

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
29 May 2008 (29.05.2008)

PCT

(10) International Publication Number
WO 2008/061330 A1

(51) International Patent Classification:
B60H 1/32 (2006.01) **B60P 3/20** (2006.01)

(21) International Application Number:
PCT/BR2007/000320

(22) International Filing Date:
21 November 2007 (21.11.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MU 8602648-8 21 November 2006 (21.11.2006) BR

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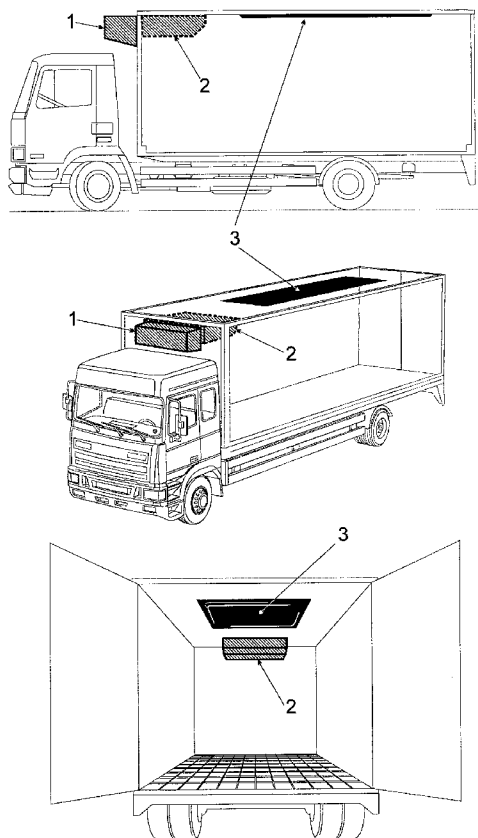
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report

(54) Title: HYBRID REFRIGERATION SYSTEM FOR TRANSPORT WITH COMBINED USE OF FORCED AIR AND EUTECTIC PLATES



(57) Abstract: Hybrid refrigeration system for transport with combined use of forced air and eutectic plates (3) composed by a hybrid system, combining the simultaneous use of the technologies of forced air and eutectic plates for refrigerated transport (cold and frozen products).

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HYBRID REFRIGERATION SYSTEM FOR TRANSPORT WITH COMBINED USE OF FORCED AIR AND EUTECTIC PLATES

The following report of patent of utility model is destined,
5 with the illustrative Figures below specified, to the description of the
characteristics, use and advantages of an equipment that has a *hybrid* cooling
system, combining the simultaneous use of the technologies of forced air and
eutectic plates for refrigerated transport (cold and frozen products), using the
available capacity of the refrigeration equipment before entering in operation in
10 traffic and using the full, nominal and exceeding capacity of the refrigeration
system during the operation in traffic.

The transport of perishable products grows every year and it is
a sector that deserves attention in order to preserve the quality of these products
for the final consumer. Based on these characteristics, the road refrigeration
15 equipment mainly destined to the transport of cold and frozen foods is an
indispensable investment today.

The refrigerated trucks are a type of equipment that use a
refrigeration apparatus to control the internal temperature and are used to
transport products that need controlled temperature. Some trucks can
20 simultaneously transport different products with different temperatures, in
different compartments called frozen, cold and dry ones.

The products that need a more rigid conservation and a more
controlled temperature are: beef, fish, chicken and pork; juices; pulps and other
bulk beverages; milky products; margarine and vegetable cream; frozen or super-
25 frozen foods; ice creams; pies; fats; sweetshop products that need special
temperature; ready meals for the consumption and similar; frozen vegetables;
fruits and green vegetables, among others.

The transport of those products is divided in two categories. The first is called “transfer” and is the transport from the producing companies to the distribution centers (DC), made through refrigeration trucks mainly installed in semi-trailer chassis. The second category, called “urban distribution”, considers the transport from the DC to the final points of sale and is made through refrigerated trucks installed in trucks chassis, small trucks and $\frac{3}{4}$ trucks.

