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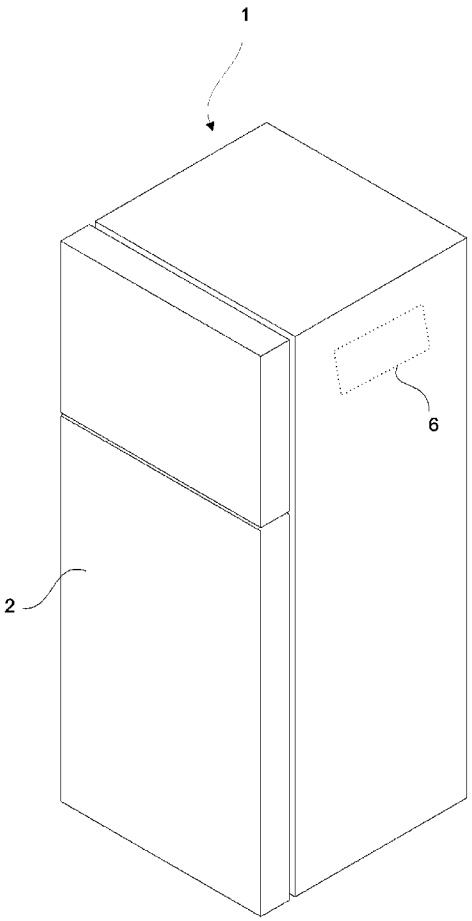
(54) Title: A REFRIGERATOR

Figure 1



(57) Abstract: The present invention relates to a refrigerator (1) of the present invention comprising at least one fresh food compartment (2) wherein foods to be cooled are placed, a thawing compartment (3) disposed in the fresh food compartment (2), wherein the frozen foods are placed for being stored without being spoiled during and after the thawing process and a heater (4) providing the heating of the thawing compartment (3).

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Description

A REFRIGERATOR

[0001] The present invention relates to a refrigerator having the function of thawing frozen foods.

[0002] In refrigerators comprising fresh food and freezing compartments, the foods stored in the freezing compartment are generally made ready to be consumed or used after being thawed by being taken out of the freezing compartment. In the state of the art, in order to perform the thawing process, compartments are disposed in the fresh food compartment with temperature higher with respect to the freezing compartment, equipped with special heating mechanisms and wherein the thawing process is performed. The foods are preferably stored also in these compartments until the time of use after being thawed. The temperature increasing inside the thawing compartment during the process of thawing the frozen foods leads to the increase of the microbiological load on the foods.

[0003] In the state of the art United States Patents No US4385075 and US5930454, a refrigerator is explained which comprises a special thawing casing.

[0004] In the state of the art Chinese Patent Application No. CN1967115, a freezer is described wherein the thawing time is shortened and the thawing efficiency is increased by directing ultraviolet rays onto the food to be thawed by means of reflecting surfaces.

[0005] The aim of the present invention is the realization of a refrigerator wherein food thawing and storage processes are performed safely.

[0006] The refrigerator realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises at least one fresh food compartment wherein foods to be cooled are placed, a thawing compartment disposed in the fresh food compartment, wherein the frozen foods are placed for being stored without being spoiled during and after the thawing process, and a heater providing the heating of the thawing compartment. The resistant-type or infrared heater provides the food to be thawed by heating up by conduction, convection and/or radiation. Thus, the foods are thawed in the thawing compartment and if

desired are stored in the thawing compartment. The refrigerator furthermore comprises at least one ultraviolet lamp disposed on the thawing compartment, providing sterilization during a predetermined sterilization time and a control unit providing the activation of the ultraviolet lamp when the heater is deactivated. Thus, the pathogenic microorganisms and bacteria with the risk of growing with the effect of the temperature increasing during the thawing of the frozen products are prevented from being active and remaining alive.

[0007] In an embodiment of the present invention, the ultraviolet lamp does not operate when the heater is operated. The ultraviolet lamp is operated only for the purpose of sterilization and the heater performs the thawing process alone. The ultraviolet lamp and the heater never operate simultaneously.

