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(54) **REFRIGERATION APPARATUS AND METHOD**

(57) There is disclosed a refrigeration apparatus (102) comprising a main body portion (104) and a door (105) constructed and arranged to be moved between an open position in which access is enabled to a storage compartment (126) in the main body portion, and a closed position in which the door (105) is closed against a door frame of the main body portion so as to enclose the storage compartment (126). The refrigeration apparatus (102) comprises a compressor (114) for compressing and driving a refrigerant through a refrigeration circuit (106) of the refrigeration apparatus. The refrigeration apparatus (102) comprises a controller (120), the controller being configured to monitor a load of the compressor (114) to obtain compressor load information, and the controller configured to determine a closure status of the door (105) based at least in part on the compressor load information.

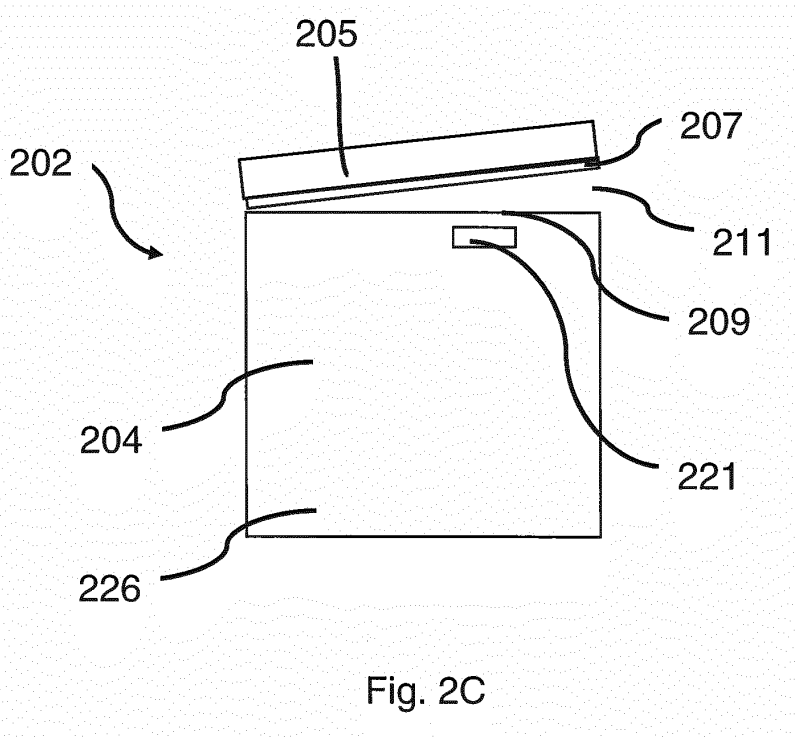

Fig. 2C

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Description

Technical Field

[0001] The present disclosure relates to a refrigeration apparatus and a method of operating a refrigeration apparatus. More particularly the present disclosure relates to detecting correct closure of a door of a refrigeration apparatus.

Background

[0002] Refrigeration apparatus are known. Refrigeration apparatus operate to keep perishables, such as food and drink, cold or below a certain temperature. Known refrigeration apparatus include fridges and freezers.

Summary

[0003] According to a first aspect disclosed herein, there is provided a refrigeration apparatus comprising: a main body portion; a door constructed and arranged to be moved between an open position in which access is enabled to a storage compartment in the main body portion, and a closed position in which the door is closed against a door frame of the main body portion so as to enclose the storage compartment; and a compressor for compressing and driving a refrigerant through a refrigeration circuit of the refrigeration apparatus; the refrigeration apparatus comprising a controller, the controller being configured to monitor a load of the compressor to obtain compressor load information, and the controller configured to determine a closure status of the door based at least in part on the compressor load information.

[0004] According to an example, the closure status of the door comprises one of: open; correctly closed; incorrectly closed.

[0005] According to an example, the load of the compressor comprises an electrical current load and/or a torque load.

[0006] According to an example, the refrigeration apparatus comprises a sensor constructed and arranged to sense when the door has been moved from the open position to the closed position.

[0007] According to an example, the sensor comprises one of: a switch; an optical sensor; a camera.

[0008] According to an example, the controller is configured to start the timer when it is determined that the door has been moved from the open position to the closed position.

[0009] According to an example, the controller is configured to determine if the load on the compressor reaches a threshold value within a threshold time.

[0010] According to an example, the controller is configured to cause an alert to a user indicating that the closure status of the door comprises an incorrect closure, when it is determined by the controller that the load on the compressor has not reached the threshold value in the threshold time.

[0011] According to an example, the refrigeration apparatus comprises a temperature sensor for sensing a temperature of an evaporator of the refrigeration circuit.

[0012] According to an example, in response to a determination by the controller that a temperature of the evaporator is above a threshold temperature, and a determination by the controller that the load on the compressor has not reached the threshold value in the threshold time, the controller is configured to cause an alert to a user indicative of a leakage of the refrigerant.

[0013] According to an example, in response to a determination by the controller that a temperature of the evaporator is at or below a threshold temperature, and a determination by the controller that the load on the compressor has not reached the threshold value in the threshold time, the controller is configured to cause an alert to a user indicating that the closure status of the door comprises an incorrect closure.

[0014] According to an example, the refrigeration apparatus comprises a fridge and/or a freezer.

