



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 510 769 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication: **02.03.2005 Bulletin 2005/09** (51) Int Cl.7: **F25D 29/00, F25D 17/06**

(21) Application number: **04077036.4**

(22) Date of filing: **14.07.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(72) Inventors:
• **Facco, Amelio**
35010 Marsango Padova (IT)
• **Dalla Tor, Paolo**
30020 Gaggio di Marcon Venezia (IT)

(30) Priority: **29.08.2003 IT MI20031682**

(74) Representative: **Coppo, Alessandro et al**
Ing. Barzanò & Zanardo Milano S.p.A.,
Via Borgonuovo, 10
20121 Milano (IT)

(71) Applicant: **Afinox S.r.l.**
35010 Marsango (Padova) (IT)

(54) **Method and system for the refrigeration of food products**

(57) System for the refrigeration of a food product inside an insulated cell equipped with a refrigerating unit, a temperature measurement sensor of said food product and a measurement sensor of the temperature inside the cell, comprising an electronic control unit

which controls said refrigerating unit and receives the measurements from said sensors, said electronic control unit being capable of calculating a descent index of the product obtained by measuring the temperature inside the cell and the temperature of the food product in pre-selected successive moments of time.

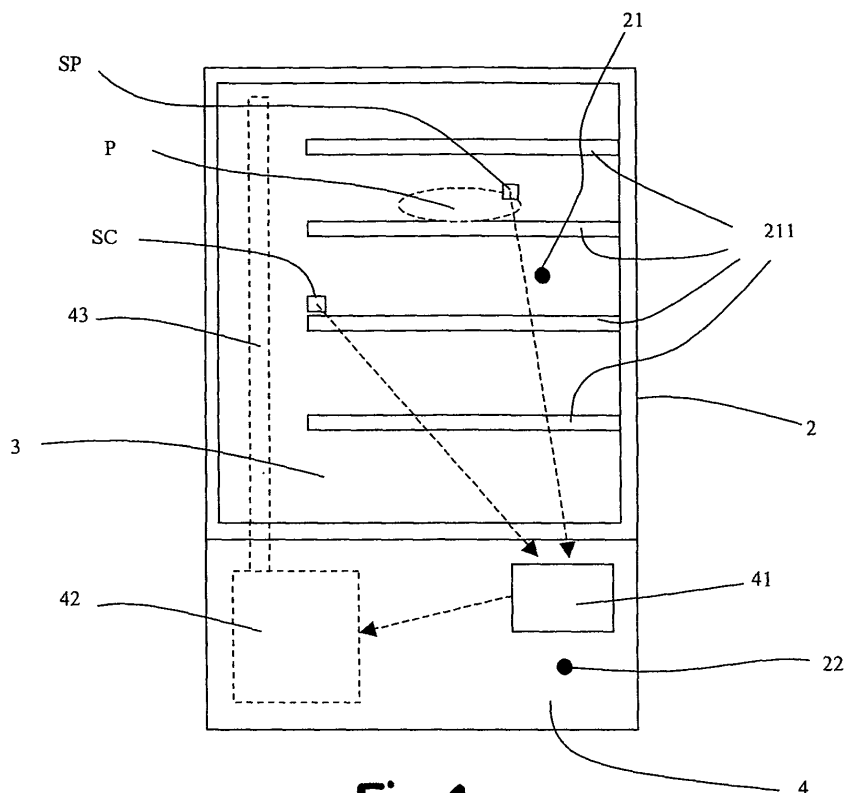


Fig.1

EP 1 510 769 A1

Description

[0001] The present invention relates to a method and system for the refrigeration of food products. In particular, the present invention relates to a method and system for the rapid lowering of the temperature of food products situated inside an insulated cell.

[0002] For the purposes of the present invention, rapid lowering of the temperature refers to the passage of a food product from a high positive temperature, for example 80°C, to a temperature lower than 10°C, for example 3°C within a time period ranging from 90 minutes to 110 minutes.

[0003] This lowering must be rapid to limit to the maximum, the formation of the bacterial charge which is formed and multiplies between 10°C and 65°C.

