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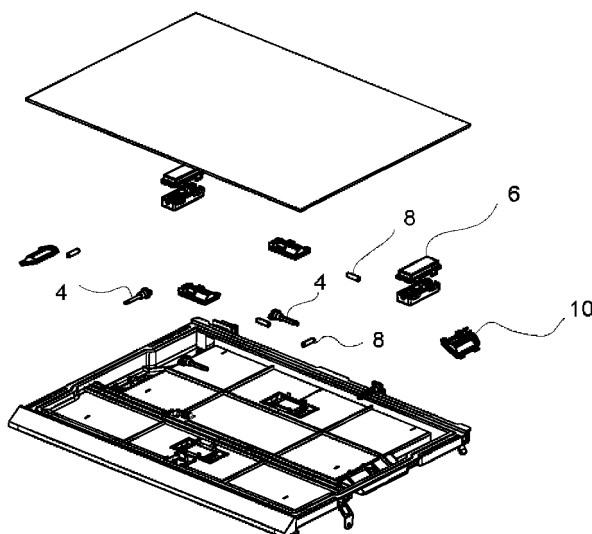
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(54) **A REFRIGERATOR DETECTING THE MALFUNCTION OF THE UV LIGHT SOURCE**

(57) The present invention relates to a refrigerator (1) comprising a body (2); a compartment (3) which is disposed in the body (2) and wherein the foodstuffs are placed; at least one UV light source (4) which is positioned so as to emit light into the compartment (3); and a control unit (7) which controls the operation of the UV light source (4), wherein the refrigerator further compris-

es a sensor (8) which detects at least one of the operational parameters of the UV light source (4), and a control unit (7) which compares the data received from the sensor (8) with the parameter values predetermined by the producer for the case where the UV light source (4) is not functioning so as to decide whether the UV light source (4) is functioning or not.

Figure 2



Description

[0001] The present invention relates to a refrigerator which detects whether the UV light source is functioning or not and which warns the user when the light source is not functioning.

[0002] There are many pathogenic microorganisms such as bacteria, viruses or harmful substances such as pesticide residues on the packaged foods, fruits and vegetables placed in the refrigerator. Especially when the packaged foods are placed in compartments without being cleaned, harmful microorganisms and substances on the packages directly threaten human health. Moreover, although vegetables and fruits are consumed after being washed, sometimes cleaning with water is not sufficient to remove bacteria and viruses.

[0003] In the state of the art, in order to provide the user with cleaner and safer foodstuffs, there are refrigerators comprising shelves or crispers with UV light sources.

[0004] The UV light sources disposed in the cooling device are operated only when the door of the cooling device is closed in order to prevent any risk to the health of the user. Thus, the user is prevented from being exposed to UV rays when the door of the cooling device is open. Therefore, the user cannot see whether the UV light is active or not and assumes that the UV light sources are activated each time the door of the cooling device is closed. In case the UV light sources malfunction due to any reason, the foodstuffs which are supposed to be disinfected in the compartment are not disinfected, and the refrigerator cannot carry out the disinfection function preferred by the user.

[0005] In the state of the art United States Patent Application No. US2012051030, a UV light source is disclosed, which is detachably attached to the refrigerator. The document also discloses a control box which adjusts the activation/deactivation and the operation time of said UV light source and which comprises a white light sensor detecting the operation of the UV light source.

[0006] The state of the art does not contain any refrigerator which detects the malfunction of the UV light source and which warns the user.

[0007] The aim of the present invention is the realization of a refrigerator which detects whether the UV light source is functioning or not and which informs the user of the operational status of the UV light sources.

[0008] The refrigerator of the present invention comprises a compartment wherein at least UV light source is disposed. The compartment can be a crisper, a shelf or a door shelf which is suitable for receiving the UV light source. The refrigerator of the present invention comprises a control unit which adjusts the operational conditions. At the regions of the refrigerator where the UV light sources are placed, at least one sensor is disposed, which measures the operational parameters of the UV light source, that is the temperature, the intensity or the ultraviolet wavelength. The data received from the sensor is

compared with the temperature, the intensity and/or the wavelength value of the UV light source predefined by the producer in the control unit for the case where the UV light source is not functioning. Thus, it is determined whether the UV light source is functioning or not.

[0009] In an embodiment of the present invention, the UV light source is a source which emits light at the UVC wavelength. The UVC light sources emit a light in the range of 160-280 nm.

