(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 August 2006 (24.08.2006)

PCT

(10) International Publication Number
WO 2006/087007 A1

(51) International Patent Classification:
A47F 3/04 (2006.01) *F25B 9/00* (2006.01)

(21) International Application Number:
PCT/EP2005/001722

(22) International Filing Date:
18 February 2005 (18.02.2005)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **CARRIER CORPORATION** [US/US]; One Carrier Place, Farmington, CT 06034-4015 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BRÖSTL, Rudolf** [DE/DE]; Kreuzstrasse 39, 76287 Rheinstetten (DE). **BLOCH, Edwin** [DE/DE]; Mainstrasse 16, 64297 Darmstadt (DE). **SCHREY, Rainer** [DE/DE]; Clausthaler Strasse 23, 45145 Essen (DE).

(74) Agent: **KLUNKER.SCHMITT-NILSON.HIRSCH**; Winzererstrasse 106, 80797 Munich (DE).

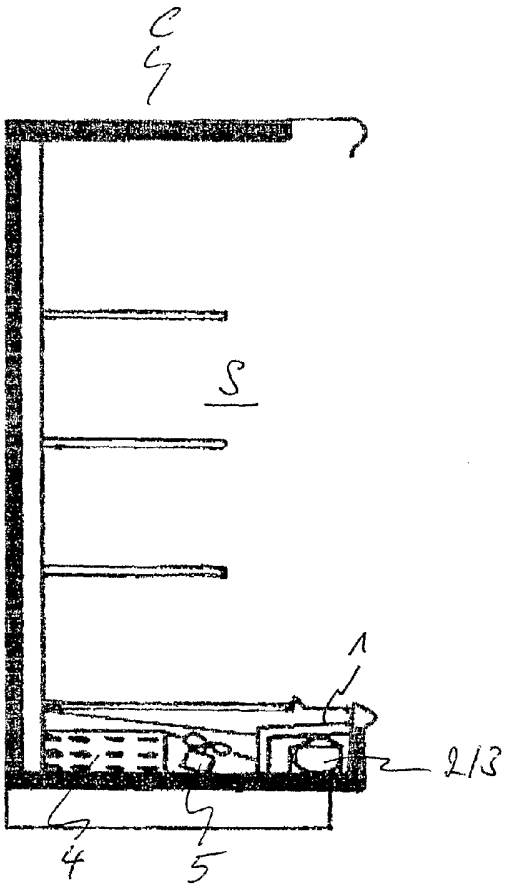
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR,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

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

[Continued on next page]

(54) **Title:** TRANSCRITICAL REFRIGERATION DISPLAY UNIT



(57) **Abstract:** The invention relates to a display unit comprising at least one compressor, at least one fluid/gas heat exchanger for cooling the compressed gas, at least one evaporator, at least one expansion device and high pressure conduits connecting the afore-mentioned components with each other to form a transcritical refrigeration circuit, especially a carbon dioxide refrigeration circuit. According to the invention at least the compressor (2) and the fluid/gas heat exchanger (3) are arranged within a compartment (1), which is removable from 225 the display unit (C).

WO 2006/087007 A1

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Transcritical Refrigeration Display Unit

The subject of the present invention is a display unit comprising at least one compressor, at least one fluid/gas heat exchanger for cooling the compressed gas, at least one evaporator, at least one expansion device and conduits connecting the afore-mentioned components with each other to form a "transcritical" refrigeration circuit, especially a carbon dioxide refrigeration circuit. The term "transcritical" refrigeration circuit refers to a refrigeration circuit which can be operated in a subcritical as well as a super- or transcritical mode.

The term "display unit" shall include all kind of display units, especially cabinets, multideck cabinets, roll-in cabinets, counters et cetera. Display units as mentioned before are well known to a skilled person.

EP-A-0 908 688 discloses display units as described above as well as a refrigeration plant, by which one or more display units are connected via their fluid/gas heat exchangers to a refrigeration cycle. The heat given up from the transcritical refrigeration circuit of each display unit via its fluid/gas heat exchanger is discharged to the refrigeration cycle. Within the refrigeration cycle a fluid such as water is circulating; an anti-freeze-agent may be added to the circulating fluid if required. These kinds of refrigeration cycles are designed in a way that their pressures do not exceed 25 bar.

