



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication: **16.01.2013 Bulletin 2013/03** (51) Int Cl.: **F25D 17/06 (2006.01) F25D 29/00 (2006.01)**

(21) Application number: **11174276.3**

(22) Date of filing: **15.07.2011**

(84) Designated Contracting States: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR Designated Extension States: BA ME (71) Applicant: WHIRLPOOL CORPORATION Benton Harbor Michigan 49022 (US)	(72) Inventor: Olivani, Andrea 21025 Comerio (IT) (74) Representative: Guerci, Alessandro Whirlpool Europe S.r.l. Patent Department Viale G. Borghi 27 21025 Comerio (VA) (IT)
---	---

(54) **A method for fast freezing food**

(57) A method for fast freezing food in a refrigerator apparatus comprising a fresh food compartment, a freezer compartment, a refrigeration system having a compressor, a condenser, a first evaporator situated in said freezer compartment, and a second evaporator situated in said fresh food compartment, and in which at least a fan situated in said freezer compartment is used for providing air flow over said first evaporator and over a food

item to be fast frozen, the method comprising the steps of switching on the compressor when the temperature in the fresh food compartment is above a predetermined first set value and to switch on the fan when the compressor is running. When the temperature in the fresh food compartment is below the predetermined first set value the compressor is switched off and the fan is kept running until the temperature in the freezer compartment reaches a predetermined second set value.

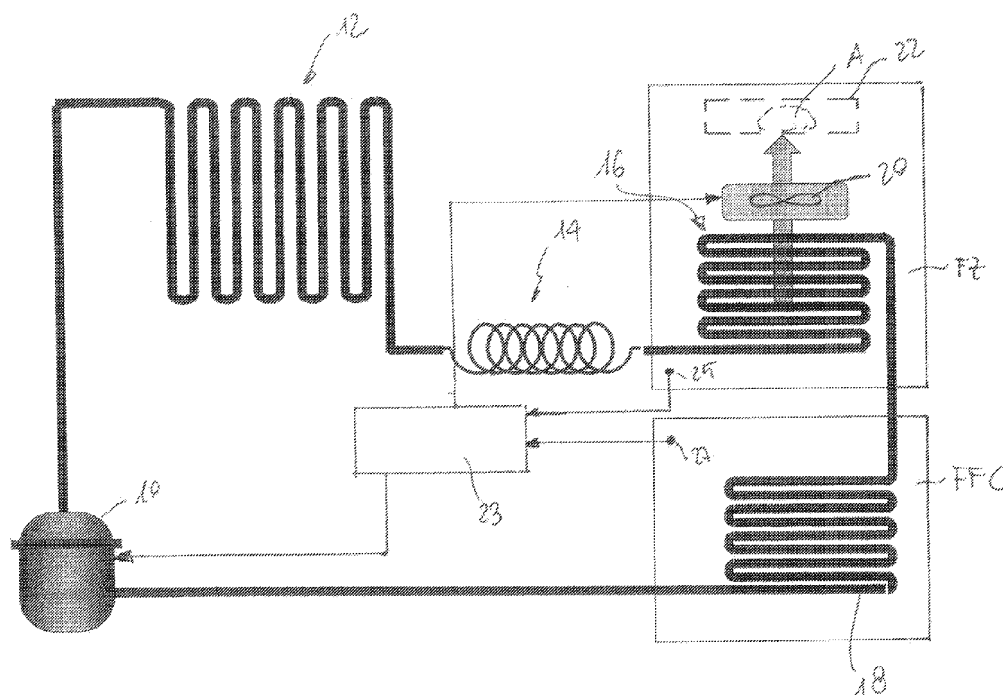


Fig. 1

Description

[0001] The present invention relates to a method for fast freezing food in a refrigerator apparatus. More precisely, the present invention relates to a method to be implemented in a refrigerator apparatus comprising a fresh food compartment, a freezer compartment, a refrigeration system having a compressor, a condenser, a first evaporator situated in said freezer compartment, and a second evaporator situated in said fresh food compartment. With the term "refrigerator apparatus" we mean any refrigeration appliance including two cavities for food storage at two different temperatures, i.e. a fresh food compartment in which the food is stored at a temperature around 5°C and a freezer compartment in which the food is stored at a temperature around -18°C. In the refrigeration apparatus according to the present invention the refrigeration system elements, i.e. the compressor, the condenser, the first and second evaporators, are connected in series in a closed loop.

