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(54) **Method for dynamically controlling frost formation on a refrigerator evaporator and refrigerator in which such method is implemented**

Verfahren zur dynamischen Kontrolle der Eisbildung an einem Kühlschrankverdampfer und Kühlschrank in dem das Verfahren angewandt ist

Procédé pour le contrôle dynamique de la formation de givre sur un évaporateur d'une armoire frigorifique et armoire frigorifique sur laquelle ce procédé est réalisé

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Description

This invention relates to a method for controlling frost formation on a refrigerator evaporator, with said evaporator there being associated capacitive sensor means connected to evaporator defrosting control means which activate a usual electrical resistance element associated with said evaporator.

From EP-A-0 563 751 in the name of the present applicant a method and device are known for controlling frost formation on the evaporator of a refrigerator (upright refrigerator, freezer or the like) using capacitive sensor means associated with the evaporator. Specifically, this method comprises measuring the variation of an electrical signal generated by at least one electrically powered capacitive conductor (8) associated with the evaporator, and on the basis of this variation operating the usual heating element associated with the evaporator for its defrosting.

This method is implemented by a device comprising at least one electrical conductor associated with the evaporator, means for powering this conductor and means for controlling an electrical signal generated by said conductor, said signal varying on the basis of the frost present on the evaporator, said control means comparing said signal with a reference value and acting on the heating element on the basis of this comparison.

With this method, the known device operates by comparing the signal from the conductor or capacitive sensor with a predetermined reference signal. This reference signal is chosen on the basis of a particular distance between the sensor plates.

Although this device operates substantially well, it has proved too sensitive to even minimum variations in the distance between said plates, even though contained within tolerance limits. In particular it has been found that during the use of the refrigerator, even small differences between the distance between plates and an optimum value result in mistaken intervention of the defrosting control means on the heating element, this intervention occurring either when there is no need or only after the formation of a relatively thick layer of frost on the evaporator, according to the particular circumstances.

Another similar device is known from US-A-4 347 709, in which a high resistive epoxy resin hermetically seals a capacitive sensor plate disposed adjacent a surface of the evaporator.

There has therefore arisen the need to preset the control means for each particular refrigerator so as to regulate its operation according to the actual distance between the plates of the capacitive sensor positioned on the evaporator. However, this results in a considerable increase in the manufacturing and maintenance costs of such refrigerators.

In addition, there are problems of operational type linked to the need to find an optimum value for the reference signal when several capacitive sensors are po-

sitioned on the evaporator, the distance between their plates varying from sensor to sensor, and linked to the always present tolerances involved in their assembly on the evaporator.

US-A-4 400 949 discloses a frost deposition detector for an air cooler disposed in a refrigerating chamber. A signal, used to activate defrosting, is generated when the electric current flowing through the motor of the air blower for the air cooler reaches a threshold value which is proportional to the initial current value corresponding to the state of no frost deposition.

An object of the present invention is to provide a method and device for controlling frost formation on the evaporator and for implementing defrosting when necessary, which are totally independent of the conditions under which the capacitive sensors are positioned in relation to the evaporator, and which therefore do not require any presetting operation.

A further object is to provide a method and corresponding device of the aforesaid type which is able to compensate for the assembly tolerances of each capacitive sensor on the evaporator, which is not influenced by the temperature variations undergone by said sensor during measurement, and which is not sensitive to the transistors which switch the usual refrigerator compressor on and off.

These and further objects which will be apparent to the expert of the art are attained by a method as stated in the appended main claim.

Hence according to the invention the reference value (that memorized) is dynamic, ie is evaluated after each defrosting cycle and in any event after the initial starting of the refrigerator. This value can also vary for the initial cycles following starting, but tends towards an optimum value which is unique for that refrigerator and can differ from that of other totally identical refrigerators. This therefore dispenses with the need for presetting to achieve acceptable evaporator defrosting, because in implementing the method an optimum evaporator defrosting cycle is automatically achieved.

The aforesaid method is implemented by a refrigerator having the features stated in the appended claim 12.

The present invention will be more apparent from the accompanying drawing, which is provided by way of non-limiting example and in which:

Figure 1 is a block scheme of a first embodiment of the device according to the invention;

Figure 2 is a block scheme of a second embodiment of the device according to the invention;

Figure 3 is a circuit diagram of part of the device of the invention shown in Figure 2;

Figure 4 is a general block scheme of the method according to the invention;

Figures 5 to 8 are flow diagrams relative to the implementation of particular stages of the method shown in Figure 4; and

Figure 9 is a practical embodiment of a part of the device of the invention which is common to both the embodiments thereof shown in Figures 1 and 2.

With reference to Figures 1 to 9, the device of the invention comprises a control unit 1, preferably of microprocessor type (provided with its own memory cells, not shown), for controlling and operating a usual electrical defrosting resistance element 2 (positioned at an evaporator 3, for example of flat type provided in a preservation or refrigeration compartment 5 of an upright refrigerator 7 which also comprises a usual freezer compartment 8) and a usual motor-compressor unit 4. In proximity to two opposing faces 3A and 3B of the evaporator there are provided flat elements 10 and 11 spaced from said faces by members 13 formed of any known electrically insulating material. The elements 10 and 11 and those portions of the evaporator 3 positioned in front of them define capacitive sensors connected to the unit 1, by means of which this latter senses and evaluates the presence of frost on the evaporator. By virtue of the arrangement of the elements 10 and 11 (which can also exceed two in number, as shown in Figure 9) the frost is measured on both evaporator faces and provides greater accuracy in the control of this frost without the measurement being negatively affected by the transistors which switch the compressor 4 on and off.

Two NTC (negative temperature coefficient) temperature sensors 15 and 16 are also connected to the unit 1, the sensor 15 being positioned at the evaporator 3 to measure its temperature and the second sensor 16 being positioned in the freezer compartment 8.

The first sensor enables the unit 1 to measure the evaporator temperature and feeds this unit with a reference value to start or stop the compressor 4. This sensor also determines the end of the evaporator defrosting stage effected by the resistance element 2.

For example, this stage is halted when the evaporator temperature reaches a value close to or slightly greater than 4°C.

As stated, the second NTC sensor 16 measures the temperature of the compartment 8 to ensure that the temperature in this compartment does not fall below a predetermined value, for example -21°C (preset by a usual potentiometer 17). When the sensor 16 senses this "critical" temperature, the unit 1 halts the motor-compressor unit 4 and operates the resistance element 2, which it maintains in operation until the evaporator temperature reaches a second predetermined maximum value of -5°C. On reaching this temperature the motor-compressor unit 4 is automatically returned to operation to again cool the compartment 8.

The signal from the sensor 16 which senses the "critical" temperature in the compartment 8 has precedence in the control of the compressor or motor-compressor unit 4. In this respect, when this temperature appears, the motor-compressor unit is in any event halted (and is not further caused to operate) as this signifies

that the temperature in the refrigeration compartment 5 is definitely low and sufficient for food preservation.