[0008] In an embodiment of the present invention, the ultraviolet lamp emits ultraviolet rays with wavelengths between 240 nm and 280 nm. The ultraviolet light consists of rays with wavelengths ranging from 210 nm to 328 nm. When the DNA of the microorganisms growing with the food and the oxygen in the compartment absorbs these rays, cell death occurs. The wavelength range between 240 nm and 280 nm is the ultraviolet ray range with the highest effect on microorganisms. By means of using the ultraviolet lamp that emits rays with wavelengths between 240 nm and 280 nm, effective sterilization is provided.

[0009] In an embodiment of the present invention, the control unit compares the thawing time with the time elapsed since the initiation of the thawing process and when the time elapsed reaches the thawing time, deactivates the heater during the predetermined sterilization time and activates the ultraviolet lamp. When the time required for the food to be almost completely thawed ends, the heater is deactivated and the ultraviolet lamp is operated. Thus, the microorganisms growing on the food with the effect of the increased temperature are eliminated with the effect of ultraviolet rays and the food is provided to be consumed or stored safely.

[0010] In an embodiment of the present invention, the control unit compares the time elapsed since the initiation of the thawing process with the surface

thawing time lower value and the surface thawing upper value forming the time interval predetermined by the producer and whereat the thawing of the food surface starts, activates the ultraviolet lamp and deactivates the heater during the predetermined sterilization time when the time elapsed since the initiation of the thawing process reaches the surface thawing time lower value and deactivates the ultraviolet lamp and activates the heater when the time elapsed since the initiation of the thawing process reaches the surface thawing time upper value. Thus, the heater and the ultraviolet lamp are activated in a coordinated manner with each other. When the food surface starts to thaw with the effect of the heat emitted from the heater, the microorganisms that start to grow with the effect of the increased temperature are eliminated by applying ultraviolet rays.

[0011] In an embodiment of the present invention, the refrigerator comprises at least one valve disposed on the thawing compartment and that allows the flow of cold air into the thawing compartment. The temperature in the thawing compartment is increased by means of the heater for thawing the frozen foods. After the thawing process is completed, the temperature of the thawing compartment is required to be decreased for storing the foods without being spoiled. Cooling of the thawing compartment is realized by opening the valve and thus by the hot hair being replaced with the cold air in the fresh good compartment. The control unit compares the time elapsed since the initiation of the thawing process with the predetermined thawing time corresponding to the weight of the food to be thawed and that is required for the food to be almost completely thawed, opens the valve after the thawing time ends and the thawing process is completed, and closes the valve when the temperature of the thawing compartment reaches a predetermined thawed food storage temperature. By means of the control unit, the valve is operated in a controlled and safe manner and the temperature of the thawing compartment is provided to be kept at the values predetermined by the producer. The control unit activates the ultraviolet lamp during the predetermined sterilization time when the valve is changed from the open position to the closed position. Thus, the microbiological load of the air that fills into the thawing compartment is

reduced, the foods are prevented from being spoiled and the color and taste of the foods are prevented from changing and the thawing compartment is provided to be cooled in a controlled manner.

[0012] In an embodiment of the present invention, the sterilization times predetermined by the user vary depending on the type and weight of the foodstuffs and on the food thawing period.

[0013] In an embodiment of the present invention, the refrigerator comprises a collection container disposed on the thawing compartment, wherein the liquid moving away from the food as the frozen food is thawed is collected. The ice cubes on the food liquefy during the thawing process and pour into the collection container by draining downwards from over the food.

[0014] In an embodiment of the present invention, the refrigerator comprises a button that is disposed on the thawing compartment and that serves to start the thawing process. Thus, the thawing compartment is provided to be used under the control of the user.

[0015] In an embodiment of the present invention, the refrigerator comprises a display which shows the user whether the thawing process is still being performed or completed. The information that the thawing process is still being performed and/or completed is displayed to the user by the display.

[0016] By means of the present invention, the microorganisms which form during and after the thawing process and cause the foods to spoil are eliminated by means of the ultraviolet lamp activated during the predetermined sterilization time between the frozen food thawing periods. Thus, the foodstuffs are provided to be thawed and stored in a hygienic manner without a change in the color and taste of the foods.