[0010] In an embodiment of the present invention, the UV light source is a U-shaped fluorescent lamp or a flat fluorescent lamp.

[0011] In an embodiment of the present invention, the UV light source is placed into a holder such that the UV light source is easily mounted to the shelf or the compartment. In this embodiment, the sensor is positioned on the holder, in the vicinity of the UV light source.

[0012] In an embodiment of the present invention, the refrigerator comprises an inverter for the operation of the UV light sources. The inverter converts the power received from the control unit to a voltage value suitable for the operation of the UV light source so as to supply power to the UV light source. The inverter is disposed in a box. In this embodiment, a sensor which measures temperature is disposed in the box. Said sensor detects the temperature value of the inverter when the latter is in operation. The control unit compares said temperature value with the temperature value of the box predetermined by the producer for the case where the UV light source is not functioning. Thus, it is determined whether the UV light source is functioning or not.

[0013] In an embodiment of the present invention, the inverter energizes a plurality of UV light sources. In this embodiment, when at least one of the UV light sources malfunctions, the temperature value received from the sensor disposed in the box exceeds the temperature value predetermined by the producer for the case where no UV light source is functioning. The control unit compares the temperature data of the inverter for the operation of each UV light source with the data received from the sensor so as to calculate the number of nonfunctioning UV light sources.

[0014] In an embodiment of the present invention, the sensor can be connected in series or parallel so as to receive data from two UV light sources.

[0015] The refrigerator of the present invention conveys an error warning to the user via a display and/or mobile device by means of a wireless communication module when the malfunction of at least one UV light source is detected. The warning conveyed to the user can be audible and/or written. For example, a blue warning light may be lit on the display when the UV light sources are functioning, and a red one when the UV light source malfunctions.

[0016] In an embodiment of the present invention, the refrigerator conveys an error warning to the producer or the technical service units via the wireless communication module by means of a server when at least one UV

light source is detected to malfunction.

[0017] By means of the present invention, a refrigerator is realized, wherein the user can check whether the foodstuffs placed therein are disinfected or not.

[0018] The refrigerator realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 - is the perspective view of the refrigerator of the present invention.

Figure 2 - is an exploded view of the compartment wherein the UV light sources are disposed in an embodiment of the refrigerator of the present invention.

Figure 3 - is the exploded view of the box wherein the inverter is disposed in an embodiment of the refrigerator of the present invention.

[0019] The elements illustrated in the figures are numbered as follows:

1. Refrigerator
2. Body
3. Compartment
4. UV light source
5. Inverter
6. Box
7. Control unit
8. Sensor
9. Wireless communication module
10. Holder

[0020] The refrigerator (1) comprises a body (2); a compartment (3) which is disposed in the body (2) and wherein the foodstuffs are placed; at least one UV light source (4) which is positioned so as to emit light into the compartment (3); and a control unit (7) which controls the operation of the UV light source (4).

[0021] The refrigerator (1) of the present invention comprises a sensor (8) which detects at least one of the operational parameters of the UV light source (4), and a control unit (7) which compares the data received from the sensor (8) with the parameter values predetermined by the producer for the case where the UV light source (4) is not functioning so as to decide whether the UV light source (4) is functioning or not.

[0022] The sensor (8) disposed in the refrigerator (1) of the present invention detects the operational parameters of the UV light source (4). The control unit (7) contains the parameters predetermined by the producer for the case where the UV light source (4) is not functioning. Thus, the data received from the sensor (8) is compared with the parameters predetermined by the producer so as to determine whether the UV light source (4) is functioning or not.

[0023] In an embodiment of the present invention, the sensor (8) measures at least one of the operational parameters such as temperature, intensity, ultraviolet wavelength, etc. For example, the temperature in the

body (2) when the UV light source (4) is active is compared with the temperature data stored in the control unit (7) for the case where the UV light source (4) is not active so as to determine whether the UV light source (4) is functioning or not. Moreover, the intensity of the UV light source (4) and the ultraviolet wavelength of the UV light source (4) when the same is functioning can be compared with the data for the case where the UV light source (4) is not functioning for the t_0 time.

[0024] In an embodiment of the present invention, the refrigerator (1) comprises a holder (10) wherein the UV light source (4) is disposed, and at least one sensor (8) which is disposed on the holder (10). Thus, the sensor (8) is easily mounted in the vicinity of the UV light source (4) so as to detect the required operational parameters.

