments in the fridge-freezer, the air ducts become complicated. Besides, the cost has been raised as well. Especially, in the case of branching off by-pass channels from the main circulating air duct for the purpose of providing the by-pass channels in all the circulating air ducts, then the number of branched-off air ducts are increased by the number of the by-pass channels. This requires a larger space for arrangement. As a result, the size or capacity of a compartment such as a refrigerator room or a freezer

is required to be reduced, or alternatively, a large-sized refrigerator may have to be required, which has posed another problem.

SUMMARY OF THE INVENTION

Example embodiments of the present invention may obtain a refrigerator which is provided with a deodorizing function for deodorizing the smell of such as food and allowed to be free from insufficient refrigeration. Example embodiments of the present invention may obtain a refrigerator which is provided with a deodorizing device usable without losing the deodorizing performance for a long time. Example embodiments of the present invention may also obtain a highly reliable refrigerator with no fear of an ozone-related harmful influence on such as food. Example embodiments of the present invention may obtain a simply-structured refrigerator, which is allowed to deodorize all the compartments. Example embodiments of the present invention may obtain a small-sized and low-cost refrigerator.

According to one aspect of the present invention, there is provided a refrigerator comprising: a plurality of compartments, which is provided in a front part of the body of the refrigerator, for storing such as food; a cooling device, which is installed in a cooling device chamber provided in a back part of the body of the refrigerator, for producing refrigerated air for refrigerating the plurality of compartments; an inside fan, which is installed in the cooling device chamber, for blowing off the refrigerated air produced by the cooling device to the plurality of compartments; a draft air duct, which is a passage of air flow of refrigerated air to be blown off forcibly by the inside fan to the plurality of compartments; a damper, which is installed in the draft air duct, opening/closing so as to allow/prevent the supply of the refrigerated air to the plurality of compartments; a by-pass channel, which is provided in the draft air duct between the damper and the cooling device and used for returning the refrigerated air produced by the cooling device to the cooling device; and a deodorizing device, which is installed inside the by-pass channel, for deodorizing the refrigerated air to be supplied to the plurality of compartments; a deodorizing damper, which is installed in the by-pass channel, for regulating a flow rate of the refrigerated air, so that the

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refrigerated air is not supplied to the by-pass channel while a refrigerating operation is being carried out; wherein the damper is closed so that the refrigerated air inside the draft air duct between the damper and the cooling

device is blown off forcibly to the by-pass channel.

In the refrigerator, the deodorizing device may include a deodorizing filter for absorbing odor elements, and a refreshing unit for decomposing the odor elements absorbed by the deodorizing filter so as to prolong the life of the deodorizing filter.

In the refrigerator, air resistance in the by-pass channel having the deodorizing device inside may be higher than air resistance in the draft air duct for supplying the refrigerated air to the plurality of compartments so that the refrigerated air is not easily supplied to the by-pass channel in the case of opening the damper for allowing the supply of the refrigerated air to the plurality of compartments.

The refrigerator may further include a deodorizing damper, which is installed in the by-pass channel, for regulating the flow rate of the refrigerated air, so that the refrigerated air is not supplied to the by-pass channel while a refrigerating operation is being carried out.

According to another aspect of the present invention, there is provided a refrigerator comprising: a plurality of compartments, which is provided in a front part of the body of the refrigerator, for storing such as food; two cooling devices, which are installed in a back part of the body of

the refrigerator, for producing refrigerated air in different temperatures so as to refrigerate the plurality of compartments; two separate draft air ducts corresponding to the two cooling devices for blowing off the refrigerated air in different temperature ranges produced by the two cooling devices independently to different compartments with different temperatures of the plurality of compartments; and a deodorizing device; wherein the deodorizing device includes, deodorizing filters, which are provided in the two separate draft air ducts, for absorbing odor elements, and refreshing units for decomposing the odor elements absorbed by the deodorizing filters so as to prolong lives of the deodorizing filters.

The refrigerator may include by-pass channels provided, respectively, in the two individual draft air ducts; and deodorizing devices installed, respectively, in the by-pass channels.

Further scope of applicability of example embodiments of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since

various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinafter and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 is a side sectional view of a refrigerator according to a first embodiment of the present invention;

Fig. 2 is a partial front view illustrating a main part of the air ducts of the refrigerator according to the first embodiment of the present invention;

Fig. 3 is a schematic diagram of air ducts illustrating a schematic structure of the air ducts of the refrigerator according to the first embodiment;

Fig. 4 is an explanatory diagram illustrating the structure of a filter according to the first embodiment;

Fig. 5 is a diagram illustrating the state of a deodorizing device 22 being installed according to the first embodiment of the present invention;

Fig. 6 is a control flow chart illustrating a flow

of controlling the deodorizing device of the refrigerator according to the first embodiment of the present invention;

Fig. 7 is a side sectional view of a refrigerator according to a second embodiment of the present invention;

Fig. 8 is a partial front view illustrating a main part of the air ducts of the refrigerator according to the second embodiment of the present invention;

Fig. 9 is a schematic diagram of air ducts illustrating a schematic structure of the air ducts of the refrigerator according to the second embodiment of the present invention;

Fig. 10 is a control flow chart illustrating a flow of controlling a deodorizing device of the refrigerator according to the second embodiment of the present invention;

Fig. 11 is a control flow chart illustrating a flow of controlling a deodorizing device of a refrigerator according to a third embodiment of the present invention;

Fig. 12 is a schematic diagram of air ducts illustrating a schematic structure of the air ducts of a refrigerator according to a fourth embodiment of the present invention;

Fig. 13 is a partial front view illustrating a main part of the air ducts of the refrigerator according to the

fourth embodiment of the present invention;

Fig. 14 is a side sectional view of the refrigerator according to the fourth embodiment of the present invention; and

Fig. 15 is a control flow chart illustrating a flow of controlling the refrigerator according to the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals indicate like elements through out the several views.

Embodiment 1.

A first embodiment of the present invention will be discussed with reference to Fig. 1 through Fig. 5. Fig. 1 is a side sectional view of a refrigerator according to the first embodiment of the present invention. A reference numeral 1 denotes a body of the refrigerator. A reference numeral 2 denotes an insulating box, which is filled with insulating materials. A reference numeral 7 denotes a refrigerator room, which is placed in an upper part of the

body 1 of the refrigerator. A reference 8 denotes a convertible compartment (a multi-purpose compartment), which is placed below the refrigerator room 7, and the temperature of which is switched over in a wide range of temperatures for storing things from vegetables to frozen food. A reference numeral 9 denotes a vegetable compartment, which is placed below the convertible compartment 8, for storing such as vegetables. A reference numeral 10 denotes a freezer (a freezer compartment), which is placed below the vegetable compartment 9, for storing such as frozen food.

A reference numeral 3 denotes an opening/closing door for the refrigerator room, which is provided in the front part of the refrigerator room 7. A reference numeral 4 denotes a drawer-type door for the convertible compartment, which is provided in the front part of the convertible compartment 8. A reference numeral 5 denotes a drawer-type door for the vegetable compartment, which is provided in the front part of the vegetable compartment 9. A reference numeral 6 denotes a drawer-type door for the freezer, which is provided in the front part of the freezer 10. A reference numeral 11 denotes a compressor, which is installed in a machine compartment 11a provided at a lower back of the body 1 of the refrigerator. A reference numeral 13 denotes a cooling device, which is

installed in a cooling device chamber provided in a back part of the body 1 of the refrigerator. A reference numeral 12 denotes a defrosting heater for thawing frost settled on the cooling device 13.

A reference numeral 14 denotes an inside fan for blowing off cool air refrigerated by the cooling device 13 forcibly to the respective compartments such as the refrigerator room 7 and the freezer 10 in the body 1 of the refrigerator. A reference sign 19A denotes a draft air duct for the refrigerator room, which is a passage of refrigerated air flow to the refrigerator room 7. A reference sign 20A denotes a draft air duct for the freezer, which is a passage of refrigerated air flow to the freezer 10. A reference sign 15A is a damper for the refrigerator room, which is provided inside the draft air duct 19A for the refrigerator room, for regulating the flow rate of refrigerated air to be supplied to the refrigerator room 7. A reference sign 15B denotes a damper for the convertible compartment, which is provided inside the draft air duct for the convertible compartment, for regulating the flow rate of refrigerated air to be supplied to the convertible compartment 8. A reference sign 15C denotes a damper for the freezer, which is provided inside the draft air duct 20A for the freezer, for regulating the flow rate of refrigerated air to be

supplied to the freezer 10.