[0017] The model embodiments relating to a refrigerator realized in order to attain the aim of the present invention are illustrated in the attached figures, where:

[0018] Figure 1 – is the perspective view of a refrigerator.

[0019] Figure 2 – is the perspective view of the thawing compartment.

[0020] The elements illustrated in the figures are numbered as follows:

1. Refrigerator
2. Fresh food compartment

3. Thawing compartment
4. Heater
5. Ultraviolet lamp
6. Control unit
7. Valve

[0021] The following symbols are used for explicating the refrigerator (1) of the present invention:

- t_s: The sterilization time predetermined by the producer
- t: The time elapsed since the initiation of the thawing process
- t_1: The thawing time corresponding to the weight of the food to be thawed and that is required for the food to be almost completely thawed
- t_2: Surface thawing time lower value
- t_3 : Surface thawing time upper value

[0022] The refrigerator (1) comprises at least one fresh food compartment (2) wherein foods to be cooled are placed, a thawing compartment (3) disposed in the fresh food compartment (2), wherein the frozen foods are placed for being stored without being spoiled during and after the thawing process and a heater (4) providing the heating of the thawing compartment (3). The heater (4) can be a resistant-type or infrared/halogen lamp. The thawing process is performed in the thawing compartment (3) by conveying air onto the food by conduction, convection and/or radiation. The foods are thawed in the thawing compartment (3) and stored in the thawing compartment (3). The refrigerator (1) comprises at least one ultraviolet lamp (5) disposed on the thawing compartment (3), providing sterilization during a predetermined sterilization time (t_s) and a control unit (6) providing the ultraviolet lamp (5) to be activated when the heater (4) is deactivated. By means of the heater (4) and the ultraviolet lamp (5) operating in a coordinated manner, the growth of bacteria and microorganisms caused by the thawing process is prevented while the thawing process is performed.

[0023] In an embodiment of the present invention, the ultraviolet lamp (5) never operates simultaneously with the heater (4). The ultraviolet lamp (5) is used only for sterilization. The ultraviolet lamp (5) is deactivated during the

time wherein the heater (4) remains active for thawing the frozen food.

[0024] In an embodiment of the present invention, the ultraviolet lamp (5) emits ultraviolet rays with wavelengths between 240 nm and 280 nm. Since the wavelength range between 240 nm and 280 nm is the ray range with the highest effect on microorganisms, the microbiological load of the foods are effectively reduced.

[0025] In an embodiment of the present invention, the control unit (6) compares the time (t) elapsed since the initiation of the thawing process with the predetermined thawing time (t_1) corresponding to the weight of the food to be thawed and when the time (t) elapsed reaches the thawing time (t_1), deactivates the heater (4) during the predetermined sterilization time (t_s) and activates the ultraviolet lamp (5). By means of the sterilization time (t_s), the ultraviolet light density to be applied is optimized and the ultraviolet lamp (5) is activated in a controlled manner. Thus, the growth of microorganism in the foods during the thawing process and the storing process after the thawing process is prevented and the color changes occurring due to exposition to ultraviolet rays for a long time are avoided. When the time required for the food to be almost completely thawed is completed, the heater (4) is deactivated and the ultraviolet lamp (5) is operated. Thus, the microorganisms growing on the food with the effect of the increased temperature are eliminated with the effect of ultraviolet rays and the food is provided to be consumed or stored safely.

[0026] In an embodiment of the present invention, the control unit (6) compares the time (t) elapsed since the initiation of the thawing process with the surface thawing time lower value (t_2) and the surface thawing time upper value (t_3) forming the time interval predetermined by the producer and whereat the thawing of the food surface starts, activates the ultraviolet lamp (5) and deactivates the heater (4) during the predetermined sterilization time (t_s) when the time (t) elapsed since the initiation of the thawing process reaches the surface thawing time lower value (t_2) and deactivates the ultraviolet lamp (5) and activates the heater (4) when the time (t) elapsed since the initiation of the thawing process reaches the surface thawing time upper value (t_3). Thus, the ultraviolet lamp (5) is

activated as soon as the surface thawing starts and thus the growth of bacteria and microorganisms caused by the thawing process is prevented. When the surface thawing is completed, the heater (4) is activated again and the food is provided to be completely thawed.

