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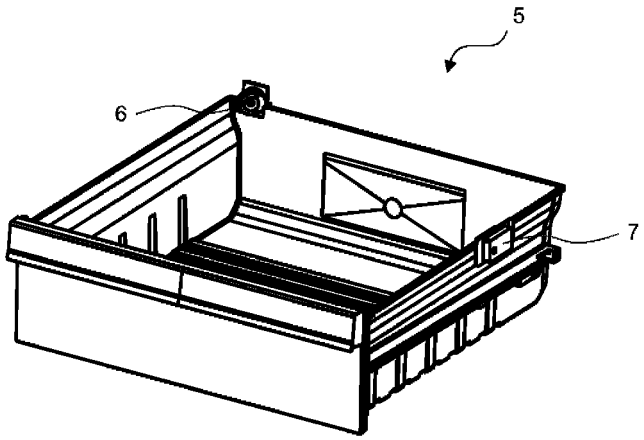
(54) A REFRIGERATOR COMPRISING A HUMIDIFIER

(57) The present invention relates to a refrigerator (1) comprising a body (2); a protective cover (3) which is disposed in the body (2); a water reservoir (4); a drawer (5) which is positioned under the protective cover (3) and which is used for loading fruits and vegetables; a steam generator (6) which is disposed in the drawer (5) and which converts the water delivered from the water reservoir (4) into steam to be delivered into the drawer (5) as steam; at least one ambient sensor (7) which is disposed in the drawer (5) so as to detect the temperature and/or humidity level; and a control unit (8) which is disposed in the body (2), which adjusts the humidity level and which has a memory.

Figure 2



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Description

[0001] The present invention relates to a refrigerator which performs the humidifying process to keep the foodstuffs in the crisper fresh.

[0002] It is a very important requirement that the foodstuffs placed into the crisper in the refrigerators are stored for a long time without losing their properties. The relative humidity of hot and humid vegetables loaded into the crisper from outside is considered as 100% due to their structure. When placed in the crisper having cold and relatively dry air, the foodstuffs start to lose moisture rapidly due to the temperature and vapor pressure difference between the outside temperature and steam pressure thereof and the temperature and steam pressure after being placed in the crisper. This continues until it is balanced. During the transition, sensors (RH-T) which measure relative humidity and temperature can be misleading. This is caused because in the measurements carried out after loading, the moisture lost by the loaded products is measured instead of the actual relative humidity of the crisper environment. During the transition and balancing, different types of humidification processes are required. In the state of the art, the crisper cover provides passive control for moisture conservation. However, due to the temperature difference of the newly loaded foodstuffs at ambient temperature, evaporative moisture loss is high until it cools down. Moreover, depending on the frequency of use of the crisper, the moisture loss of the vegetables during the opening and closing thereof is also notable. Since the humidity lost cannot be added to this area, this causes the foodstuffs in the crisper to lose liquid, to shrivel and lose freshness. In the state of the art, moisture is added from outside to compensate these moisture losses.

[0003] Moisture addition feature, which is generally performed by means of a water reservoir and an atomizer which function as a steam generator, can be applied from the surface or bottom of the water. Especially when moisture or steam generation is aimed by applying current from the surface of the water, the water particles passing through the metal plate holes turn into water vapor, and since it has sufficient speed, the need for a fan is eliminated. This type of atomizers can be arranged in the horizontal or vertical position. In this case, the atomizer is required to be located at the bottom of the water reservoir or the water should be transferred to the atomizer. In such designs, since the perforated atomizer is affected by the water pressure, leakage occurs in the holes of the metal plate. In case of an increase in this leakage, water accumulates in the crisper and the resulting water drops block the front of the atomizer. It is observed that this leakage occurs when the atomizer is not operating and when the system is not energized and does not occur when it is constantly energized. The amount of leaking water varies depending on the pressure proportional to the level of the water entering the atomizer. Therefore, performance decrease and cost increase occur in the humidification processes realized without calculating the absolute humidity of the foodstuffs in the crisper and without considering the water pressure coming from the water reservoir.

