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(2) and other part (6, 7) is on the edge (5) of the frame (3) which are in the mechanical coupling for closing or opening of the door (2). At least one of the first part (6) or the second part (7) is having a flexible reservoir (10), and adapted to house water either in solid state or liquid state, the system (1) further comprising a heating and cooling mechanism (11) adapted to be in heat exchange coupling with the water inside the flexible reservoir (10) and adapted to change water into solid state to liquid state, or liquid state to solid state, wherein when the door (2) is to be opened, the heating and cooling mechanism (11) heats the water to change from solid state to liquid state, and when the door (2) is to be closed, the heating and cooling mechanism (11) converts water from liquid state to solid state.



Description

[0001] This invention refers to a door opening and closing system according to claim 1, and a refrigerator comprising the door opening and closing system according to the claim 13.

Background of the Invention

[0002] Available door opening and closing structures are having various mechanical components, which during the course of time deteriorate due to wear and tear. This leads to a reduction in efficiency of closing and locking of the door. Sometimes, these doors locking becomes unreliable to the level such that either they shall not lock at all, or if once locked than it gets difficult to open them. Further, the doors of electronics goods like washing machines or refrigerators normally have frame rubber seals for preventing water or air leakage. This mechanical construction has a life time which is related with door on-off number. Because, all door on-off causes damages on the frame rubber seals and mechanical hinges, this causes air or water leakage after some time and performance of these machines decreases.

[0003] PCT Patent Publication No. WO9511362 discloses an opening/closing device for use in a door member, such as a refrigerator or a microwave oven is able to be opened at either desired side thereof. The opening/closing device comprising at least a pair of hinge pins and a main body with which the door is assembled. The cover section of the main body has pin guide grooves for receiving the corresponding hinge pins. A pair of latch members are enclosed in the main body, apart from each other and connected to pivot cams. The pivot cams are pivotally fixed at pivot shafts with the bottom surface. This pivot cams have pin retaining grooves to receive and retain the hinge pins when the door is closed.

[0004] US Patent Publication No. US5530992 discloses a hinge for use along each side of a refrigerator or on furniture to permit safe opening of the door or lid from either side. Each hinge includes a hinge rod forming a swivel axis for the door, said rod held in an axle take-up receiver. At least one and preferably two interlocks are located at or near the top and bottom of each hinge rod. The interlocks comprise a hinge pick-up axially aligned with the swivel axis of the hinge and a hinge element which becomes mechanically coupled to the pick-up when the door is opened in the other direction. Magnetic means are used to keep the hinge rod engaged with the swivel axis and to form the airtight seal between the door and the cabinet.

[0005] The above-said prior arts are having magnetic sealing elements and complex mechanical structure, which still have the same problem of wear and tear of mechanical structure on long run which reduces efficiency of closing and locking the door.

Object of the Invention

[0006] It is therefore the object of the present invention is to provide a door opening and closing mechanism which is having minimal or no mechanical components for opening or closing the door to a frame.

Description of the Invention

[0007] The before mentioned object is solved by a door opening and closing system according to claim 1, and a refrigerator comprising the door opening and closing system according to claim 13.

[0008] A door opening and closing system having a door and a frame, such that one of the edge of the door is in mechanical coupling to one of the edge of the frame for closing or opening of the door, the door closing and opening comprises an arrangement of a first part and a second part, the first part is having a cavity, and the second part is having a complimentary structure with respect to the cavity, such that the complimentary structure is adapted to make a fitting into the cavity of the first part when the second part is mechanically coupled to the first part to close the door, and wherein the complimentary structure is adapted to release from the fitting to open the door, wherein one of the parts is placed on the edge of the door and other part is on edge of the frame which are in the mechanical coupling for closing or opening of the door. At least one of the first part or the second part is having a flexible reservoir, and adapted to house a liquid solution, in particular water, either in solid state or liquid state, the system further comprising a heating and cooling mechanism adapted to be in heat exchange coupling with the water inside the flexible reservoir and adapted to change water into solid state to liquid state, or liquid state to solid state, wherein when the door is to be opened, the heating and cooling mechanism heats the water to change from solid state to liquid state, and when the door is to be closed, the heating and cooling mechanism converts water from liquid state to solid state.

[0009] This provides a mechanism for opening and closing of door with minimum mechanical components, and making the closing and opening of door less complex and long lasting.

[0010] Further preferred embodiments are subject-matter of dependent claims and/or of the following specification parts. It is understood that the liquid solution can be water or another similar liquid, which can be used for all embodiments of the invention.

[0011] According to a preferred embodiment of the system, the heating and cooling mechanism comprising an evaporator pipe adapted to be in heat exchange coupling with the liquid solution, in particular water, inside the flexible reservoir, such that the evaporator pipe is adapted to receive heat from the water, and adapted to change water from liquid state to solid state.

[0012] This embodiment is beneficial as it provides for a simple mechanism to convert state of water from liquid

state to solid state.

[0013] According to a further preferred embodiment of the system, the evaporator pipe is passing through the flexible reservoir to be in direct contact to the water within the flexible reservoir.

[0014] This embodiment is helpful, as it provides for simple implimentation of heat exchange coupling of the evaporator pipe with the water of the flexible reservoir.

[0015] According to a further embodiment of the system, the heating and cooling mechanism comprising a heater pipe adapted to be in heat exchange coupling with the water inside the flexible reservoir, such that the evaporator pipe is adapted to provide heat to the water, and adapted to change water from solid state to liquid state.

[0016] This embodiment is beneficial as it provides for a simple mechanism to convert state of water from solid state to liquid state.

[0017] According to another embodiment of the system, the heater pipe is passing through the flexible reservoir to be in direct contact to the water within the flexible reservoir.