The sensors 15 and 16 are represented in Figure 1 by symbols known to the expert of the art and are therefore not further described.

The device of Figure 1, operating by the method described hereinafter, is completely electronic and comprises a unit 1 which, as stated, is preferably a microprocessor comprising usual analog/digital converters (not shown) which receive the electrical signals in analog form from the sensors 15, 16 and from the potentiometer 17 and convert them into digital signals which can be processed by the unit 1.

In Figures 2 and 3 (in which parts corresponding to those of the already described figures are indicated by the same reference numerals), the unit 1 is preferably a microprocessor circuit without analog/digital converters as it is no longer connected to a potentiometer or to NTC sensors (the function of which is performed by the unit 1 by presetting temperature data), it being connected instead to an electronic interface 30 of known type (from which the unit 1 receives signals at its input) based on a 14 stage binary counter 31 with an internal oscillator enabling a digital signal (V_D) to be generated as output; analog/digital conversion can be achieved with a standard internal timed event counter. The unit 30 is connected to usual electrical components well known to the expert of the art and therefore not further described. It should be noted that the capacitive sensor for detecting frost on the evaporator is connected in parallel with a further capacitor.

The unit 1 is connected to two temperature sensors 33 and 34 for sensing the "critical" temperature of the freezer compartment and evaporator 3 respectively in order to recognize when the defrosting stage has terminated. The sensors 33 and 34 are in the form of usual temperature-controlled relays (klixons).

The unit 1 controls a moving contactor 35 which enables power to be fed to either the compressor 4 (which is consequently operated) or to the electrical defrosting resistance element 2 via an electrical line 39. In the line 36 which connects the contactor 35 to the motor-compressor unit 4 there is a usual moving contactor 37 controlled in known manner by a usual thermostat for example of electromechanical type (not shown).

The method of the invention will now be described in terms of the operation and use of the devices of the described figures.

With reference to Figures 4 to 8, the method is implemented by the device of the invention (via its unit 1) in three main cycles, namely a procedure initiation cycle 40, a refrigeration cycles 41 in which the usual preservation and freezing temperatures are created in the refrigerator 7, and a defrosting cycle 42. This cycle is however partly contained in the cycle 41, as will be described. After the procedure initiation cycle, the cycles 41 and 42 alternate with each other.

With reference to Figure 5, the cycle 40 comprises,

following initial starting of the refrigerator 43, a stage 44 in which the temperature of the evaporator 3 is measured by the sensor 15; during this stage the compressor 4 does not operate and remains in this state until the measured evaporator temperature reaches or exceeds a predetermined value (eg. 4.5°C) beyond which it is certain that no more frost is present on the evaporator. When the temperature reaches this value, the procedure passes to a stage 45 in which the voltage V_d between the plates of the capacitive sensors 10 and 11 (in the form of an electrical signal therefrom) is measured and memorized; this voltage will be considered to be the reference voltage in defining a base value to be used for deciding on the need to defrost the evaporator after stage 41.

The unit 1 then activates the compressor (stage 46) and the (minimum) evaporator temperature is then checked (by the NTC sensor 15) to ascertain that it has not reached the "critical" temperature, equal to a predetermined value (preset the potentiometer 17), for example -24°C. This occurs in stage 47.

If this temperature is reached, the procedure passes to stage 48 in which the compressor is halted, and then to stage 49 in which the evaporator is checked for (maximum acceptable) temperature.

When this reaches a maximum determined value (eg. -5°C), the unit 1 evaluates (in stage 50) the temperature of the freezer compartment 8 (via the sensor 16). If this temperature is not less than a predetermined value (critical temperature), eg. -21°C, the compressor 4 is returned to operation and the procedure returns to stage 46. If it is less, then the procedure passes to the refrigeration cycle 41. It should be noted that the freezer critical temperature is normally never reached. However if the refrigerator were to be located in an environment in which there is a relatively low temperature (for example 10°C), as the heat losses through the usual refrigerator insulation are different for the freezer compartment 8 than for the preservation compartment 5 it can happen that whereas the sensor 15 on the evaporator measures a temperature sufficient to maintain the compartment 5 at an adequate value, the sensor 16 in the freezer compartment shows that there is too high a temperature greater than this latter; in this case cycle 41 is implemented, ie the compressor is returned to operation.

If however the temperature at the evaporator is relatively high (greater than -5°C) but the temperature in the compartment 8 is insufficiently low, the procedure returns to stage 46, ie the compressor is returned to operation without entering the cycle 41, which would also operate the electrical resistance element 2, as will be described. This is because it is obviously not necessary to defrost the evaporator.

In this latter (see Figure 6) the compressor is activated (stage 51), after which (stage 52) the temperature of the compartment 8 is again measured to determine if it is below a minimum acceptable value (-24°C). If it is

not less than this critical temperature (-24°C), the compressor is maintained in operation. If it is less, the compressor is halted (stage 53) by the unit 1, which then evaluates whether the freezer temperature is less than the said -21°C (stage 54). If it is less, the unit 1 activates the electrical resistance element 2 for usual evaporator defrosting (stage 55), performed within the cycle 41 under examination (not to be confused with that performed within the cycle 42, which is of longer duration).

Following stage 54 and if the evaporator temperature is not less than -21°C, after a sufficiently long predetermined time (eg. 2 minutes) the unit executes stage 56 in which it evaluates (via the sensor 15) whether the evaporator temperature exceeds a maximum acceptable value (-5°C) (ie it detects when the maximum acceptable evaporator temperature is reached). If this temperature is unacceptable it returns to stage 53. Alternatively (if the temperature in stage 55 exceeds -5°C due to the activation of the resistance element 2), defrosting is halted by deactivating the element heating the evaporator (stage 57), and the voltage (V_F) across the capacitive sensors 10 and 11 is measured (by the electrical signals originating from them) (stage 59). If this voltage is greater than or equal to the previously memorized voltage V_d and if the ratio of these voltages exceeds a predetermined coefficient (for example by 10% or double, etc.), the unit 1 executes the defrosting cycle 42. The reference value is preferably equal to the value V_d increased by a percentage (or by a predefined coefficient); the measured value V_F is compared with this value (by the unit 1, which contains usual comparison means such as comparators, logic gates or the like).

If V_F is less than V_d (or a multiple thereof), the unit 1 returns to stage 51.

In the case of defrosting, the unit 1 activates the resistance element 2 in stage 60 and then checks the evaporator temperature (stage 61). When this exceeds the value at which all the frost is sure to have melted (4.5°C), the unit 1 deactivates the resistance element 2 (stage 62) and proceeds to measure the voltage across the plates of each capacitive sensor 10 and 11 (stage 63). In this manner a value V_d is defined (then multiplied by the correction percentage coefficient, or not), which can also be different from the value V_d previously defined in stage 45.