[0002] EP 0558095 discloses a refrigerator apparatus having a first evaporator placed in the fresh food compartment and a second evaporator placed in the freezer compartment, where in each compartment a fan is used and in which such fans are switched on only when the compressor is operating. Such document does not disclose any fast freezing function of the appliance.

[0003] It is well known in the field of the above refrigeration appliances having two cavities the need of boosting freezing performances (particularly for small food quantities, i.e. 1-2 kg) that are stored in a dedicated area of the freezer, where the two cavities are simultaneously refrigerated by means of two evaporators (so called "mono-circuit layout").

[0004] Extra freezing features (such as rapid freezing, shock freezing, quick chill, etc.) are typically required by customers when they place a small amount of food (1-2 kg) that is at ambient temperature inside a freezer and they are willing to quickly reduce food temperature in order to maintain the proper texture and organoleptic features of food when it will be reheated. Extra freezing conditions are typically achieved in today products by increasing the running time of the compressor (typically during these functions operation the compressor run time is 100%, while during normal operation is around 45% - cycling mode). These functions are commonly used across several products with only one evaporator (e.g. side by side or chest freezer or upright freezer) or also with two cavities but with also two evaporators that are cooled down independently (e.g. by means of electrovalves in the circuit that allows two independent cooling modes: freezer alone or freezer + fresh food compartments). By increasing the running time of the compressor, the temperature inside the freezer cavity will progressively decrease, enhancing the freezing speed of stored food. However, this operation mode of the compressor is not suitable for the simpler cooling circuit configuration with two evaporators connected in series (mo-

no-circuit layout). Since for this configuration the two cavities are operating together simultaneously, it is necessary to balance size and shape of the two evaporators in order to ensure proper temperatures of the two compartments, under a defined range of operating conditions (e.g. from 16 °C to 43 °C ambient temperature). So, when extra freezer performances are requested to the appliance, the cooling power of the freezer will be limited by the fresh food compartment temperature operation (typically +5 °C), significantly limiting the functionality of the "extra freezing" functions.

[0005] It is therefore an object of the present invention to provide a method of controlling the above mentioned type of refrigerator apparatus in which, while maintaining the simple (and low cost) circuit having no electrovalve (mono-circuit layout), very good performances are obtained as far as fast freezing of food is concerned.

[0006] The above object is reached thanks to a method and to apparatus as well having the features listed in the appended claims.

[0007] According to the invention, at least a fan is situated in the freezer compartment for providing an air flow over said first evaporator and over a food item to be fast frozen.

[0008] The solution according to the invention does include also a control of the fan inside the freezer compartment in order to improve the heat exchange process between cold air and selected food items and to modulate the on/off time of the compressor and the on/off time of the fan independently one from the others. In the refrigeration appliance according to the invention is not necessary to use any further fan in the fresh food compartment. According to a preferred embodiment, the fan in the freezer compartment is preferably positioned in a place where it will be able to suck air from the evaporator outlet and to drive the cold air on the food mass that the customer is willing to quickly freeze (around 1-2 kg located into the extra freezing area). Basically the idea is to run the compressor operation as usual, allowing compressor switch on or off accordingly to fresh food compartment reaching target temperature (typically cycling around +5 °C), and running the fan or fans in the freezer compartment not only during compressor ON phases, but also partially during the compressor OFF phases. As a result, during compressor ON phases, the food to be frozen will be cooled down by cold air stream coming from freezer evaporator. During compressor OFF phases, the fan will continue to blow cold air on the food items to be frozen (the thermal inertia of the rest of the cavity being used to guarantee that the air blown on the additional food mass will be cold enough). In order to avoid excessive warming of the total food load stored inside the freezer compartment during compressor OFF phase, the fan is switched-off accordingly to the temperature sensor of the freezer cavity when the temperature goes beyond a predetermined threshold, such threshold being preferably around -16 °C).

