



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
11.06.2008 Bulletin 2008/24

(51) Int Cl.:
A47F 3/04 (2006.01)

(21) Application number: **05803586.6**

(86) International application number:
PCT/ES2005/000555

(22) Date of filing: **18.10.2005**

(87) International publication number:
WO 2007/023194 (01.03.2007 Gazette 2007/09)

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

(30) Priority: **25.08.2005 ES 200502182**

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(54) **IMPROVED HEAT RECOVERY SYSTEM WHICH IS INTENDED FOR AIR-CONDITIONING AND TO REDUCE THE COLD CORRIDOR EFFECT**

(57) The invention relates to an improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect. More specifically, the invention relates to a system for making use of heat that is released during the condensing and/or cooling of a refrigerant fluid, in order subsequently to heat an airflow passing through an open retail refrigeration cabinet or

lines of same, using a specially-designed unit for distributing and supplying heated air. The inventive assembly is equipped with a regulation and control device which can be used to maintain acceptable comfort levels for customers in the areas surrounding said open retail refrigeration cabinets or lines of same. The inventive system represents a significant improvement in relation to the design of the previously-patented system.

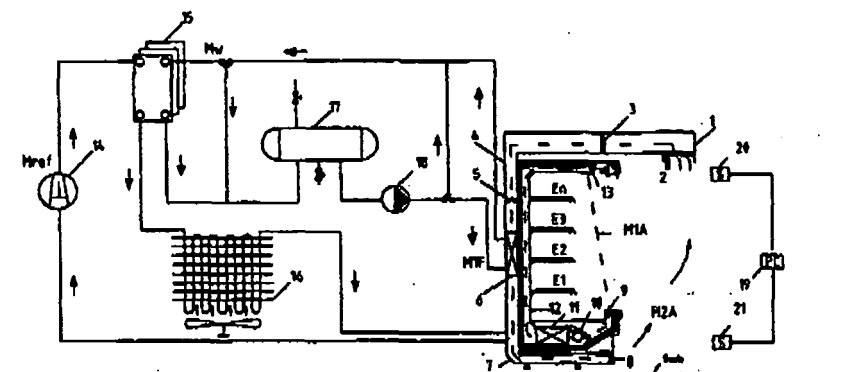


FIG. 2

Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates in general to an improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect produced in open retail refrigeration cabinets or lines of same.

[0002] The heat evolved by a refrigerant fluid during the prior condensation or cooling process of it is made use of in a condensation unit or in an intermediate heat exchanger housed between that condensation unit and the discharge line of the compressor or of an array of positive or negative temperature compressors, belonging to the refrigerating circuits of refrigeration cabinets to be found in retail outlets; with the aim of using this heat evolved by the refrigerant fluid for air-conditioning and to reduce the cold corridor effect produced in the vicinity of those open retail refrigeration cabinets or lines of same, owing to the direct contact between the external face of the refrigeration air curtain of the refrigeration cabinet and the air inside a retail outlet.

[0003] Therefore, the object of this invention relates to the design of an improved system for making use of the heat released by a refrigerant fluid in a condensation unit or in an intermediate heat exchanger during the prior condensation or cooling process thereof, for air-conditioning and to reduce the cold corridor effect, as described previously.

PRIOR ART OF THE INVENTION

[0004] Retail outlets concerned with the distribution of perishable cold products are fitted with various kinds of refrigeration cabinet designed exclusively for the sale of these food products. Coming within this type of refrigeration cabinet are open retail refrigeration cabinets.

[0005] The products stored in these refrigeration cabinets require for their conservation a refrigerated ambience with certain given temperature levels. On account of their design and with the aim of maintaining the interior of the refrigeration cabinet at a desired refrigeration temperature, they are provided with a refrigerated air curtain, which demarcates the ambience of the retail outlet from the interior ambience of those open retail refrigeration cabinets.

[0006] Open retail refrigeration cabinets continually extract heat from the ambient air of the retail outlet owing to the direct contact existing between the external face of the refrigerated air curtain and the air inside the refrigeration cabinet. For that reason, in the vicinity of open retail refrigeration cabinets there exists an ambient temperature that is appreciably less than in the rest of the retail outlet, which is proportional to the installed cold density, defined on the basis of the ratio existing between the cooling power extracted by open retail refrigeration cabinets and the retail surface area.

[0007] In retail outlets intended for the distribution of

perishable food products when open retail refrigeration cabinets are installed facing each other, a phenomenon is produced known as the cold corridor, where the temperature at floor level can be around 5-10 K less than compared to the rest of the retail outlet. This local reduction in temperature in the vicinity of open retail refrigeration cabinets or lines of same produces a certain ambient discomfort for the customer, as a result of which they tend to stay away, leading to a drop in sales, if no special measures are adopted.