[0025] In an embodiment of the present invention, the refrigerator (1) comprises an inverter (5) which transmits power to the UV light source (4), a box (6) wherein the inverter (5) is disposed, and at least one sensor (8) which is disposed in the box (6) and which measures the temperature of the inverter (5). In said embodiment, an inverter (5) is required when the UV light source (4) is positioned in a compartment (3) away from the control unit (7). The inverter (5) is a voltage converter which energizes the UV light source (4). In this embodiment, the temperature value for the case where the inverter (5) is functioning so as to energize the UV light source (4) is compared with the temperature value predetermined by the producer for the case where the inverter (5) is not functioning. The difference between the two values enables the control unit (7) to determine whether the UV light source (4) is functioning or not.

[0026] In an embodiment of the present invention, the refrigerator (1) comprises a control unit (7) which compares the inverter (5) temperature measured by the sensor (8) when the inverter (5) supplies power simultaneously to at least two UV light sources (4) with the inverter (5) temperature predetermined by the producer for the case where all the UV light sources (4) are functioning, which makes a comparison by deducting the inverter (5) temperature value for the case where one UV light source (4) is functioning if the data received from the sensor (8) is lower than the inverter (5) temperature predetermined by the producer for the case where all the UV light sources (4) are functioning, and which repeats the last process in each step so as to detect the number of nonfunctioning UV light sources (4). In this embodiment, for example, if the inverter (5) energizes two UV light sources (4), the control unit (7) knows that the inverter (5) temperature is above 5°C in case both UV light sources (4) are active. If the data received from the sensor (8) is below 5°C, the control unit (7) compares the data received from the sensor (8) with the temperature value, for example 2°C, the inverter (5) temperature would reach if one UV light source (4) is active. For example, if the value measured by the sensor (8) is between 2°C and 5°C, it is determined that one UV light source (4) has malfunctioned, if said value is below 2°C, it is determined that both UV light

sources (4) have malfunctioned.

[0027] In an embodiment of the present invention, the refrigerator (1) comprises a wireless communication module (9) which informs the user that the UV light source (4) is not functioning via a display or a mobile device if it is determined that at least one UV light source (4) is not functioning. Thus, if the UV light sources (4) are not functioning, the user can take action to replace the same.

[0028] In an embodiment of the present invention, the refrigerator (1) comprises a wireless communication module (9) which informs the producer or the technical service unit that the UV light source (4) is not functioning via a server if it is determined that at least one UV light source (4) is not functioning. Thus, the producer or the technical service unit can be informed of the malfunction so as to make necessary repairs.

[0029] By means of the present invention, a refrigerator (1) is realized, comprising a UV light source (4) which can carry out the disinfection process without any interruption.

Claims

1. A refrigerator (1) comprising a body (2); a compartment (3) which is disposed in the body (2) and where-in the foodstuffs are placed; at least one UV light source (4) which is positioned so as to emit light into the compartment (3); and a control unit (7) which controls the operation of the UV light source (4), **characterized by** a sensor (8) which detects at least one of the operational parameters of the UV light source (4), and a control unit (7) which compares the data received from the sensor (8) with the parameter values predetermined by the producer for the case where the UV light source (4) is not functioning so as to decide whether the UV light source (4) is functioning or not.
2. A refrigerator (1) as in Claim 1, **characterized by** a sensor (8) which measures at least one of the operational parameters such as temperature, intensity, ultraviolet wavelength, etc.
3. A refrigerator (1) as in Claim 1 or 2, **characterized by** a holder (10) wherein the UV light source (4) is disposed, and at least one sensor (8) which is disposed on the holder (10).
4. A refrigerator (1) as in Claim 2, **characterized by** an inverter (5) which transmits power to the UV light source (4), a box (6) wherein the inverter (5) is disposed, and at least one sensor (8) which is disposed in the box (6) and which measures the temperature of the inverter (5).
5. A refrigerator (1) as in Claim 4, **characterized by** a control unit (7) which compares the inverter (5) tem-

perature measured by the sensor (8) when the inverter (5) supplies power simultaneously to at least two UV light sources (4) with the inverter (5) temperature predetermined by the producer for the case where all the UV light sources (4) are functioning, which makes a comparison by deducting the inverter (5) temperature value for the case where one UV light source (4) is functioning if the data received from the sensor (8) is lower than the inverter (5) temperature predetermined by the producer for the case where all the UV light sources (4) are functioning, and which repeats the last process in each step so as to detect the number of nonfunctioning UV light sources (4).