Within transcritical refrigeration circuits of display units pressures of 90 bar and more occur. For that reason all components and conduits mentioned above have to be able to withstand these high pressures. Nevertheless, neither the owner and service persons of supermarkets nor their customers are interested

in being confronted with such high pressures. Additionally each leak in a component or conduit can result in bigger problems as any gas escaping from a leaking high pressure conduit or component can result in serious injuries of service persons and customers.

The main object of the present invention is to provide a display unit, which avoids the above-discussed problem regarding the high pressures within a transcritical refrigeration circuit, especially within a carbon dioxide refrigeration circuit.

A further object of the present invention is to provide a display unit, which in case of any fault of one of the above-mentioned components enables an easy and quick replacement of a non-operating component by an operating component. This replacement of a non-operating component should be manageable even by a person not skilled in the art.

Furthermore, it is an object of the present invention to provide an assembly of the above-mentioned components and conduits, which can be (pre)manufactured and which only has to be integrated into the display unit at the display unit's production site or in the supermarket.

In accordance with an embodiment of the present invention, this problem and these objects are achieved by a display unit as claimed in claim 1.

The innovative concept upon which the present invention is based is that at least the compressor and the fluid/gas heat exchanger are arranged within a compartment, which can be removable from the display unit.

The compartment should be designed so as to be stable enough to at least substantially reduce the effect of any breach or leakage of any of the compo-

nents comprising the refrigerant under pressure. Various materials can be used for the compartment, for example metal sheet, plastic material, etc. It is also possible to use different material in combination, for example a hard shell together with a dampening material. It is particularly possible to provide the hard shell at the outside and the dampening material at the inner side thereof. It is also possible to provide the compartment with a venting means, like an opening, a discharge valve, etc. in order to allow venting of the refrigerant after a failure of the refrigeration circuit.

It is possible to removably attach the compartment to a support structure within the display unit, for example a frame, etc. of the display unit. The compartment can comprise an attachment means, like an attachment flange, for attaching the compartment to the support structure. It might be sufficient to have the compartment rest on the support structure, it is also possible to additionally secure the compartment removably thereto, for example by means of a nut and bold fastener. A positioning means can be provided with the support structure and/or with the compartment in order to ensure a precise positioning of the compartment in the installed condition. The positioning means can have a conical shape or can be V-shaped in order to allow for easy inserting as well as precise positioning.

Display means, like instruments, a screen, etc., for displaying an operational condition and/or operating means, like knobs, etc. can be provided on the compartment's outer side in order to adjust cooling output, correct temperature, etc. A powerline with a plug may lead out of the compartment. Similarly, signal lines can be provided. Quick couplings can be provided in order to fluidly couple components within the compartment with exterior components, conduits, etc. Accordingly, the compartment can easily be replaced by merely decoupling the quick couplings and unplugging the powerline.

For cooling the fluid/heat exchanger, it is possible to provide a "back cooling" to the compartment or directly to the fluid/gas heat exchanger. Such back cooling can be provided by means of a "low pressure" cooling circuit, e.g. with another refrigerant and even with air or water. The respective conduits can be connected to the compartment with a quick release coupling, for example.

In accordance with an embodiment additional or all of the above-mentioned components forming the transcritical refrigeration circuit are arranged within said compartment.

In case of any leak in one of the above-mentioned components or conduits the compartment will function as a buffer for the escaping gas. For that reason no direct disturbance or harm to service persons and customers should occur.

In case of any fault of one of the above-mentioned components the component does not have to be repaired within the display unit or replaced from the display unit, which normally takes for at least 30 minutes. During this period the display unit is out of order. According to the innovative concept the whole compartment can be removed and replaced by another compartment, housing operating components. The time for replacing the compartment takes about 10 minutes or less. The repair of the non-operating component can then be realized without any time pressure and stress.