[0004] In the state of the art German Patent Application No. DE102013225716, a humidifier is disclosed, comprising a detachable water tank.

[0005] In the state of the art Chinese Patent Application No. CN108224879, a design is disclosed, wherein the humidifier applies cold vapor onto the crisper lid as the crisper lid is closed.

[0006] The aim of the present invention is to improve the water tightness at the region where steam is discharged in refrigerator drawers having a steam generator.

[0007] The refrigerator realized in order to attain the aim of the present invention, explicated in the claims, comprises a body; a protective cover which is disposed in the body; a water reservoir; a drawer which is positioned under the protective cover and which is used for loading fruits and vegetables; a steam generator which is disposed in the drawer and which converts the water delivered from the water reservoir into steam to be delivered into the drawer as steam; at least one ambient sensor which is disposed in the drawer so as to detect the temperature and/or humidity level; and a control unit which is disposed in the body, which adjusts the humidity level and which has a memory. The water directly or indirectly delivered from the water reservoir by means of preferably the atomizer disposed in the steam generator is separated into particles in the form of steam and distributed into the drawer used as a crisper such that the humidity level is increased. This arrangement is obtained by opening and closing the steam generator at certain intervals, and there are a number of parameters which trigger the steam generator such as opening/closing of the drawer especially thanks to the ambient sensor data being used by the control unit.

[0008] Moreover, the refrigerator comprises the steam generator which is positioned vertically in the body such that only one surface thereof is in contact with the water delivered from the water reservoir. One surface, having a preferably perforated grill, of the steam generator positioned vertically contacts the water horizontally. Depending on the amount of water delivered to the steam generator and the time of closure, a certain amount of pressure is applied towards the drawer. In order to ensure that the steam generator completes a predetermined target operation time and under the condition that the closure time is higher than the open time, the control unit carries out the algorithm of operating the steam generator in case the specific humidity calculated according to the data received from the ambient sensor after the target operation time ensuring the predetermined number of closing/opening is reached is within the lower and upper limits, and of operating the steam generator for a predetermined time if the steam generator is not operated for a predetermined time in case said specific humidity is

not with the lower and upper limits. Two separate operation phases are defined, and in the first phase, the steam generator is operated during the predetermined open and closure times, and the value received from the ambient sensor is not taken into consideration before the target time is completed. After the target time is completed, it is checked whether the specific humidity is within the determined range according to the data received from the ambient sensor, and the steps of delivering steam if it is within the range and of not delivering steam if it is not are carried out. Thus, independent of the different frequencies of drawer usage, the ideal level for the absolute humidity is obtained and the water pressure hitting the steam generator is decreased. In order to prevent condensation, the steam generator is enabled to be operated by being opened/closed such that the closure time is higher than the open time. Moreover, independent of the fullness level of the drawer, the control unit can regulate the humidity level without any leaks and condensation in the steam generator. All these technical advantages are provided only by carrying out an algorithm without requiring any additional component or cost.

[0009] In an embodiment of the present invention, the refrigerator comprises the control unit which resets the target operation time if the drawer is opened before reaching the target operation time. Thus, independent of whether the user uses the drawer, the algorithm performed by the control unit can continuously carry out the humidification process.

[0010] In an embodiment of the present invention, the refrigerator comprises a water delivery channel which transfers water from the water reservoir to the steam generator, and a water level sensor which is disposed in the water delivery channel. The water delivery channel connects the water reservoir to the steam generator. By means of the water level sensor disposed in the water delivery channel, the water pressure acting on the steam generator can be actively measured, and the control unit can process this data.

[0011] In an embodiment of the present invention, the refrigerator comprises a control unit which ensures that the steam generator is kept closed and open for predetermined time according to the data received from the water level sensor in case the specific humidity is not within the lower and upper limits. Since the formation of water drops which causes leaks in the steam generator depends on pressure, the closure time is calculated according to this assessment. Thus, by detecting the humidity values outside the lower and upper limits determined by the control unit, any possibility of leak formation is very quickly avoided, and the pressure is prevented by delivering steam into the drawer.