[0027] In an embodiment of the present invention, the refrigerator (1) comprises at least one valve (7) disposed on the thawing compartment (3) and that allows the flow of cold air into the thawing compartment (3). The heat transfer between the thawing compartment (3) and the fresh food compartment (2) or the freezing compartment is provided by means of the valve (7). The control unit (6) compares the time (t) elapsed since the initiation of the thawing process with the thawing time (t_1) predetermined by the user, corresponding to the weight of the food to be thawed and that is required for the food to be almost completely thawed, opens the valve (7) after the time elapsed (t) reaches the thawing time (t_1) and the thawing process is completed and closes the valve (7) when the temperature of the thawing compartment (3) reaches a predetermined thawed food storing temperature (T), for example - 2 ° C which is the appropriate minimum storing temperature for meat. Thus, the valve (7) operates only within certain control steps and the temperature of the thawing compartment (3) is kept within the values predetermined by the producer. The control unit (6) operates the ultraviolet lamp (5) during the predetermined sterilization time (t_s) when the valve (7) is changed from the open position to the closed position. Thus, the microbiological load of the air that fills into the thawing compartment (3) is reduced, the foods are prevented from being spoiled and the color and taste of the foods are prevented from changing. After the sterilization time (t_s) ends and the sterilization process is completed, the control unit (6) opens the valve (7) and thus provides the continuation of the cooling of the thawing compartment (3) in a controlled manner.

[0028] By means of the present invention, the ultraviolet lamp (5) that provides sterilization in the thawing compartment (3) is operated in a controlled manner. The ultraviolet radiation density is directly proportional with the radiation time and the radiation intensity in the fixed time period. While

sterilization effectiveness decreases at low radiation intensity, oxidation and color change can occur in foods at high radiation intensity. By means of the predetermined sterilization times (t_S), the ultraviolet light density is optimized and the ultraviolet lamp (5) is activated in a controlled manner. Thus, the growth of microorganism in the foods during the thawing process and the storing process after the thawing process is prevented and the color changes occurring due to exposition to ultraviolet rays for a long time are avoided.

Claims

1. A refrigerator (1) **comprising** at least one fresh food compartment (2) wherein foods to be cooled are placed, a thawing compartment (3) disposed in the fresh food compartment (2), wherein the frozen foods are placed for being stored without being spoiled during and after the thawing process and a heater (4) providing the heating of the thawing compartment (3), **characterized by** at least one ultraviolet lamp (5) disposed on the thawing compartment (3), providing sterilization during a predetermined sterilization time (t_s) and a control unit (6) providing the ultraviolet lamp (5) to be activated when the heater (4) is deactivated.
2. A refrigerator (1) as in Claim 1, **characterized by** the ultraviolet lamp (5) which is never operated simultaneously with the heater (4).
3. A refrigerator (1) as in Claim 1 or 2, **characterized by** the ultraviolet lamp (5) that emits ultraviolet rays with wavelengths between 240 nm and 280 nm.
4. A refrigerator (1) as in any one of the above claims, **characterized by** the control unit (6) that activates the ultraviolet lamp (5) and deactivates the heater (4) during the predetermined sterilization time (t_s) when the time (t) elapsed since the initiation of the thawing process reaches the thawing time (t_1).
5. A refrigerator (1) as in any one of the above claims, **characterized by** the control unit (6) that activates the ultraviolet lamp (5) and deactivates the heater (4) during the predetermined sterilization time when the time (t) elapsed since the initiation of the thawing process reaches the surface thawing time lower value (t_2), and deactivates the ultraviolet lamp (5) and activates the heater (4) when the time (t) elapsed since the initiation of the thawing process reaches the surface thawing time upper value (t_3).
6. A refrigerator (1) as in any one of the above claims, **comprising** at least one valve (7) disposed on the thawing compartment (3) and that allows the flow of cold air into the thawing compartment (3), **characterized by** the control unit (6) that activates the ultraviolet lamp (5) during the predetermined sterilization time (t_s) when the valve (7) is changed from the open position to the closed position.