According to a further embodiment of the present invention the compartment is preferably arranged below the show room or storing compartment of the display unit.

This arrangement enables an easy and quick replacement of the compartment.

Further characteristics and advantages of the invention will become clearer from the following detailed description of preferred embodiments thereof, described by way of nonlimiting examples with reference to the attached drawings, in which:

Figures 1 and 3 are schematic lateral cross–sections of preferred embodiments
Figure 2 is a schematic perspective view of the same preferred embodiment as shown in figure 1

In figures 1 and 2 a multideck cabinet C is shown. Below the show room or storing compartment S a compartment 1 is arranged. Within that compartment 1 a compressor 2, a fluid/gas heat exchanger 3 for cooling the compressed gas and conduits – not shown in figures 1 to 3 – are arranged. Outside of the compartment 1 an evaporator 4 and an expansion device – not shown in figures 1 to 3 – are arranged; the afore–mentioned components are connected with each other to form a transcritical refrigeration circuit, especially a carbon dioxide refrigeration circuit, as e. g. described in the above–mentioned EP–A–0 908 688.

The aforementioned expansion device is preferably designed as an expansion valve, while the compressor 2 is preferably designed as a frequency controlled compressor.

According to a further embodiment of the present invention the amount of the medium, circulating in the transcritical refrigeration circuit does not exceed 1000 g.

As can be seen from figure 3 (cooling) air 6 is forced by the ventilating fans 5,5' to flow through the evaporator 4, wherein the air is cooled against the evaporating refrigerant of the transcritical refrigeration circuit, and via the back–

flow-channel 7 to the show room or storing compartment S of the multideck cabinet C. This flow of the circulating cooling air is already known to a skilled person.

The ventilating fans 5,5' are especially frequency controlled ventilating fans. This enables an optimal adaptation of the power of the ventilating fans 5,5' to the required cooling capacity.

According to the embodiment shown in figure 3 all aforementioned components forming the transcritical refrigeration circuit are arranged within a compartment 1, that can be removed as a whole from the multideck cabinet C.

Not shown in figures 1 to 3 is the at least one quick coupling, by which the fluid/gas heat exchanger 3 can be connected easily and quickly to a refrigeration cycle or plant.

If the compartment 1 has to be removed or replaced by an other compartment only the connection to the power source, which is at least necessary for the compressor(s) and the fan(s), and the quick coupling have to be separated.

More and more, display units as described above are built as modules having the same dimensions, e. g. a length of 1250 mm. These modules are connected to each other in case a display unit having a length of x * 1250 mm (wherein x = 1, 2, 3, ...) is required.

According to a further embodiment of the present invention each module has its own compartment 1.

Claims

1. Display unit comprising a compressor (2), a fluid/gas heat exchanger (3) for cooling the compressed gas, an evaporator, an expansion device and high pressure conduits connecting the aforementioned components with each other to form a transcritical refrigeration circuit, **characterized** in that at least the compressor (2) and the fluid/gas heat exchanger (3) are arranged within a compartment (1).

2. Display unit according to Claim 1, in which all components forming the transcritical refrigeration circuit are arranged within said compartment (1).

3. Display unit according to Claim 1 or Claim 2, in which said compartment (1) is arranged below the show room or storing compartment (S) of the display unit (C).

4. Display unit according to one or more of the preceding claims, in which the amount of the medium circulating in the transcritical refrigeration circuit, does not exceed 1000 g.

5. Display unit according to one or more of the preceding claims, in which the expansion device is an expansion valve.

6. Display unit according to one or more of the preceding claims, in which the compressor (2) is a frequency controlled compressor.

7. Display unit according to one or more of the preceding claims, in which the display unit comprises at least one quick–coupling, by which the fluid/gas heat exchanger (3) is connected to a refrigeration cycle or plant.

8. Display unit according to one or more of the preceding claims, wherein the transcritical refrigeration unit is a carbon dioxide refrigeration circuit.

9. Display unit according to one or more of the preceding claims, wherein the compartment is removable from the display unit (C).