[0015] According to a second aspect there is provided a method of operating a refrigeration apparatus comprising: monitoring a load of a compressor of the refrigeration apparatus so as to obtain compressor load information; and determining a closure status of a door of the refrigeration apparatus based at least in part on the compressor load information.

[0016] According to an example, the method comprises alerting a user that the closure status of the door comprises an incorrect closure, at least in part in response to a determination that a load on the compressor has not reached a threshold value in a threshold time following a determination by a sensor that the door has been moved from an open position to a closed position.

[0017] According to an example, the alerting a user that the closure status of the door comprises an incorrect closure being at least in part in response to a determination that a temperature of an evaporator of the refrigeration apparatus is at or below a threshold temperature.

Brief Description of the Drawings

[0018] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a refrigeration apparatus according to an example.

Figure 2A shows schematically a refrigeration apparatus with a door of the refrigeration apparatus in an open state.

Figure 2B shows schematically a refrigeration apparatus with a door of the refrigeration apparatus in a correctly closed state.

Figure 2C shows schematically a refrigeration apparatus with a door of the refrigeration apparatus in an incorrectly closed state.

Figure 3 shows schematically a plot of compressor load against time according to an example.

Figure 4 shows schematically a flow chart of a method according to an example.

Detailed Description

[0019] As briefly described above, refrigeration apparatus are known. Refrigeration apparatus are operate to keep perishables, such as food and drink, cold or below a certain temperature. Known refrigeration apparatus include fridges (also referred to as refrigerators) and freezers. Also known are combined fridge-freezers, which have separate fridge and freezer compartments. A known refrigeration apparatus comprises a door for allowing access to a storage compartment of the apparatus, for storing food for example. If the door is incorrectly closed then this may lead to an undesirable temperature rise within the refrigeration apparatus, and/or increased power consumption in attempting to maintain the refrigeration apparatus at the required temperature.

[0020] Figure 1 shows a refrigeration apparatus 102 according to an example. The refrigeration apparatus 102 comprises a main body portion 104. A door 105 is movable between open and closed positions so as to provide access to a compartment or cabinet 126 for storing one or more items, such as food and drink, in an interior of the main body portion 104. When in the closed position the door 105 is configured to enclose the compartment 126. In Figure 1 the door 105 is closed and therefore the compartment 126 is not visible. A power connector is schematically shown at 140. Power connector 140 enables the refrigeration apparatus 102 to be connected to a mains power supply, for example, for powering the refrigeration apparatus.

[0021] A refrigeration system or circuit is shown generally at 106. The refrigeration circuit 106 comprises an evaporator 108, and a condenser 110. A compressor is schematically shown at 114, between evaporator 108 and condenser 110. An expansion device is schematically shown at 116, between condenser 110 and evaporator 108. The evaporator 108, compressor 114, condenser 110, and expansion device 116 are connected by pipes or tubes 112 for enabling a refrigerant to move around the system 106, in a closed-loop manner. Movement of the refrigerant is shown schematically by the block arrows. As is known, the refrigerant is evaporated in evaporator 108 of refrigeration apparatus 102, which then absorbs heat in the compartment 126 so as to cool down or keep cool one or more items stored therein. The refrigerant then releases this absorbed heat outside of the refrigeration apparatus 102 to the ambient atmosphere before being recycled in the refrigeration circuit 106. The refrigerant is cooled down by being passed through expansion device 116, before re-entering the refrigeration apparatus 102. The compressor 114 acts, at least in part, to drive the refrigerant through the circuit 106. Therefore a load or demand, such as an electrical current and/or torque on the compressor 114 may be considered indicative of how much cooling is required or is being carried out. For example, when the refrigeration apparatus 102 is first turned on then a temperature in the compartment 126 will be relatively high. For example the temperature in the compartment 126 may be ambient temperature, which may be about 15°C. Accordingly the load on the compressor will be relatively high as it works to drive the temperature in the compartment 126 down to an operating temperature. Where the refrigeration apparatus 102 comprises a fridge, the operating temperature may be in the region of 1°C to 5°C, and preferably between about 3°C and 5°C. Where the refrigeration apparatus comprises a freezer, the operating temperature may be in the region of - 15°C and -20°C, and preferably about -18°C.

[0022] A temperature sensor is shown schematically at 118. The temperature sensor 118 is operable to sense or detect a temperature of the evaporator 118. This aspect will be described in more detail below.

[0023] A sensor is shown schematically at 121. The sensor 121 is operable to detect when the door 105 is closed, or operable to sense when an attempt has been made (e.g. by a user) to close the door. In other words the sensor 121 is constructed and arranged to sense when the door 105 has been moved from an open position to a closed position.

[0024] Sometimes, after a user has moved the door 105 from the open position to the closed position, the door may in fact be incorrectly closed. For example, a user may attempt to close the door of the refrigeration apparatus 102, but a properly or correctly closed state is prevented by one or more badly positioned items in the refrigeration apparatus pressing out against the door 105, preventing a correctly closed state from being achieved. The door 105 may also be incorrectly closed, for example, if a seal or gasket of the door (and/or corresponding door frame) has failed, for example if the seal has perished or become loose. A failed seal may mean for example that cold air in the compartment 126 can escape, to be replaced by warmer, ambient air, requiring the compressor 114 to work harder to maintain the compartment 126 at the required temperature. It may be difficult for a user to see or notice when this occurs, since from a distance it may appear that the door 105 has been successfully or correctly closed. Open, correctly closed, and incorrectly closed states are further described with respect to Figures 2A to 2C, below.