The storage in a refrigerated environment is a great technological conquest, allowing facing the perishing and deterioration of the foods, reducing the production costs, increasing the quality of those products and reducing losses and wastes.

Studies show that the use of refrigeration techniques is increasing due to the population growth in the great urban centers and due to the distance from the production places, making necessary a larger time between the production and the consumption.

There is a larger demand in the great urban centers due to the largest product consumption of the retail companies, that don't have adequate place and equipment to store great amounts of products. Besides, there is the prohibition of the entrance of big vehicles in the cities for performing such distribution. Thus, the use of smaller vehicles is the best logistics option; however, these vehicles usually have a refrigeration equipment with lower capacity related to the needs of operational demand, since the capacity of the conventional refrigeration systems (forced air or eutectic plates) is designed for nominal loads (up to 20-30 openings of doors a day) and not for intensive loads (40 to 60 openings of doors a day).

If such systems are designed to this larger thermal load, they will have an idle capacity, in case there are not intermittent loads in a distribution, becoming expensive (unfeasible investment) and heavy for commercial application.

Considering these problems and with the aim of overcoming them, the *hybrid refrigeration system for transport with combined use of forced air with eutectic plates* was developed, object of the present report, consisting of a *hybrid* equipment that uses in a combined way the refrigeration system with forced air and the system of eutectic plates, in order to obtain an increase of operational refrigeration capacity during the larger refrigeration demand, when the own refrigeration system doesn't have instantaneous capacity or is suffering excessive demand due to the instantaneous capacity.

Once the transport refrigeration system can have variable capacity in accordance with the momentary rotation of the diesel engine of the truck (called coupled system), that depends on the urban traffic mainly in big cities, the eutectic plates are previously frozen before beginning the transport/distribution, and can also thermo-accumulate cold during the moments of high rotation of the engine (during the transport/distribution) to be used during low speed or in frequent openings of doors for unloading. Thus, this *hybrid* system has full capacity of minimizing the change of the internal temperature of the refrigerated truck during the transport.

For the perfect understanding and visualization of the characteristics and advantages delivered by the *hybrid refrigeration system for transport with combined use of forced air and eutectic plates*, not limitative Figures are included to this report for consultation. The Figures are:

Figure 1: Lateral, perspective and front views of a possible configuration of the state of technique known as refrigeration equipment for transport through forced air (heat exchange through transfer) in turbulent regime.

Figure 2: Lateral, perspective and front views of a possible configuration of the state of technique known as

refrigeration electric equipment for transport through eutectic plates (heat exchange through convection) in laminar regime.

Figure 3: Lateral, perspective and front views of a possible configuration of the proposed *hybrid* equipment.

In accordance with all above mentioned Figures, the *hybrid refrigeration system for transport with combined use of forced air and eutectic plates* (Figure 3) is composed by a refrigeration equipment with forced air (heat exchange through transfer) in turbulent regime (Figure 1), which simultaneously works with one refrigeration system of eutectic plates (Figure 2) (heat exchange through convection) in turbulent regime - when the refrigeration system is turned on - and in laminar regime - when the refrigeration system is turned off - during loading and unloading operations, resulting in a system whose efficiency obtained by the synergy of the two parts is extremely superior to the work performed by each one separately, and the cost is lower than the sum of the two parts separately installed. As an additional advantage the final weight of the *hybrid* system is 40% inferior of each system, which is a significant factor for the transportation.

The refrigeration equipment with forced air (heat exchange through transfer) in turbulent regime of the proposed system can be of any existent type in the market, i.e.: coupled, coupled and electric, coupled and diesel, diesel or diesel and electric, and the difference among those is only the placement of the condensing unit (1) and the way as the compressor of the system is driven - in all cases the evaporator (2) is basically placed in the same way. Thus, we have:

In the COUPLED systems the driving force of the compressor comes from the engine of the vehicle. In that way the system will be in operation just when the engine of the vehicle is turned on.