A reference numeral 16 denotes a blow-off outlet for the refrigerator room for supplying refrigerated air through the draft air duct 19A for the refrigerator room into the refrigerator room 7. A reference numeral 17 denotes a blow-off outlet for the convertible compartment for supplying refrigerated air through the draft air duct for the convertible compartment into the convertible compartment 8. A reference numeral 18 denotes a blow-off outlet for the freezer for supplying refrigerated air through the draft air duct 20A for the freezer into the freezer 10. A reference numeral 21 denotes a by-pass channel, which is provided inside a main draft air duct which is a passage of refrigerated air guided to the respective compartments in the body 1 of the refrigerator. Then, a deodorizing device 22 is provided inside the by-pass channel 21. By closing those dampers (15a, 15b, 15c), refrigerated air passes through the by-pass channel 21 and then returns to the cooling device 13. Thus, a short cycle occurs. This short cycle is a passage of air flow through which refrigerated air circulates from the upstream of the cooling device 13 back to the cooling device 13 without flowing into any of the compartments of the body 1 of the refrigerator.

Fig. 2 is a partial front view illustrating a main

part of the air ducts of the refrigerator according to the first embodiment. The figure shows the draft air ducts for supplying refrigerated air to the respective compartments only. Return passages of the refrigerated air flow from the respective compartments are not shown. In the figure, elements which are the same as or equivalent to those of Fig. 1 are assigned the same reference numerals or signs, and will not be explained here. With referring to the figure, reference sign 19A represents the draft air duct for the refrigerator room, reference sign 20A represents the draft air duct for the freezer, and a reference numeral 25 denotes a draft air duct for the convertible compartment for supplying refrigerated air to the convertible compartment 8. A reference numeral 26 denotes a draft air duct for an ice-maker (not shown) for supplying refrigerated air into the ice-maker which is provided inside or separately from the freezer 10.

A reference numeral 15E denotes a damper for the ice-maker, which is provided inside the draft air duct for the ice-maker 26, for regulating the flow rate of refrigerated air supplied to the ice-maker. Then, the deodorizing device 22 is installed inside the by-pass channel 21. In the case of all the dampers provided in the draft air ducts being closed, refrigerated air is not supplied to the draft air ducts having little air

resistance, but the refrigerated air is supplied to the by-pass channel 21 whose air resistance is high. This causes the short cycle. As a result, all the refrigerated air in the enclosed space by the dampers including the cooling device chamber is to pass forcibly through the deodorizing device 22 by means of the inside fan 14. Hence, a deodorizing effect may be achieved. For that reason, even when the dampers are opened, an offensive smell will not be supplied to the respective compartments.

Now, when at least one of the dampers 15A, 15B, 15C, 15E is opened, refrigerated air is supplied to the draft air ducts having little air resistance. Therefore, the refrigerated air is not supplied to the by-pass channel 21 whose air resistance is high. For that reason, the short cycle does not occur. As a result, little deodorizing effect may be obtained by the deodorizing device 22. However, there will be no resistance caused in the air ducts while a refrigerating operation is being carried out. Hence, insufficiency will not be caused in the refrigerating performance.

Now, Fig. 3 is a schematic diagram of air ducts illustrating a schematic structure of the air ducts of the refrigerator according to the first embodiment. The schematic diagram shows the passages of air flow of the refrigerator room 7 and the freezer 10 only. Then, the

passages of the convertible compartment 8, the ice-maker and the vegetable compartment 9 are not shown. In the figure, elements which are the same as or equivalent to the elements of Fig. 1 and Fig. 2 are assigned the same reference numerals or signs, and will not be explained here. With referring to the figure, reference sign 19A represents the draft air duct for the refrigerator room and reference sign 20A represents the draft air duct for the freezer. A reference sign 19B denotes a return air duct for the refrigerator room, which is a passage of returning refrigerated air flow to the cooling device 13 after refrigerating the inside of the refrigerator room 7. A reference sign 20B denotes a return air duct for the freezer, which is a passage of returning refrigerated air flow to the cooling device 13 after refrigerating the inside of the freezer 10.

Now, a filter to be used in the deodorizing device 22 will be discussed with reference to Fig. 4. Fig. 4 is a diagram illustrating the structure of a filter according to the first embodiment of the present invention. With referring to the figure, a reference numeral 23 denotes a deodorizing filter, which is built in the deodorizing device 22. As shown by a reference sign 23b, the deodorizing filter may be substances such as zeolite 115, copper manganese 116 and activated charcoal 117, which are

stuck on fibrous pulp 118, then formed into a paper, and thereafter formed into a corrugated cardboard as shown by a reference sign 23a. Alternatively, as shown by a reference sign 23c, the particles of substances such as those mentioned above may be sintered to form the deodorizing filter to be used.

The deodorizing device 22 composed of those elements may be installed in the draft air ducts for blowing off refrigerated air into the respective compartments in the body 1 of the refrigerator. As a result, the deodorizing filter absorbs such substances as methyl-captan and tri-methyl-amine which are the cause of an offensive smell or odors substances given off from such as food stored in the respective compartments in the body 1 of the refrigerator. For that reason, an offensive smell will not be given off from the respective compartments in the body 1 of the refrigerator. It is particularly effective in deodorization if the deodorizing device 22 is installed in such a manner as to clog the by-pass channel 21 as shown in Fig. 5. As a result, all the refrigerated air is allowed to pass forcibly through the filter 23 of the deodorizing device 22 and thus effective in deodorization. Alternatively, the deodorizing filter 23 may be formed by supporting titanium oxide which is a photo-catalyst. If titanium oxide is used for the deodorizing filter 23 and

light emitting diode is used for a refreshing unit, the deodorizing device is allowed to have a simple structure. As a result, a highly-reliable and low-cost deodorizing device may be obtained. Hence, an odorless highly-reliable and low-cost refrigerator may be provided. In addition to that, the refrigerator is allowed to become more minimized than that using other refreshing unit such as a black light.

Fig. 5 is a diagram illustrating the state of the deodorizing device 22 when installed according to the first embodiment of the present invention. With referring to the figure, reference numeral 21 represents the by-pass channel, reference numeral 23 represents the deodorizing filter, and a reference numeral 24 denotes a refreshing unit for the deodorizing filter 23. With further referring to the figure, as the deodorizing filter 23 is fitted in such a manner as to clog the by-pass channel 21, all the refrigerated air is allowed to pass forcibly through the deodorizing filter 23. Hence, a deodorization efficiency may be enhanced.

Furthermore, the filter refreshing unit 24 such as an LED light-emitting device, which emits ultraviolet rays, may be added in the deodorizing device 22. The ultraviolet ray has a property of prolonging the life of the filter through oxidation-reduction reaction by decomposing odors

substances absorbed by the filter 23. As a result, the life of the filter 23 is prolonged, which may save a lot of trouble over changing filters. Hence, an odorless and low-cost refrigerator may be provided. This also allows the refrigerator to be more minimized than using such as a black light for the filter refreshing unit 24. Furthermore, this allows air duct resistance in the by-pass channel 21 to be reduced, and therefore the by-pass channel 21 may also be minimized. In addition to that, refrigerated air is allowed to pass through the filter 23 of the deodorizing device 22 in an efficient manner in a deodorizing operation. Hence, a small-sized and compact refrigerator performing a highly efficient deodorization may be obtained. Thus, a compact deodorizing device may be provided in the air duct and air duct resistance may be reduced. On top of it, an energy efficient refrigerator consuming less power may be provided.

Now, a method for operating the refrigerator according to the first embodiment is discussed with reference to Fig. 6. Fig. 6 is a control flow chart illustrating a flow of controlling the deodorizing device of the refrigerator according to the first embodiment. Normally, while the compressor 11 installed in the body 1 of the refrigerator is operating, at least one of the dampers provided in the air ducts for supplying

refrigerated air to the respective compartments is opened. Therefore, refrigerated air is supplied little into the by-pass channel 21 in which the deodorizing device 22 having a high air resistance is installed. For that reason, it is efficient to perform a deodorizing operation while the compressor 11 is not working. Conditions for stopping the compressor 11 may be such that the refrigerator is performing a defrosting operation, and the operating time of the compressor accumulated from immediately after the termination of a defrosting operation has reached a given time.

Now, according to the present invention, it is designed that when a deodorizing operation is requested while the compressor 11 is operating, the compressor 11 is forced to stop, so that the refrigerator enters into the deodorizing operation mode. With referring to the figure, a reference sign S1 denotes a compressor stopping step for stopping the compressor 11. A reference sign S2 denotes a damper closing step for closing all the dampers for regulating the flow rate of refrigerated air to be supplied to the respective compartments. A reference sign S3 denotes an inside fan operating step for operating the inside fan 14. A reference sign S4 denotes a timer-on step for starting a timer for measuring an operating time of the inside fan 14.

A reference sign S5 denotes an inside fan operating time judgement step for judging whether the operating time of the inside fan 14 has reached the given time or not. A reference sign S6 denotes an inside fan stopping step for stopping the operation of the inside fan 14. A reference sign S7 denotes a deodorizing operation terminating step.