[0018] This embodiment is helpful, as it provides for simple implimentation of heat exchange coupling of the heater pipe with the water of the flexible reservoir.

[0019] According to a further embodiment of the system, the flexible reservoir is comprised in the second part.

[0020] This embodiment is beneficial, as it provides a simple implementation of the opening and closing system with a flexible and strengthened structure for second part.

[0021] According to an embodiment of the system, the system comprises one first part and one second part, such that the second part is adapted to be in form of alphabetic character "P" when the water inside the flexible reservoir converts into solid state, and the first part is arranged to be inserted into the protruding part of the alphabetic character "P" shaped second part for closing the door.

[0022] This embodiment is beneficial, as it provides for simple implementation of opening and closing system, however providing strengthened locking when the door is closed due to change of state of water into solid state, and ease of opening the door when the door is unlocked due to change of state of water into the liquid state.

[0023] According to a further embodiment of the system, the system comprises two first part and one second part, such that second part is adapted to be in form of alphabetic character "T" when the water inside the flexible part converts into solid state, and the first parts are arranged to be inserted into the protruding part of the alphabetic character "T" shaped second part for closing the door.

[0024] This embodiment is beneficial, as it provides for further strengthening of the locking of the door when the door is closed.

[0025] According to a further preferred embodiment of the system, the system comprising a user input module adapted to receive user input for opening of the door, a microcontroller adapted to receive the user input from

the user input module, to process the user input to generate a heat control signal, and a heater adapted to receive the heat control signal and adapted to heat the heater pipe, wherein the heater pipe heats the water inside the flexible reservoir to change water from solid state to liquid state.

[0026] This embodiment is beneficial, as it provides for an automated and controlled mechanism for opening and closing of the door.

[0027] According to another embodiment of the system, the microcontroller is adapted to recognize closing of the door, and accordingly generate a cooling signal, the system comprising a cooling unit adapted to receive the cooling signal and cools the evaporator pipe, wherein the evaporator pipe cools the water inside the flexible reservoir to change water from liquid state to solid state.

[0028] This embodiment is beneficial, as it provides for inbuilt cooling unit for selfsustained functioning of the door opening and closing system, and as well as provides for automated and controlled mechanism for opening and closing the door.

[0029] According to a further embodiment of the system, multiple arrangements of the first part and the second part are provided along the edges of the door and the frame, and the user input module is adapted to receive the user input with respect to opening of the door from either of the edges having arrangements of the first part and the second part, the microcontroller adapted to receive the user input from the user input module, to process the user input to generate the heat control signal, and the heater is adapted to receive the heat control signal and adapted to heat the heater pipe which is coupled to flexible reservoir of the one or more arrangements of first part and the second part placed on the edge of the door and the frame for which the user input for opening the edge of the door is received.

[0030] This embodiment is beneficial, as it provides for a system for opening and closing of the door from more than one edges of the door.

[0031] According to another embodiment of the system, the user input module comprises a touch based sensor which is adapted to sense touch of a user and adapted to generate the user input.

[0032] This embodiment is beneficial, as it provides for a user-friendly implementation of user input module.

[0033] The before mentioned object is also solved by a refrigerator of claim 13. The refrigerator comprising the door closing and opening system according to the claim 1 to 12, wherein the frame is part of the body of the refrigerator.

[0034] This embodiment is beneficial, as it provides for door closing and opening system in the refrigerator.

[0035] According to a further preferred embodiment of the refrigerator, the first part is affixed to the door of the refrigerator, and the second part is affixed to the body of the refrigerator.

[0036] This embodiment is beneficial, as it provides for a convenient implementation of the door opening and

closing system for the refrigerator.

[0037] According to a further embodiment of the refrigerator, the cooling unit is the compressor of the refrigerator.

[0038] This embodiment is beneficial, as it provides for self-sustained cooling unit, and there is no requirement for any external cooling unit for changing state of water to solid state inside the flexible reservoir, rather compressor of the refrigerator provides the effect for cooling unit.

[0039] Further benefits, goals and features of the present invention will be described by the following specification of the attached figures, in which components of the invention are exemplarily illustrated. Components of the devices and method according to the inventions, which match at least essentially with respect to their function, can be marked with the same reference sign, wherein such components do not have to be marked or described in all figures.

[0040] The invention is just exemplarily described with respect to the attached figure in the following.

Brief Description of the Drawings

[0041]

Fig. 1 illustrates a schematic diagram of a system for closing and opening door according to one embodiment of the invention.

Fig. 2a illustrates a system having second part comprising the water reservoir and is in the shape of an alphabetic character "T" when the water inside the reservoir in solid state.

Fig 2b illustrates the system having second part comprising the water reservoir and is in the shape of an alphabetic character "I" when the water inside the reservoir in liquid state.

Fig. 3a illustrates a system having second part comprising the water reservoir and is in the shape of an alphabetic character "P" when the water inside the reservoir in solid state.

Fig 3b illustrates the system having second part comprising the water reservoir and is in the shape of an alphabetic character "I" when the water inside the reservoir in liquid state.

Detailed Description of the Drawings

[0042] Current invention focuses on providing a door, which can be closed and locked with minimal mechanical elements involved, thus helping in reduction of mechanical wear and tear which occurs while closing and opening of the door. This invention further has implementation in white goods like refrigerators, washing machines, dishwashers etc. These white goods use the door closing

and opening system, but are not limited thereto, however, the door closing and opening system can be used for any products or goods which can provide an ecosystem which can maintain fast change of state of water from solid state to liquid state and vice-versa.