The unit 1 then determines a delay in starting the compressor equal to a minimum time necessary to be certain that the evaporator 3 has been defrosted (stage 64) and then restarts the refrigeration cycle (ie the stage 51).

The unit 1 executes the aforesaid stages in continuation. In particular the determination of the temperature of the evaporator 3 and of the freezer compartment and the comparison of the signals (V_F) from the capacitive sensors (10, 11) with the memorized and corrected signal (V_d) can be performed continuously during each cycle 40, 41 or 42 of operation of the refrigerator 7 or during successive time periods at equal times apart.

It should be noted that (with reference to Figure 8 in which parts corresponding to those of the already described figures are indicated by the same reference numerals), in order to comply with current regulations, following stage 59 and whenever the measured V_F value is not greater than or equal to V_d , the unit 1 executes a stage 70 in which it investigates whether the refrigeration cycle 41 has been underway continuously for more than a predetermined time period (for example 72 hours). If it has, then the unit 1 resets a counter (stage 71) which measures the duration of each cycle 41 and then executes the cycle 42 (ie the stage 60). If it has not, then it executes stage 51.

Consequently according to the method of the invention and using the described device, frost formation on the evaporator 3 is evaluated by evaluating a dynamic reference value which varies for each particular refrigerator and according to the temperature of the environment in which the refrigerator is situated, this reference value, suitably corrected by a predefined factor (a percentage, eg. 10%, or a multiple) acting as the basis for comparison with an "actual" value corresponding to frost formation on the evaporator. It should be noted that this value can also vary in accordance with the constructional details of the refrigerator 7 and its use.

In this manner, costly and lengthy operations involved in setting the device are avoided and in addition the device is used more correctly.

Different embodiments of the device have been described. Other embodiment are however possible within the light of the present description (such as embodiments in which the evaluation of V_F in stage 58 is not preceded by any evaporator defrosting - as in stage 55 - but is effected directly after stage 54).

Claims

1. A method for controlling frost formation on a refrigerator evaporator, with said evaporator there being associated capacitive sensor means positioned at the evaporator of the refrigerator and connected to evaporator defrosting control means which activate a usual electrical resistance element associated with said evaporator following stoppage of the usual compressor, characterised by measuring and memorizing, subsequent to initial starting of the refrigerator (7) and after each defrosting cycle (42) of the evaporator (3), an electrical signal (V_d) generated by the capacitive sensor (10, 11) and comparing this memorized signal (V_d) with actual electrical signals (V_F) generated by said sensor means (10, 11) during the use of the refrigerator (7) following each defrosting cycle (42) or the initial starting, the refrigerator (7) being halted for a subsequent defrosting cycle whenever the actual signals (V_F) differ from the memorized signals (V_d) by more than a certain predetermined value.
2. A method as claimed in claim 1, characterised in that during the starting cycle (40) of the refrigerator (7) the evaporator temperature is measured and compared with a predetermined temperature at which the frost on said evaporator has at least largely melted, and if the measured temperature is found to be greater than or equal to the predetermined temperature, the electrical signal (V_d) generated by the sensor means (10, 11) is measured and memorized following this comparison and then compared with the actual signal (V_F) emitted by these latter.
3. method as claimed in claim 1, characterised in that during the starting cycle (40) the evaporator temperature is checked for minimum and maximum acceptable value, and when this latter is achieved and exceeded the temperature in the freezer compartment (8) is measured in order to decide whether or not to start the operating cycle (41) of the refrigerator (7), ie its refrigeration cycle.
4. A method as claimed in claim 1, characterised in that during the refrigeration cycle (41) the evaporator temperature is checked for minimum acceptable value, and if this is attained the temperature of the freezer compartment (8) is measured following stoppage of the compressor (4), and if this is less than a minimum acceptable value the evaporator heating element (2) is activated for a limited period, said activation being followed by measuring the evaporator temperature for maximum acceptable value, the attaining and exceeding of which resulting in deactivation of said element (2) and measurement of the actual electrical signal (V_F) emitted by the capacitive sensor means, said measurement being followed by comparison between said actual signal and the memorized signal, the evaporator defrosting cycle (42) then being executed if the ratio of these signals exceeds a certain predetermined value.
5. A method as claimed in claim 1 or 4, characterised in that the predetermined value is a correction value for the memorized signal (V_d) emitted by the capacitive sensor means (10, 11), said correction value being a percentage value or a determined numerical multiplier.
6. A method as claimed in claim 1, characterised in that the defrosting cycle (42) comprises activating the heating element (2) until the evaporator temperature reaches or exceeds a value at which the frost on said evaporator is sure to have largely melted, after which said element (2) is deactivated and the electrical signal from the capacitive sensor means (10, 11) is evaluated and memorized to replace the corresponding previously memorized signal (V_d).

the refrigeration cycle (41) then being restarted after a sufficiently long preset delay period.

7. A method as claimed in claim 1, characterised in that the comparison between the memorized signal (V_d) and the actual signals (V_F) is effected continuously. 5
8. A method as claimed in claim 1, characterised in that the comparison between the memorized signal (V_d) and the actual signals (V_F) is effected at discrete time intervals. 10
9. A method as claimed in claim 2 or 4 or 6, characterised in that the temperature evaluation of the evaporator (3) and freezer compartment (8) is effected continuously. 15
10. A method as claimed in claim 2 or 4 or 6, characterised in that the temperature evaluation of the evaporator (3) and freezer compartment (8) is effected at discrete time intervals. 20
11. A method as claimed in claim 1, characterised in that the defrosting cycle (42) is effected after a predetermined time period during which the presence of excessive frost on the evaporator is not detected. 25
12. A refrigerator in which the method of claim 1 is implemented, comprising an evaporator, capacitive sensor means positioned at the evaporator at least one food preservation compartment, at least one heating element for defrosting said evaporator, and heating element control means connected to said sensor means, characterised in that said control means (1) comprise means for memorizing an electrical signal (V_d) generated by said sensor means (10, 11) subsequent to initial starting (40) of the refrigerator (7) and subsequent to each evaporator defrosting cycle (42), comparator means for comparing said memorized signal (V_d) with actual signals (V_F) generated by said sensor means (10, 11) during normal use of the refrigerator (7), ie during execution of the usual refrigeration cycle (41) between two successive defrostings (42) or after the starting (40) of the refrigerator (7), and operating means for stopping the compressor (4) and for operating the heating element (2) whenever said comparator means detect that the ratio of said memorized signal (V_d) to the actual signals (V_F) exceeds a predetermined value. 30 35 40 45 50
13. A refrigerator as claimed in claim 12, characterised in that the memorizing means, the comparator means and the operating means are a microprocessor unit (1). 55
14. A refrigerator as claimed in claim 13, characterised

in that the microprocessor unit (1) is connected to temperature sensors (15, 16) associated respectively with the evaporator (3) and the freezer compartment (8), and to regulator means (17) for setting temperature values for comparison with corresponding actual values measured by said sensors (15, 16) during refrigerator operation.