[0025] The sensor 121 may comprise a switch 120 which is activated when the door 105 is closed against a door frame of the main body portion 104. Alternatively the sensor 121 may comprise a camera or an optical sensor.

[0026] A controller is shown schematically at 120. The controller 120 comprises a memory 122 and a processor 124. In this example the controller 120 is operable to monitor operations of the refrigeration apparatus 102. In this example the controller 120 is operable to control operations of the refrigeration apparatus 102. For example the controller 120 can monitor and control operations of one or more components of the refrigeration circuit 106. For example the controller 120 can monitor a load (e.g. current and/or torque) of the compressor 114. For example the controller 120 can monitor a temperature of evaporator 108, by receiving temperature information from temperature sensor 118. For example the controller 120 can monitor a current on stator windings of the compressor 114. In some examples the torque load or demand on the compressor can be derived from the determined electrical current load or demand of the compressor 114.

[0027] In this example a display is schematically shown at 130. The display may comprise an LCD display, and/or one or more LEDs. The display 130 is operable to display one or more alerts to a user (for example a flashing light), for example to alert the user that the door of the refrigeration apparatus is incorrectly closed, or that there is a leakage of refrigerant. The display may also, for example, display when the door is correctly closed. For example a green light may be indicative of correct closure, and a red light may be indicative of incorrect closure. In the example of Figure 1 a speaker is schematically shown at 132. The speaker 132 is operable to sound one or more audible alerts to a user (e.g. a beeping or buzzing noise), for example to alert the user that the door of the refrigeration apparatus is incorrectly closed, and/or that there is a leakage of refrigerant. In some examples, the refrigeration apparatus may comprise only one of display 130 and speaker 132.

[0028] Figures 2A to 2C are schematic plan views showing different closure states of a door 205 of a refrigeration apparatus 202. Figures 2A to 2C respectively show closure states where the door 205 is open, correctly closed, and incorrectly closed.

[0029] In Figure 2A, the door 205 of refrigeration apparatus 202 is open. The door 205 comprises a seal or gasket 207. A door frame 209 on main body portion 204 is schematically shown. The door frame 209 may additionally or alternatively comprise a seal or gasket. The sensor 221 can sense that the door is open. In this open state a user can access the internal compartment 226 of the refrigeration apparatus, for example to remove an item from the compartment 226 or to place an item in the compartment 226.

[0030] In Figure 2B the door 205 is shown in a correctly closed state. In Figure 2B the door 205 is closed and sealed against door frame 209. Accordingly refrigerated air in the compartment 226 cannot escape from refrigeration apparatus 202 (other than, perhaps, insignificant or undetectable amounts of escaping air). Sensor 221 senses that the door 205 is in a closed state.

[0031] In Figure 2C the door 205 is improperly closed. In Figure 2C the door 205 is not fully sealed against door frame 209. That is, although sensor 221 senses that the door has been closed, one or more gaps or holes 211 exist between door 205 and door frame 209. Cold, refrigerated air from the compartment 226 can escape from the one or more gaps 211. Warmer, ambient air from the environment (e.g. kitchen) can flow in to the compartment through the one or more gaps 211. As described above the one or more gaps 211 may be caused by an item in the compartment 226 pushing against the door 205. Additionally or alternatively the one or more gaps 211 may be caused by a damaged seal 207. In some situations the incorrect closure of door 205 is not sensed by sensor 221 because the one or more gaps 211 is located at a position between the door 205 and door frame 209 which is remote from the sensor 221. In some situations the incorrect closure of door 205 is not sensed by sensor 221 due to the sensor 221 being insufficiently sensitive.

[0032] Generally speaking "incorrectly closed" may be distinguished from "correctly closed", in that when the door is incorrectly closed refrigerated air in the compartment 126 can escape from the compartment 126. Or in other words it may be considered that when incorrectly closed the door 205 is not sealed against a door frame 209 of the refrigeration apparatus 202. This contrasts with a correctly closed state, in which the door 205 is correctly sealed against door frame 209, and refrigerated air cannot escape from compartment 226.

[0033] Figure 3 is a graph schematically showing a plot of compressor load or demand (e.g. current or torque) against time. The solid line A is a plot showing a load-time curve when the refrigerator door is correctly closed. The dashed line B is a plot showing a load-time curve when the refrigerator door is incorrectly closed.

[0034] Referring to plot A, at time t0 the refrigerator door is properly or correctly closed. Initially the load of the compressor increases as the compressor works to cool down the refrigeration apparatus to compensate for a rise in temperature caused by the door having being open. The load peaks at time t1, before reducing and settling to a threshold load L_T, or steady state load at time t2. In some examples the threshold load L_T comprises a predetermined load value or a target load value that is being monitored by the controller. In some examples the threshold load L_T comprises a range of values, such that a load falling within that range is considered to meet the threshold requirement. In some examples, the load must be within the threshold range for a threshold time (e.g. 30 seconds) to satisfy the threshold requirement.

[0035] Referring to plot B, at time t0 an attempt is made to close the door of the refrigeration apparatus. However, the door is incorrectly or not fully closed. In this example the load does not reach the threshold load L_T. This is because in this example the compressor is having to work harder to compensate for the heat loss due to the incorrectly closed door.