[0012] In an embodiment of the present invention, the refrigerator comprises a valve which is positioned between the water reservoir and the steam generator at the same level as the steam generator with respect to the base of the drawer, and which is activated as the steam generator is operated. Said component, which is preferably a solenoid valve, is activated only when the atomizer is operated. Thus, excess water is prevented from being delivered to the atomizer. Consequently, the water pressure is prevented from affecting the atomizer and the pressure is minimized.

[0013] In an embodiment of the present invention, the refrigerator comprises a control unit which enables the steam generator to be operated intermittently during the time determined according to the data received from the water level sensor where the water remaining between the valve and the steam generator is converted to steam by means of the steam generator. Thus, by converting all or some of the water between the valve and the steam generator after the valve is closed into mist, the water pressure acting on the atomizer is decreased or eliminated.

[0014] A 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.
Figure 2 - is the perspective view of the drawer.
Figure 3 - is the top view of the drawer.
Figure 4 - is the sideways cross-sectional view of the drawer.

[0015] The elements illustrated in the figures are numbered as follows:

1. Refrigerator
2. Body
3. Protective cover
4. Water reservoir
5. Drawer
6. Steam generator
7. Ambient sensor
8. Control unit
9. Water delivery channel
10. Water level sensor
11. Valve

[0016] The refrigerator (1) comprises a body (2); a protective cover (3) which is disposed in the body (2); a water reservoir (4); a drawer (5) which is positioned under the protective cover (3) and which is used for loading fruits and vegetables; a steam generator (6) which is disposed in the drawer (5) and which converts the water delivered from the water reservoir (4) into steam to be delivered into the drawer (5) as steam; at least one ambient sensor (7) which is disposed in the drawer (5) so as to detect the temperature and/or humidity level; and a control unit (8) which is disposed in the body (2), which adjusts the humidity level and which has a memory. The water directly or indirectly delivered from the water reservoir (4) by hitting preferably the atomizer disposed in the steam generator (6) is separated into particles in the form of steam and distributed into the drawer (5) used as a crisper such that the humidity level is increased. This arrange-

ment is obtained by opening and closing the steam generator (6) at certain intervals, and there are a number of parameters which trigger the steam generator (6) such as opening/closing of the drawer (5) especially thanks to the ambient sensor (7) data being used by the control unit (8).

[0017] Moreover, the refrigerator (1) comprises the steam generator (6) which is positioned vertically in the body (2) such that only one surface thereof is in contact with the water delivered from the water reservoir (4). One surface, having a preferably perforated grill, of the steam generator (6) positioned vertically contacts the water horizontally. Said region is also defined as the region where the atomizer contacts the water. Depending on the amount of water delivered to the steam generator (6) and the closure time of the steam generator (6), a certain amount of pressure is applied by the water towards the drawer (5). In the algorithm, separate processing steps for precooling after loading into the drawer (5) and the case where the humidity is balanced are performed. In the first phase, the control unit (8) ensures that the steam generator (6) is closed/opened for a predetermined number of times so as to complete a predetermined target operation time under the condition that the closure time is higher than the open time. This phase is designed as precooling and it is aimed to reach the balance in terms of humidity and temperature. During a kind of duty cycle, the open-close commands given for the steam generator (6) continue without taking any ambient sensor (7) data into account. For example, a 30-minute cycle, where the steam generator (6) is closed for 5 minutes and operated for 30 seconds, is defined, and the interior of the drawer (5) gets close to the specific humidity-temperature levels. In order to prevent any condensation problem by continuously delivering steam into the drawer (5), the closure time is defined as higher than the open time. The control unit (8) ensures that the steam generator (6) is operated in case the specific humidity calculated according to the data received from the ambient sensor (7) is within the lower and upper limits after the target time is completed, and ensures that the steam generator (6) is operated for a predetermined time if the steam generator (6) is not operated for a predetermined time in case said specific humidity is not with the lower and upper limits. For example, when cold steam is not delivered into the drawer (5) for more than 10 minutes, cold water steam is delivered for 40 seconds, and the water applying pressure to the steam generator (6) is prevented from forming droplets. Two separate operation phases are defined, and in the first phase, the steam generator (6) is operated during the predetermined open and closure times, and the value received from the ambient sensor (7) is not taken into consideration before the target time is completed. After said precooling time and the target time are completed, it is checked whether the specific humidity is within the determined range according to the data received from the ambient sensor (7), and the steps of delivering steam if it is within the range and of not delivering steam if it is not within the range are carried out. Thus, independent of the different frequencies of drawer (5) usage, the ideal level for the absolute humidity is obtained and the water pressure hitting the steam generator (6) is decreased. In order to prevent possible condensation in the drawer (5), the steam generator (6) is enabled to be operated in a open/close cycle where the closure time is preferably significantly, for example 10 times, higher than the open time. Moreover, independent of the fullness level of the drawer (5), the control unit (8) can regulate the humidity level without any leaks and condensation in the steam generator (6). All these technical advantages are provided only by carrying out an algorithm without requiring any additional component or cost.