15. A refrigerator as claimed in claim 13, characterised in that the microprocessor unit (1) controls usual moving contactor means (35) for activating the compressor (4) and the heating element (2).

15 Patentansprüche

1. Verfahren zur Steuerung der Eisbildung auf einem Kühlschrankverdampfer, mit dem kapazitive Sensormittel verbunden sind, die am Verdampfer angeordnet und mit Steuermitteln zur Verdampferenteisung verbunden sind, welche ein mit dem Verdampfer verbundenes, übliches, elektrisches Widerstandselement aktivieren, wobei diese Aktivierung nach dem Ausschalten des üblichen Kompressors erfolgt, **dadurch gekennzeichnet**, daß ein durch den kapazitiven Sensor (10, 11) erzeugtes, elektrisches Signal (V_d) beim Anfangsstart des Kühlschranks (7) und nach jedem Enteisungszyklus (42) des Verdampfers (3) aufeinanderfolgend gemessen und gespeichert wird, daß das gespeicherte Signal (V_d) mit dem aktuellen, elektrischen Signal (V_F) verglichen wird, das durch die Sensormittel (10, 11) während des Gebrauchs des Kühlschranks (7) nach jedem Enteisungszyklus (42) oder Anfangsstart erzeugt wird, und daß der Kühlschrank (7) für die Dauer eines nachfolgenden Enteisungszyklus ausgeschaltet wird, und zwar immer dann, wenn die aktuellen Signale (V_F) von den gespeicherten Signalen (V_d) um mehr als einen gewissen, vorbestimmten Wert abweichen.
2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Verdampferetemperatur während des Startzyklus (40) des Kühlschranks (7) gemessen wird und mit einer vorbestimmten Temperatur verglichen wird, bei der das Eis auf dem Verdampfer mindestens größtenteils geschmolzen ist, und daß in demjenigen Fall, in dem sich herausgestellt hat, daß die gemessene Temperatur größer als die vorbestimmte Temperatur oder gleich der vorbestimmten Temperatur ist, das durch die Sensormittel (10, 11) erzeugte, elektrische Signal (V_d) nach dem genannten Vergleich gemessen und gespeichert und dann mit dem von den Sensormitteln abgegebenen, aktuellen Signal (V_F) verglichen wird.
3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Verdampferetemperatur während des

- Startzyklus (40) auf einen minimalen und maximalen, annehmbaren Wert hin geprüft wird und daß beim Erreichen und Überschreiten des maximalen, annehmbaren Werts die Temperatur im Gefrierfach (8) gemessen wird, um zu entscheiden, ob der Arbeitszyklus (41), nämlich der Kühlzyklus, des Kühlschranks beginnen soll.
4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Verdampferetemperatur während des Kühlzyklus (41) auf einen minimalen, annehmbaren Wert hin geprüft wird, daß beim Erreichen dieses Werts und nach dem Ausschalten des Kompressors (4) die Temperatur des Gefrierfachs (8) gemessen wird und daß in demjenigen Fall, in dem die Temperatur des Gefrierfachs geringer als ein minimaler, annehmbarer Wert ist, das Verdampferheizelement (2) für eine begrenzte Zeitdauer eingeschaltet wird, wobei diesem Einschalten das Messen der Verdampferetemperatur für den maximalen, annehmbaren Wert folgt, dessen Erreichen und Überschreiten zum Ausschalten des Heizelements (2) und zum Messen des von den kapazitiven Sensormitteln abgegebenen, aktuellen Signals führt, und wobei auf dieses letztgenannte Messen ein Vergleich zwischen dem aktuellen Signal und dem gespeicherten Signal folgt und wobei ferner dann der Verdampferenteisungszyklus (42) ausgeführt wird, wenn das Verhältnis dieser Signale einen gewissen, vorbestimmten Wert überschreitet.
5. Verfahren nach Anspruch 1 oder 4, dadurch gekennzeichnet, daß der vorbestimmte Wert ein Korrekturwert für das von den kapazitiven Sensormitteln (10, 11) abgegebene, gespeicherte Signal (V_d) ist, wobei der Korrekturwert ein Prozentsatzwert oder ein vorbestimmter, numerischer Faktor ist.
6. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Enteisungszyklus (42) folgende Vorgänge umfaßt:
- das Heizelement (2) wird eingeschaltet, bis die Verdampferetemperatur einen Wert erreicht oder überschreitet, bei dem das Eis auf dem Verdampfer sicher größtenteils geschmolzen ist,
 - danach wird das Heizelement (2) ausgeschaltet, und das von den kapazitiven Sensormitteln (9, 10) kommende, elektrische Signal wird ausgewertet und gespeichert, um das entsprechende, vorher gespeicherte Signal (V_d) zu ersetzen, und
 - dann wird der Kühlzyklus (41) nach einer genügend langen, voreingestellten Verzögerungsdauer wieder eingeleitet.
7. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Vergleich zwischen dem gespeicherten Signal (V_d) und den aktuellen Signalen (V_F) stetig ausgeführt wird.
8. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Vergleich zwischen dem gespeicherten Signal (V_d) und den aktuellen Signalen (V_F) in diskreten Zeitintervallen ausgeführt wird.
9. Verfahren nach Anspruch 2, 4 oder 6, dadurch gekennzeichnet, daß die Auswertung der Temperatur des Verdampfers (3) und des Gefrierfachs (8) stetig ausgeführt wird.
10. Verfahren nach Anspruch 2, 4 oder 6, dadurch gekennzeichnet, daß die Auswertung der Temperatur des Verdampfers (3) und des Gefrierfachs (8) in diskreten Zeitintervallen ausgeführt wird.
11. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Enteisungszyklus (42) nach einer vorbestimmten Zeitdauer eingeleitet wird, während der die Anwesenheit von erheblichem Eis auf dem Verdampfer nicht festgestellt worden ist.
12. Kühlschrank, bei dem das Verfahren gemäß Anspruch 1 durchgeführt wird und der einen Verdampfer, am Verdampfer angeordnete, kapazitive Sensormittel, mindestens ein Speisefrischhaltefach, mindestens ein Heizelement zur Enteisung des Verdampfers und mit den Sensormitteln verbundene Steuermittel für das Heizelement aufweist, **dadurch gekennzeichnet**, daß die Steuermittel (1) folgendes aufweisen:
- Mittel zur Speicherung eines elektrischen Signals (V_d), das von den Sensormitteln (10, 11) auf den Anfangsstart (40) des Kühlschranks (7) hin und bei jedem Verdampferenteisungszyklus (42) erzeugt wird,
 - Komparatormittel zum Vergleich des gespeicherten Signals (V_d) mit von den Sensormitteln (10, 11) während des normalen Gebrauchs des Kühlschranks (7), d.h. während der Durchführung des üblichen Kühlzyklus (41) zwischen zwei aufeinanderfolgenden Enteisungen oder nach dem Start (40) des Kühlschranks (7), erzeugten, aktuellen Signalen (V_F) und
 - Operationsmittel zum Ausschalten des Kompressors (4) und zum Einschalten des Heizelements (2), das immer dann eingeschaltet wird, wenn die Komparatormittel feststellen, daß das Verhältnis des gespeicherten Signals (V_d) zu den aktuellen Signalen (V_F) einen vorbestimmten Wert überschreitet.
13. Kühlschrank nach Anspruch 12, dadurch gekennzeichnet, daß die Speichermittel, die Komparator-

mittel und die Operationsmittel durch eine Mikroprozessoreinheit (1) gebildet sind.