In the DIESEL systems the driving force of the compressor comes from an exclusive diesel engine. The system is usually applied for great distances and its operation does not require the engine of the vehicle is turned on.

In the ELECTRIC systems the driving force of the compressor
5 comes from an electric motor, which can use alternating current or direct current from stationary facilities (buildings) and/or electric generators and/or batteries/alternators.

To this equipment of forced air, that can be from any of the ones above mentioned, is allied the refrigeration system of eutectic plates (3),
10 whose primary supply is usually an electric motor, which means the driving force of the compressor - to the condensing unit (4) and used to refrigerate the plates - can come from a compressor electrically driven that is usually linked to the local source, being the operation generally requires the vehicle be parked and linked to an external point of electric power supply, what is made during approximately 1
15 to 2 hours before the load and unload work.

In a practical case it means that when the truck is loaded with the products to be transported, the compartment will already be suffering the refrigeration due to the thermal inertia of the low temperature of the eutectic plates that were previously frozen. In that way the refrigeration system through
20 forced air will easily maintain the refrigeration stability of the compartment, even when depending on the low rotations of the vehicle engine, to which it is coupled, and the stops which it will be submitted in the largest demand of the great urban centers.

During the transport the eutectic plates can be - or not -
25 interlinked to the refrigeration system. The preferred configuration is the systems are linked, which will make possible the eventual re-freezing of the eutectic plates when the truck is in movement.

The proposed system is also proved perfectly adequate to the transfers that in general use refrigeration trucks of larger load (semi-trailer chassis).

From the refrigeration systems current available to transport
5 the most used for the transfer category is the independent system, called diesel equipment, i.e., the system that sustains the refrigeration power through an independent engine (generally using diesel) and that maintains its uninterrupted operation independently of the operation and/or speed of the vehicle.

The independent diesel system has as a disadvantage its high
10 cost of installation and maintenance (since its wearing will be larger due to the uninterrupted operation of the system during the product transport) and its high cost of operation (operational cost) by being powered by diesel.

It does not occur with the proposed *hybrid* system, since it
uses the temperature inertia, provided by the eutectic plates, allowing an
15 equivalent efficiency to the one of the independent diesel system, and can use a compressor coupled to the vehicle engine, making the system cheapest related to the installation, maintenance and use.

The difference of costs between the “independent diesel
system” and the proposed *hybrid* system is about 50% (fifty percent), i.e., the
20 *hybrid* equipment necessary to refrigerate the same internal volume of a refrigeration truck with independent diesel equipment has an installation cost of about the half of the value of the independent diesel equipment. Additionally, the *hybrid* system is 40% lighter than the independent diesel equipment as a whole and also the *hybrid* system has smaller maintenance and operational costs.

25 In some specific needs the proposed *hybrid* system can also be configured with compressor driven by a diesel engine independent of the vehicle engine.

The *hybrid refrigeration system for transport with combined use of forced air and eutectic plates* is completely versatile in constructive terms, can be configured with any amount of eutectic plates or evaporators, as well as it can be linked in a parallel or series way and is driven through a coupled
5 compressor, a compressor driven by an independent electrical engine or an explosion engine.

Such versatility allows its installation in several transport vehicles, independently of its internal volume, amount of compartments and different temperatures in its interior. It can also be driven by a diesel independent
10 engine to the systems of forced air and eutectic plates and not depending on the geometry and installation places of the eutectic plates and evaporators inside the refrigeration truck.

After all exposed, the unique characteristics of use easiness of the *hybrid refrigeration system for transport with combined use of forced air and*
15 *eutectic plates* are clear, as well as the intrinsic advantages due to its innovations related to the feasibility, efficiency and economy offered to its users, endowing it with the necessary requirements to deserve the privilege of patent of utility model.