When a deodorizing operation is requested, the compressor 11 is stopped in S1 initially. However, if the compressor has already stopped in such a case where the refrigerator is performing a defrosting operation, or the accumulated operating time of the compressor 11 has reached the given time just after the termination of a defrosting operation, then the stopping state of the compressor is unchanged. Then, in S2, all the dampers for regulating the flow rate of refrigerated air, for regulating an amount of refrigerated air to be supplied to the respective compartments, are closed. In S3, the inside fan 14 is started to operate. Then, in S4, the timer, which may be built in such as a microcomputer provided in a control unit for controlling the operation of the refrigerator, is started to count. This timer is provided for controlling the operating time of the inside fan 14.

Then, in S5, it is judged whether the inside fan 14 has operated for the given period of time or not. As a result, if it is judged that the inside fan 14 has not yet

operated for the given period of time, then the operation returns to S5 to continue the counting. If it is judged in S5 that the inside fan 14 has operated for the given period of time, then the operation proceeds to S6 to stop the operation of the inside fan 14, and a counted time by the timer is reset. It is to be noted, according to this embodiment, that the given time is a time required for all the air in the cooling device chamber accommodating the cooling device 13 passing through the deodorizing device 22. The given time may be a period of several seconds to several minutes. If the volume of air around the cooling device 13 is 0.05 cubic meters, for example, then the operating time of the inside fan 14 may be some 30 seconds. When the operation of the inside fan is stopped in S6, then the deodorizing operation of the refrigerator is terminated in S7.

As discussed with reference to step S3, while the compressor 11 is operating, the air resistance is high, and therefore little air is allowed to pass through the deodorizing device 22 installed in the by-pass channel 21. However, by operating the inside fan 14 with all the dampers for regulating the flow rate of refrigerated air in the respective compartments being closed, all the air around the cooling device 13 is allowed to circulate. As a result, refrigerated air passed through the deodorizing

device 22 is deodorized through the absorption function of the deodorizing device 22.

Accordingly, when the dampers for regulating the flow rate of refrigerated air for regulating an amount of refrigerated air supplied to the respective compartments are opened at the time of operating the compressor 11, no odor is allowed to flow into the respective compartments of the refrigerator. Hence, an odorless refrigerator with an image of cleanliness may be obtained. Furthermore, a deodorizing operation is performed after the termination of a defrosting operation, and therefore there is no fear of an offensive smell given off as a result of a temperature rise in the cooling device chamber just after terminating a defrosting operation flowing into the respective compartments of the refrigerator. Hence, an odorless refrigerator may be obtained. Still further, refrigerated air is not allowed to pass through the deodorizing device 22 while the compressor 11 is operating, which may prevent a refrigeration performance from being lowered as well.

Furthermore, almost all of the refrigerated air in the air ducts for supplying the refrigerated air in the body 1 of the refrigerator passes through the cooling device 13 together with odors. Then, the odors are easily enclosed between the refrigeration fins of the cooling

device 13 as a result of the cooling device 13 getting frosted. Then, these enclosed odors are given off in the cooling device chamber as an offensive smell as the settled frost thaws as a result of a temperature rise by such as a defrosting operation. For that reason, according to this embodiment, the by-pass channel 21 accommodating the deodorizing device 22 is structured so that the short cycle occurs thereby returning refrigerated air which is blown off by the inside fan 14 to the cooling device chamber accommodating the cooling device 13 through the by-pass channel 21. This allows the cooling device chamber where offensive smells given off from the respective compartments of the refrigerator easily accumulate to stagnate, to be deodorized in an efficient manner. Hence, an odorless refrigerator with an image of cleanliness may be provided. Alternatively, however, the by-pass channel 21 and the draft air ducts may be provided separately. In that case, the by-pass channel does not influence on the fan performance of the draft air ducts such as the size and length of a draft air duct. Thus, the by-pass channel is allowed to be designed with less restriction. Hence a low-cost refrigerator may be obtained.

Embodiment 2.

A second embodiment of the present invention will be

discussed with reference to Fig. 7 through Fig. 10. Fig. 7 is a side sectional view of a refrigerator according to the second embodiment of the present invention. Fig. 8 is a partial front view illustrating a main part of the draft air ducts of the refrigerator according to the second embodiment. Fig. 9 is a schematic diagram of the draft air ducts illustrating a schematic structure of the draft air ducts of the refrigerator according to the second embodiment. In Fig. 7, Fig. 8 and Fig. 9, elements which are the same as or equivalent to those discussed in the first embodiment are assigned the same reference numerals or signs, and will not be discussed here. According to this embodiment, a deodorizing damper 15D for regulating the flow rate of air passing through the by-pass channel 21 is provided inside the by-pass channel 21 of the body 1 of the refrigerator according to the first embodiment.

With referring to Fig. 7, Fig. 8 and Fig. 9, reference sign 15D represents the deodorizing damper provided inside the by-pass channel 21. Therefore, the resistance of air passing through the by-pass channel 21 may be regulated by the deodorizing damper 15D, which means that the air resistance is not necessarily required to be high in the by-pass channel 21. As a result, the deodorizing device 22 and the by-pass channel 21 are allowed to be simplified and designed with less

restriction. Hence, a refrigerator may be obtained at a low cost. In this case, the deodorizing damper 15D may be opened in a deodorizing operation, and the deodorizing damper 15D may be closed in a refrigerating operation. In the case of carrying out a refrigerating operation and a deodorizing operation at the same time, the opening of the deodorizing damper 15D is adjusted so as to regulate the flow rate of refrigerated air to be supplied to the bypass channel in such a manner that the refrigeration performance is not lowered.

With reference to Fig. 8, the deodorizing damper 15D is provided on the downstream side of the deodorizing device 22 between the deodorizing device 22 and the cooling device 13. Alternatively, however, as shown in Fig. 9, the deodorizing damper 15D may be provided on the upstream side of the deodorizing device 22 between the deodorizing device 22 and the cooling device 13. Fig. 9 shows the air ducts for guiding refrigerated air to the refrigerator room 8 and the freezer 10 exclusively. The air ducts for guiding refrigerated air to the vegetable compartment 9 and air ducts for guiding refrigerated air to other compartments are not shown in Fig. 9.

Fig. 10 is a control flow chart illustrating a flow of controlling the deodorizing device of the refrigerator according to the second embodiment. With referring to the

figure, a reference sign S11 denotes a refrigerator room selecting step for deodorization. The refrigerator room selecting step for deodorization is a step for selecting a compartment to be deodorized, and in this particular example, the refrigerator room 7 is selected to be deodorized. A reference sign S12 denotes a deodorizing operation switch-on step for turning on a deodorizing operation switch for a compartment (refrigerator room 8) selected in S11. A reference sign S13 denotes a defrosting judgement step for judging whether the refrigerator is performing a defrosting operation or not.

A reference sign S31 denotes a deodorizing operation denying step for denying a deodorizing operation if it is judged in S13 that the refrigerator is performing a defrosting operation. A reference sign S14 denotes a deodorizing judgement step for judging whether the refrigerator is in the deodorizing operation mode or not if it is judged in S13 that the refrigerator is not performing a defrosting operation. A reference sign S41 denotes a deodorizing operation continuing step for continuing the deodorizing operation if it is judged in S14 that the refrigerator is in the deodorizing operation mode. A reference sign S15 denotes a deodorizing operation starting step for the refrigerator room for starting a deodorizing operation for the refrigerator room if it is

judged in S14 that the refrigerator is not in the deodorizing operation mode.

A reference sign S16 denotes a timer starting step for starting the timer to count the operating time of the inside fan 14. A reference sign S17 denotes a damper opening step for the refrigerator room for opening the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room only. A reference sign S18 denotes a deodorizing damper opening step for opening the deodorizing damper 15D. A reference sign S19 denotes an inside fan stop judgment step for judging whether the inside fan 14 is stopped or not.

A reference sign S20 denotes an inside fan operation starting step for starting the inside fan 14 to operate if it is judged in S19 that the inside fan 14 is not working. A reference sign S21 denotes an inside fan operating time confirming step for judging whether the time counted by the timer for measuring the operating time of the inside fan 14 has reached the give time or not. A reference sign 22 denotes a deodorizing damper closing step for closing the deodorizing damper 15D. A reference sign 23 denotes a deodorizing operation terminating step for the refrigerator room.

When a deodorizing operation is requested for the refrigerator room 7, then the refrigerator room is

selected for deodorization in S11 initially. Then, in S12, the deodorizing operation switch is turned on. The deodorizing operation switch may be provided on such as a liquid-crystal display panel which may be installed in the front part, for example, of the refrigerator.

Alternatively, the function of selecting a compartment to be deodorized may also be provided on the display panel. Then, in S13, it is judged whether a defrosting operation is being carried out or not. If it is judged that a defrosting operation is being carried out, then in S31 a deodorizing operation is denied so that a deodorizing operation is not carried out and the current operation is continued.

This has an effect of preventing insufficient refrigeration caused by air in the cooling device chamber flowing into the refrigerator room when the temperature of the air in the cooling device chamber rises as a result of the temperature rise of the cooling device 13 by a defrosting operation. Even in such a case, however, a deodorizing operation may be performed only for the cooling device chamber. If it is judged in S13 that a defrosting operation is not being carried out, then it is judged in S14 whether any one of the compartments is in the deodorizing operation mode or not. Then, if there is a compartment in the deodorizing operation mode, then in S41

the deodorizing operation is continued.