14. Kühlschrank nach Anspruch 13, dadurch gekennzeichnet, daß die Mikroprozessoreinheit (1) mit Temperatursensoren (15, 16), von denen jeweils einer dem Verdampfer (3) und dem Gefrierfach (8) zugehört, und mit Einstellmitteln (17) zur Einstellung von Temperaturwerten für den Vergleich mit von den Sensoren (16, 16) während des Kühlschrankbetriebs gemessenen, entsprechenden, aktuellen Werten verbunden ist.
15. Kühlschrank nach Anspruch 13, dadurch gekennzeichnet, daß die Mikroprozessoreinheit (1) übliche Kontaktarmittel (35) zum Einschalten des Kompressors (4) und des Heizelements (2) steuert.

Revendications

1. Procédé de contrôle de la formation de givre sur un évaporateur de réfrigérateur, un moyen de capteur capacitif positionné au niveau de l'évaporateur du réfrigérateur et connecté à un moyen de commande de dégivrage d'évaporateur étant associé audit évaporateur, lequel active un élément de résistance électrique habituel associé audit évaporateur suite à l'arrêt du compresseur habituel, caractérisé par la mesure et la mémorisation, suite à un démarrage initial du réfrigérateur (7) et après chaque cycle de dégivrage (42) de l'évaporateur (3), d'un signal électrique (V_d) généré par le capteur capacitif (10, 11) et par la comparaison de ce signal mémorisé (V_d) avec des signaux électriques réels (V_F) générés par ledit moyen de capteur (10, 11) pendant l'utilisation du réfrigérateur (7) suite à chaque cycle de dégivrage (42) ou au démarrage initial, le réfrigérateur (7) étant arrêté pendant un cycle de dégivrage suivant chaque fois que les signaux réels (V_F) diffèrent des signaux mémorisés (V_d) de plus d'une certaine valeur prédéterminée.
2. Procédé selon la revendication 1, caractérisé en ce que, pendant le cycle de démarrage (40) du réfrigérateur (7), la température de l'évaporateur est mesurée et est comparée à une température prédéterminée à laquelle le givre sur ledit évaporateur a au moins largement fondu et si la température mesurée s'avère être supérieure ou égale à la température prédéterminée, le signal électrique (V_d) généré par le moyen de capteur (10, 11) est mesuré et mémorisé suite à cette comparaison puis est comparé au signal réel (V_F) émis par ce dernier.
3. Procédé selon la revendication 1, caractérisé en ce que, pendant le cycle de démarrage (40), la température de l'évaporateur est vérifiée quant à une va-

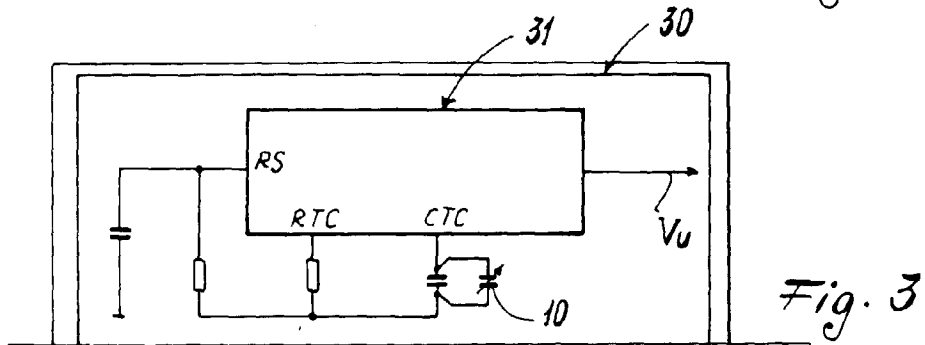
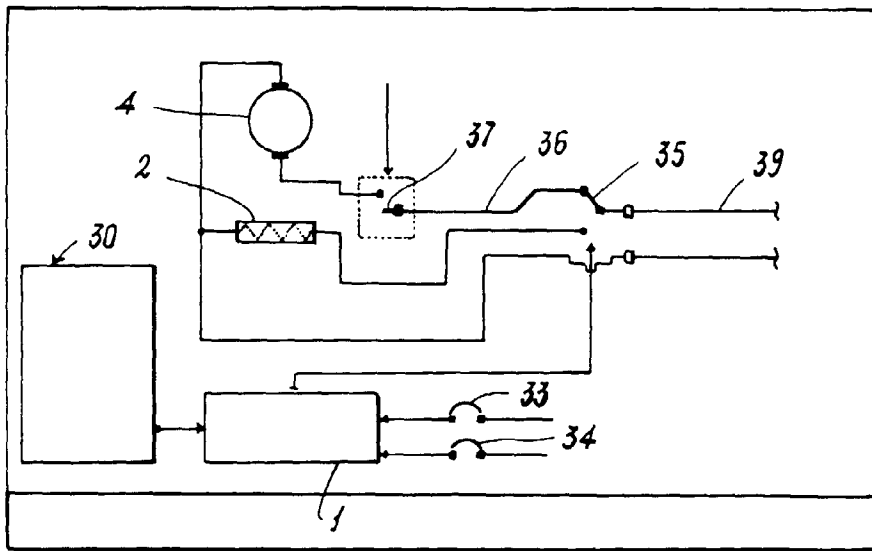
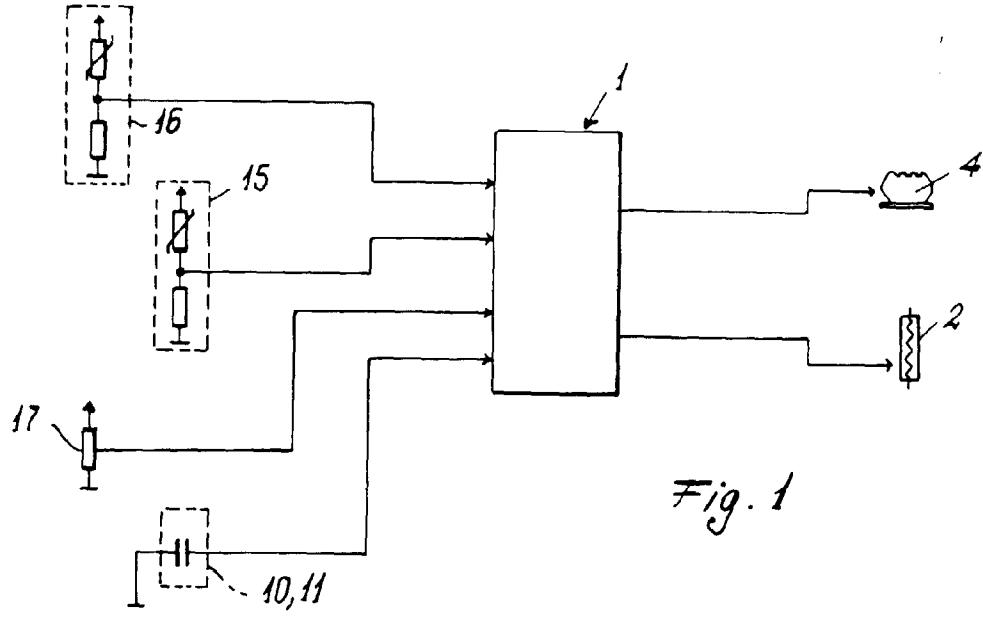
leur minimum acceptable et une valeur maximum acceptable et lorsque cette dernière est atteinte et dépassée, la température du compartiment de congélation (8) est mesurée afin de décider si oui ou non il convient de démarrer le cycle de fonctionnement (41) du réfrigérateur (7), c'est-à-dire son cycle de réfrigération.