[0004] Insulated cells in which there is a cooling body, consisting of a cooling circuit possibly assisted by one or more fans suitable for circulating air to increase the convection coefficient inside the cell, are known in the state of the art.

[0005] Current cooling cycles do not take into account the different types of food, their different dimensions and physical characteristics. A few regulation possibilities are envisaged which only partially consider these differences. Furthermore, an incorrect use of these regulations could harm the organoleptic properties of food, its healthiness or preservation.

[0006] The Applicant has dealt with the problem of providing an efficient and homogenous cooling process for the rapid lowering of the temperature of food situated inside an insulated cell, in which the food products can have varying characteristics.

[0007] The Applicant has conceived a method for the refrigeration of food products in which, by means of a monitoring of the parameters acquired inside a refrigeration cell containing food, at least one of a series of predetermined modes or procedures is autonomously selected for rapidly lowering the temperature of food, respecting the maximum time limit established by the specifications and at the same time guaranteeing the best preservation of the organoleptic properties and healthiness of the food product.

[0008] The parameters acquired inside the cell are preferably parameters associated with the temperature of the environment and food products.

[0009] The criteria for selecting the cooling procedure can be manually inserted or obtained with a self-acquisition method in the sense that the selection criteria of the temperature lowering procedure can be redefined in relation to the performance of the apparatus by means of a self-acquisition cycle.

[0010] An aspect of the present invention relates to a cooling method for a food product inside an insulated cell equipped with a cooling unit, characterized in that it comprises the following phases:

- a) activating a cooling unit with a pre-established functioning procedure, selected from a series of predefined functioning modes,
- b) calculating a descent index of the product obtained by registering the temperature inside the cell and the temperature of the food product in two predetermined successive moments of time,
- c) on the basis of said calculated index, selecting a functioning procedure chosen from said series of predefined functioning modes,
- d) repeating phases b) and c) for a predefined number of times at pre-selected time intervals.

[0011] A further aspect of the present invention relates to a system for the cooling of a food product inside an insulated cell equipped with a cooling unit, a temperature measuring sensor of said food product and a measuring sensor of the temperature inside the cell, characterized in that it comprises an electronic control unit which controls said cooling unit and receives the measurements from said sensors, said electronic control unit being capable of calculating a descent index of the product obtained by measuring the temperature inside the cell and the temperature of the food product in pre-selected successive moments of time, and, on the basis of said calculated index, of selecting a functioning mode for said cooling unit, selected from a series of pre-defined functioning modes.

[0012] The characteristics and advantages of the method and system according to the present invention will appear more evident from the following illustrative and nonlimiting description, of an embodiment with reference to the enclosed figures in which:

- figure 1 is a scheme of an insulated cell for the cooling of food products according to the present invention;
- figure 2 is a graph of the temperature registered with time, suitable for calculating the rapid cooling index of the present invention.

[0013] With reference to the above figures, an insulated cell comprises a container body 2, in which there is a compartment for food products 21, whose walls are appropriately insulated and equipped with a series of shelves 211 suitable for housing food products P.

[0014] Below said food compartment 21, there is preferably a control section 22 comprising an electronic control unit 41, equipped with a suitable control push-button board for a user (not shown) and a cooling unit comprising a condensing unit 42 connected to an evaporator 43, which is inserted in the food compartment 2.

[0015] A sensor or probe for detecting the temperature of the cell SC and a sensor or probe SP for detecting the temperature of the food product P, are present in said food compartment.

[0016] Said sensors are connected with said electronic control unit 41, which suitably drives the condensing unit 42 and at least one fan (not shown) situated inside said food compartment.

[0017] The refrigeration system of food products operates in the following way.

[0018] A IDP (Product Descent Index) is obtained from the registration on the part of the sensor of the temperature inside the cell, in the first cooling cycle phases. The calculation of said index is effected on a predetermined number NV of points and is repeated for (NV-1) of times. The number of registrations over a period of time is obviously greater than or equal to two (NV>=2).

[0019] Each time the IDP index is calculated, the data registered at successive moments t_n and t_{n+1} (sampling time Δt) are used, wherein T_c and T represent the temperature of the cell registered by the cell probe and the temperature of the food product registered by the product probe, respectively.