[0008] There currently exist methods for mitigating this cold corridor effect, one of which is to use grilles in the lower part of the refrigeration cabinets which, by means of a system of fans, collect the cold air in the corridor and then channel it for extraction.

[0009] There exist other methods in which condensation unit of the refrigeration system is installed in the upper part of open retail refrigeration cabinets (if the cabinets are small the condenser unit is located in the lower part), thereby making use of the heat given off during the condensation process of the refrigerant fluid in order to raise the temperature in the interior of the retail outlet, with the consequent economic drawback if we take into account that during the summer months this heat input then has to be eliminated by the air-conditioning system.

[0010] Other systems have been designed, in which the heat released by the refrigerant fluid during the condensation process is made use of, this heat being channelled towards the interior of the retail outlet via a system of ducts designed for this purpose and/or in other cases, the actual air-conditioning of the retail outlet is used.

[0011] A heat recovery system is known for air-conditioning and reduction of the cold corridor effect, and is described in document ES-2.167-280, owned by FROST-TROL, SA, the content of which is incorporated into this specification as reference. This document of the prior art describes an air-conditioning system for retail outlets and/or for distributor shops for perishable food products, which describes a system for making use of the air heated during the condensation process of a refrigerant fluid in the condenser units belonging to the refrigeration circuits of open retail refrigeration cabinets. In this case, the condensation unit is located in the upper part of the refrigeration cabinet, thereby taking advantage of the heat evolved during the condensation of the refrigerant. By means of some channelling ducts the hot air is supplied via the lowest part of the refrigeration cabinet towards the interior of the retail premises, and also to any other place.

DESCRIPTION OF THE INVENTION

[0012] In accordance with the present invention, a system is proposed which permits the drawbacks mentioned above to be diminished by means of designing an improved system for heat recovery in which the heat evolved by a refrigerant fluid during the prior condensation or cooling process is made use of in a condensation

unit or in an intermediate heat exchanger housed between that condensation unit and the discharge line of a compressor or of an array of positive or negative temperature compressors, or of any refrigeration system.

[0013] Starting from this premise, the inventive system is applicable to open retail refrigeration cabinets or lines of same designed for the retail of perishable food products, for positive or negative temperatures. The system comprises a unit for the recovery and exploitation of the heat, as well as a unit for distributing and supplying heated air towards the interior of a retail outlet or a large retail store or an area to be air-conditioned, or any other place.

[0014] The heat recovery and exploitation unit contains a heat exchanger housed in the unit for distributing and supplying heated air, an intermediate heat exchanger and/or a condenser unit, an insulated tank and a circulation pump.

[0015] The intermediate heat exchanger and/or the condensation unit is arranged in the discharge line of the compressor or of the array of compressors, with the aim of making use of the heat evolved by the refrigerant fluid during the condensation of cooling process of the latter. The intermediate heat exchanger and/or the condensation unit can be housed in a machine room intended for this purpose or outside of it or in open retail refrigeration cabinets or lines of same.

[0016] The heat evolved by the refrigerant fluid is absorbed in the condensation unit and/or in the heat exchanger by a secondary working fluid. The recirculation of the secondary fluid is carried out using a circulation pump, interconnected with an insulated tank and with the heat exchanger that is housed in the duct for channelling and supplying the hot air. The geometry, design and number of heat exchangers used in the heat recovery and exploitation unit will depend on the installed cooling power.

[0017] The unit for distributing and supplying heated air towards the interior of the area to air-condition comprises an air suction grille, an interchangeable filter, a fan unit interconnected with the regulation system for the system and some air diffusers located in the lower part of the open retail refrigeration cabinet. The unit for distributing and supplying heated air can be housed in the rear part of an open retail refrigeration cabinets or outside of it.

[0018] The entire inventive assembly is provided with a device for regulating and controlling certain established conditions of comfort for the permanence of people and customers in general in these retail outlets.

[0019] As well as establishing a comfortable climate for the customers, the inventive system described above has the advantage of gradually reducing the relative humidity of the air inside a retail outlet or in a large retail store or in an area to air-condition, or anywhere else, thereby helping to reduce the installed cooling power and the overall energy consumption of these retail outlets.

[0020] Below, in order to facilitate a better understanding of this descriptive specification and forming an inte-

gral part thereof, some figures are attached in which, on an illustrative rather than limiting basis, the object of the invention has been represented.

5 **BRIEF DESCRIPTION OF THE FIGURES**

[0021]

Figure 1 shows a perspective view of an open retail refrigeration cabinet forming the object of the invention. In this case, a curtain of refrigerated air is shown (m_{1A}) and a flow of hot air (m_{2A}), generated starting from the exploitation of the heat evolved during the prior condensation or cooling process of a refrigerant fluid. Via certain ducts for channelling and pulsing (4, 7) of air and certain air diffusers (8), the flow of heated air (m_{2A}) is introduced into the interior of a retail outlet or a large retail store or an area to air-condition, via the lower part of the open retail refrigeration cabinets or lines of same.