4. Procédé selon la revendication 1, caractérisé en ce que, pendant le cycle de réfrigération (41), la température de l'évaporateur est vérifiée quant à une valeur acceptable minimum et si celle-ci est atteinte, la température du compartiment de congélation (8) est mesurée suite à l'arrêt du compresseur (4) et si celle-ci est inférieure à une valeur acceptable minimum, l'élément de chauffage d'évaporateur (2) est activé pendant une période limitée, ladite activation étant suivie par la mesure de la température de l'évaporateur quant à une valeur acceptable maximum dont l'atteinte et le dépassement aboutit à la désactivation dudit élément (2) et à la mesure du signal électrique réel (V_F) émis par le moyen de capteur capacitif, ladite mesure étant suivie par une comparaison entre ledit signal réel et le signal mémorisé; le cycle de dégivrage d'évaporateur (42) étant alors exécuté si le rapport de ces signaux excède une certaine valeur prédéterminée.
5. Procédé selon la revendication 1 ou 4, caractérisé en ce que la valeur prédéterminée est une valeur de correction pour le signal mémorisé (V_d) émis par le moyen de capteur capacitif (10, 11), ladite valeur de correction étant une valeur de pourcentage ou un multiplicateur numérique déterminé.
6. Procédé selon la revendication 1, caractérisé en ce que le cycle de dégivrage (42) comprend l'activation de l'élément chauffant (2) jusqu'à ce que la température de l'évaporateur atteigne ou excède une valeur à laquelle on est sûr que le givre sur ledit évaporateur a fondu largement, après quoi ledit élément (2) est désactivé et le signal électrique provenant du moyen de capteur capacitif (10, 11) est évalué et mémorisé afin de remplacer le signal mémorisé préalablement correspondant (V_d), le cycle de réfrigération (41) étant alors redémarré après une période de retard pré-établie suffisamment longue.
7. Procédé selon la revendication 1, caractérisé en ce que la comparaison entre le signal mémorisé (V_d) et les signaux réels (V_F) est réalisée en continu.
8. Procédé selon la revendication 1, caractérisé en ce que la comparaison entre le signal mémorisé (V_d) et les signaux réels (V_F) est réalisée selon des intervalles temporels discrets.
9. Procédé selon la revendication 2, 4 ou 6, caracté-

risé en ce que l'évaluation de la température de l'évaporateur (3) et du compartiment de congélation (8) est réalisée en continu.

10. Procédé selon la revendication 2, 4 ou 6, caracté- 5
risé en ce que l'évaluation de la température de
l'évaporateur (3) et du compartiment de congélation
(8) est réalisée selon des intervalles temporels dis-
crets. 10
11. Procédé selon la revendication 1, caractérisé en ce
que le cycle de dégivrage (42) est réalisé après une
période temporelle prédéterminée pendant laquelle
la présence de givre en une quantité excessive sur
l'évaporateur n'est pas détectée. 15
12. Réfrigérateur dans lequel le procédé de la revendi-
cation 1 est mis en oeuvre, comprenant un évapo-
rateur, un moyen de capteur capacitif positionné au
niveau de l'évaporateur, au moins un compartiment
de conservation de nourriture, au moins un élément
chauffant pour dégivrer ledit évaporateur et un
moyen de commande d'élément chauffant connec-
té audit moyen de capteur, caractérisé en ce que
ledit moyen de commande (1) comprend un moyen 25
pour mémoriser un signal électrique (V_d) généré par
ledit moyen de capteur (10, 11) suite à un démarra-
ge initial (40) du réfrigérateur (7) et suite à chaque
cycle de dégivrage d'évaporateur (42), un moyen
de comparateur pour comparer ledit signal mémo-
risé (V_d) à des signaux réels (V_F) générés par ledit
moyen de capteur (10, 11) pendant une utilisation
normale du réfrigérateur (7), c'est-à-dire pendant
une exécution du cycle de réfrigération habituel (41)
entre deux dégivrages successifs (42) ou après le
démarrage (40) du réfrigérateur (7) et un moyen de
fonctionnement pour arrêter le compresseur (4) et
pour faire fonctionner l'élément chauffant (2) cha-
que fois que ledit moyen de comparateur détecte
que le rapport dudit signal mémorisé (V_d) sur les
signaux réels (V_F) excède une valeur prédétermi-
née. 40
13. Réfrigérateur selon la revendication 12, caractérisé
en ce que le moyen de mémorisation, le moyen de 45
comparateur et le moyen de fonctionnement sont
une unité de microprocesseur (1).
14. Réfrigérateur selon la revendication 13, caractérisé
en ce que l'unité de microprocesseur (1) est con- 50
nectée à des capteurs de température (15, 16) as-
sociés respectivement à l'évaporateur (3) et au
compartiment de congélation (8), et à un moyen de
régulateur (17) pour établir des valeurs de tempé-
rature en vue d'une comparaison avec des valeurs 55
réelles correspondantes mesurées par lesdits cap-
teurs (15, 16) pendant un fonctionnement de réfri-
gérateur.