[0009] Instead of switching off the fan, the control proc-

ess unit of the appliance can also reduce its speed. Therefore the switching off of the fan has to be intended here either as an actual stop of the fan, or to a reduction of the speed thereof in order to obtain a technical effect similar to an actual switching off.

[0010] Further advantages and features of a method and apparatus according to the invention will be clear from the following detailed description with reference to the accompanying drawings in which:

- Figure 1 is a schematic representation of the refrigeration circuit of a refrigerator apparatus according to the invention; and
- Figure 2 is a block diagram showing how the refrigeration circuit of figure 1 is controlled.

[0011] With reference to the drawings, a refrigeration circuit according to the invention comprises a compressor 10, a condenser 12, an expansion device 14 (for instance a capillary tube), a first evaporator 16 placed in a freezer compartment FZ and a second evaporator 18 placed downstream the first evaporator 16 and placed in a fresh food compartment FF. In the freezer compartment FZ a fan 20 is placed for providing air flow over the first evaporator 16 and over a food item A to be fast frozen and placed in a dedicated zone 22 of the freezer compartment FZ for fast freezing of food. In the example shown in figure 1 the fan is sucking air from the first evaporator 16 and delivers it to the dedicated fast freezing zone 22, but it is clear that other configurations may be adopted, for instance where the fan blows air to the evaporator and to the dedicated zone 22. Moreover, more fans 20 can be used.

[0012] An electronic control process unit 23 is linked to a temperature sensor 25 placed in the freezer compartment FZ and to a temperature sensor 27 placed in the fresh food compartment (FFC), and sends driving signals to the compressor 10 and to the fan 20.

[0013] In figure 2 it is shown the process which starts when the user put a food item A in the dedicated zone 22 of the freezer compartment FZ. Of course this fast freezing or quick freezing process may be started by activating a switch which changes the usual process according to which the fan 20 in the freezer compartment FZ is either switched off when the compressor 10 is switched off or it is kept continuously switched off. On the other hand the control method according to the invention may be adopted as a default control method, and therefore used even if there is no need of fast freezing (in this case there is no need of a fast freezing switch or button).

[0014] When the temperature in the fresh food compartment FFC is higher than a first set temperature (for instance 5°C), the compressor 10 is switched on together with the fan 20 in the freezer compartment FZ (block 30). When the temperature in the fresh food compartment FFC is below the first set temperature, the compressor 10 is switched off (block 32) while the fan 20 is kept run-

ning up to when the temperature in the freezer compartment FZ is above a second set temperature (for instance -16°C). At this point also the fan 20 is switched off (block 34) and the control waits for the raising of temperature in the fresh food compartment FFC above the first set temperature, when both the compressor 10 and the fan 20 are both switched on again. Both set temperatures are stored in the control process unit 23 and may be changed either in the production line or by the user. The preferred temperature values for the first set temperature are comprised between 0°C and 10°C, more preferably between 2°C and 8°C.

[0015] The preferred temperature values for the second set temperature are comprised between -18°C and -14°C, more preferably between -17°C and -15°C.

[0016] From the above detailed description it is clear that the method according to the invention allows a simple and inexpensive way of providing a mono-circuit refrigerator with efficient fast freezing capabilities, with the simple addition of a fan in the freezer compartment and minor modification in the algorithm controlling the refrigeration circuit.