[0020] The formula which allows the IDP index to be calculated is the following:

$$IDP = \frac{K \left(\frac{T_n - T_{n+1}}{t_{n+1} - t_n} \right)}{\sqrt{|T_{n+1}|} \times \sqrt{|T_{n+1} - T_{cn+1}|}}$$

K is a constant coefficient suitable for obtaining easily manageable IDP values (for example values higher than a unit).

[0021] Figure 2 illustrates a graph of the food product temperature TSP and internal temperature of the cell TSC. Three sampling points A, B and C are also indicated.

[0022] The example of the embodiment described envisages four predetermined temperature cooling modes or procedures.

[0023] Further temperature cooling modes or procedures can be included within the scope of the present invention.

[0024] Said cooling modes are defined by four values of said IDP index: IDP; IDP1, IDP2, IDP3 and IDP4, wherein $IDP1 > IDP2 > IDP3 > IDP4 > 0$.

[0025] A first mode identified as "slow cooling" is defined when the IDP index calculated is greater than the IDP1 index, and envisages that the minimum temperature of the cell be defined by a first pre-selected cell parameter CB. In this mode, the velocity of the evaporator fans is regulated at approximately a first pre-selected velocity value FA1.

[0026] A second mode identified as "medium cooling" is defined when the IDP index calculated is less than the IDP1 index and greater than the IDP2 index, and envisages that the minimum temperature of the cell be defined by a first pre-selected cell parameter CB. In this mode, the velocity of the evaporator fans is regulated at approximately a second pre-selected velocity value FA2.

[0027] A third mode identified as "fast cooling" is defined when the IDP index calculated is less than the IDP2 index and greater than the IDP3 index, and envisages that the minimum temperature of the cell be defined by a second pre-selected cell parameter CC. In this mode, the velocity of the evaporator fans is regulated at approximately a third pre-selected velocity value FA3. This regulation of the cell T° is maintained until the temperature measured by the product probe has substantially reached the value of a first pre-selected product parameter CD. When this has been reached, the cell is subsequently regulated in relation to said first pre-selected cell parameter CB.

[0028] A fourth mode identified as "intense cooling" is defined when the IDP index calculated is less than the IDP3 index and greater than the IDP4 index, and envisages that the minimum temperature of the cell be defined by the second pre-selected cell parameter CC. In this mode, the velocity of the evaporator fans is regulated at approximately a fourth pre-selected velocity value FA4. This regulation of the cell temperature is maintained until the temperature measured by the product probe has substantially reached the value of the first pre-selected product parameter CD. When this has been reached, the cell is subsequently regulated in relation to said first pre-selected cell parameter CB.

[0029] The cooling modes described above are terminated when the product probe has reached the desired temperature.

[0030] One of the above cooling modes is selected with each new determination of the IDP index. Furthermore, the starting cooling mode of the system can be selected by the user, the initial mode is preferably the medium cooling procedure.

[0031] When the IDP index registered is lower than the minimum index value (IDP4) for any of the cooling modes, and it is impossible to obtain the temperature cooling in the times envisaged, the "intense cooling" will be effected in any case and at the same time an overload signal will be emitted.

[0032] The IDPn indexes (for example IDP1, IDP2, IDP3 and IDP4) can be inserted manually or they can be obtained by means of a demonstrative self-acquisition cooling mode or procedure of the system.

[0033] Said demonstrative cooling cycle is effected with a "sample" product and the most onerous IDP index, close to the overload value, is determined, by effecting the calculations in a time period higher than that of the sampling tt.

[0034] Said overload index IDS, is calculated referring to two successive moments of time ta and tb (for example at a distance of at least 30 minutes from each other), and with the cell functioning in an intense cooling mode.

$$IDS = \frac{K \left(\frac{T_a - T_b}{t_b - t_a} \right)}{\sqrt{|T_b|} x \sqrt{|T_b - T_{cb}|}}$$

[0035] Once this index has been calculated the IDP1, IDP2, IDP3 and IDP4 indexes can be calibrated, for example as follows:

IDP4 = IDS;
IDP3 = IDS X (IDP3F/IDP4F);
IDP2 = IDS X (IDP2F/IDP4F);
IDP1 = IDS X (IDP1F/IDP4F);

wherein IDP1F, IDP2F, IDP3F and IDP4F are theoretical values inserted manually before effecting the self-acquisition cycle.