If it is judged in S14 that there is no compartment in the deodorizing operation mode, then in S15 a deodorizing operation is started for the refrigerator room 7, so that the refrigerator room enters into the deodorizing operation mode. Then, in S16 the timer built in such as a microcomputer for measuring the operating time of the inside fan 14 is started to count. However, if the inside fan 14 is not working at that time, the timer is designed not to count.

Thereafter, in S17 only the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room, for regulating an amount of refrigerated air to be supplied to the refrigerator room 7, is opened. Then, in S18, the deodorizing damper 15D is also opened. In S19, it is judged whether the inside fan 14 is operating or not. If it is judged that the inside fan is not working, then in S20 the inside fan 14 is started to operate. Then, in S21, it is judged whether the operating time of the inside fan 14, which is counted by the timer built in such as a microcomputer installed in the control unit for controlling the operation of the refrigerator, has reached the given time or not.

It is to be noted here that this timer is provided for controlling the operating time of the inside fan 14.

Specifically, the timer counts a period of operating time of the inside fan 14 from a deodorizing operation started. The given time is a time required for all the air in the refrigerator room 7 and around the cooling device 13 passing through the deodorizing device 22. If the volume of air in the refrigerator room 7 and around the cooling device 13 is 0.3 cubic meters, for example, then some 1.5 minutes are sufficient for the operating time of the inside fan 14.

Thus, the deodorizing operation is allowed to be performed in such a short time. This is because all the dampers for regulating the flow rate of refrigerated air for the compartments are closed except the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room. The larger the number of closed dampers for regulating the flow rate of refrigerated air provided in the draft air ducts for the respective compartments in the refrigerator is, the higher the flow rate of air passing through the deodorizing device becomes. As a result, a deodorizing operation for the refrigerator room may be achieved in a short time.

Then, if it is judged in S21 that the inside fan 14 has not operated for the given time, then the operation returns to S20 to continue the counting of the operating time. If it is judged in S21 that the inside fan 14 has

already operated for the given time, then in S22 the deodorizing damper 15D is closed and the counted time by the timer is reset. It is to be noted, according to this embodiment, that the given time is a time required for all the air of the cooling device chamber containing the cooling device 13 passing through the deodorizing device 22. The given time may be around several seconds to several minutes. If the volume of air around the cooling device 13 is 0.05 cubic meters, for example, the operating time of the inside fan 14 may be some 30 seconds. In S22, when the deodorizing damper 15D is closed, then in S23 the deodorizing operation for the refrigerator room 7 is terminated.

As aforementioned, according to this embodiment, refrigerated air is supplied to the by-pass channel in or after a defrosting operation, and thus a deodorizing operation is performed before starting a refrigerating operation. Accordingly, when the dampers for regulating the flow rate of refrigerated air, for regulating an amount of refrigerated air supplied to the respective compartments, are opened at the time of operating the compressor 11, no odor is allowed to flow into the respective compartments of the refrigerator. Hence, an odorless refrigerator with an image of cleanliness may be obtained. Furthermore, a deodorizing operation is

performed after the termination of a defrosting operation, and therefore there is no fear of an offensive smell given off as a result of a temperature rise in the cooling device chamber just after terminating a defrosting operation flowing into the respective compartments of the refrigerator. Hence, an odorless refrigerator may be obtained. Still further, refrigerated air is not allowed to pass through the deodorizing device 22 while the compressor 11 is operating, which may also contribute to preventing a refrigeration performance from being lowered.

Furthermore, according to this embodiment, the by-pass channel 21 accommodating the deodorizing device 22 is structured so that the short cycle occurs thereby returning refrigerated air which is blown off by the inside fan 14 to the cooling device chamber accommodating the cooling device 13 through the by-pass channel 21. This allows the cooling device chamber where offensive smells given off from the respective compartments of the refrigerator easily accumulate to stagnate, to be deodorized in an efficient manner. Hence, an odorless refrigerator with an image of cleanliness may be provided.

In other words, refrigerated air after refrigerating the respective compartments of the refrigerator passes through the cooling device 13 together with odors which are given off from such as food. In this case, odor

substances may easily be enclosed between frosted fins. Then, as frost thaws on the frosted fins in such as a defrosting operation as a result of a temperature rise, the odors are given off to cause an offensive smell or an unpleasant odor. According to this embodiment, refrigerated air passed through the cooling device 13 is taken into the short cycle so as to be deodorized. Hence, a refrigerator which may achieve a speedy and efficient deodorization may be provided.

Further, according to this embodiment, the deodorizing operation is tried to be performed as much as possible even while the compressor 11 is operating (in a refrigerating operation for the compartments such as the refrigerator room 7, the convertible compartment 8, the vegetable compartment 9 and the freezer 10). This allows offensive smells given off from such as food stored in the respective compartments to be deodorized. Hence, an odorless refrigerator with an image of cleanliness may be provided.

Embodiment 3.

According to this embodiment, an opening adjusting function is added to all the dampers for regulating the flow rate of refrigerated air provided in the body 1 of the refrigerator discussed in the second embodiment. Fig.

11 is a control flow chart illustrating a flow of controlling a deodorizing device of a refrigerator according to a third embodiment of the present invention. With referring to the figure, a reference sign S50 denotes a refrigerator room selecting step for deodorization. The refrigerator room selecting step for deodorization is a step for selecting a compartment to be deodorized, and in this particular example, the refrigerator room 7 is selected to be deodorized. A reference sign S51 denotes a deodorizing operation switch-on step in which a deodorizing operation switch is turned on for a compartment (refrigerator room 7) selected in S50. A reference sign S52 denotes a defrosting judgement step in which it is judged whether the refrigerator is performing a defrosting operation or not.

A reference sign S71 denotes a deodorizing operation denying step in which a deodorizing operation is denied if it is judged in S52 that the refrigerator is performing a defrosting operation. A reference sign S53 denotes a deodorizing judgement step in which it is judged whether the refrigerator is in the deodorizing operation mode or not if it is judged in S52 that a defrosting operation is not being carried out. A reference sign S81 denotes a deodorizing operation continuing step in which a deodorizing operation is continued if it is judged in S53

that the refrigerator is in the deodorizing operation mode. A reference sign S54 denotes a deodorizing operation starting step for the refrigerator room in which a deodorizing operation is started for the refrigerator room if it is judged in S53 that the refrigerator is not in the deodorizing operation mode.

A reference sign S55 denotes a timer starting step in which the timer is started to count the operating time of the inside fan 14. A reference sign S56 denotes a damper opening step for the refrigerator room in which only the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room is opened with adjusting the opening. A reference sign S57 denotes a deodorizing damper opening step in which the deodorizing damper 15D is opened. A reference sign S58 denotes an inside fan stop judgment step in which it is judged whether the inside fan 14 is stopped or not.

A reference sign S59 denotes an inside fan operation starting step in which the inside fan is operated if it is judged in S58 that the inside fan 14 is not operating. A reference sign S60 denotes an inside fan operating time confirming step in which it is judged whether the counted time by the timer for measuring the operating time of the inside fan 14 has reached the given time or not. A reference sign S61 denotes a deodorizing damper closing

step in which the deodorizing damper 15D is closed. A reference sign S62 denotes a deodorizing operation terminating step for the refrigerator room.

When a deodorizing operation is requested for the refrigerator room 7, then the refrigerator room 7 is selected in S50 for deodorization initially. Then, in S51, the deodorizing operation switch is turned on. The deodorizing operation switch may be provided on such as a liquid-crystal display panel which may be installed in the front part, for example, of the refrigerator. Alternatively, the function of selecting a compartment to be deodorized may also be provided on the display panel. Then, in S52, it is judged whether a defrosting operation is being carried out or not. If it is judged that a defrosting operation is being carried out, then in S71, a deodorizing operation is denied to be performed, so that no deodorizing operation is carried out and the current operation is continued.

This has an effect of preventing insufficient refrigeration caused by air in the cooling device chamber flowing into the refrigerator room when the temperature of the air in the cooling device chamber rises as a result of the temperature rise of the cooling device 13 by a defrosting operation. Even in such a case, however, a deodorizing operation may be performed only for the

cooling device chamber. If it is judged in S52 that a defrosting operation is not being carried out, then it is judged in S53 whether any one of the compartments is in the deodorizing operation mode or not. Then, if there is a compartment in the deodorizing operation mode, then in S81 the deodorizing operation is continued.

If it is judged in S53 that there is no compartment in the deodorizing operation mode, then in S54 a deodorizing operation is started for the refrigerator room 7, so that the refrigerator room enters into the deodorizing operation mode. Then, in S55 the timer built in such as a microcomputer for measuring the operating time of the inside fan 14 is started to count. However, if the inside fan 14 is not working at that time, the timer is designed not to count.