15. Réfrigérateur selon la revendication 13, caractérisé
en ce que l'unité de microprocesseur (1) commande
un moyen de contacteur mobile habituel (35) pour
activer le compresseur (4) et l'élément chauffant
(2).



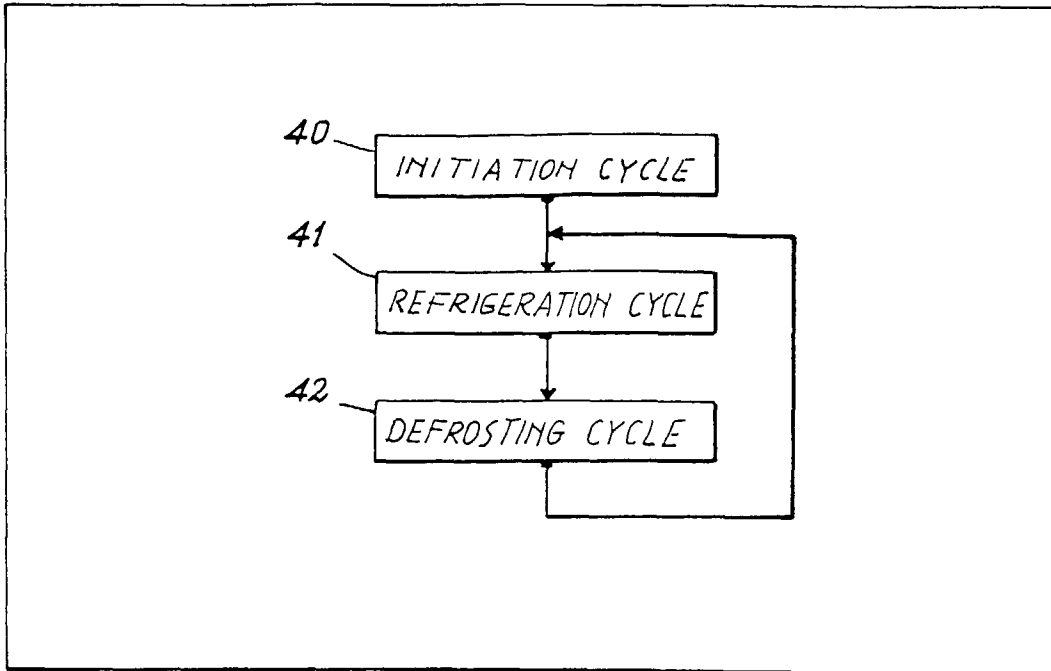