[0018] In an embodiment of the present invention, the refrigerator (1) comprises the control unit (8) which resets the target operation time if the drawer (5) is opened before reaching the target operation time. By resetting the memory of the control unit (8), in case of any user invention, the precooling phase is restarted, and the ambient sensor (7) data is taken into account at a delayed time. Thus, independent of whether the user uses the drawer (5), the algorithm performed by the control unit (8) can continuously carry out the humidification process.

[0019] In an embodiment of the present invention, the refrigerator (1) comprises a water delivery channel (9) which transfers water from the water reservoir (4) to the steam generator (6), and a water level sensor (10) which is disposed in the water delivery channel (9). The water delivery channel (9) connects the water reservoir (4) to the steam generator (6), and partially determines the pressure applied by the water onto the atomizer. By means of the water level sensor (10) disposed in the water delivery channel (9), the water pressure acting on the steam generator (6) can be actively measured, and the control unit (8) can process this data.

[0020] In an embodiment of the present invention, the refrigerator (1) comprises a control unit (8) which ensures that the steam generator (6) is kept closed and open for predetermined time according to the data received from the water level sensor (10) in case the specific humidity is not within the lower and upper limits. Since the formation of water drops which causes leaks in the steam generator (6) depends on pressure, the closure time is calculated according to this assessment. Since the amount of drops formed decreases as the water level decreases, the closure time increases or the open time is reduced while the closure time remains constant. By detecting the humidity values outside the lower and upper limits determined by the control unit (8), any possibility of leak formation is very quickly avoided, and the unwanted pressure is prevented by delivering steam into the drawer (5).

[0021] In an embodiment of the present invention, the refrigerator (1) comprises a valve (11) which is positioned between the water reservoir (4) and the steam generator (6) at the same level as the steam generator (6) with respect to the base of the drawer (5), and which is activated as the steam generator (6) is operated. Said com-

ponent, which is preferably a solenoid valve, is activated only when the atomizer is operated. The vertical distance between the atomizer and the valve (11) is limited within the range of 0-100 mm, and thus, excess water is prevented from being delivered onto the atomizer due to decreasing pressure. In other words, the water pressure is prevented from affecting the atomizer and the pressure is minimized.

[0022] In an embodiment of the present invention, the refrigerator (1) comprises a control unit (8) which enables the steam generator (6) to be operated intermittently during the time determined according to the data received from the water level sensor (10) where the water remaining between the valve (11) and the steam generator (6) is converted to steam by means of the steam generator (6). Thus, by converting all or some of the water between the valve (11) and the steam generator (6) after the valve (11) is closed into mist, the water pressure acting on the atomizer is decreased or eliminated. The control unit (8) calculates the time of converting the water remaining between the solenoid valve (11) and the atomizer into mist. This time approximately represents the time difference to be applied between the operation of the atomizer and the operation of the valve (11). By converting all or some of the water between the valve (11) and the atomizer after the valve (11) is closed into mist, the water pressure acting on the atomizer is decreased or eliminated.