[0036] In some examples the refrigeration apparatus

comprises a timer. The timer may be controlled by controller 120. In some examples the timer is started when the refrigerator door is closed, or at least sensor 121 has sensed (correctly or incorrectly) that the door has been closed. Therefore, the controller 120 may start the timer when sensor 121 senses that the door has been closed. A threshold time t_x is shown in Figure 3. In some examples, if the load on the compressor settles to a threshold load (e.g. load L_T) within the threshold time t_x, then the door is determined by the controller 120 to have been fully or correctly closed. On the other hand, if the load on the compressor does not settle to the threshold load (e.g. load L_T) within the threshold time t_x, then the door is determined by the controller 120 to have been improperly, or not fully, closed. Thus, the controller determines that the load curve A represents a door closure status where the door has been fully or correctly closed, and determines that load curve B represents a door closure status where the door is incorrectly closed, such that the door is incorrectly sealed against the door frame of the refrigeration apparatus. The threshold time tx may be, for example, 30 seconds or a minute.

[0037] In some examples where the compressor load does not fall to the threshold load L_T within the threshold time t_x, this is due to a reason other than the door being incorrectly closed. For example, failure of the compressor load to reach the threshold load L_T may be due to a leakage of refrigerant. In some examples, a leakage of refrigerant is detected by sensing a temperature of the evaporator e.g. detecting temperature of evaporator 108 using temperature sensor 118. The temperature sensor 118 may comprise, for example, a thermistor such as a negative temperature coefficient (NTC) thermistor. Therefore in some examples determining a closure status of the door comprises, when the compressor load fails to reach the threshold value within the threshold time, determining a temperature of the evaporator. If the temperature of the evaporator is above a threshold temperature T_t, then the failure of the compressor to settle to the threshold load L_T is determined by the controller 120 to be due to leakage of refrigerant rather than due to incorrect door closure. If on the other hand the temperature of the evaporator is below the threshold temperature T_t, then the failure of the compressor to settle to the threshold load L_T is determined by the controller 120 to be due to incorrect door closure. The threshold temperature T_t may vary dependent on refrigerator apparatus type e.g. whether it is a fridge or a freezer. By way of example only, where the refrigeration apparatus comprises a fridge, T_t is about 2°C. By way of example only, where the refrigeration apparatus comprises a freezer, T_t is about -15°C.

[0038] In some examples the refrigeration apparatus 102 is configured and arranged to alert a user of incorrect door closure or refrigerant leakage, for example using display 130 and/or speaker 132 shown in Figure 1. In some examples the refrigeration apparatus can provide an output or alert relating to both door closure status and refrigerant leakage status. For example the refrigeration apparatus could provide an output showing that the door is correctly closed and there is no refrigerant leakage, or the door is incorrectly closed and there is no refrigerant leakage, or the door is correctly closed and there is refrigerant leakage etc.

[0039] In some examples the controller 120 can also determine when the door is in an open state, for example when a user is placing items in or removing items from the refrigeration apparatus 102. For example the controller 120 may receive this information from sensor 121. Additionally or alternatively the controller 120 may be able to determine that the door 105 is open based at least in part on received compressor load information. By way of example, the compressor load may be relatively high (e.g. higher than when the door is closed and incorrectly closed) when the door is open, to compensate for the refrigerated air escaping via the open door 105.

[0040] A method according to an example is shown in Figure 4.

[0041] At S1 a door 105 of a refrigeration apparatus 102 is open, for example because a user is placing an item in and/or removing an item from the refrigeration apparatus 102.

[0042] At S2, the user closes the door. Closure, or attempted closure of the door 105, may be sensed by sensor 121.

[0043] At S3, a timer is started and compressor load information (e.g. electrical current and/or torque) is monitored and obtained.

[0044] At S4, a determination is made as to whether the compressor load has reached a threshold value within a threshold time.

[0045] If the determination at S4 is "yes", then the method proceeds to S5, where it is determined that the door has been closed correctly.

[0046] If on the other hand the determination at S4 is "no", then at S6 a temperature of the evaporator 108 of the refrigeration apparatus is monitored or checked using temperature sensor 118.

[0047] At S7, a determination is made as to whether a temperature of the evaporator is above a set or threshold value.

[0048] If the determination at S7 is "yes", then as shown at S8 it is determined that there is a gas leakage (i.e. a leakage of refrigerant).

[0049] Then, at S10 an alert (e.g. an audible or visual alert) is provided so as to alert a user of the gas leakage.

[0050] If the determination at S7 is "no", then it is determined at S9 that the door 105 of the refrigeration apparatus 102 is incorrectly closed.

[0051] Then, at S10 an alert (e.g. an audible or visual alert) is provided so as to alert a user of the incorrectly closed door.

[0052] In some examples, a type of alert provided at S10 differs depending on whether there is a gas leakage or the door is incorrectly closed.

[0053] It will be understood that the processor or

processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0054] Reference is made herein to data storage, or memory, for storing data. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory.

[0055] Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

[0056] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A refrigeration apparatus comprising:

   a main body portion;
   a door constructed and arranged to be moved between an open position in which access is enabled to a storage compartment in the main body portion, and a closed position in which the door is closed against a door frame of the main body portion so as to enclose the storage compartment; and
   a compressor for compressing and driving a refrigerant through a refrigeration circuit of the refrigeration apparatus;
   the refrigeration apparatus comprising a controller, the controller being configured to monitor a load of the compressor to obtain compressor load information, and the controller configured to determine a closure status of the door based at least in part on the compressor load information.