6. A refrigerator (1) as in any one of the above claims, **characterized by** a wireless communication module (9) which informs the user that the UV light source (4) is not functioning via a display or a mobile device if it is determined that at least one UV light source (4) is not functioning.
7. A refrigerator (1) as in any one of the above claims, **characterized by** a wireless communication module (9) which informs the producer or the technical service unit that the UV light source (4) is not functioning via a server if it is determined that at least one UV light source (4) is not functioning.

Figure 1

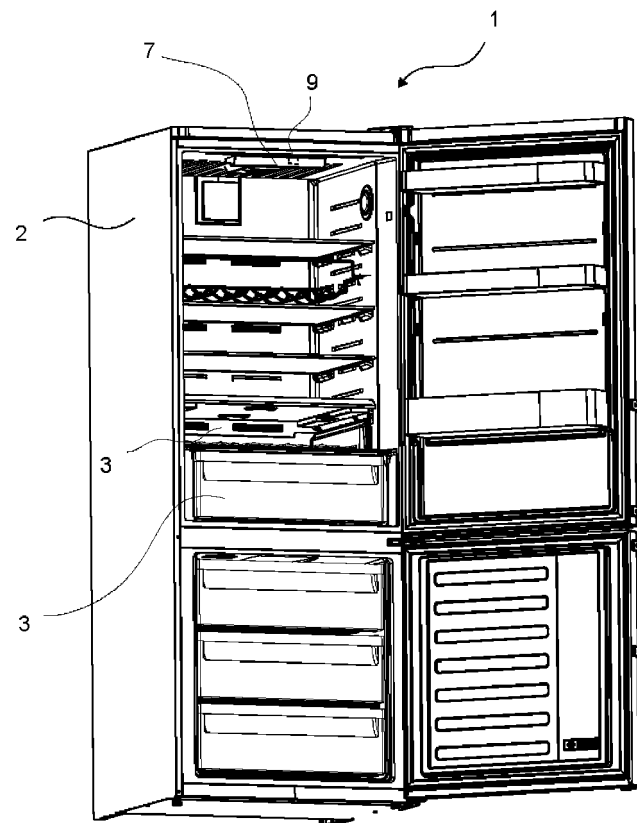


Figure 2

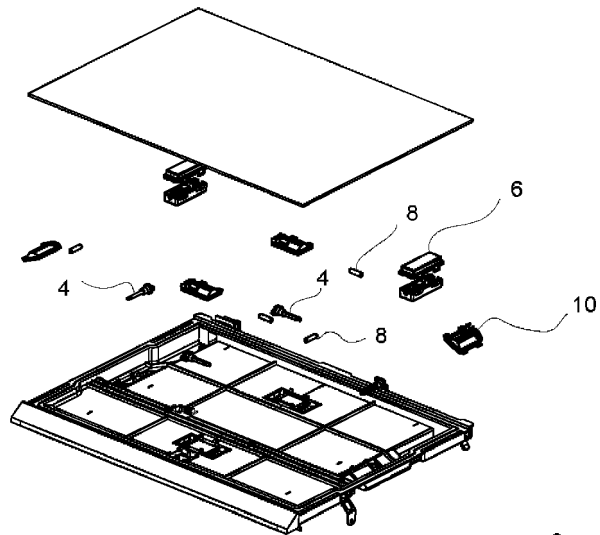
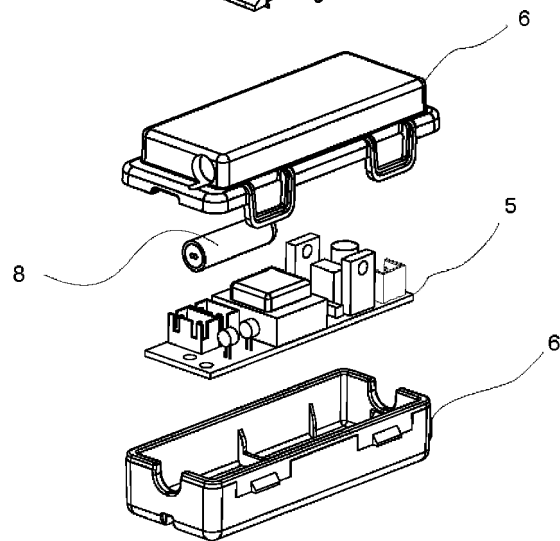


Figure 3





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 EP 21 17 6409

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