Thereafter, in S56, only the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room, for regulating an amount of refrigerated air to be supplied to the refrigerator room 7, is opened with adjusting the opening (at 45 degrees, for example). Also, the deodorizing damper 15D is opened in S57. Specifically, the opening of the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room is adjusted so that the flow rate of air passing through the deodorizing device 22 and the flow

rate of air passing through the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room become equal. The opening of the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room may be obtained in advance by confirming the opening through such as experiments. For example, according to the refrigerator of this embodiment, this opening is some 45 degrees. In S58, it is judged whether the inside fan 14 is operating or not. Then, if the inside fan 14 is not operating, then in S59 the inside fan 14 is started to operate. Then, in S60 it is judged whether the operating time of the inside fan 14, which is counted by the timer built in such as a microcomputer provided in the control unit for controlling the operation of the refrigerator, has reached the given operating time or not.

It is to be noted here that this timer is provided for controlling the operating time of the inside fan 14. Specifically, the timer counts a period of operating time of the inside fan 14 from a deodorizing operation started. The given time is a time required for all the air in the refrigerator room 7 and around the cooling device 13 passing through the deodorizing device 22. If the volume of air in the refrigerator room 7 and around the cooling device 13 is 0.3 cubic meters, for example, then some 1.5 minutes are sufficient for the operating time of the

inside fan 14.

Such a speedy deodorization may be achieved because all the dampers for regulating the flow rate of refrigerated air for the compartments are closed except the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room. In other words, it is designed that only a minimum required capacity or space is deodorized. For that reason, a speedy deodorization may be achieved for the refrigerator room.

Then, if it is judged in S60 that the inside fan 14 has not operated for the given time, then the operation returns to S59 to continue the counting of the operating time. If it is judged in S60 that the inside fan 14 has already operated for the given time, then in S61 the deodorizing damper 15D is closed and the counted time by the timer is reset. It is to be noted, according to this embodiment, that the given time is a time required for all the air of the cooling device chamber containing the cooling device 13 passing through the deodorizing device 22. The given time may be around several seconds to several minutes. If the volume of air around the cooling device 13 is 0.05 cubic meters, for example, the operating time of the inside fan 14 may be some 30 seconds. In S61, when the deodorizing damper 15D is closed, then in S62 the deodorizing operation for the refrigerator room 7 is

terminated.

Accordingly, when the dampers for regulating the flow rate of refrigerated air, for regulating an amount of refrigerated air supplied to the respective compartments, are opened at the time of operating the compressor 11, no odor is allowed to flow into the respective compartments of the refrigerator. Hence, an odorless refrigerator with an image of cleanliness may be obtained. Furthermore, a deodorizing operation is performed after the termination of a defrosting operation, and therefore there is no fear of an offensive smell given off as a result of a temperature rise in the cooling device chamber just after terminating a defrosting operation flowing into the respective compartments of the refrigerator. Hence, an odorless refrigerator may be obtained. Still further, refrigerated air is not allowed to pass through the deodorizing device 22 while the compressor 11 is operating, which may also contribute to preventing a refrigeration performance from being lowered.

Furthermore, according to this embodiment, the by-pass channel 21 accommodating the deodorizing device 22 is structured so that the short cycle occurs thereby returning refrigerated air which is blown off by the inside fan 14 to the cooling device chamber accommodating the cooling device 13 through the by-pass channel 21. This

allows the cooling device chamber where offensive smells given off from the respective compartments of the refrigerator easily accumulate to stagnate, to be deodorized in an efficient manner. Hence, an odorless refrigerator with an image of cleanliness may be provided.

Still further, according to this embodiment, the opening of the opening adjustable damper is adjusted so that the flow rate of refrigerated air passing through the by-pass channel and the flow rate of refrigerated air passing through the draft air duct containing the opening adjustable damper become equal. The deodorizing operation is tried to be performed as much as possible even while the compressor 11 is operating (in a refrigerating operation for the compartments such as the refrigerator room 7, the convertible compartment 8, the vegetable compartment 9 and the freezer 10). This allows offensive smells given off from such as food stored in the respective compartments to be deodorized while a refrigerating operation is being carried out. Hence, an odorless refrigerator with an image of cleanliness may be provided.

Still more, the dampers for regulating the flow rate of refrigerated air for supplying refrigerated air to the respective compartments are provided with the opening adjusting function. Thus, the flow rate of air passing

through the deodorizing device 22 and the flow rate of air passing through the air ducts for supplying refrigerated air to the respective compartments such as the refrigerator room 7 are allowed to become equal. In other words, a refrigerator, which allows the time, which is required for all the air in the compartments such as the refrigerator room 7 and around the cooling device 13 passing the deodorizing device 22, to be shortened while refrigerating the respective compartments, may be provided. In the case of opening the damper 15A for regulating the flow rate of refrigerated air at 45 degrees, for example, if the volume of air in the refrigerator room 7 and around the cooling device 13 is 0.3 cubic meters, then the operating time of the inside fan 14 is some one minute. Thus, the deodorizing operation may be achieved in a shorter period than that of the refrigerator discussed in the second embodiment.

Embodiment 4.

Fig. 12 is a schematic diagram of air ducts illustrating a schematic structure of the air ducts of a refrigerator according to a fourth embodiment of the present invention. Fig. 13 is a partial front view illustrating a main part of the air ducts of the refrigerator according to the fourth embodiment. Fig. 14

is a side sectional view of the refrigerator according to the fourth embodiment of the present invention. In Fig. 12, Fig. 13 and Fig. 14, elements which are the same as or equivalent to those discussed in the first embodiment through the third embodiment are assigned the same reference numerals or signs, and will not be discussed here. With referring to the figures, reference numeral 7 represents the refrigerator room, reference numeral 10 represents the freezer, a reference sign 13A denotes a cooling device for refrigerating, a reference sign 13B denotes a cooling device for freezing, a reference sign 14A denotes an inside fan for refrigerating, and a reference sign 14B denotes an inside fan for freezing. Then, as shown in Fig. 12, an air duct section for refrigerating, through which refrigerating air in higher temperatures circulates, and an air duct section for freezing, through which freezing air in lower temperatures circulates, are completely separated and controlled independently.

As shown in Fig. 13, in the air duct section for refrigerating including the cooling device 13A for refrigerating, there are the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room provided in the air duct 19A for the refrigerator room, the damper for regulating the flow rate of refrigerated

air for the vegetable compartment provided in the air duct for the vegetable compartment, and so on. Similarly, in the air duct section for freezing including the cooling device 13B for freezing, there are the damper 15C for regulating the flow rate of refrigerated air for the freezer provided in air duct 20A for the freezer, the damper 15B for regulating the flow rate of refrigerated air for the convertible compartment provided in the air duct 25 for the convertible compartment, the damper 15E for regulating the flow rate of refrigerated air for the ice-maker provided in the air duct 26 for the ice-maker, and so on.

Furthermore, in the air duct section for refrigerating, there is a by-pass channel 21A for refrigerating in which a deodorizing device 22A for refrigerating temperatures and a deodorizing damper 15DA for refrigerating temperatures are installed. Similarly, in the air duct section for freezing, there is a by-pass channel 21B for freezing in which a deodorizing device 22B for freezing temperatures and a deodorizing damper 15DB for freezing temperatures are installed.

Further, as shown in Fig. 14, reference numeral 7 represents the refrigerator room, reference numeral 9 represents the vegetable compartment, reference numeral 8 represents the convertible compartment and reference

numeral 10 represents the freezer. The temperature of the convertible compartment may be switched in a wide range of temperatures from higher temperatures for storing such as vegetables to lower temperatures suitable for storing such as frozen food. The cooling device 13A for refrigerating is placed in the back part of the vegetable compartment 9 behind a heat insulating divider, where the inside fan 14A for refrigerating and the by-pass channel 21A for refrigerating are provided. The cooling device 13B for freezing is placed in the back part of the convertible compartment 8 behind a heat insulating divider, where the inside fan 14B for freezing and the by-pass channel 21A for freezing are provided.

Furthermore, in all the air ducts for supplying refrigerated air to the respective compartments, the dampers for regulating the flow rate of refrigerated air (such as the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room, the damper 15C for regulating the flow rate of refrigerated air for the freezer, the damper 15B for regulating the flow rate of refrigerated air for the convertible compartment, and the damper 15E for regulating the flow rate of refrigerated air for the ice-maker) are provided, respectively. The opening of each of the respective dampers is adjusted individually.

Therefore, the air ducts for refrigeration on the refrigerating side and the freezing side are separated from each other. The by-pass channels for deodorization having the deodorizing devices installed therein are also provided respectively on the independent refrigerating and freezing sides. This allows the deodorizing operations to be performed independently. On the refrigerating side, specifically, temperatures are higher and therefore odors are liable to occur. For that reason, the number of deodorizing operations may be increased on the refrigerating side only. Alternatively, the period of a deodorizing operation may be prolonged. Even in those cases, it is designed not to increase the temperatures of respective compartments in the freezing side, so that an efficient deodorization is obtained. Hence, a highly reliable refrigerator which is free from insufficient refrigeration may be obtained.