Fig. 4

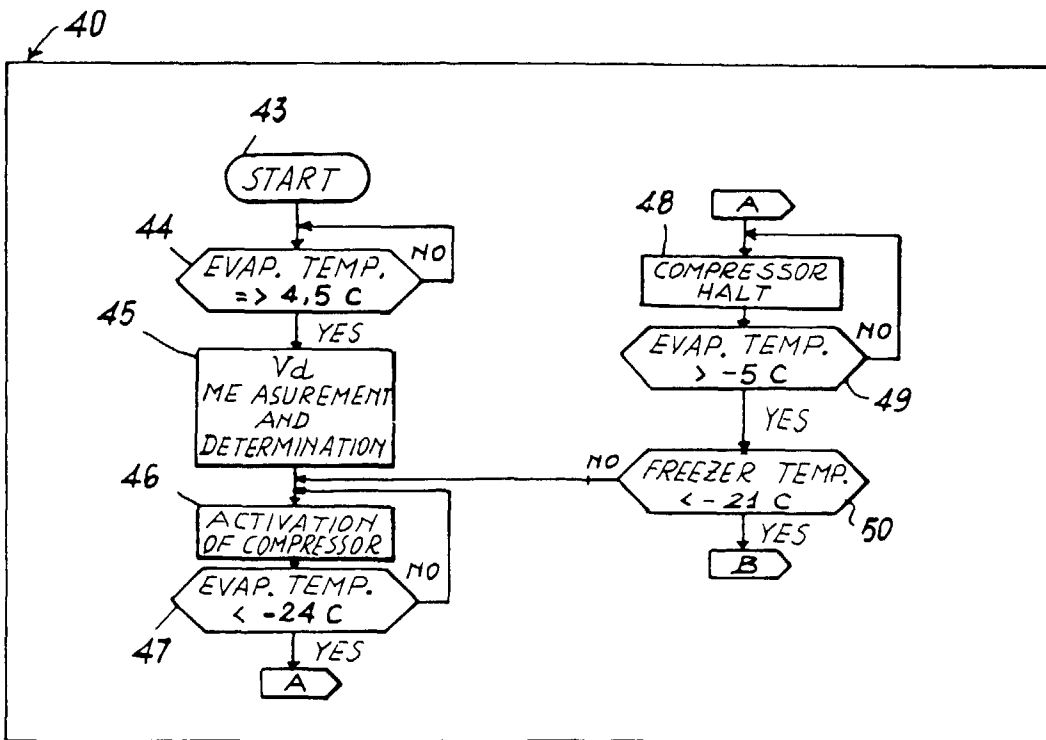


Fig. 5

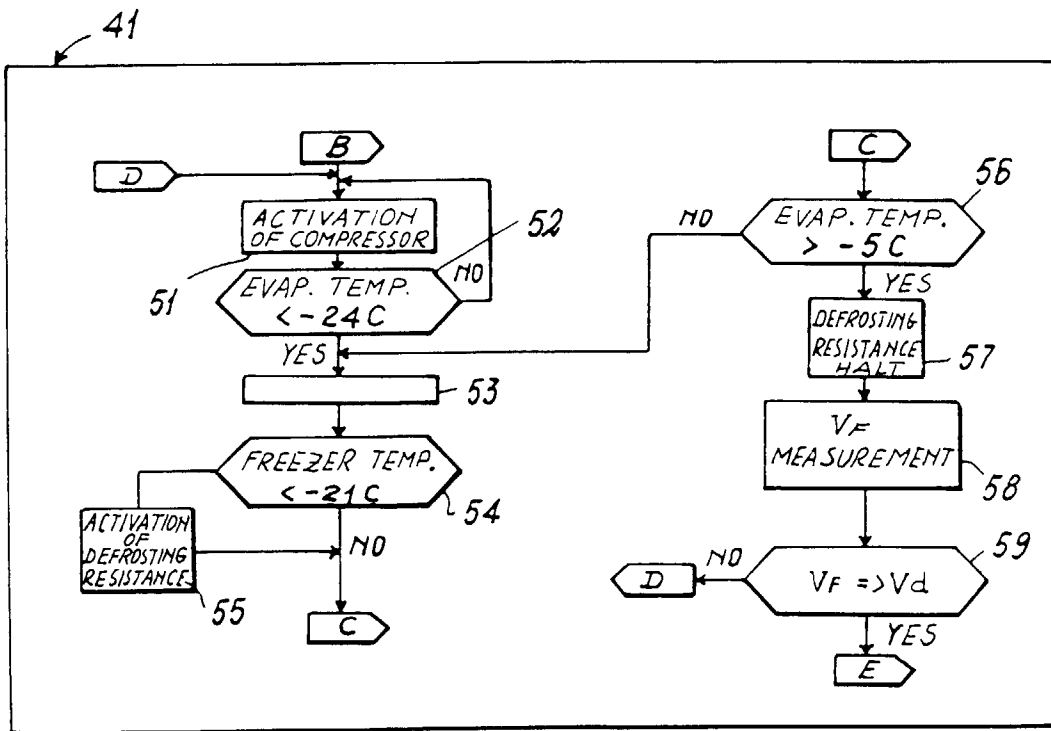


Fig. 6

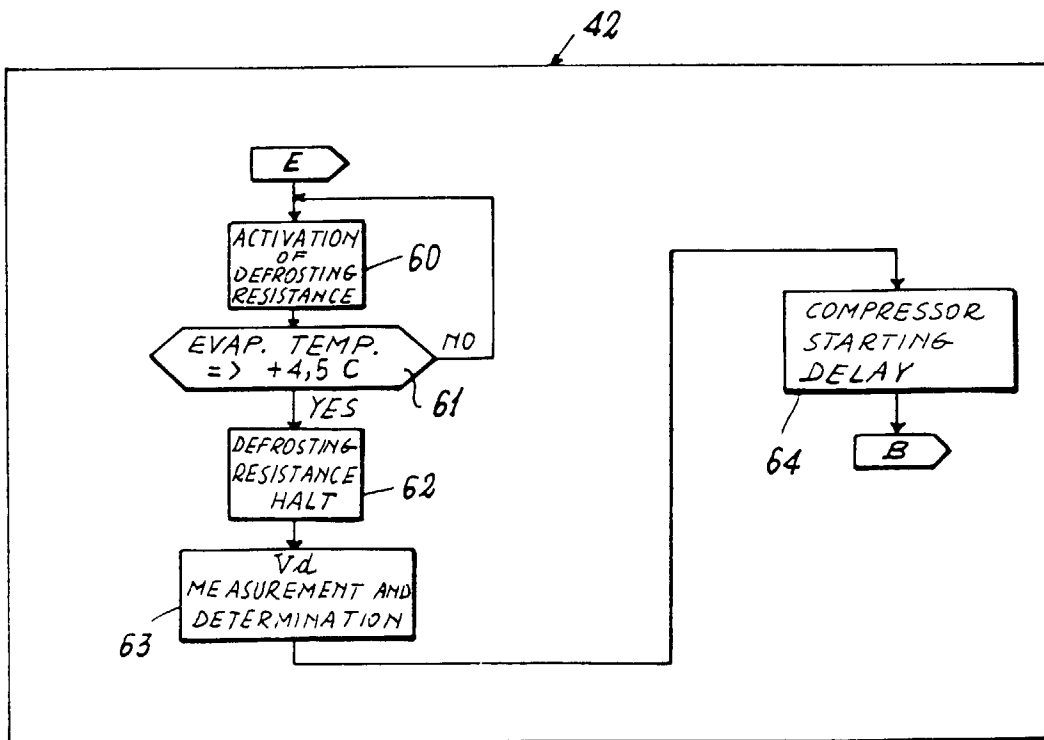


Fig. 7

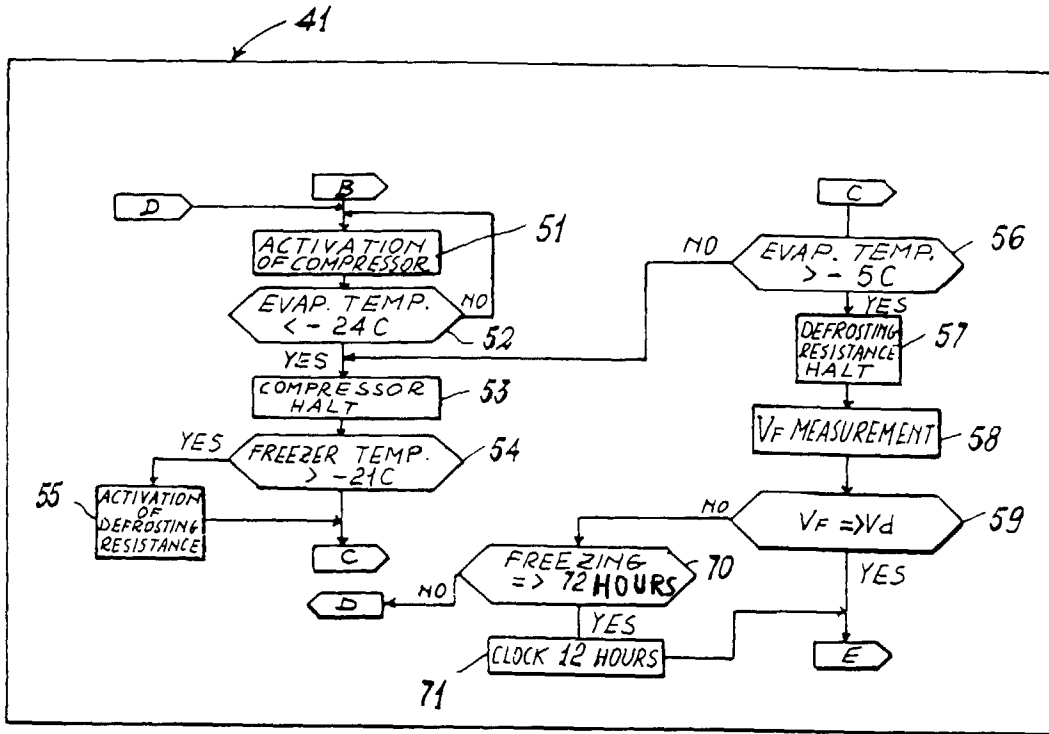


Fig. 8

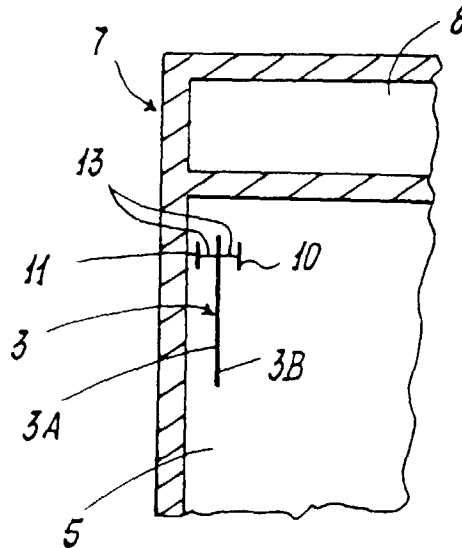


Fig. 9