[0043] Fig. 1 illustrates a schematic representation of a door opening and closing system 1. The system 1 is implemented onto a door and a frame. The frame can be part of an opening into the house, or part of a body or housing for providing access to a device or its parts. The door and frame are functionally coupled to provide the closure of an access due to a mechanical coupling between an edge of the door and an edge of the frame. Generally, the door is mechanically coupled to the frame in two ways, i.e., at one of the edge the door and the frame are hinged, so that the door can rotate around the edge of the frame, and at other edge the door is mechanically coupled to the other edge of the frame for closing the door. The edges of door and frame involved for closing the door are generally at opposite edges of the door and the frame coupled for rotating the door.

[0044] The system 1 includes an arrangement of a first part 6 and a second part 7 which are enabled to effectuate both the mechanical coupling as mentioned above, i.e., the hinging of the door to the frame, and closing of the door to the frame. The first part 6 is having a cavity and the second part 7 is having a complimentary structure 9, which compliments the cavity 8, so that a fitting can be made for closing and locking the door. Also, the complimentary structure 9 compliments the cavity 8 for opening of the door.

[0045] To provide the complimentary structure 9 to the second part 7, the second part 7 is provided with a flexible reservoir 10. The flexible reservoir 10 have water filled inside which converts into solid state for expanding the flexible reservoir 10 and into the liquid state for bringing the flexible reservoir 10 to its normal and non-expanded state. Also, when the water changes to solid state, it hardens, and which further hardens the flexible reservoir 10. When the flexible reservoir 10 expands, it forms a complimentary structure 9 which are protrusions and which fits into the cavity 8. Also, as on expansion, the flexible reservoir 10 hardens, it strengthens the fitting of the complimentary structure 9 into the cavity 8 and further strengthens the locking and closing of the door. When the flexible reservoir 10 is in non-expanded state, the complimentary structure 9 loses its protrusions and then there is no fitting between cavity 8 and the complimentary structure 9. For a strengthened mechanical coupling between the first part 6, and the second part 7, the first part 6 is made of a solid material, which generally do not change its state easily.

[0046] In an alternate embodiment, the flexible reservoir 10 is comprised in the first part 6. The second part 7 in such case is made of a solid material and the complimentary structure 9 has a protrusion which do not change. The reduction in size of the cavity 8 makes a strong grip onto the protrusion and provides an efficient

locking and closing of the door to the frame. When the water inside the flexible reservoir 10 converts into a liquid state, the flexible reservoir 10 moves into non-expanded state, and the size of the cavity 8 increase which loses the grip onto the protrusion of the complimentary structure 9 which further facilitates in opening of the door.

[0047] For facilitating the change of state of water, a heating and cooling mechanism 11 is provided which is in heat exchange coupling with the water inside the flexible reservoir 10 and changes water into solid state to liquid state, or liquid state to solid state. When the door is to be opened, the heating and cooling mechanism 11 heats the water to change from solid state to liquid state, and when the door is to be closed, the heating and cooling mechanism 11 converts water from liquid state to solid state.

[0048] The heating and cooling mechanism 11 includes an evaporator pipe 12 which is in heat exchange coupling with the water inside the flexible reservoir 10. The evaporator pipe 12 has a cool fluid running through the pipe. The cool fluid inside the evaporator pipe 12 receives heat from the water, and change water from liquid state to solid state. In an alternate embodiment, the evaporator pipe 12 is not required, rather any other cooling mechanism can be used which can quickly change the water inside the flexible reservoir 10 into the solid state.

[0049] In one embodiment, the evaporator pipe 12 is passing through the flexible reservoir 10 to be in direct contact to the water within the flexible reservoir 10. This increases efficiency of heat transfer from water inside the reservoir to the evaporator pipe 12. In yet another embodiment, a surface of the evaporator pipe 12 is in physical contact to a surface of the flexible reservoir 10 for heat transfer, and not in direct contact with water inside the flexible reservoir 10. For this embodiment, the flexible reservoir 10 should be made of a good heat conductor. Also, for still better efficiency, the flexible reservoir 10 and the evaporator pipe 12 shall be so arranged that large part of their surface area is in physical contact to each other.

[0050] The heating and cooling mechanism 11 includes a heater pipe 13 which is in heat exchange coupling with the water inside the flexible reservoir 10. The heater pipe 13 has a hot fluid running through the heater pipe 13. The hot fluid inside the heater pipe 13 transfers heat to the water which is in solid state, and change water from solid state to liquid state. In an alternate embodiment, the heater pipe 13 is not required, rather any other heating mechanism can be used which can quickly change the water inside the flexible reservoir 10 into the liquid state.

[0051] In another embodiment, the heater pipe 13 is passing through the flexible reservoir 10 to be in direct contact to the water within the flexible reservoir 10. This increases efficiency of heat transfer from the heater pipe 13 to the water inside the flexible reservoir 10. In yet another embodiment, a surface of the heater pipe 13 is

in physical contact to a surface of the flexible reservoir 10 for heat transfer, and not in direct contact to the water inside the flexible reservoir 10. For this embodiment, the flexible reservoir 10 should be made of a good heat conductor. Also, for a better efficiency, the flexible reservoir 10 and the heater pipe 10 shall be so arranged that large part of their surface area is in physical contact to each other.

[0052] The system 1 includes a user input module 15 which receives user input 16 for opening of the door 2 from a user, a microcontroller 17 which receives the user input 16 from the user input module 15 and processes the user input 16 to generate a heat control signal 18. The system 1 also includes a heater 19 which receives the heat control signal 18 and heats the heater pipe 13. The heater pipe 13 heats the water inside the flexible reservoir 10 to change water from solid state to liquid state. In one embodiment, the automated mechanism for heating the heater pipe 13 is not required, rather a user can manually activate heating of the heater pipe 13. In one embodiment, the heater 19 is not required, rather an internal heating source of device can be used in which the system 1 is placed, or the heater pipe 13 receives heat from an external mechanism which is not part of the system 1.