Claims

1. A method for fast freezing food in a refrigerator apparatus comprising a fresh food compartment (FFC), a freezer compartment (FZ), a refrigeration system having a compressor (10), a condenser (12), a first evaporator (16) situated in said freezer compartment (FZ), and a second evaporator (18) situated in said fresh food compartment (FFC), **characterized in that** at least a fan (20) situated in said freezer compartment (FZ) is used for providing air flow over said first evaporator (16) and over a food item (A) to be fast frozen, the method comprising the steps of switching on the compressor (10) when the temperature in the fresh food compartment (FFC) is above a predetermined first set value and to switch on the fan (20) when the compressor (10) is running, and **in that** when the temperature in the fresh food compartment (FFC) is below said predetermined first set value the compressor (10) is switched off and the fan (20) is kept running until the temperature in the freezer compartment (FZ) reaches a predetermined second set value.
2. A method according to claim 1, wherein the first set temperature is comprised between 0°C and 10°C and the second set temperature is comprised between -18°C and -14°C.
3. A method according to claim 2, wherein the first set temperature is comprised between 2°C and 8°C and the second set temperature is comprised between -17°C and -15°C.

4. A refrigerator apparatus comprising a fresh food compartment (FFC), a freezer compartment (FZ), a refrigeration system having a compressor (10), a condenser (12), a first evaporator (16) situated in said freezer compartment (FZ) and a second evaporator (18) situated in said fresh food compartment (FFC), **characterized in that** it comprises at least a fan (20) situated in said freezer compartment (FZ) for providing air flow over said first evaporator (16) and over a food item (A) to be fast frozen. 5
10
5. A refrigerator apparatus according to claim 4, further comprising a control process unit (23) adapted to switch on the compressor (10) and the fan (20) when the temperature in the fresh food compartment (FFC) is above a predetermined first set value, to switch off the compressor (10) when the temperature in the fresh food compartment (FFC) is below said predetermined first set value and to keep running the fan (20) when the compressor is in a switched off configuration until the temperature in the freezer compartment (FZ) reaches a second predetermined set value. 15
20
6. A refrigerator apparatus according to claim 5, wherein the control process unit (23) is adapted to be set by the user also in a no fast freezing configuration in which the fan (20) is switched on only when the compressor (10) is switched on. 25
30
7. A refrigerator apparatus according to claim 5, wherein the control process unit (23) is adapted to be set by the user also in a no fast freezing configuration in which the fan (20) is permanently switched off. 35