CLAIM

Hybrid refrigeration system for transport with combined use of forced air and eutectic plates, characterized by a refrigeration equipment of forced air (heat exchange through transfer) in turbulent regime (Figure 1), which
5 works simultaneously with a refrigeration system of eutectic plates (heat exchange through convection) in laminar regime (when the refrigeration system is turned off) or in turbulent regime (when the refrigeration system is turned on) (Figure 2).

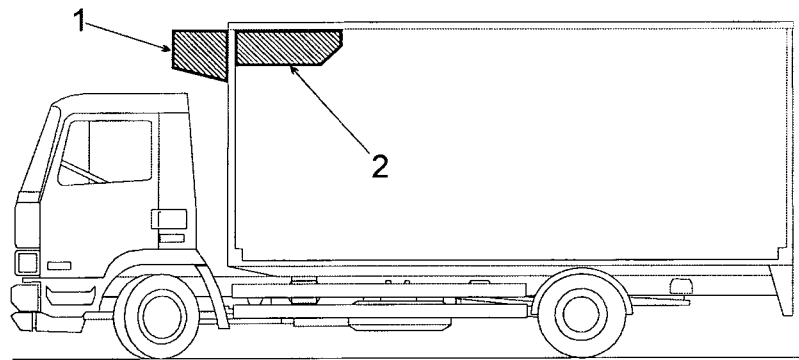
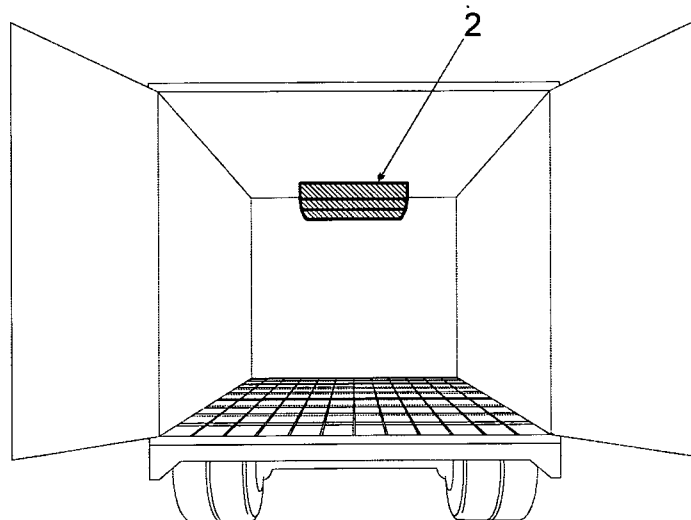
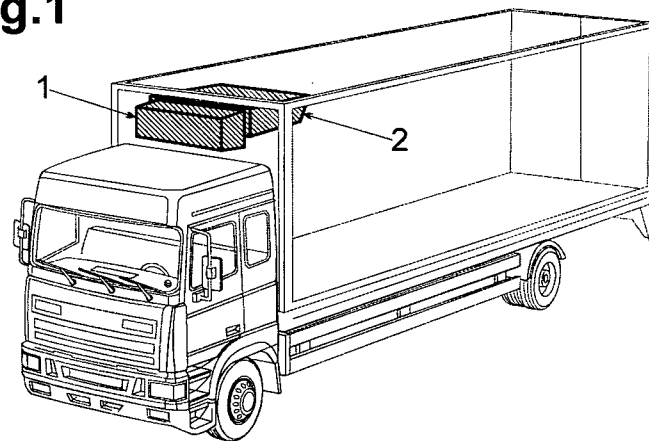