2. A refrigeration apparatus according to claim 1, wherein the closure status of the door comprises one of: open; correctly closed; incorrectly closed.

3. A refrigeration apparatus according to claim 1 or claim 2, wherein the load of the compressor comprises an electrical current load and/or a torque load.

4. A refrigeration apparatus according to any of claims 1 to 3, comprising a sensor constructed and arranged to sense when the door has been moved from the open position to the closed position.

5. A refrigeration apparatus according to claim 4, wherein the sensor comprises one of: a switch; an optical sensor; a camera.

6. A refrigeration apparatus according to claim 4 or claim 5 comprising a timer, wherein the controller is configured to start the timer when it is determined that the door has been moved from the open position to the closed position.

7. A refrigeration apparatus according to claim 6, the controller configured to determine if the load on the compressor reaches a threshold value within a threshold time.

8. A refrigeration apparatus according to claim 7, the controller configured to cause an alert to a user that the closure status of the door comprises an incorrect closure, when it is determined by the controller that the load on the compressor has not reached the threshold value in the threshold time.

9. A refrigeration apparatus according to claim 7, the refrigeration apparatus comprising a temperature sensor for sensing a temperature of an evaporator of the refrigeration circuit.

10. A refrigeration apparatus according to claim 9, wherein in response to a determination by the controller that a temperature of the evaporator is above a threshold temperature, and a determination by the controller that the load on the compressor has not reached the threshold value in the threshold time, the controller configured to cause an alert to a user of a leakage of the refrigerant.

11. A refrigeration apparatus according to claim 9, wherein in response to a determination by the controller that a temperature of the evaporator is at or below a threshold temperature, and a determination by the controller that the load on the compressor has not reached the threshold value in the threshold time, the controller configured to cause an alert to a user indicating that the closure status of the door comprises an incorrect closure.

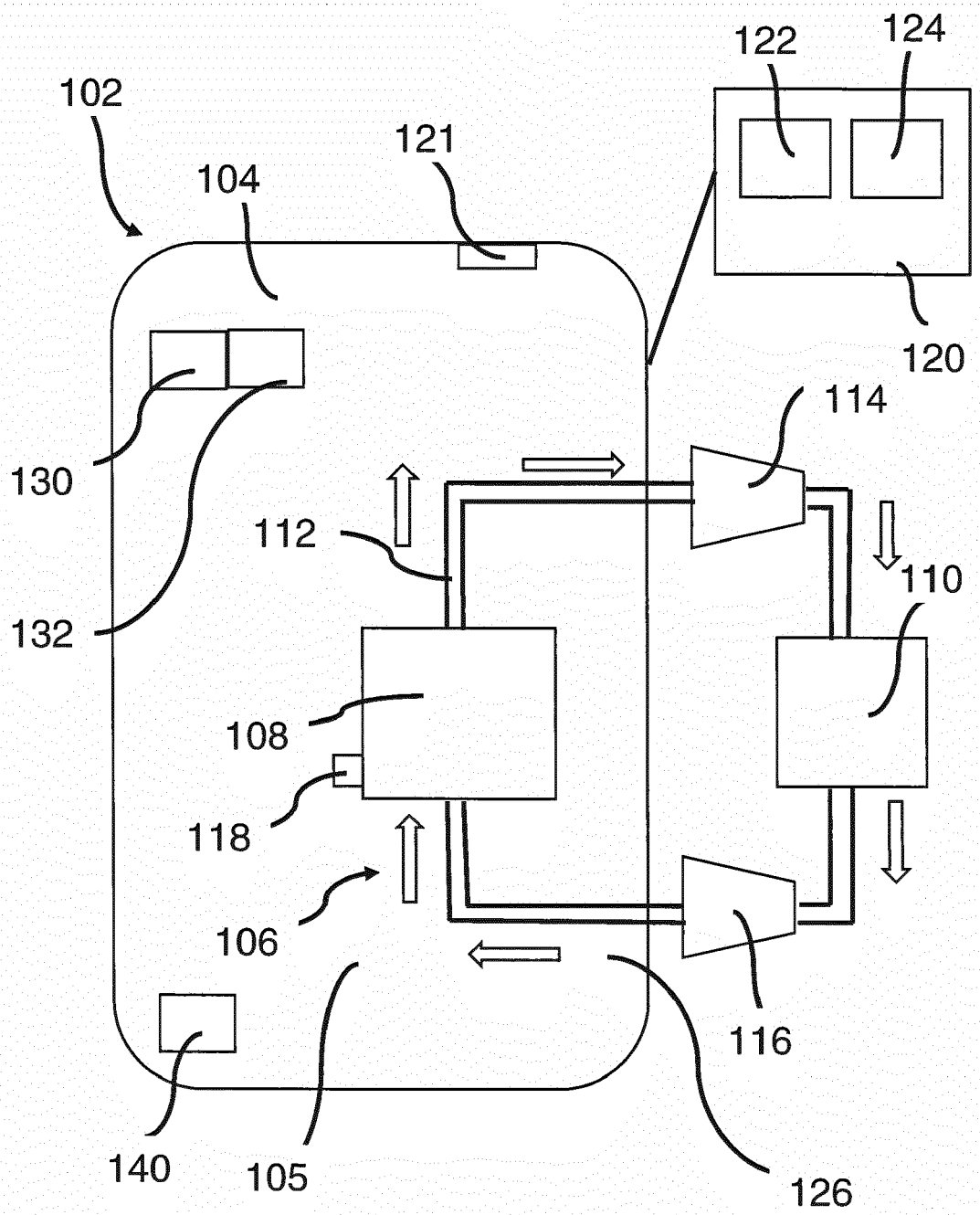
12. A refrigeration apparatus according to any of claims 1 to 11, the refrigeration apparatus comprising a fridge and/or a freezer.