Fig. 15 is a control flow chart illustrating a flow of controlling the refrigerator according to the fourth embodiment of the present invention. With referring to the figure, a reference sign S90 denotes a step for selecting a compartment to be deodorized, and with this particular example, a refrigerator room selecting step for deodorization in which the refrigerator room 7 is selected to be deodorized. A reference sign S91 denotes a

deodorizing operation switch-on step in which the deodorizing operation switch is turned on for a compartment (refrigerator room 7) selected in S90. A reference sign S92 denotes a defrosting judgement step in which it is judged whether a defrosting operation is being carried out in the respective compartments on the refrigerating side or not.

A reference sign S111 denotes a deodorizing operation denying step in which a deodorizing operation is denied if it is judged in S92 that a defrosting operation is being carried out. A reference sign S93 denotes a deodorizing judgement step in which it is judged whether the refrigerating side is on the deodorizing operation mode or not if it is judged in S92 that a defrosting operation is not being carried out. A reference sign S121 denotes a deodorizing operation continuing step in which a deodorizing operation is continued if it is judged in S93 that the refrigerating side is on the deodorizing operation mode. A reference sign S94 denotes a deodorizing operation starting step for the refrigerator room in which a deodorizing operation is started for the refrigerator room if it is judged in S93 that the refrigerating side is not on the deodorizing operation mode.

A reference sign S95 denotes a timer starting step in which the timer is started for counting the operating

time of the inside fan 14A for refrigerating. A reference sign S96 denotes a damper opening step for the refrigerator room in which only the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room is opened with adjusting the opening thereof. A reference sign S97 denotes a deodorizing damper opening step for refrigerating in which the deodorizing damper 15DA for refrigerating is opened. A reference sign S98 denotes a refrigerating inside fan stop judgement step in which it is judged whether the inside fan 14A for refrigerating is stopped or not.

A reference sign S99 denotes a refrigerating inside fan operation starting step in which the inside fan 14A for refrigerating is started to operate if it is judged in S98 that the inside fan 14A for refrigerating is not operating. A reference sign S100 denotes a refrigerating inside fan operating time confirming step in which it is judged whether the time counted by the timer for measuring the operating time of the inside fan 14A for refrigerating has reached the given time or not. A reference sign S101 denotes a deodorizing damper closing step in which the deodorizing damper 15DA for refrigerating is closed. A reference sign S102 denotes a deodorizing operation terminating step for the refrigerator room.

When a deodorizing operation is requested for the

refrigerator room 7, then the refrigerator room 7 is selected to be deodorized initially in S90, and then the deodorizing operation switch is turned on in S91. The deodorizing operation switch may be provided on such as a liquid-crystal display panel which may be installed in the front part of the refrigerator, for example. Alternatively, the function of selecting a compartment to be deodorized may be provided on the display panel. Then, in S92, it is judged whether a defrosting operation is being carried out in the respective compartments on the refrigerating side or not. If it is judged that a defrosting operation is being carried out, then in S111, a deodorizing operation is denied to be performed, so that no deodorizing operation is carried out and the current operation is continued.

This has an effect of preventing insufficient refrigeration caused by air in the cooling device chamber for refrigerating flowing into the refrigerator room 7 when the temperature of the air in the cooling device chamber for refrigerating rises as a result of the temperature rise of the cooling device 13A by a defrosting operation. Even in such a case, however, a deodorizing operation may be performed only for the cooling device chamber. If it is judged in S92 that a defrosting operation is not being carried out, then it is judged in

S93 whether any one of the compartments on the refrigerating side is in the deodorizing operation mode or not. Then, if there is a compartment in the deodorizing operation mode, then in S121 the deodorizing operation is continued.

If it is judged in S93 that there is no compartment on the refrigerating side in the deodorizing operation mode, then in S94 a deodorizing operation is started for the refrigerator room 7, so that the refrigerator room enters into the deodorizing operation mode. Then, in S95 the timer built in such as a microcomputer for measuring the operating time of the inside fan 14A for refrigerating is started to count. However, if the inside fan 14A for refrigerating is not working at that time, the timer is designed not to count.

Thereafter, in S96, only the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room, for regulating an amount of refrigerated air to be supplied to the refrigerator room 7, is opened with adjusting the opening (at 45 degrees, for example). Also, the deodorizing damper 15DA is opened in S97. Specifically, the opening of the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room is adjusted so that the flow rate of air passing through the deodorizing device 22A and the flow

rate of air passing through the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room become equal.

The opening of the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room may be obtained in advance by confirming the opening through such as experiments. For example, according to the refrigerator of this embodiment, this opening is some 45 degrees. In S98, it is judged whether the inside fan 14A for refrigerating is operating or not. Then, if the inside fan 14A for refrigerating is not operating, then in S99 the inside fan 14A for refrigerating is started to operate. Then, in S100 it is judged whether the operating time of the inside fan 14A for refrigerating, which is counted by the timer built in such as a microcomputer provided in the control unit for controlling the operation of the refrigerator, has reached the given operating time or not.

It is to be noted here that this timer is provided for controlling the operating time of the inside fan 14A for refrigerating. Specifically, the timer counts a period of operating time of the inside fan 14A for refrigerating from a deodorizing operation started. The given time is a time required for all the air in the refrigerator room 7 and around the cooling device 13A passing through the deodorizing device 22A. If the volume of air in the

refrigerator room 7 and around the cooling device 13A is 0.3 cubic meters, for example, then some 1.5 minutes are sufficient for the operating time of the inside fan 14A for refrigerating.

Such a speedy deodorization may be achieved because all the dampers for regulating the flow rate of refrigerated air for the compartments are closed except the damper 15A for regulating the flow rate of refrigerated air for the refrigerator room. In other words, it is designed that only a minimum required capacity or space is deodorized. For that reason, a speedy deodorization may be achieved for the refrigerator room.

Then, if it is judged in S100 that the inside fan 14A for refrigerating has not operated for the given time, then the operation returns to S99 to continue the counting of the operating time. If it is judged in S100 that the inside fan 14A for refrigerating has already operated for the given time, then in S101 the deodorizing damper 15DA is closed and the counted time by the timer is reset. It is to be noted, according to this embodiment, that the given time is a time required for all the air of the cooling device chamber containing the cooling device 13A for refrigerating passing through the deodorizing device 22A. The given time may be around several seconds to several minutes. If the volume of air around the cooling

device 13 is 0.05 cubic meters, for example, the operating time of the inside fan 14A for refrigerating may be some 30 seconds. In S101, when the deodorizing damper 15DA for refrigerating is closed, then in S102 the deodorizing operation for the refrigerator room 7 is terminated.

Accordingly, when the dampers for regulating the flow rate of refrigerated air, for regulating an amount of refrigerated air supplied to the respective compartments, are opened at the time of operating the compressor 11, no odor is allowed to flow into the respective compartments of the refrigerator. Hence, an odorless refrigerator with an image of cleanliness may be obtained. Furthermore, a deodorizing operation is performed after the termination of a defrosting operation, and therefore there is no fear of an offensive smell given off as a result of a temperature rise in the cooling device chamber just after terminating a defrosting operation flowing into the respective compartments of the refrigerator. Hence, an odorless refrigerator may be obtained. Still further, refrigerated air is not allowed to pass through the deodorizing device 22 while the compressor 11 is operating, which may also contribute to preventing a refrigeration performance from being lowered.

Furthermore, according to this embodiment, the bypass channel 21A accommodating the deodorizing device 22

is structured so that the short cycle occurs thereby returning refrigerated air which is blown off by the inside fan 14A for refrigerating to the cooling device chamber accommodating the cooling device 13A for refrigerating through the by-pass channel 21A. This allows the cooling device 13A for refrigerating where offensive smells given off from the respective compartments of the refrigerator easily accumulate to stagnate, to be deodorized in an efficient manner. Hence, an odorless refrigerator with an image of cleanliness may be provided.

Further, according to this embodiment, the deodorizing operation is tried to be performed as much as possible even while the compressor 11 is operating (in a refrigerating operation for the compartments such as the refrigerator room 7, and the vegetable compartment 9). This allows offensive smells given off from such as food stored in the respective compartments to be deodorized. Hence, an odorless refrigerator with an image of cleanliness may be provided.

Still more, the dampers for regulating the flow rate of refrigerated air for supplying refrigerated air to the respective compartments are provided with the opening adjusting function. Thus, the flow rate of air passing through the deodorizing device 22A for refrigerating and the flow rate of air passing through the air ducts for

supplying refrigerated air to the respective compartments such as the refrigerator room 7 are allowed to become equal. In other words, a refrigerator, which allows the time required for all the air in the compartments such as the refrigerator room 7 and around the cooling device 13A for refrigerating passing the deodorizing device 22A for refrigerating to be shortened while refrigerating the respective compartments, may be provided.