Fig.1



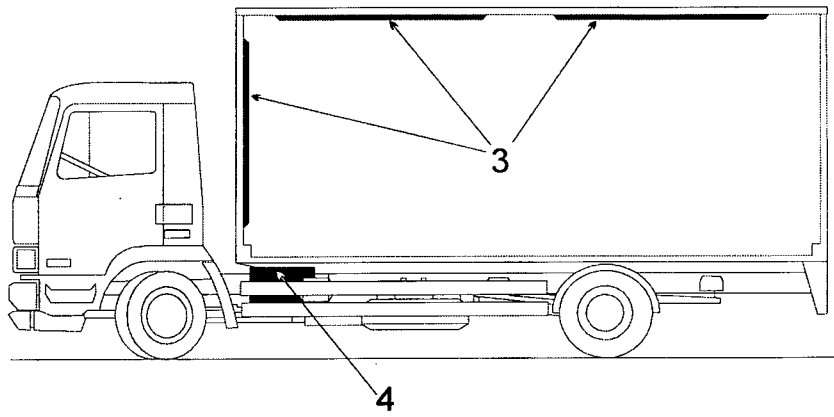
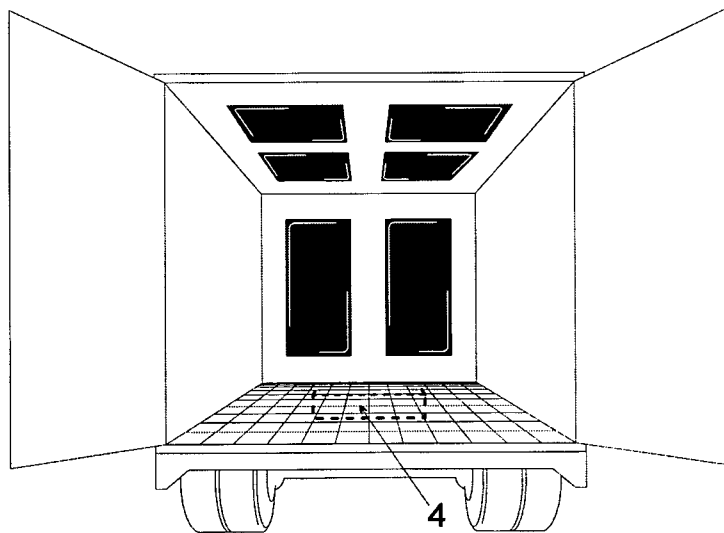
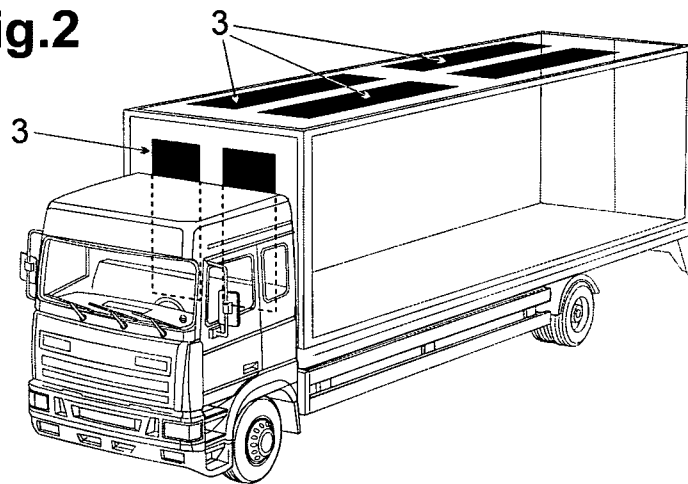