13. A method of operating a refrigeration apparatus comprising:

monitoring a load of a compressor of the refrigeration apparatus so as to obtain compressor load information; and
determining a closure status of a door of the refrigeration apparatus based at least in part on the compressor load information.

14. A method according to claim 13, comprising alerting a user that the closure status of the door comprises an incorrect closure, at least in part in response to a determination that a load on the compressor has not reached a threshold value in a threshold time following a determination by a sensor that the door has been moved from an open position to a closed position.

15. A method according to claim 14, the alerting a user that the closure status of the door comprises an incorrect closure being at least in part in response to a determination that a temperature of an evaporator of the refrigeration apparatus is at or below a threshold temperature.


102
104
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130
132
114
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116
140
105
126

Fig. 1

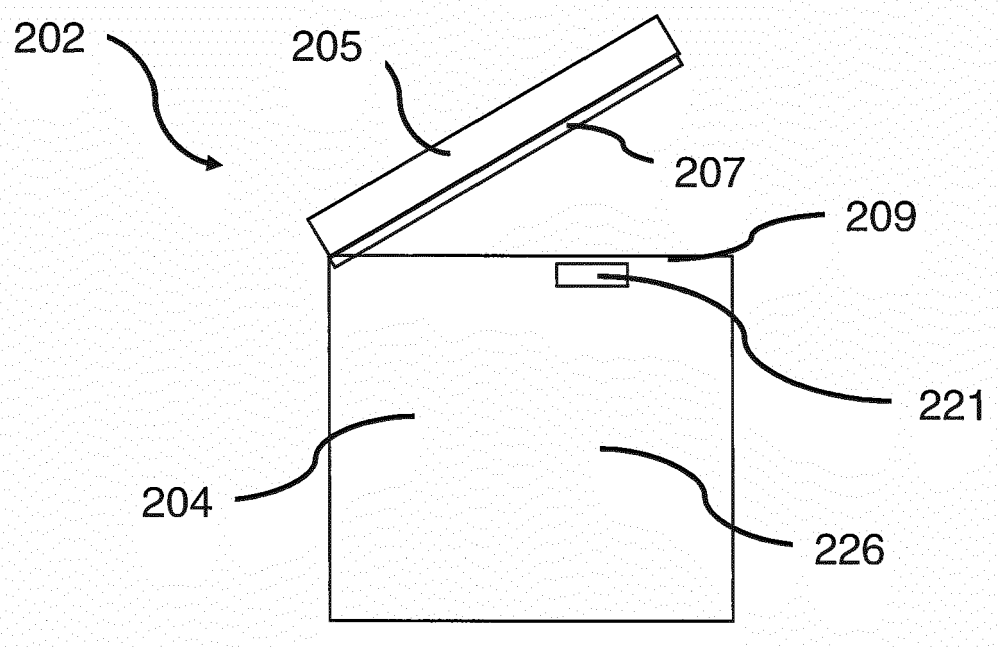

Fig. 2A

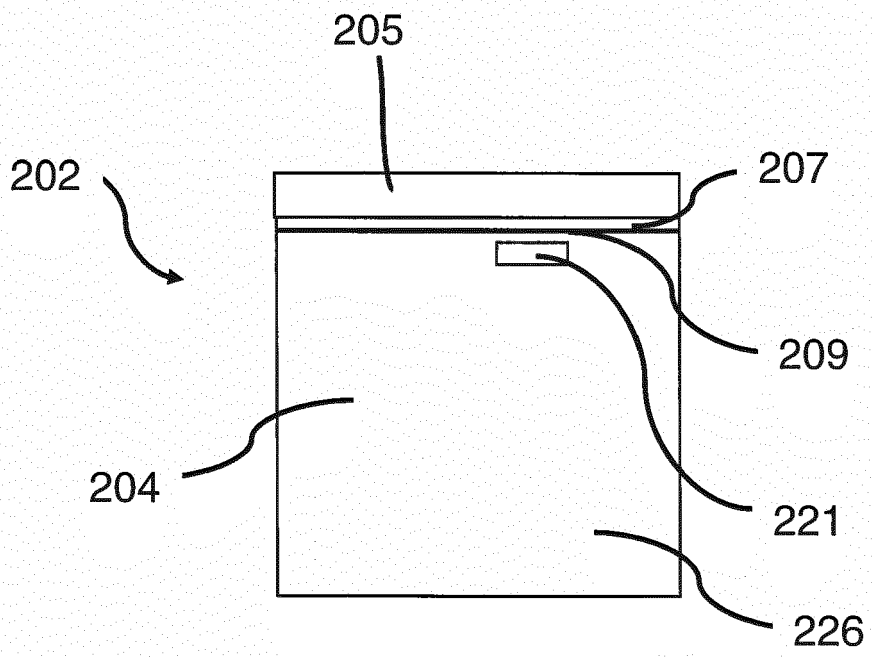

Fig. 2B

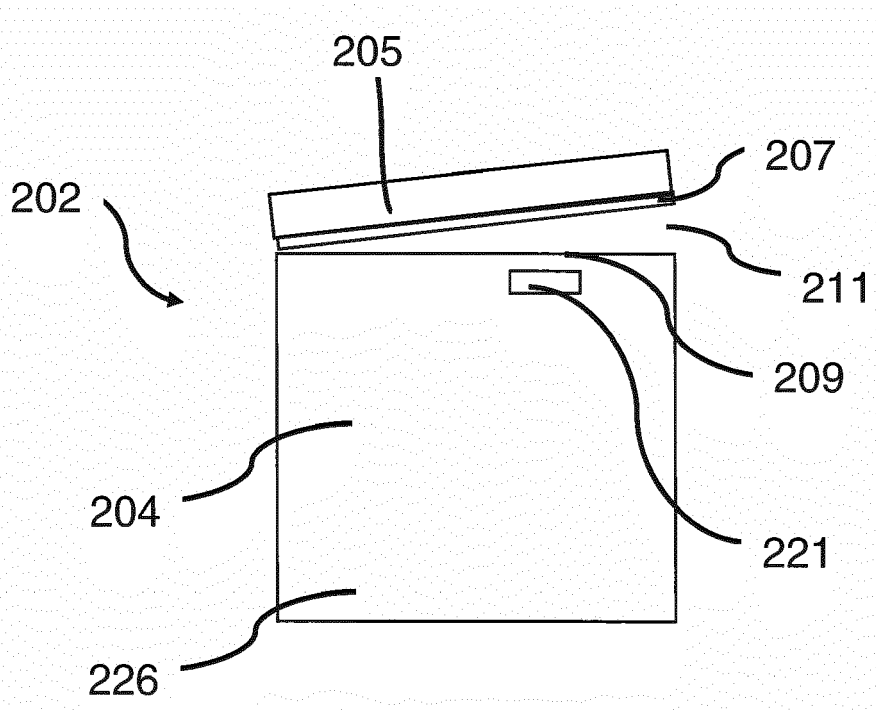

Fig. 2C

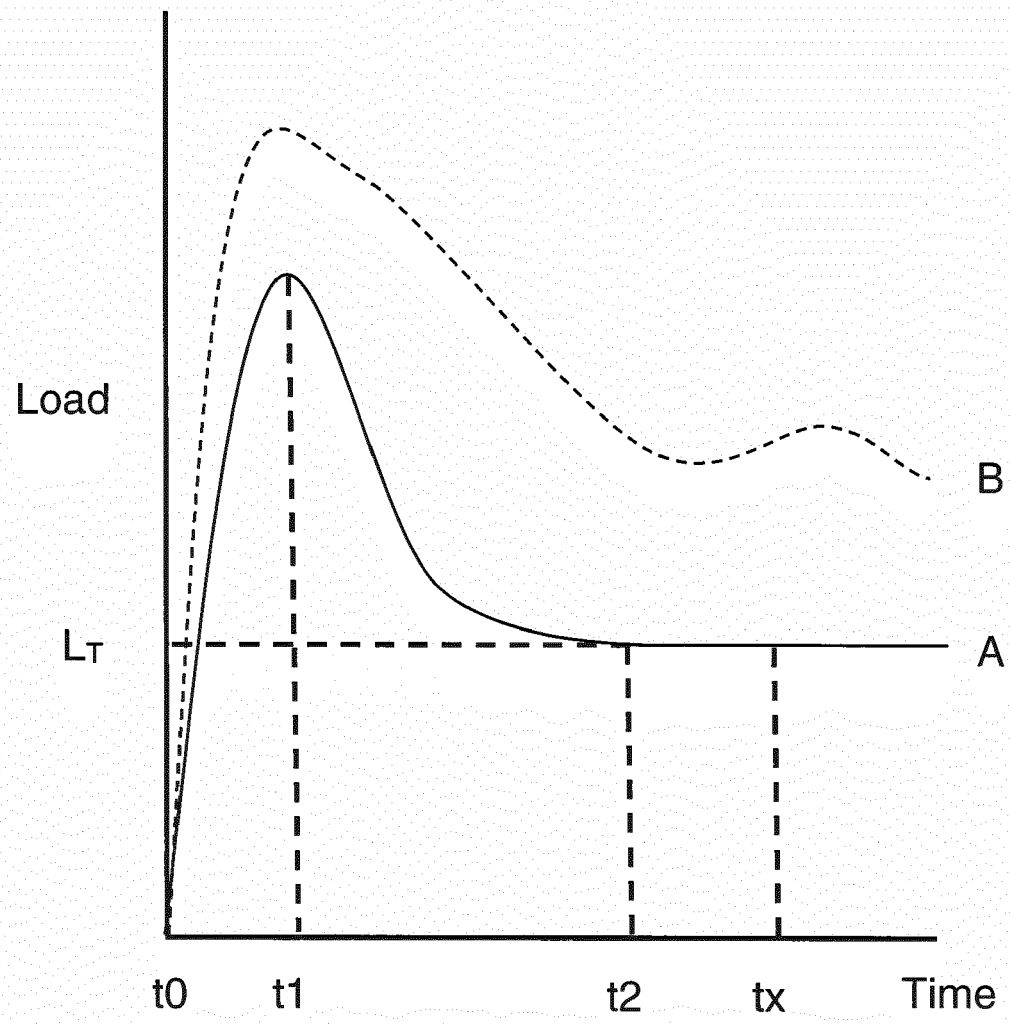

Fig. 3

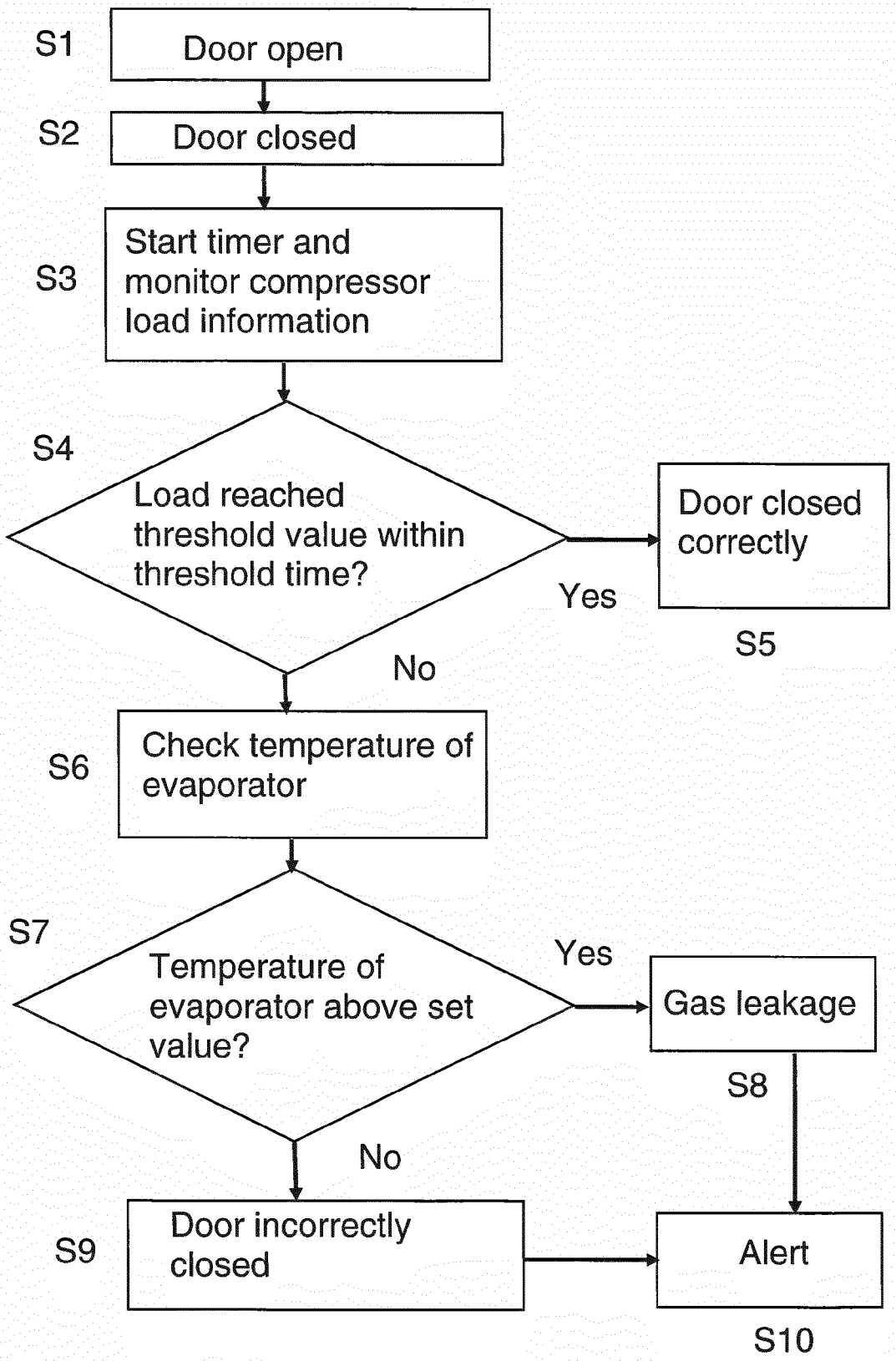
S1
Door open
S2
Door closed
S3
Start timer and monitor compressor load information
S4
Load reached threshold value within threshold time?
Yes
Door closed correctly
S5
No
S6
Check temperature of evaporator
S7
Temperature of evaporator above set value?
Yes
Gas leakage
S8
No
S9
Door incorrectly closed
Alert
S10

Fig. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 19 9228

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	DE 10 2014 005394 A1 (LIEBHERR HAUSGERÄTE OCHSENHAUSEN GMBH [DE]) 19 March 2015 (2015-03-19) * paragraphs [0014], [0029], [0030] *	1-4,12, 13 5,7-9, 14,15	INV. F25D29/00
X Y	JP 2005 024159 A (TOSHIBA CORP) 27 January 2005 (2005-01-27) * paragraphs [0021] - [0025]; figures 2,3 *	1-4,6, 12,13 7-9,14, 15	
Y	JP H05 196341 A (TOSHIBA CORP) 6 August 1993 (1993-08-06) * paragraph [0010] *	5	

TECHNICAL FIELDS SEARCHED (IPC)

F25D
F25B
F25C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 April 2018	Canköy, Necdet

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 19 9228

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