Furthermore, almost all of the refrigerated air in the air ducts for supplying the refrigerated air in the body 1 of the refrigerator passes through the cooling device 13A, 13B together with odors. Then, the odors are easily enclosed between the refrigeration fins of the cooling device 13A, 13B as a result of the cooling device 13A, 13B getting frosted. Then, these enclosed odors are given off in the cooling device chamber as an offensive smell as the settled frost thaws as a result of a temperature rise by such as a defrosting operation. For that reason, according to this embodiment, the by-pass channel 21A, 21B accommodating the deodorizing device 22A, 22B is structured so that the short cycle occurs thereby returning refrigerated air which is blown off by the inside fan 14A, 14B to the cooling device chamber accommodating the cooling device 13A, 13B through the by-pass channel 21A, 21B. This allows the cooling device

chamber where offensive smells given off from the respective compartments of the refrigerator easily accumulate to stagnate, to be deodorized in an efficient manner. Hence, an odorless refrigerator with an image of cleanliness may be provided.

In this embodiment, a description has been given of the deodorizing operation performed only on the refrigerating side. However, a similar effect may be obtained with a deodorizing operation for the compartments on the freezing side such as the freezer 10 as well (controlling such as the deodorizing device 22B for freezing and the damper 15DB for regulating the flow rate of refrigerated air for freezing which are provide inside the by-pass channel 21B for freezing) by performing the same control.

Further, according to this embodiment, the refrigerator is provided with the compartments arranged at the front part of the body of the refrigerator for storing such as food, the two cooling devices installed respectively in the two different cooling device chambers which are arranged at the back part of the body of the refrigerator for producing refrigerated air in different temperature ranges for refrigerating the inside of the respective compartments, and two independent draft air ducts for blowing off the refrigerated air in different

temperature ranges produced by the two cooling devices into the respective compartments corresponding to the different temperature ranges. Then, the refrigerator is provided with the deodorizing device, which is composed of the deodorizing filter for absorbing odor elements and the refreshing unit for decomposing the odor elements absorbed by the deodorizing filter so as to prolong the life of the deodorizing filter, in each of the two independent draft air ducts. As a result, a delicate temperature control may be achieved for the compartments in different temperatures. In addition to that, the refrigeration and deodorization may be controlled individually for the respective compartments in different temperatures.

Alternatively, however, the two independent draft air ducts may be provided, respectively, with by-pass channels, and each of the by-pass channels is provided with a deodorizing device. In that case, the by-pass channels are separated from each other, and therefore they do not affect the fan performance such as the size or length of the draft air duct of the other. As a result, the by-pass channel is allowed to be designed with less restriction. Hence, a low-cost refrigerator may be obtained.

Furthermore, in this embodiment, a description has been given of the example having two by-pass channels and

two deodorizing devices, that is, one of the by-pass channels and one of the deodorizing devices in each of the passages of air flow on the refrigerating side and the freezing side. However, only one deodorizing device may be provided alternatively. In this case, it is desirable to have the single deodorizing device on the air duct section for refrigerating because odors are liable more to occur in air duct section for refrigerating with higher refrigerating temperatures. Still alternatively, the refrigerator may be provided with three or more of the deodorizing devices and by-pass channels. In that case, a separate deodorization control may be achieved for each compartment, and thus there is no fear of transferring temperature such as a temperature rise to other compartments. Hence, a delicate deodorization and a stable refrigeration may be achieved for each compartment.

Still alternatively, in the case of a three-cooling device-system refrigerator which is provided with three cooling devices or more, the same effect may be obtained as that of the two-cooling device-system refrigerator which is provided with two cooling devices discussed with reference to Fig. 12 through Fig. 14.

Still further, the refrigerator of the present invention is designed to be provided with the deodorizing operation switch for starting/terminating a deodorizing

operation. As a result, a use-friendly convenient refrigerator, which allows the user to control a deodorizing operation as he/she desires, may be provided. The refrigerator is further provided with the selection switch for selecting a compartment to be deodorized, which allows the user to select a compartment for deodorization as he/she desires. Hence, a user-friendly convenient refrigerator, which allows the user to specify a compartment to be deodorized, may be provided.

In the fourth embodiment, a description has been given of the deodorizing operation switch and the selection switch which are to be provided. Alternatively, the deodorizing operation switch and the selection switch may be applied to the refrigerators discussed in the first embodiment to the third embodiment as well. In that case, a user-friendly convenient refrigerator, in which a deodorizing operation is allowed to be performed as the user desires, may be provided. Furthermore, the user is allowed to select a compartment to be deodorized as he/she desires. Hence, a user-friendly convenient refrigerator, in which the user is allowed to specify a compartment to be deodorized, may be provided

The effects of the refrigerator according to the present invention may be summarized as follows.

The refrigerator according to one embodiment of the present invention is characterized by including the plurality of compartments, which is provided in the front part of the body of the refrigerator, for storing such as food; the cooling device, which is installed in the cooling device chamber provided in the back part of the body of the refrigerator, for producing refrigerated air for refrigerating the plurality of compartments; the inside fan, which is installed in the cooling device chamber, for blowing off the refrigerated air produced by the cooling device to the plurality of compartments; the draft air duct, which is a passage of air flow of refrigerated air to be blown off forcibly by the inside fan to the plurality of compartments; the damper, which is installed in the draft air duct, opening/closing so as to allow/prevent the supply of the refrigerated air to the plurality of compartments; the by-pass channel, which is provided in the draft air duct between the damper and the cooling device and used for returning the refrigerated air produced by the cooling device to the cooling device; and the deodorizing device, which is installed inside the by-pass channel, for deodorizing the refrigerated air to be supplied to the plurality of compartments. Then, the damper is closed so that the refrigerated air inside the draft air duct between the damper and the cooling device

is blown off forcibly to the by-pass channel. As a result, all the refrigerated air in the enclosed space by the dampers including the cooling device chamber is to pass forcibly through the deodorizing device by means of the inside fan. Hence, a deodorizing effect may be achieved in a short time. Thus, an odorless refrigerator in which an offensive smell will not be supplied to the respective compartments even if the dampers are opened.

The refrigerator according to a next embodiment of the present invention is characterized that the deodorizing device includes the deodorizing filter for absorbing odor elements, and the refreshing unit for decomposing the odor elements absorbed by the deodorizing filter so as to prolong the life of the deodorizing filter. As a result, the filter life may be prolonged, which can save a lot of trouble over changing filters. Hence, an odorless and low-cost refrigerator may be provided.

The refrigerator according to a next embodiment of the present invention is characterized that the deodorizing filter includes titanium oxide which is a photocatalyst, and the refreshing unit includes light emitting diode which emits ultraviolet rays. As a result, a highly-reliable and low-cost deodorizing device may be obtained. Hence, an odorless highly-reliable and low-cost refrigerator may be provided. In addition to that, the

refrigerator is allowed to become more minimized than that using other refreshing unit such as a black light.

The refrigerator according to a next embodiment of the present invention is characterized that air resistance in the by-pass channel having the deodorizing device inside is higher than air resistance in the draft air duct for supplying the refrigerated air to the plurality of compartments so that the refrigerated air is not easily supplied to the by-pass channel in the case of opening the damper for allowing the supply of the refrigerated air to the plurality of compartments. As a result, the deodorizing device causes no air resistance in the air ducts while a refrigerating operation is being carried out. Hence, a refrigerator having a deodorizing effect without causing insufficiency in refrigeration may be obtained.

The refrigerator according to a next embodiment of the present invention is characterized by including the deodorizing damper, which is installed in the by-pass channel, for regulating a flow rate of the refrigerated air, so that the refrigerated air is not supplied to the by-pass channel while a refrigerating operation is being carried out. As a result, the resistance of air passing through the by-pass channel may be regulated by the deodorizing damper, which means that the air resistance is not required to be high in the by-pass channel. For that

reason, the decolorizing device and the by-pass channel are allowed to be simplified and designed with less restriction. Hence, a highly-reliable refrigerator may be obtained at a low cost.

The refrigerator according to a next embodiment of the present invention is characterized that the by-pass channel is installed independently of the draft air duct. As a result, the by-pass channel is allowed to be provided independently. In that case, the by-pass channel does not influence on the fan performance of the draft air ducts such as the size and length of a draft air duct. Thus, the by-pass channel is allowed to be designed with less restriction. Hence a low-cost refrigerator may be obtained.

The refrigerator according to a next embodiment of the present invention is characterized by including the plurality of draft air ducts for supplying the refrigerated air to the plurality of compartments; and the opening adjustable damper, which is installed in at least one of the plurality of draft air ducts, for regulating the flow rate of the refrigerated air. Then, the opening of the opening adjustable damper is adjusted so that the flow rate of refrigerated air passing through the by-pass channel and the flow rate of refrigerated air passing through the draft air duct having the opening adjustable damper inside become the same. As a result, offensive

smells given off from such as food stored in the respective compartments are allowed to be deodorized while a refrigerating operation is being carried out. Hence, an odorless refrigerator with an image of cleanliness may be provided. In addition to that, the time required for all the air in the compartments such as the refrigerator room and around the cooling device for refrigerating passing the deodorizing device for refrigerating is allowed to be shortened.