Fig.2



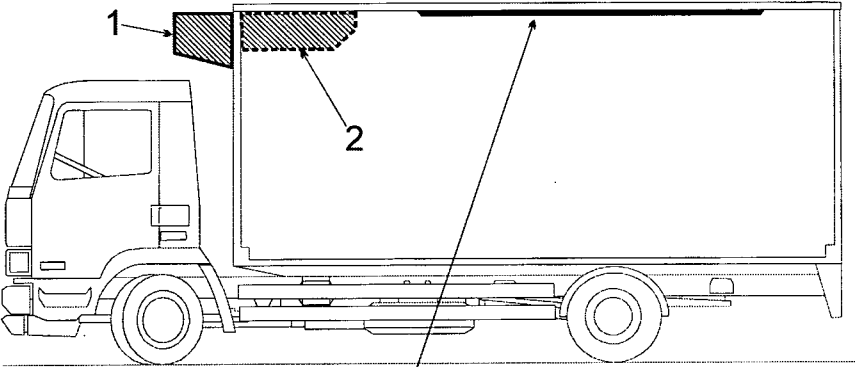
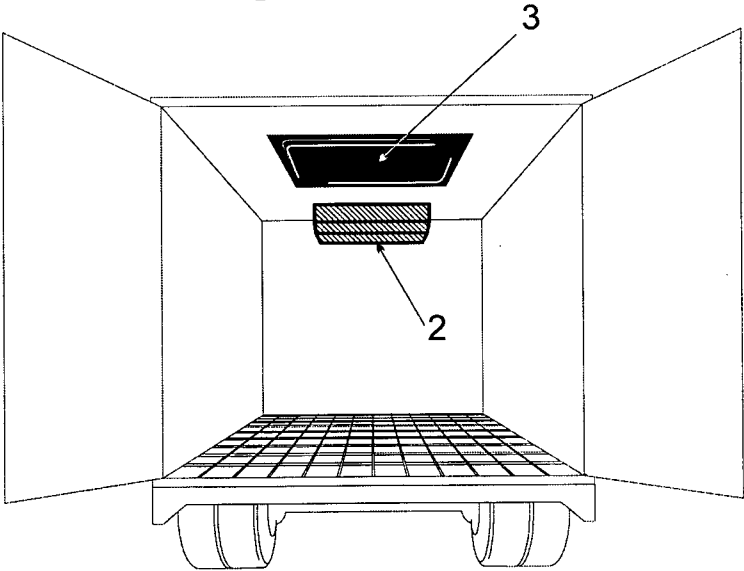
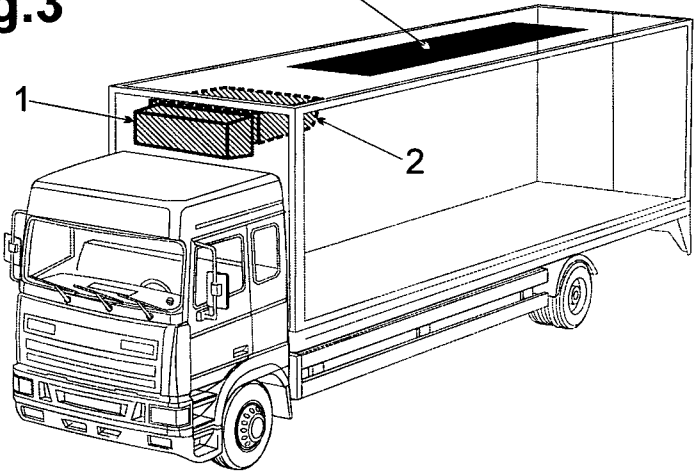


Fig.3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR 2007/000320

A. CLASSIFICATION OF SUBJECT MATTER

IPC⁸: **B60H 1/32** (2006.01); **B60P 3/20** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC⁸: B60H 1/32, B60P 3/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004 020 236 A1 (VINCE II ET AL.) 5 February 2004 (05.02.2004) <i>abstract, fig.1-4; passages 27, 30, 34 -36</i> --	1
X	GB 1 170 138 A (CHAMBOURCY [FR]) 12 November 1969 (12.11.1969) <i>abstract; page 2, line 12 to line 54, fig. 1-5</i> --	1
A	US 6 543 245 B1 (WALDSCHMIDT) 8 April 2003 (08.04.2003) <i>abstract; fig. 1, 3; passages 2, 6-7</i> ----	1

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search
7 February 2008 (07.02.2008)Date of mailing of the international search report
14 March 2008 (14.03.2008)Name and mailing address of the ISA/ AT
Austrian Patent Office
Dresdner Straße 87, A-1200 ViennaAuthorized officer
RODLAUER G.

Facsimile No. +43 / 1 / 534 24 / 535

Telephone No. +43 / 1 / 534 24 / 321

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/BR2007/000320

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