40

45

50

55

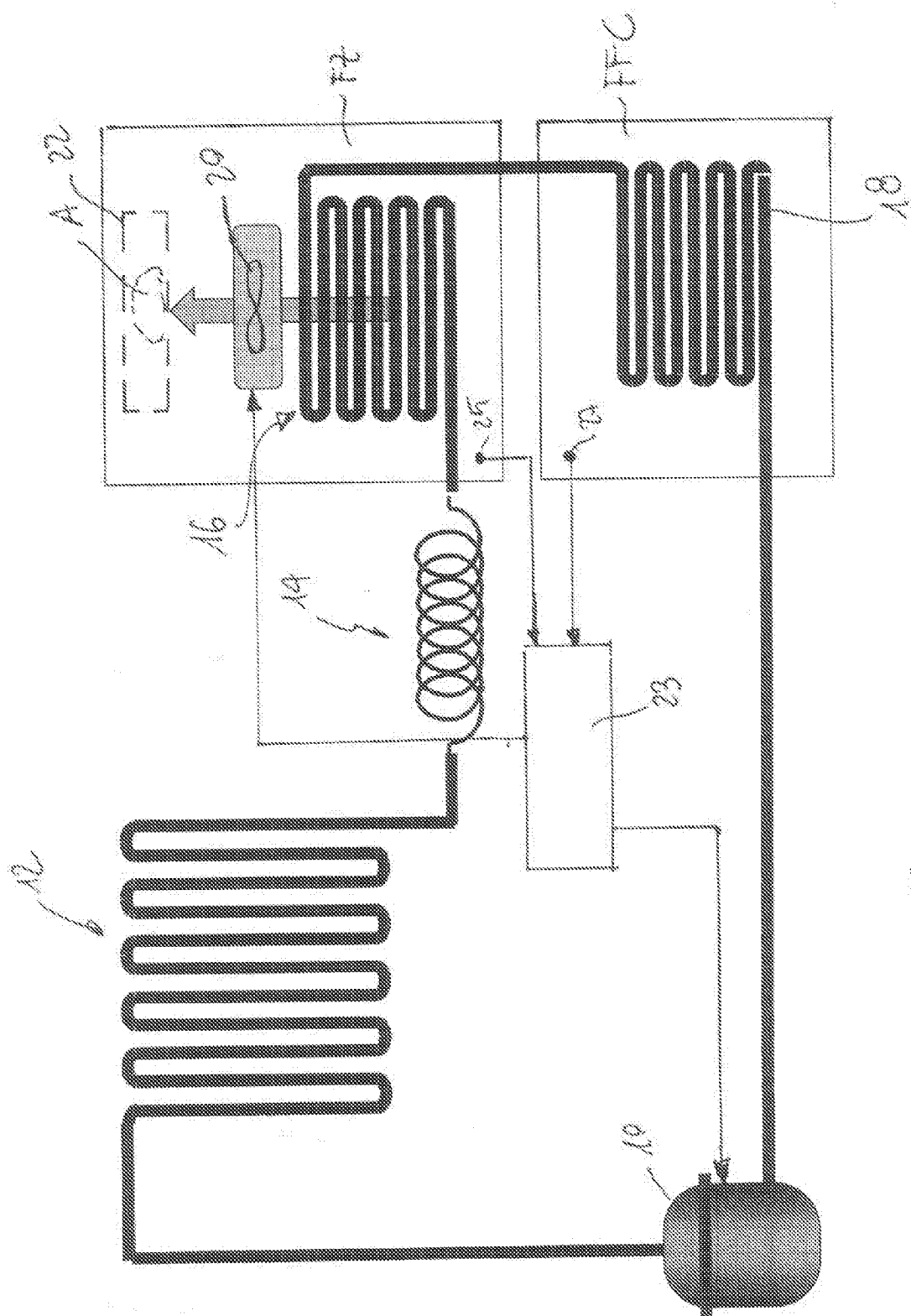


Fig. 1

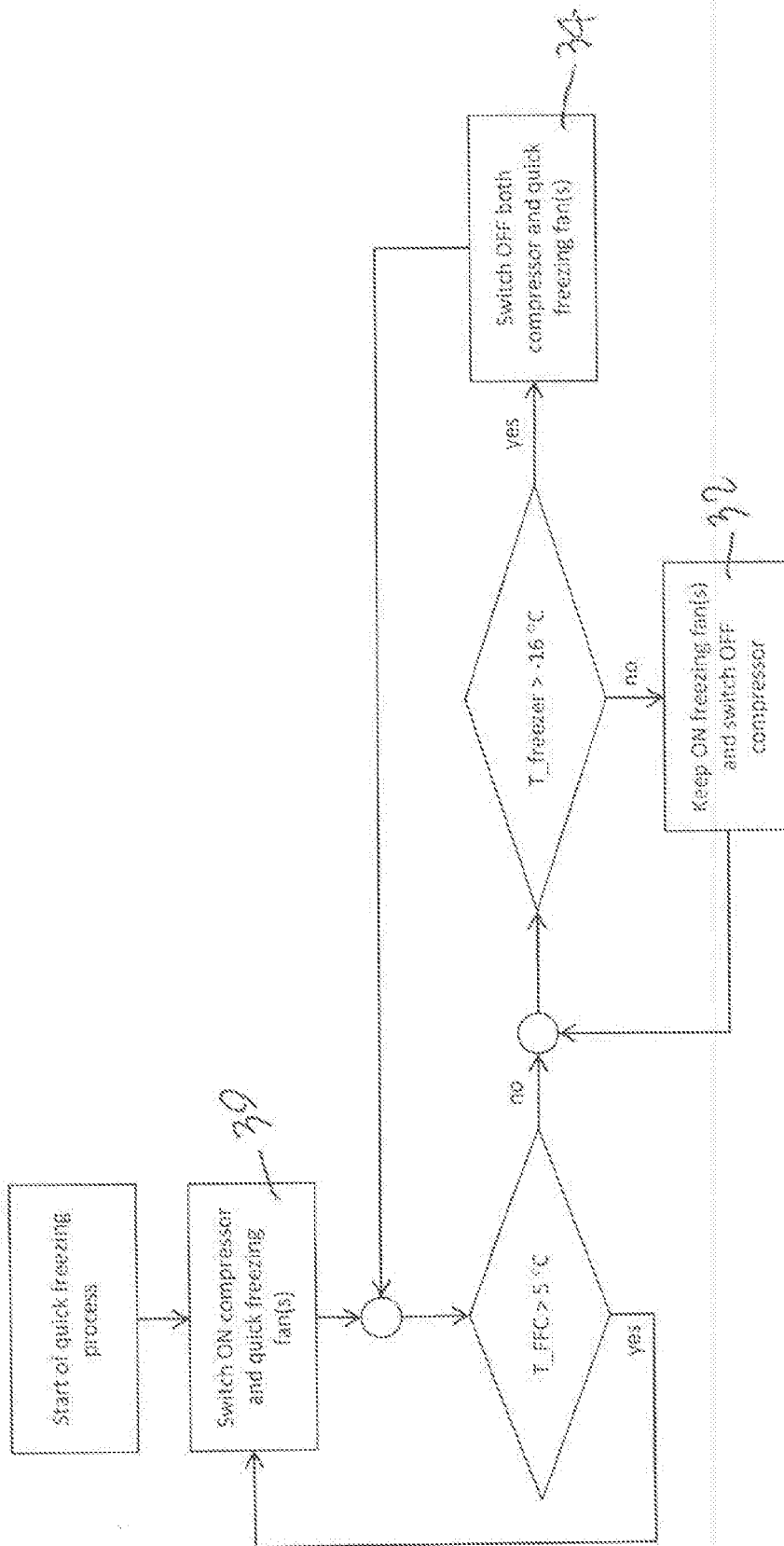


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 11 17 4276

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	WO 99/42772 A1 (GUROVA ELENA VLADIMIROVNA [RU]; GUROV SERGEJ VIKTOROVICH [RU]) 26 August 1999 (1999-08-26) * abstract *	1-5	INV. F25D17/06 F25D29/00
X	WO 00/71947 A1 (WORK SMART ENERGY ENTPR INC [US]) 30 November 2000 (2000-11-30) * page 11, paragraph 4; figure 1 *	4	
A		1	
X	EP 0 845 643 A2 (CANDY SPA [IT]) 3 June 1998 (1998-06-03) * claim 4; figure 1 *	4	
A		1	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25D F25B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 December 2011	Examiner Jessen, Flemming
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 03.02 (P04C01)

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

EP 11 17 4276

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.

05-12-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
W0 9942772	A1	26-08-1999	NONE
W0 0071947	A1	30-11-2000	AU 5166100 A 12-12-2000 CN 1363027 A 07-08-2002 EP 1180230 A1 20-02-2002 W0 0071947 A1 30-11-2000
EP 0845643	A2	03-06-1998	DE 69732468 D1 17-03-2005 DE 69732468 T2 30-03-2006 EP 0845643 A2 03-06-1998 ES 2236780 T3 16-07-2005 IT MI962475 A1 27-05-1998

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0558095 A [0002]