[0023] In the refrigerator (1) of the present invention, the water tightness problem of the steam generators (6) disposed in the drawer (5) is eliminated without using any additional component or cost, and the user satisfaction for all the steam generators (6) positioned vertically is increased.

Claims

1. A refrigerator (1) comprising a body (2); a protective cover (3) which is disposed in the body (2); a water reservoir (4); a drawer (5) which is positioned under the protective cover (3) and which is used for loading fruits and vegetables; a steam generator (6) which is disposed in the drawer (5) and which converts the water delivered from the water reservoir (4) into steam to be delivered into the drawer (5) as steam; at least one ambient sensor (7) which is disposed in the drawer (5) so as to detect the temperature and/or humidity level; and a control unit (8) which is disposed in the body (2), which adjusts the humidity level and which has a memory, **characterized by** the steam generator (6) which is positioned such that only one surface thereof is in contact with the water delivered from the water reservoir (4), and
   a control unit (8) which ensures that

   - the steam generator (6) is closed/opened for a predetermined number of times so as to complete a predetermined target operation time under the condition that the closure time is higher than the open time,
   - the steam generator (6) is operated in case the specific humidity calculated according to the data received from the ambient sensor (7) is within the lower and upper limits after the target operation time is completed, and
   - the steam generator (6) is operated for a predetermined time if the steam generator (6) is not operated for a predetermined time in case said specific humidity is not with the lower and upper limits.

2. A refrigerator (1) as in Claim 1, **characterized by** the control unit (8) which resets the target operation time if the drawer (5) is opened before reaching the target operation time.

3. A refrigerator (1) as in Claim 1 or 2, **characterized by** a water delivery channel (9) which transfers water from the water reservoir (4) to the steam generator (6), and a water level sensor (10) which is disposed in the water delivery channel (9).

4. A refrigerator (1) as in Claim 3, **characterized by** a control unit (8) which ensures that the steam generator (6) is kept closed and open for predetermined time according to the data received from the water level sensor (10) in case the specific humidity is not within the lower and upper limits.

5. A refrigerator (1) as in any one of the above claims, **characterized by** a valve (11) which is positioned between the water reservoir (4) and the steam generator (6) at the same level as the steam generator (6) with respect to the base of the drawer (5), and which is activated as the steam generator (6) is operated.

6. A refrigerator (1) as in Claim 5, **characterized by** a control unit (8) which enables the steam generator (6) to be operated intermittently during the time determined according to the data received from the water level sensor (10) where the water remaining between the valve (11) and the steam generator (6) is converted to steam by means of the steam generator (6).