The refrigerator according to another embodiment of the present invention is characterized that a refrigerating operation is not started while a defrosting operation is being carried out. Then, a deodorizing operation is started before starting the refrigerating operation by supplying the refrigerated air to the by-pass channel in either case of in a defrost operation and after a defrosting operation. As a result, when the dampers for regulating the flow rate of refrigerated air, for regulating an amount of refrigerated air supplied to the respective compartments, are opened at the time of operating the compressor 11, no odor is allowed to flow into the respective compartments of the refrigerator. Hence, an odorless refrigerator with an image of cleanliness may be obtained. Furthermore, a deodorizing operation is performed after the termination of a

defrosting operation, and therefore there is no fear of an offensive smell given off as a result of a temperature rise in the cooling device chamber just after terminating a defrosting operation flowing into the respective compartments of the refrigerator. Hence, an odorless refrigerator may be obtained.

The refrigerator according to a next embodiment of the present invention is characterized by further including the deodorizing operation switch for starting/terminating a deodorizing operation. As a result, a use-friendly convenient refrigerator, which allows the user to control a deodorizing operation as he/she desires, may be provided.

The refrigerator according to a next embodiment of the present invention is characterized by further including the selection switch for selecting one of the plurality of compartments to be deodorized. As a result, the user is allowed to select a compartment for deodorization as he/she desires. Hence, a user-friendly convenient refrigerator, which allows the user to specify a compartment to be deodorized, may be provided.

The refrigerator according to another embodiment of the present invention is characterized by including the plurality of compartments which is provided in the front part of the body of the refrigerator, for storing such as

food; the two cooling devices, which are installed in the back part of the body of the refrigerator, for producing refrigerated air in different temperatures so as to refrigerate the plurality of compartments; the two separate draft air ducts corresponding to the two cooling devices for blowing off the refrigerated air in different temperature ranges produced by the two cooling devices independently to different compartments with different temperatures of the plurality of compartments; and the deodorizing device. Then, the deodorizing device includes, the deodorizing filters, which are provided in the two separate draft air ducts, for absorbing odor elements, and the refreshing units for decomposing the odor elements absorbed by the deodorizing filters so as to prolong the lives of the deodorizing filters. As a result, a delicate temperature control may be achieved for the compartments in different temperatures. In addition to that, the refrigeration and deodorization may be controlled individually for the respective compartments in different temperatures.

The refrigerator according to a next embodiment of the present invention is characterized by including the by-pass channels provided, respectively, in the two individual draft air ducts; and the deodorizing devices installed, respectively, in the by-pass channels. As a

result, the by-pass channels are independent of each other, and therefore they do not affect the fan performance such as the size or length of the draft air duct of the other. For that reason, the by-pass channel is allowed to be designed with less restriction. Hence, a low-cost refrigerator may be obtained.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

What is claimed is:

1. A refrigerator comprising:

a plurality of compartments, which is provided in a front part of a body of the refrigerator, for storing such as food;

a cooling device, which is installed in a cooling device chamber provided in a back part of the body of the refrigerator, for producing refrigerated air for refrigerating the plurality of compartments;

an inside fan, which is installed in the cooling device chamber, for blowing off the refrigerated air produced by the cooling device to the plurality of compartments;

a draft air duct, which is a passage of air flow of refrigerated air to be blown off forcibly by the inside fan to the plurality of compartments;

a damper, which is installed in the draft air duct, opening/closing so as to allow/prevent a supply of the refrigerated air to the plurality of compartments;

a by-pass channel, which is provided in the draft air duct between the damper and the cooling device and used for returning the refrigerated air produced by the cooling device to the cooling device; and

a deodorizing device, which is installed inside the by-pass channel, for deodorizing the refrigerated air to

be supplied to the plurality of compartments;

a deodorizing damper, which is installed in the by-pass channel, for regulating a flow rate of the refrigerated air, so that the refrigerated air is not supplied to the by-pass channel while a refrigerating operation is being carried out;

wherein the damper is closed so that the refrigerated air inside the draft air duct between the damper and the cooling device is blown off forcibly to the by-pass channel.

2. The refrigerator of claim 1, wherein the deodorizing device includes,

a deodorizing filter for absorbing odor elements,
and

a refreshing unit for decomposing the odor elements absorbed by the deodorizing filter so as to prolong a life of the deodorizing filter.

3. The refrigerator of claim 2, wherein the deodorizing filter includes a titanium oxide which is a photocatalyst,
and

wherein the refreshing unit includes a light emitting diode which emits ultraviolet rays.

4. The refrigerator of claim 1, wherein air resistance in the by-pass channel having the deodorizing device inside is higher than air resistance in the draft air duct for supplying the refrigerated air to the plurality of compartments so that the refrigerated air is not easily supplied to the by-pass channel in a case of opening the damper for allowing the supply of the refrigerated air to the plurality of compartments.

5. The refrigerator of claim 1, wherein the by-pass channel is installed independently of the draft air duct.

6. The refrigerator of claim 1, comprising:
a plurality of draft air ducts for supplying the refrigerated air to the plurality of compartments; and
an opening adjustable damper, which is installed in at least one of the plurality of draft air ducts, for regulating a flow rate of the refrigerated air;

wherein an opening of the opening adjustable damper is adjusted so that a flow rate of refrigerated air passing through the by-pass channel and a flow rate of refrigerated air passing through the draft air duct having the opening adjustable damper inside become the same.

37. The refrigerator of claim 1, wherein a refrigerating operation is not started while a defrosting operation is being carried out; and

wherein a deodorizing operation is started before starting the refrigerating operation by supplying the refrigerated air to the by-pass channel in either case of in a defrost operation and after a defrosting operation.

38. The refrigerator of claim 1, further comprising a deodorizing operation switch for starting/terminating a deodorizing operation.

39. The refrigerator of claim 8, comprising a selection switch for selecting one of the plurality of compartments to be deodorized.

10. A refrigerator comprising:

a plurality of compartments, which is provided in a front part of a body of the refrigerator, for storing such as food;

two cooling devices, which are installed in a back part of the body of the refrigerator, for producing refrigerated air in different temperatures so as to refrigerate the plurality of compartments;

two separate draft air ducts corresponding to the two cooling devices for blowing off the refrigerated air in different temperature ranges produced by the two cooling devices independently to different compartments with different temperatures of the plurality of compartments; and

a deodorizing device;

wherein the deodorizing device includes,

deodorizing filters, which are provided in the two separate draft air ducts, for absorbing odor elements, and refreshing units for decomposing the odor elements absorbed by the deodorizing filters so as to prolong lives of the deodorizing filters.

11. The refrigerator of claim 10, comprising:

by-pass channels provided, respectively, in the two individual draft air ducts; and

deodorizing devices installed, respectively, in the by-pass channels.

12. The refrigerator of claim 2, wherein air resistance in the by-pass channel having the deodorizing device inside is higher than air resistance in the draft air duct for supplying the refrigerated air to the plurality of compartments so that the refrigerated air is not easily

supplied to the by-pass channel in a case of opening the damper for allowing the supply of the refrigerated air to the plurality of compartments.

13. The refrigerator of claim 2, further comprising a deodorizing damper, which is installed in the by-pass channel, for regulating a flow rate of the refrigerated air, so that the refrigerated air is not supplied to the by-pass channel while a refrigerating operation is being carried out.

14. The refrigerator of claim 2, wherein the by-pass channel is installed independently of the draft air duct.

15. The refrigerator of claim 2, comprising:

a plurality of draft air ducts for supplying the refrigerated air to the plurality of compartments; and

an opening adjustable damper, which is installed in at least one of the plurality of draft air ducts, for regulating a flow rate of the refrigerated air;

wherein an opening of the opening adjustable damper is adjusted so that a flow rate of refrigerated air passing through the by-pass channel and a flow rate of refrigerated air passing through the draft air duct having the opening adjustable damper inside become the same.

16. The refrigerator of claim 2, wherein a refrigerating operation is not started while a defrosting operation is being carried out; and

wherein a deodorizing operation is started before starting the refrigerating operation by supplying the refrigerated air to the by-pass channel in either case of in a defrost operation and after a defrosting operation.

17. The refrigerator of claim 2, further comprising a deodorizing operation switch for starting/terminating a deodorizing operation.

18. The refrigerator of claim 3, wherein air resistance in the by-pass channel having the deodorizing device inside is higher than air resistance in the draft air duct for supplying the refrigerated air to the plurality of compartments so that the refrigerated air is not easily supplied to the by-pass channel in a case of opening the damper for allowing the supply of the refrigerated air to the plurality of compartments.

19. The refrigerator of claim 3, further comprising a deodorizing damper, which is installed in the by-pass channel, for regulating a flow rate of the refrigerated air, so that the refrigerated air is not supplied to the

by-pass channel while a refrigerating operation is being carried out.