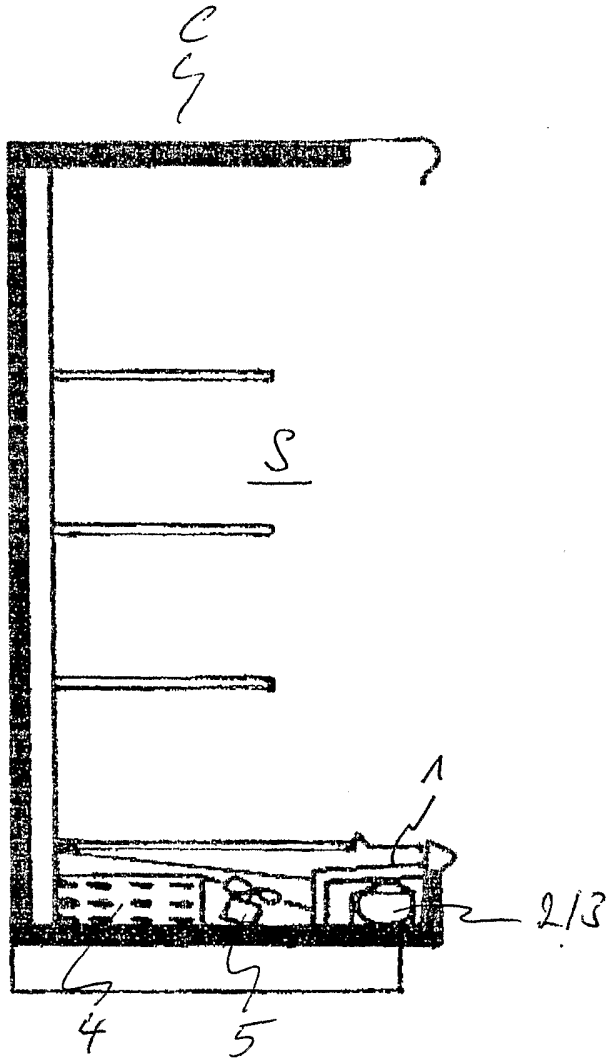


Fig. 1

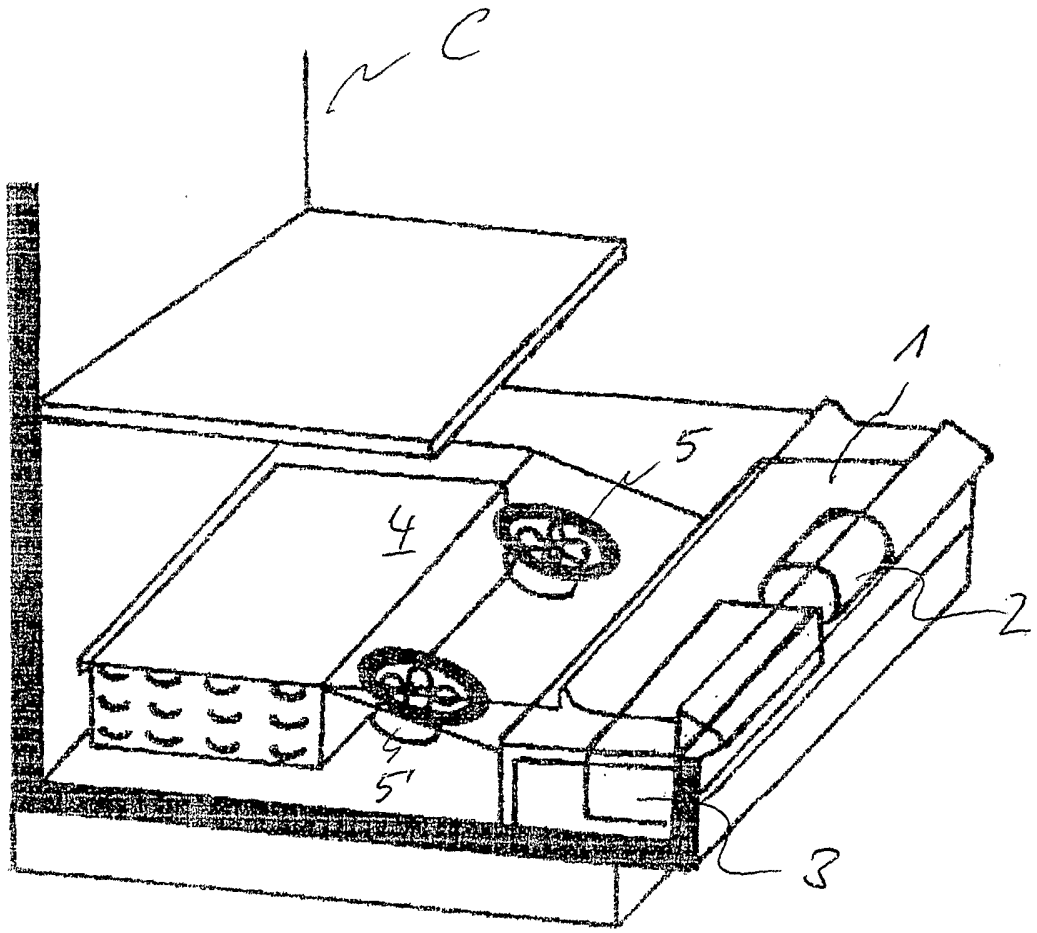


Fig. 2

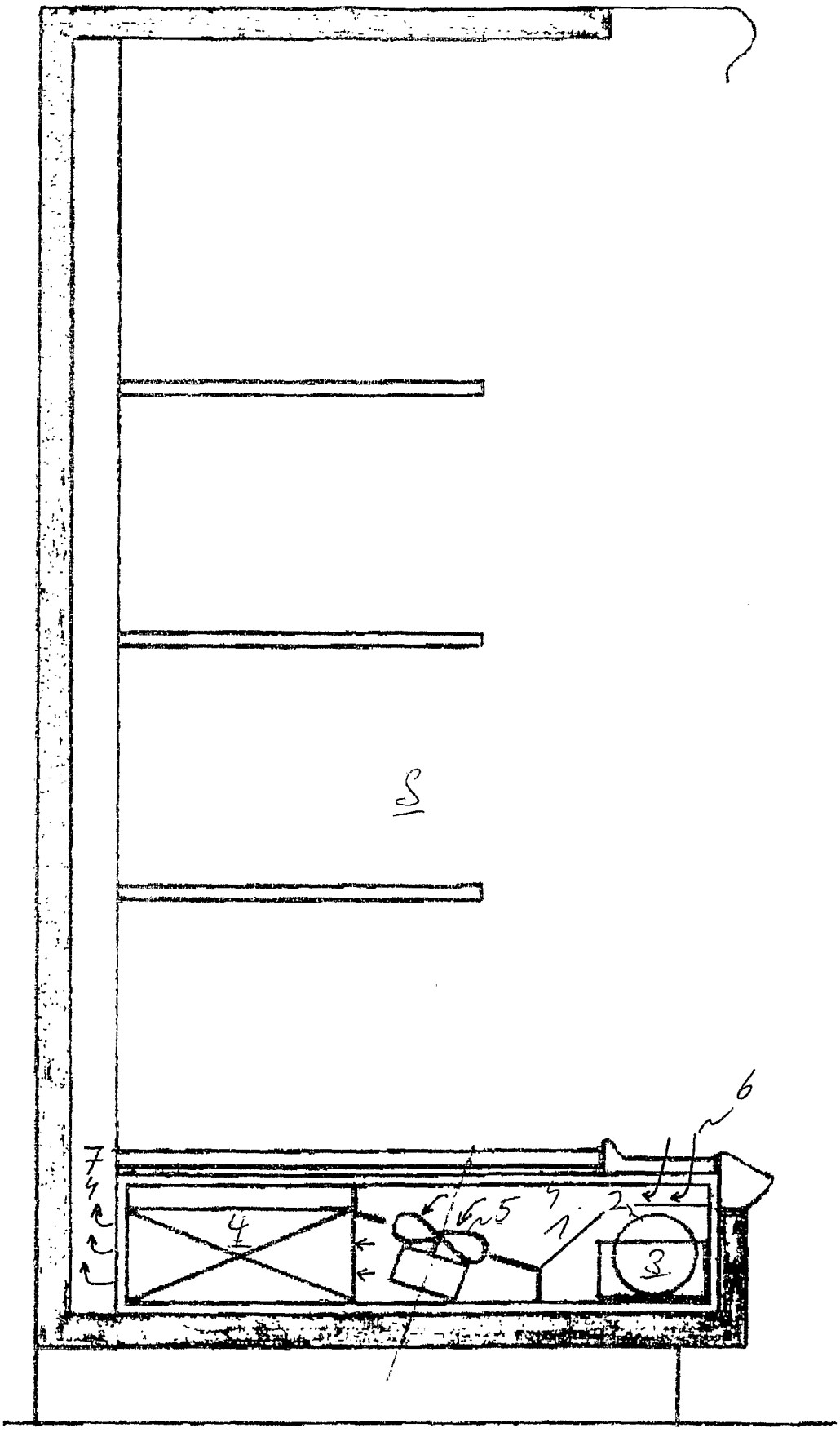


Fig 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/001722

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A47F3/04 F25B9/00

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)
IPC 7 A47F F25B

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 practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 908 688 A (COSTAN S.P.A) 14 April 1999 (1999-04-14) cited in the application paragraph '0005! - paragraph '0041!; figures 1-4	1-9
X	US 6 558 017 B1 (SARAIJI RIAD M ET AL) 6 May 2003 (2003-05-06) column 2, line 55 - column 3, line 19; figures 1,3	1-9
Y	US 3 712 078 A (MAYNARD J,CA ET AL) 23 January 1973 (1973-01-23) column 2, line 31 - column 4, line 32; figures 1-6	1-9