Figure 1

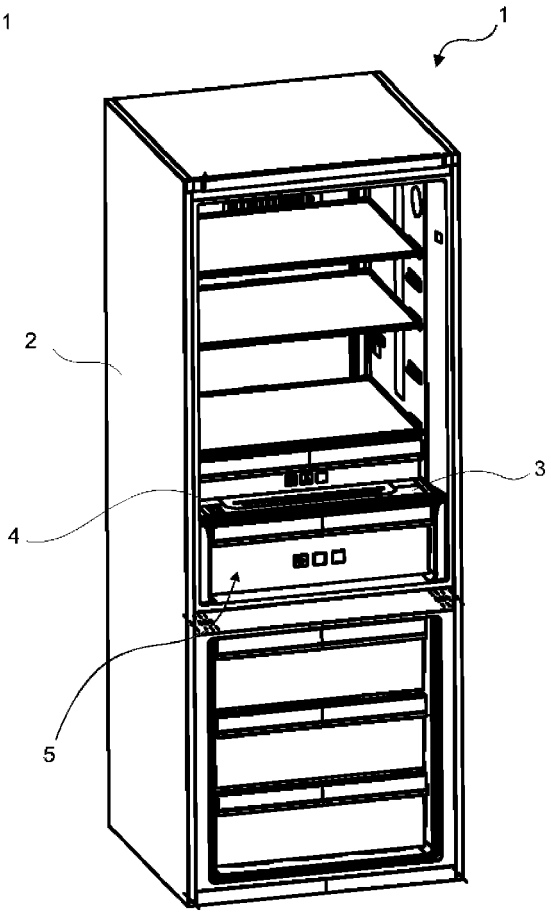


Figure 2

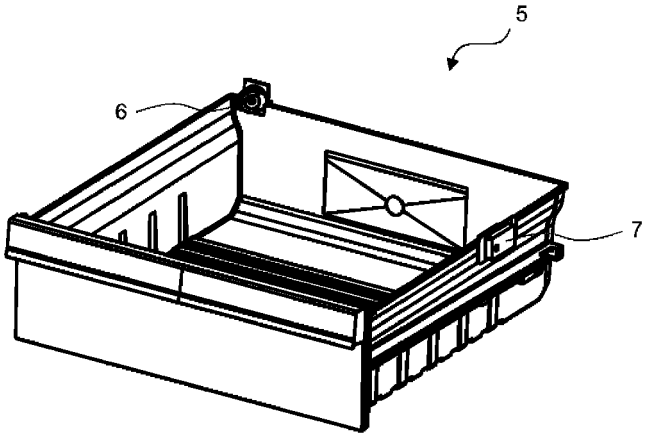


Figure 3

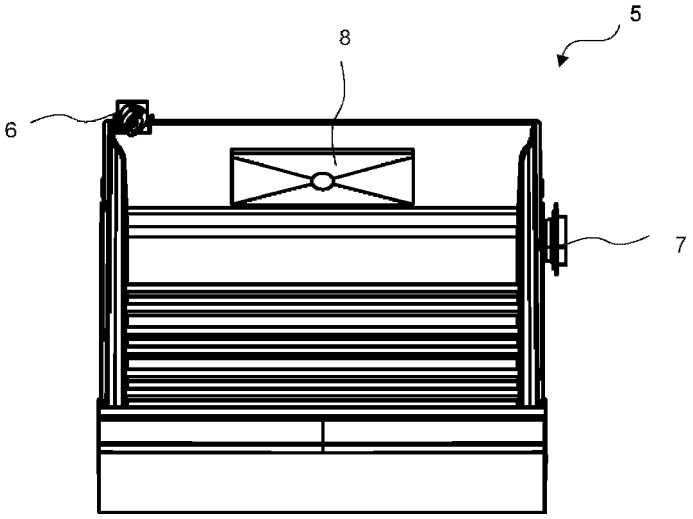
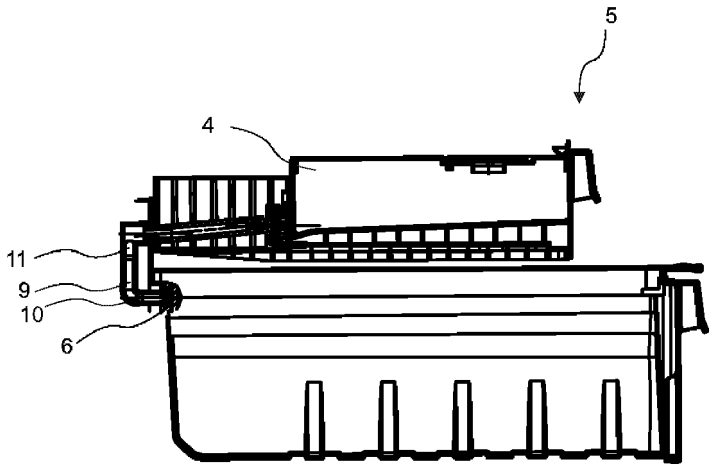


Figure 4



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EUROPEAN SEARCH REPORT

Application Number
EP 22 16 5722

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 September 2022	Dezso, Gabor

CATEGORY OF CITED DOCUMENTS

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