Claims

1. A method for the cooling of a food product inside an insulated cell equipped with a cooling unit **characterized in that** it comprises the following phases:

- a) activating a cooling unit with a pre-established functioning procedure, selected from a series of predefined functioning modes,
- b) calculating a descent index of the product obtained by registering the temperature inside the cell and the temperature of the food product in two predetermined successive moments of time,
- c) on the basis of said calculated index, selecting a functioning procedure chosen from said series of predefined functioning modes,
- d) repeating phases b) and c) for a predefined number of times at pre-selected time intervals.

2. The method according to claim 1, wherein said selection phase comprises comparing said calculated index with pre-selected product cooling index values which define times intervals wherein each interval is associated with a functioning mode of said series of functioning modes.

3. The method according to claim 2, wherein said pre-selected product cooling indexes are calculated by activating a self-acquisition mode of the cell, with a food sample and calculating an overload index.

4. The method according to claim 2, wherein said pre-selected product cooling indexes are inserted manually in an electronic control unit of the cell.

5. The method according to claim 2, wherein each cooling mode is associated with a regulation of the cooling unit.

6. A system for the cooling of a food product inside an insulated cell equipped with a refrigerating unit, a temperature measuring sensor of said food product and a measurement sensor of the temperature inside the cell, **characterized in that** it comprises an electronic control unit which controls said refrigerating unit and receives the measurements from said sensors, said electronic control unit being capable of calculating a descent index of the product obtained

EP 1 510 769 A1

by measuring the temperature inside the cell and the temperature of the food product in pre-selected successive moments of time, and, on the basis of said calculated index, of selecting a functioning mode for said cooling unit, selected from a series of predefined functioning modes.