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 October 2005	19/10/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Klintebäck, D

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/001722

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 95/08087 A (SKOPE INDUSTRIES LIMITED; MATTHEWS, BRYCE, ARTHUR) 23 March 1995 (1995-03-23) page 3, line 3 - page 5, line 23; figures 1-12	1-9
Y	WO 00/49345 A (HUSSMANN CORPORATION; COTTER, DENNIS) 24 August 2000 (2000-08-24) page 9, line 24 - page 17, line 24; figures 1-11	1,2,4-9
Y	EP 1 484 560 A (SANYO ELECTRIC CO., LTD) 8 December 2004 (2004-12-08) paragraph '0013! - paragraph '0098!; figures 1,3	1-9
E	EP 1 547 492 A (HUSSMANN CORPORATION) 29 June 2005 (2005-06-29) paragraph '0014! - paragraph '0034!; figures 1-4	1-9

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/001722

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0908688	A	14-04-1999	IT	1295482 B1	12-05-1999
US 6558017	B1	06-05-2003	CA	2414820 A1	18-06-2003
			EP	1321076 A2	25-06-2003
US 3712078	A	23-01-1973	NONE		
WO 9508087	A	23-03-1995	AU	691199 B2	14-05-1998
			AU	7667294 A	03-04-1995
WO 0049345	A	24-08-2000	AT	268457 T	15-06-2004
			AU	743194 B2	24-01-2002
			AU	3599100 A	04-09-2000
			BR	0007012 A	04-12-2001
			CA	2340642 A1	24-08-2000
			CZ	20012962 A3	17-07-2002
			DE	60011232 D1	08-07-2004
			DE	60011232 T2	07-07-2005
			EP	1153251 A1	14-11-2001
			ES	2216874 T3	01-11-2004
			HU	0105350 A2	29-04-2002
			NZ	510092 A	31-01-2003
EP 1484560	A	08-12-2004	CN	1573265 A	02-02-2005
			JP	2004360998 A	24-12-2004
			US	2004244407 A1	09-12-2004
EP 1547492	A	29-06-2005	NONE		