[0053] The microcontroller 17 also recognizes closing of the door, and accordingly generate a cooling signal 20. The system 1 also includes a cooling unit 21 which receives the cooling signal 20 and cools the evaporator pipe 12. The evaporator pipe 12 cools the water inside the flexible reservoir 10 to change water from liquid state to solid state. In one embodiment, the automated mechanism for cooling the evaporator pipe 12 is not required, rather a user can manually activate cooling of the evaporator pipe 12. In one embodiment, the cooling unit 20 is not required, rather an internal cooling source of device, like compressor or condenser, can be used in which the system 1 is placed, or the evaporator pipe 12 gets cooled by an external mechanism which is not part of the system 1.

[0054] In a further embodiment, multiple arrangements of first part 6 and second part 7 are provided along the edges of the door and the frame. Multiple arrangement provides for a flexibility to open the door from any of the edge. A user provides a user input 16 to the user input module 15 for opening the door from a particular edge of the door and the frame. The microcontroller 17 receives the user input 16 from the user input module 15 and processes the user input 16 to generate the heat control signal 18. The heater 19 receives the heat control signal 18 and heats the heater pipe 13 which are coupled to flexible reservoir 10 of the one or more arrangements of first part 6 and the second part 7 placed on the edge of the door and the frame for which the user input 16 for opening the edge of the door is received. It is to be noted that heat control signal 18 is sent to only the heater 19 which is associated to heater pipe 13 in heat exchange coupling with flexible reservoir 10 of arrangements of

those particular edges for which the user input 16 was received for opening the door. Remaining arrangements of other edge/s behaves as hinges for rotating the door around the frame. It is to be noted that in general scenario, only arrangements for one side can behave as hinges while opening the door, and the door has to be freed from other sides. Hence, the heat control signal 18 received by the heater 19 shall be for heating the heater pipe 13 which are associated to all the edges to be freed. In one scenario, where the opening of door is allowed at two edges, the arrangements at one edge behaves as hinges, and arrangements at other edge is freed for opening the door. At which end the door has to be opened, is based on the user input 16 received by the microcontroller 17.

[0055] In one embodiment, the user input module 15 has a touch based sensor which senses touch of a user and adapted to generate the user input 16.

[0056] In another embodiment, the system 1 can be implemented as part of the refrigerator, such that the arrangement of first part 6 and second part 7 is arranged on the door and opening edge of the refrigerator. In one embodiment of this implementation, the first part 6 is affixed to the door and the second part 7 is affixed to the opening edge of the body of the refrigerator. In an alternate embodiment, the compressor of the refrigerator can be used as the cooling unit 21 for cooling the evaporator pipe 12.

[0057] Fig. 2a and 2b shows the system 1 having second part 7 comprising the water reservoir 10 and is in the shape of alphabetic character "T" when the water inside the reservoir 10 is in solid state and is in the shape of alphabetic character "I" when the water inside the reservoir 10 in liquid state. The system 1 has two first part 6 and one second part 7. The two first part 6 are arranged on the door 2 and the second part 7 is arranged on the frame 3. The flexible reservoir 10 of the second part 7 provides for complimentary structure 9 with respect to the cavity 8 of the first part 6. When the water is in solid state the complimentary structure 9 is provided by protruding of the flexible reservoir 10 to make protruding parts 14, which provide shape "T" to the second part 7. The two first part 6 are arranged in such a way that they form a grip onto the protruding parts 14 of the flexible reservoir 10 of the second part 7. When the flexible reservoir 10 is in non-expanded shape, the second part 7 leaves out of grip of the first parts 6.

[0058] Fig. 3a and 3b shows the system 1 having second part 7 comprising the water reservoir 10 and is in the shape of alphabetic character "T" when the water inside the reservoir 10 is in solid state and is in the shape of alphabetic character "P" when the water inside the reservoir 10 is in liquid state. The system 1 has one first part 6 and one second part 7. The first part 6 is arranged on the door 2 and the second part 7 is arranged on the frame 3. The flexible reservoir 10 of the second part 7 provides for complimentary structure 9 for the cavity 8 of the first part 6. When the water is in solid state the complimentary

structure 9 is provided by protruding of the flexible reservoir 10 to make a protruding part 14, which provide shape "P" to the second part 7. The first part 6 is arranged in such a way that it forms a grip onto the protruding part 14 of the flexible reservoir 10 of the second part 7. When the flexible reservoir 10 is in non-expanded shape, the second part 7 leaves out of grip of the first parts 6.

[0059] The invention has application in any framework or device, however the key is availability of fast heating and cooling mechanism which can quickly convert states of the water from solid to liquid, and vice-versa.

[0060] Thus, the present invention provides for door opening and closing system 1 having a door 2 and a frame 3, such that one of the edge of the door 2 is in mechanical coupling to one of the edge of the frame 3 for closing or opening of the door 2. The door opening and closing system 1 includes an arrangement of a first part 6 and a second part 7. The first part 6 is having a cavity 8, and the second part 7 is having a complimentary structure 9 with respect to the cavity 8, such that the complimentary structure 9 makes a fitting into the cavity 8 of the first part 6 when the second part 7 is mechanically coupled to the first part 6 to close the door 2, and the complimentary structure 9 releases from the fitting to open the door 2. One of the parts 6, 7 is placed on the edge of the door 2 and other part 6, 7 is on the edge of the frame 3 which are in the mechanical coupling for closing or opening of the door 2. At least one of the first part 6 or the second part 7 is having a flexible reservoir 10, and houses a liquid solution, in particular water, either in solid state or liquid state. The system 1 further includes a heating and cooling mechanism 11 which is in heat exchange coupling with the water inside the flexible reservoir 10 and changes water into solid state to liquid state, or liquid state to solid state. When the door 2 is to be opened, the heating and cooling mechanism 11 heats the water to change from solid state to liquid state, and when the door 2 is to be closed, the heating and cooling mechanism 11 converts water from liquid state to solid state.