5

10

15

20

25

30

35

40

45

50

55

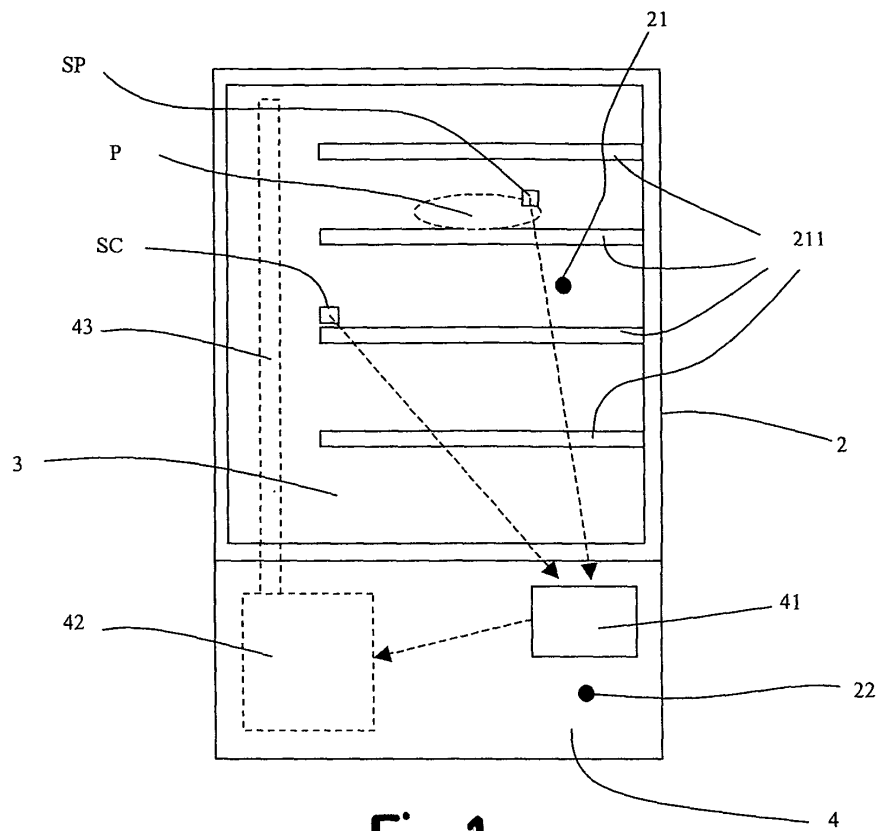


Fig.1

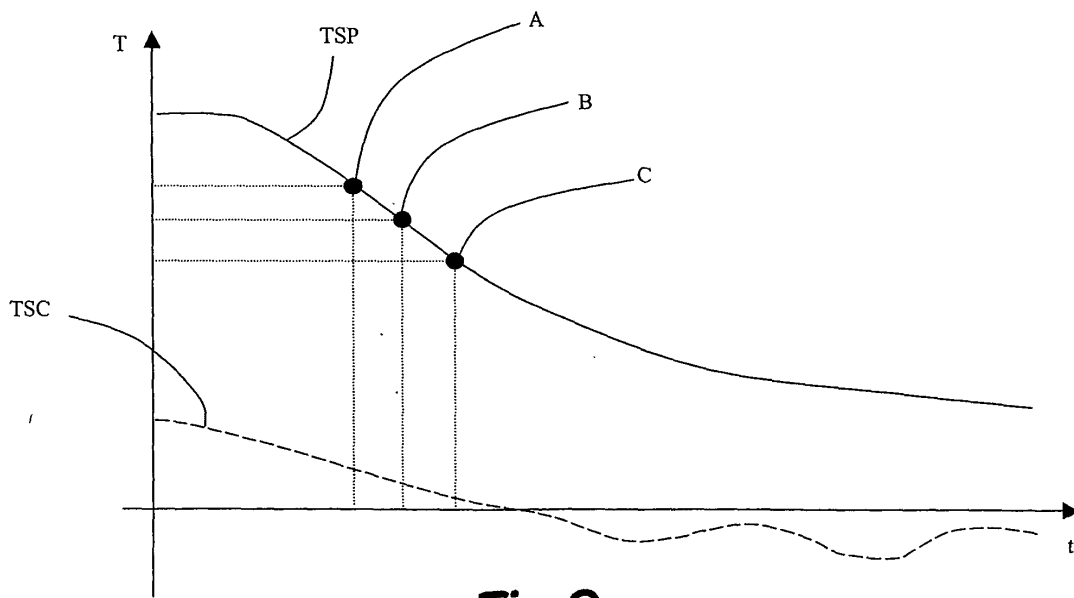


Fig.2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 07 7036

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 08, 6 August 2003 (2003-08-06) -& JP 2003 106726 A (MATSUSHITA ELECTRIC IND CO LTD; MATSUSHITA REFRIG CO LTD), 9 April 2003 (2003-04-09) * abstract; figure 5 * * paragraphs [0024], [0037] *	1-6	F25D29/00 F25D17/06
A	US 2002/039379 A1 (UKAI YOSHIYUKI) 4 April 2002 (2002-04-04) * abstract; figures 1-10 * * paragraphs [0022] - [0025], [0032] *	1-6	
A	FR 2 693 258 A (BONTAMI CONST ISOTHERMIQUES) 7 January 1994 (1994-01-07) * abstract; figures 1-4 * * page 6, line 1 - page 14, line 36 *	1-6	
A	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 15, 6 April 2001 (2001-04-06) -& JP 2000 356448 A (FUJI ELECTRIC CO LTD), 26 December 2000 (2000-12-26) * abstract; figures 1-4 *	1-6	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F25D A23L A23G A23B
A	US 2002/116936 A1 (ST-LAURENT CARL ET AL) 29 August 2002 (2002-08-29) * abstract; figure 1 * * paragraphs [0015], [0019], [0022], [0025] *	1-6	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 December 2004	Examiner Yousufi, S
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1
EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 07 7036

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-12-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2003106726 A	09-04-2003	NONE	
US 2002039379 A1	04-04-2002	JP 10117755 A	12-05-1998
FR 2693258 A	07-01-1994	FR 2693258 A1	07-01-1994
JP 2000356448 A	26-12-2000	NONE	
US 2002116936 A1	29-08-2002	CA 2365047 A1	22-06-2002
		US 2003172663 A1	18-09-2003