Figure 1

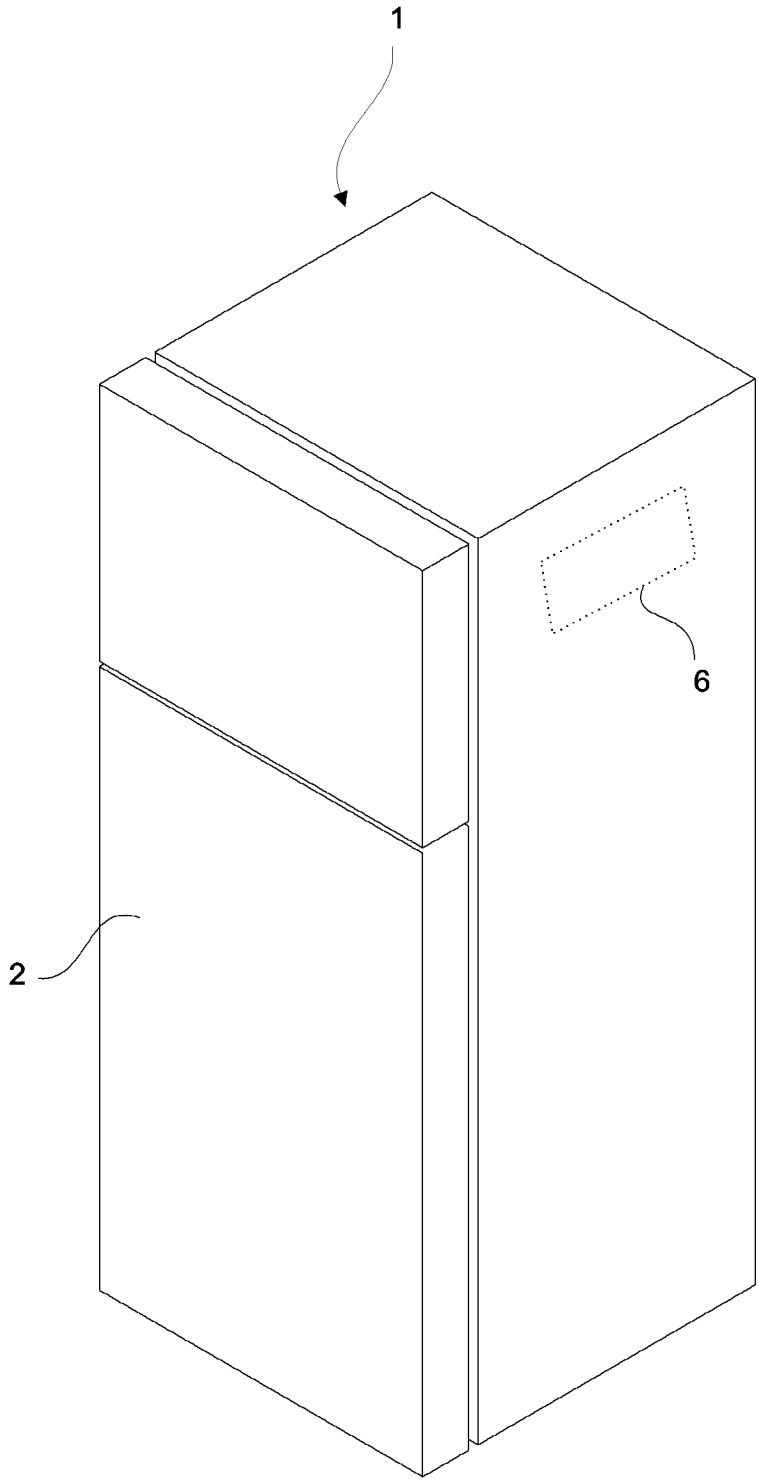

Figure 2