List of reference numbers

[0061]

- | | |
|----|---------------------------------|
| 1 | door closing and opening system |
| 2 | door |
| 3 | frame |
| 6 | first part |
| 7 | second part |
| 8 | cavity |
| 9 | complimentary structure |
| 10 | flexible reservoir |
| 11 | heating and cooling mechanism |
| 12 | evaporator pipe |
| 13 | heater pipe |
| 14 | protruding part |
| 15 | user input module |

- 16 user input
- 17 microcontroller
- 18 heat control signal
- 19 heater
- 20 cooling signal
- 21 cooling unit

and adapted to change water from liquid state to solid state.

Claims

1. A door opening and closing system (1) having a door (2) and a frame (3), such that one edge of the door (2) is in mechanical coupling with one edge of the frame (3) for closing or opening of the door (2), the door opening and closing system (1) comprising:

- an arrangement of a first part (6) and a second part (7), the first part (6) is having a cavity (8), and the second part (7) is having a complementary structure (9) with respect to the cavity (8), such that the complementary structure (9) is adapted to make a fitting into the cavity (8) of the first part (6) when the second part (7) is mechanically coupled to the first part (6) to close the door (2), and the complementary structure (9) is adapted to release from the fitting to open the door (2),

wherein one of the parts (6, 7) is placed on the edge of the door (2) and other part (6, 7) is on the edge of the frame (3) which are in the mechanical coupling for closing or opening of the door (2), wherein at least one of the first part (6) or the second part (7) is having a flexible reservoir (10) which is adapted to house a liquid solution, in particular water, either in solid state or liquid state, wherein the system (1) further comprises:

- a heating and cooling mechanism (11) is adapted to be in heat exchange coupling with the liquid solution inside the flexible reservoir (10) and is adapted to change the liquid solution into solid state to liquid state, or liquid state to solid state,

wherein when the door (2) is to be opened, the heating and cooling mechanism (11) heats the liquid solution to change from solid state to liquid state, and when the door (2) is to be closed, the heating and cooling mechanism (11) converts the liquid solution, in particular water, from liquid state to solid state.

2. The system (1) according to the claim 1, wherein the heating and cooling mechanism (11) comprising:

- an evaporator pipe (12) adapted to be in heat exchange coupling with the water inside the flexible reservoir (10), such that the evaporator pipe (12) is adapted to receive heat from the water,

3. The system (1) according to the claim 2, wherein the evaporator pipe (12) is passing through the flexible reservoir (10) to be in direct contact to the water within the flexible reservoir (10).

4. The system (1) according to any of the claims 1 to 3, wherein the heating and cooling mechanism (11) comprising:

- a heater pipe (13) adapted to be in heat exchange coupling with the water inside the flexible reservoir (10), such that the evaporator pipe (10) is adapted to provide heat to the water, and adapted to change water from solid state to liquid state.

5. The system (1) according to the claim 2, wherein the heater pipe (13) is passing through the flexible reservoir (10) to be in direct contact to the water within the flexible reservoir (10).

6. The system (1) according to any of the claims 1 to 5, wherein the flexible reservoir (10) is comprised in the second part (7).

7. The system (1) according to the claim 6, wherein the system (1) comprises one first part (6) and one second part (7), such that the second part (7) is adapted to be in form of an alphabetic character "P" when the water inside the flexible reservoir (10) converts into solid state, and the first part (6) is arranged to be inserted into the protruding part (14) of the alphabetic character "P" shaped second part (7) for closing the door (2).

8. The system (1) according to the claim 6, wherein the system (1) comprises two first part (6) and one second part (7), such that second part (7) is adapted to be in form of an alphabetic character "T" when the water inside the flexible reservoir (10) converts into solid state, and the first parts (6) are arranged to be inserted into the protruding parts (14) of the alphabetic character "T" shaped second part (7) for closing the door (2).

9. The system (1) according to any of the claims 1 to 8 comprising:

- an user input module (15) adapted to receive user input (16) for opening of the door (2);
 - a microcontroller (17) adapted to receive the user input (16) from the user input module (15), to process the user input (16), and to generate a heat control signal (18); and
 - a heater (19) adapted to receive the heat con-

trol signal (18) and adapted to heat the heater pipe (13),

wherein the heater pipe (13) heats the water inside the flexible reservoir (10) to change water from solid state to liquid state. 5

10. The system (1) according to the claim 9, wherein the microcontroller (17) is adapted to recognize closing of the door (2), and accordingly generate a cooling signal (20), the system (1) comprising: 10

- a cooling unit (21) adapted to receive the cooling signal (20) and adapted to cool the evaporator pipe (12), 15

wherein the evaporator pipe (12) cools the water inside the flexible reservoir (10) to change water from liquid state to solid state. 20

11. The system (1) according to any of the claims 9 or 10, wherein multiple arrangements of first part (6) and second part (7) are provided along the edges of the door (2) and the frame (3), and the user input module (15) is adapted to receive the user input (16) with respect to opening of the door (2) from either of the edges having arrangements of the first part (6) and the second part (7), the microcontroller (17) adapted to receive the user input (16) from the user input module (15), to process the user input (16), and to generate the heat control signal (18), and the heater (19) is adapted to receive the heat control signal (18) and adapted to heat the heater pipe (13) which is coupled to flexible reservoir (10) of the one or more arrangements of first part (6) and the second part (7) placed on the edge of the door (2) and the frame (3) for which the user input (16) for opening the edge of the door (2) is received. 25 30 35

12. The system (1) according to any of the claims 9 to 11, wherein the user input module (15) comprises a touch based sensor which is adapted to sense touch of a user and adapted to generate the user input (16). 40

13. A refrigerator comprising the door closing and opening system (1) according to the claim 1 to 12, wherein the frame (3) is part of the body of the refrigerator. 45

14. The refrigerator according the claim 13, wherein the first part (6) is affixed to the door (2) of the refrigerator, and the second part (7) is affixed to the body of the refrigerator. 50

15. The refrigerator according to any of the claims 13 or 14, wherein the cooling unit (21) is the compressor of the refrigerator. 55

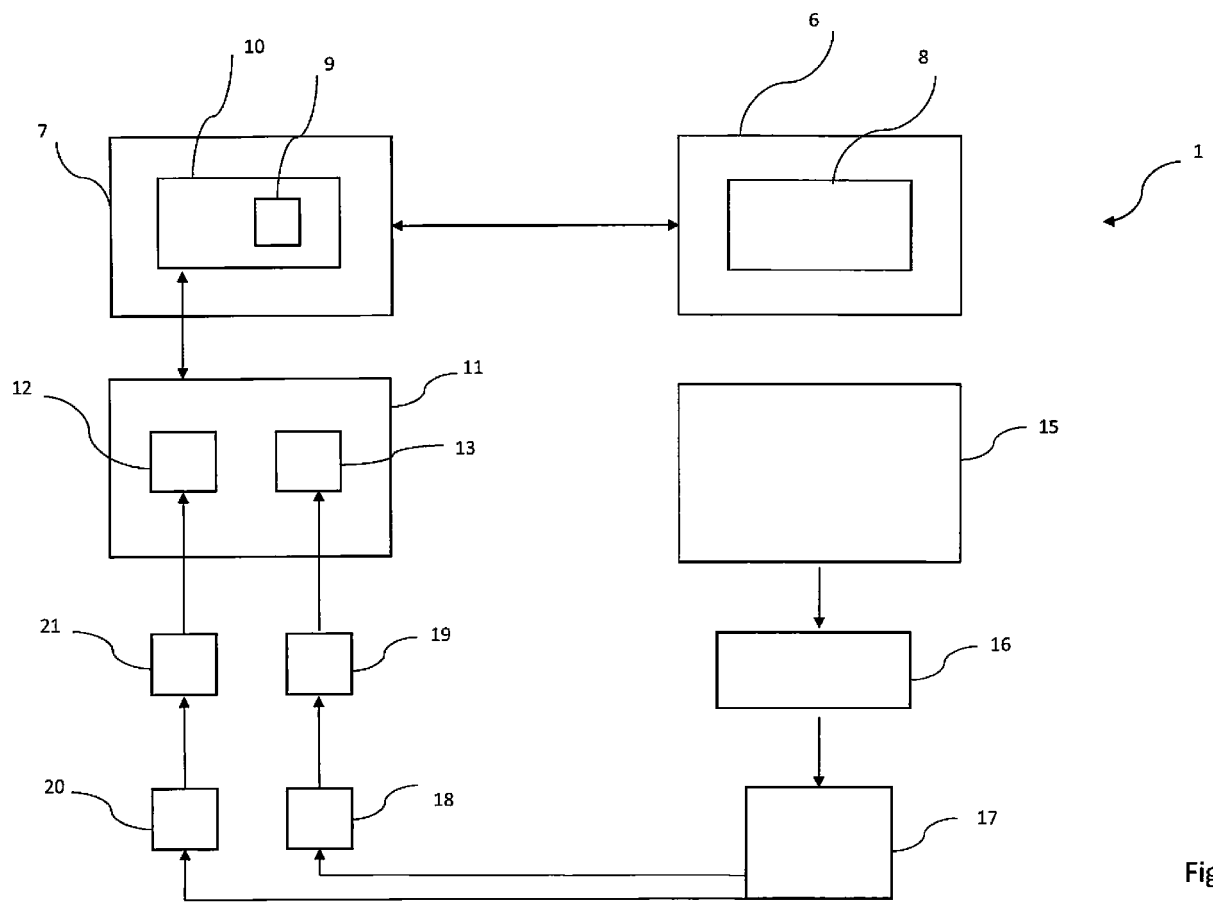


Fig. 1

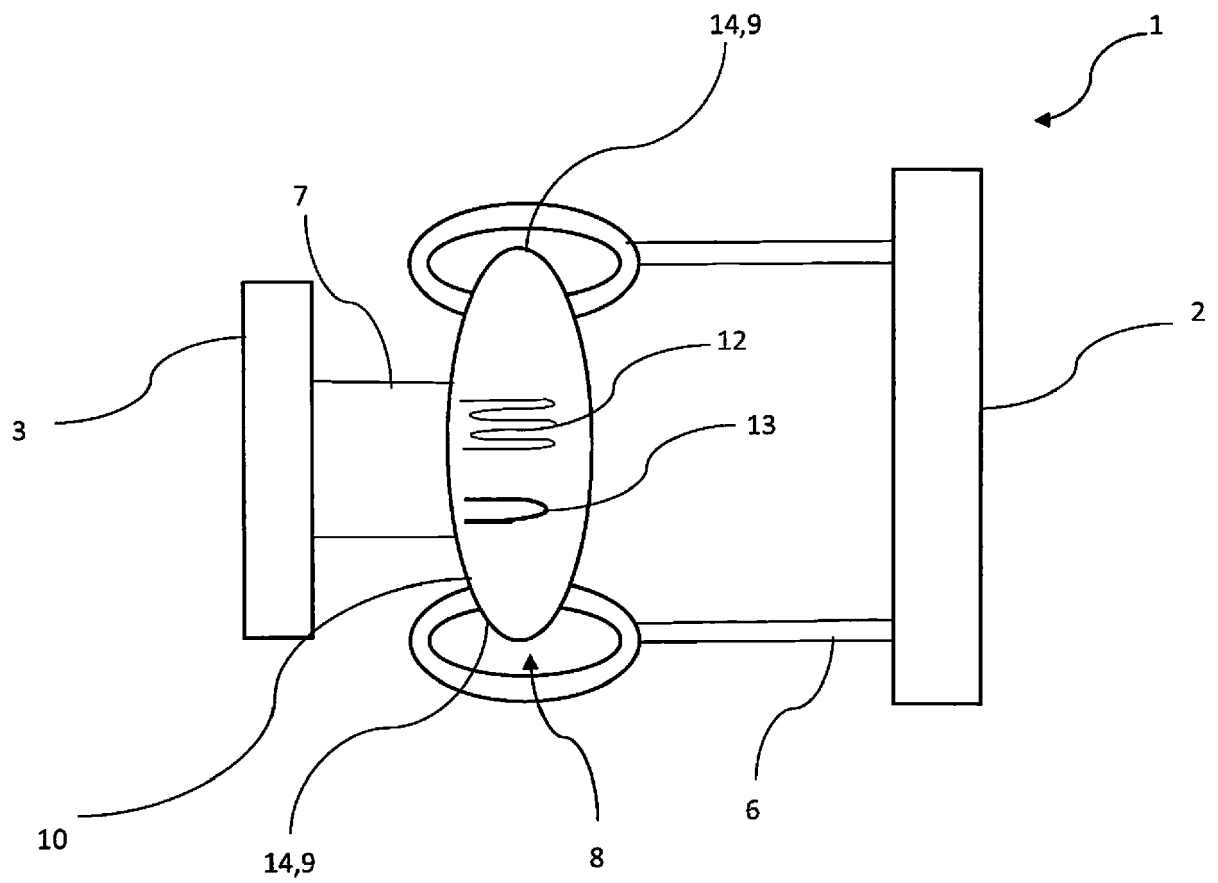


Fig. 2a

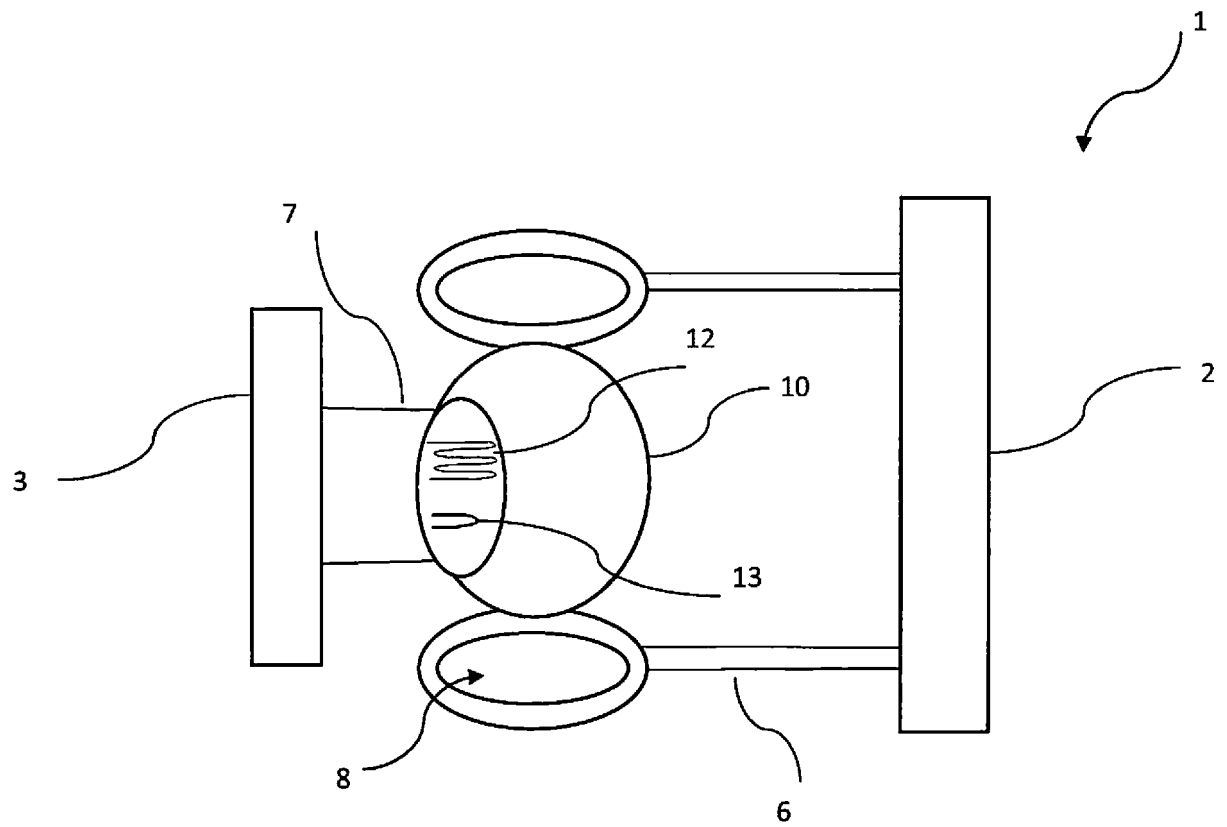


Fig. 2b

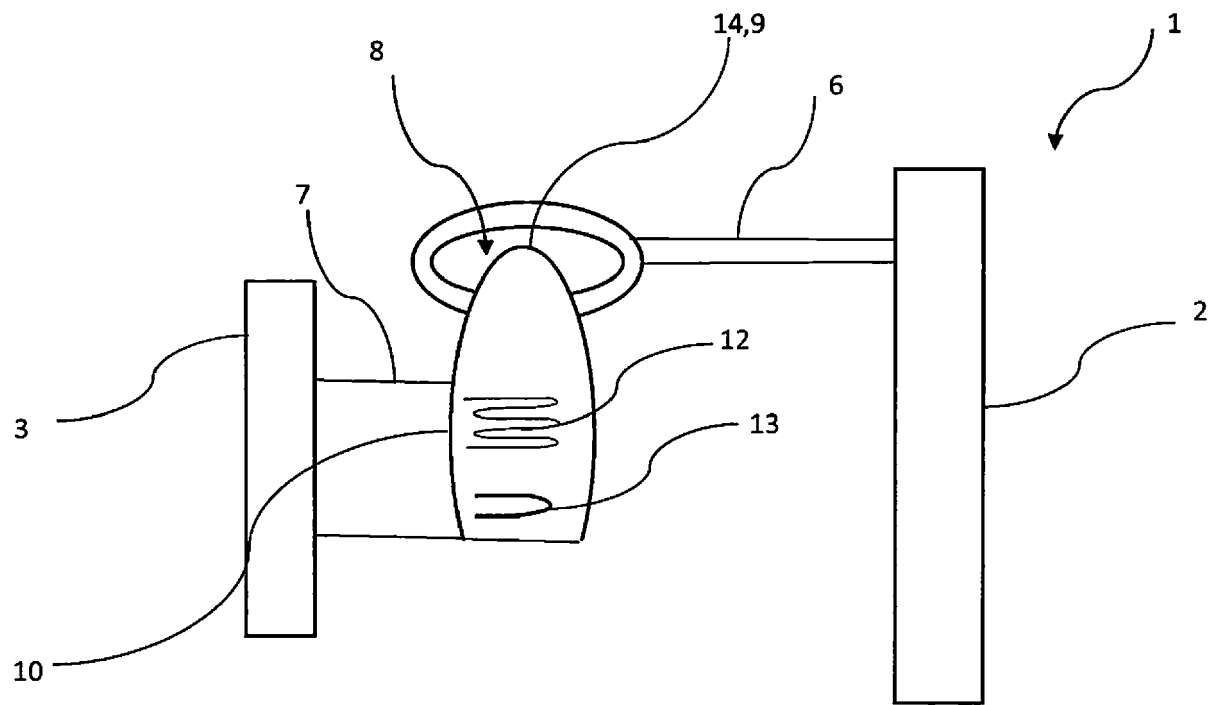


Fig. 3a

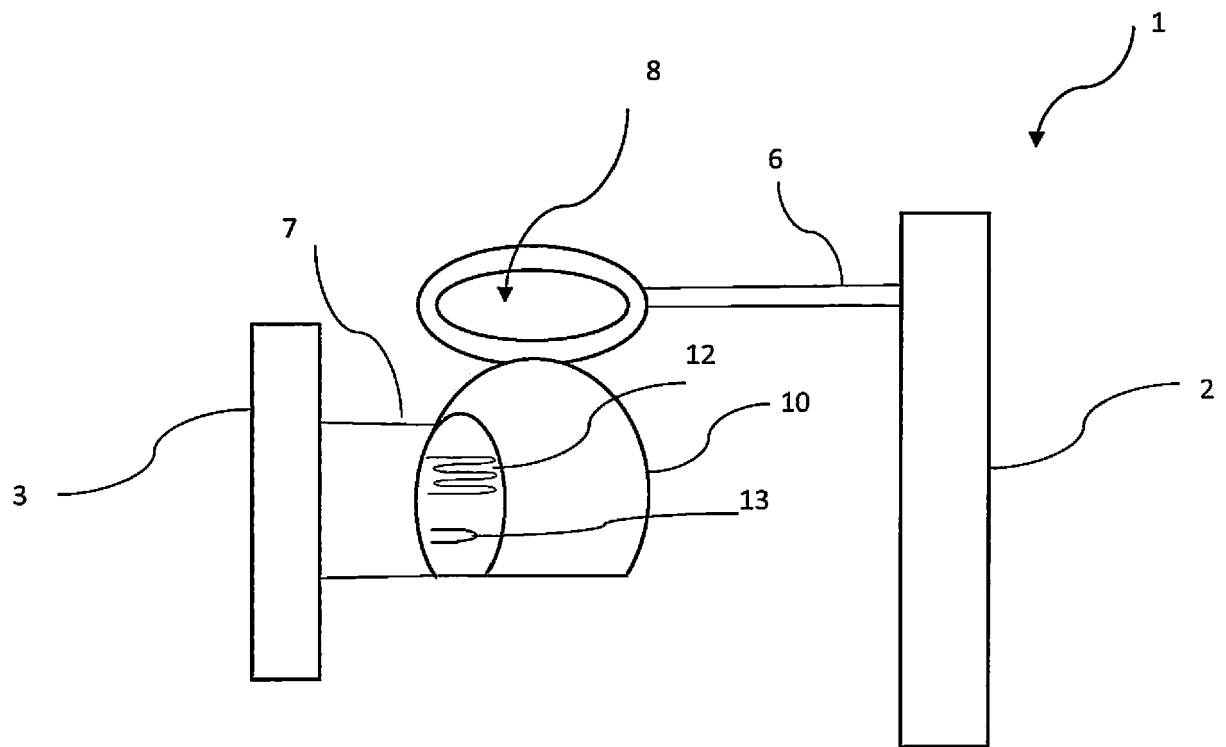


Fig. 3b



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