Figure 2 shows a view in cross-section of an open retail refrigeration cabinet taking as reference the line A-A of figure 1, interconnected with an embodiment of the refrigeration circuit for a system that is embodied with the invention.

Figure 3A and 3B shows in perspective different alternatives for the embodiment of the duct for the channelling (4) and supplying the heated air (7), forming the object of the present invention.

Figure 4 represents a general view of the improved system for heat recovery for air-conditioning and to reduce the cold corridor effect forming the object of this invention. In this case it shows the direction of recirculation of the heated air (m_{2A}), generated and pulsed by the lower part of the open retail refrigeration cabinet by means of some heat diffusers (8). The flow of hot air is sucked via a suction grille (2), suitably arranged in a particular position above the open retail refrigeration cabinet, in the inlet duct of the unit for distributing and supplying heated air (1).

DESCRIPTION OF A PREFERRED EMBODIMENT

[0022] Making reference to figures 1 to 4, an improved system has been illustrated intended for air-conditioning and to reduce the cold corridor effect. The inventive system, whose embodiment by way of example will be explained below, is applicable to open retail refrigeration cabinets or lines of same, designed for the retailing of perishable food products, arranged in a retail outlet or in a large retail store or in an area to air-condition or any other place.

[0023] In whatever case, the inventive system comprises a recovery and exploitation system for the heat evolved by a refrigerant fluid during the condensing or cooling of it, as well as a unit for distributing and supplying the heated air via the lower part of the open retail refrigeration cabinets or lines of same towards the interior of

a retail outlet or a large retail store or an area to be air-conditioned, or any other place.

[0024] The heat recovery and exploitation unit contains a heat exchanger (6) housed in the unit for distributing and supplying heated air (1), an intermediate heat exchanger (15) and/or a condenser unit (16) located in the discharge line of the compressor (14), an insulated tank (17) and a circulation pump (18), as well as the other conventional automata necessary for regulating the refrigerating facility.

[0025] The unit for distributing and supplying the heated air (1) contains an air suction grille (2), an interchangeable filter (3), fan (5), some air diffusers (8) arranged inside the ducts for channelling (4) and pulsing the heated air (7), as well as a device for regulating and controlling (19) the ambient conditions in the vicinity of open retail refrigeration cabinets or lines of same.

[0026] For the purposes of embodying the present invention, via the upper part of an open retail refrigeration cabinet or lines of same, at least one fan (5) housed in the channelling duct (4) sucks a flow of air (M_{2A}) from the interior of a retail outlet or a large retail store or an area to be air-conditioned, or any other place, via some suction grilles (2) located in the inlet duct of the unit for distributing and supplying the heated air (1). The airflow (M_{2A}) is pulsed via some interchangeable filters (3) and at least one heat exchanger (6), arranged in the duct for channelling (4) of the heated air.

[0027] As it passes through the heat exchanger (6), the air is heated owing to the thermal exchanger that is produced with the secondary fluid air (M_{1F}) of the heat recovery unit. The hot air is distributed and pulsed to the interior of a retail outlet or a large retail store or an area to be air-conditioned, or any other place, by means of some air diffusers (8) housed in the lower part of the open retail refrigeration cabinets or in lines of same.

[0028] The supplying the heated airflow (M_{2A}) to the interior of a retail outlet or a large retail store or an area to be air-conditioned or any other place is regulated by means of a control device (19), which employs certain measuring devices (20, 21) suitably distributed in the ambience to air-condition, together with the other conventional automata belonging to the refrigeration circuits of open retail refrigeration cabinets; which permits the temperature of the air to be maintained in the vicinity of the open retail refrigeration cabinets or lines of same under certain pre-established conditions; generating a microclimate of comfort for the customers of the retail outlet for the retail of perishable products.

Claims

1. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, comprising a heat recovery and exploitation unit, and a unit for distributing and supplying of the heated air via the lower part of an open retail refrigeration

cabinet or lines of same, located in the interior of a retail outlet or a large retail store or an area to be air-conditioned for the display, distribution and/or sale of perishable food products, which is used to mitigate the effect known as cold corridor; **characterised in that** the unit for distributing and supplying the heated air (1) is capable of directing the heated air towards the interior of retail premises or a large retail store or an area to be air-conditioned, as well as any other place via the lower part of the open retail refrigeration cabinet or lines of same.

2. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claim; **characterised in that** the unit for distributing and supplying the heated air (1) located in the rear part of the open retail refrigeration cabinet or lines of same or in any other place can be of any type, shape and constructive design.

3. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claim; **characterised in that** the procedure used for reducing and air-conditioning of the cold corridor effect is applicable to any refrigeration system working in positive or negative temperatures, whether or not by vapour compression, where in some physical way a prior condensation and/or cooling process is produced of a refrigerant fluid of any physical nature and chemical composition; with the aim of making use of the heat released during the process in order to raise the temperature of another working fluid used as heat-carrier flow.

4. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect according to the previous claims; **characterised in that** it is capable of making use of the heat evolved by a refrigerant fluid of any physical nature, during the prior condensation and/or cooling process of the latter, in order to heat a secondary working fluid of any physical nature, which is later on used to raise the temperature of the air as it passes through at least one heat exchanger (6), installed in the open retail refrigeration cabinet or lines of same or in any other place.

5. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** the geometry, the design and the number of heat exchangers used in the recovery unit (15, 16) and heat exploitation unit (6) will depend on the installed cooling power, and these will be able to be of any kind, geometry or design.

6. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** the secondary working fluid which absorbs heat during the process of prior cooling and/or condensation of the refrigerant fluid is stored or not in an insulated tank (17), and later on pulsed towards the heat exchanger (6) housed in an open retail refrigeration cabinet or lines of same or in any other place. 5
7. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** the unit for distributing and supplying the heated air (1) can be of any shape, design and geometry, located or otherwise in a position above the open retail refrigeration cabinet or lines of same. 10
8. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** the ducts for channelling and distributing the air (4) which direct the air towards the interior of the retail premises or a large retail store or an area to be air-conditioned, end in the outlet supplying duct for the hot air (7) located in the lower part of an open retail refrigeration cabinet or lines of same. 15
9. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, comprising a heat recovery and exploitation unit, according to the previous claims; **characterised in that** a regulating and control device (19) is used which permits adequate control of the functioning parameters of the facility. 20

Amended claims under Art. 19.1 PCT

1. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, comprising 40
a heat recovery and exploitation unit; and
a unit for distributing and supplying the heated air via the lower part of an open retail refrigeration cabinet or lines of same; 45
said units located in the interior of a retail outlet or a large retail store or an area to be air-conditioned for the display, distribution and/or sale of perishable food products, which is used to mitigate the effect known as cold corridor; 50
characterised in that
the unit for distributing and supplying the heated air (1) comprises means for extracting an airflow from the interior of the corridor via the upper part thereof through some grilles (2) and for pumping the airflow via at least one compact heat exchanger (6) which 55

is housed in the airflow entrance; where the air temperature is increased prior to introducing the flow of heated air into a duct (4) housed in the rear part of an open retail refrigeration cabinet or lines of same, which is then pulsed via the lower part of the refrigeration cabinet.

2. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claim; **characterised in that** the procedure used for reducing and air-conditioning of the cold corridor effect is applicable to any refrigeration system working in positive or negative temperatures, whether or not by vapour compression, where in some physical way a prior condensation and/or cooling process is produced of a refrigerant fluid in an intermediate heat exchanger (15) ; with the aim of making use of the heat released during the process in order to raise the temperature of a secondary working fluid in the liquid state (e.g., water, oil) used later on as a heat-carrier flow in order to raise the temperature of the air as it passes via the compact heat exchanger (6).

3. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** the design and number of intermediate heat exchangers (15) used for recovering the heat evolved by the refrigerant fluid will depend on the installed cooling power, being welded plate exchangers or not; and/or being tubular exchangers, in which the flow of refrigerant circulates counter-current the secondary fluid used as heat-carried fluid.

4. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** a secondary working fluid which absorbs heat during the process of prior cooling and/or condensation of the refrigerant fluid is stored or not in an insulated tank (17), and later pumped by a circulation pump (18) towards the compact heat exchanger (6) housed in the unit for distributing and supplying the heated air (1).

5. improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** extraction and pumping ducts for air are thermally insulated in order to reduce possible heat losses to the surrounding medium.

6. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** an outlet duct for supplying the heated

air (7) located in the lower part of the refrigeration cabinet is equipped with some rotational air diffusers (8) which provide a correct mixing of the airflow according to the volume of air entering via the top of the duct (4).

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7. Improved heat recovery system which is intended for air-conditioning and to reduce the cold corridor effect, according to the previous claims; **characterised in that** a regulating and control device (19) is used which automatically regulates the temperature of the corridor and the other functioning parameters of the facility (working pressures and temperatures of the compressor array), varying the volume of secondary fluid traversing the intermediate heat exchanger (15) and the compact heat exchanger (6) acting on some three-way valves which guarantee certain adequate conditions of comfort for the permanence of persons in the retail outlets.

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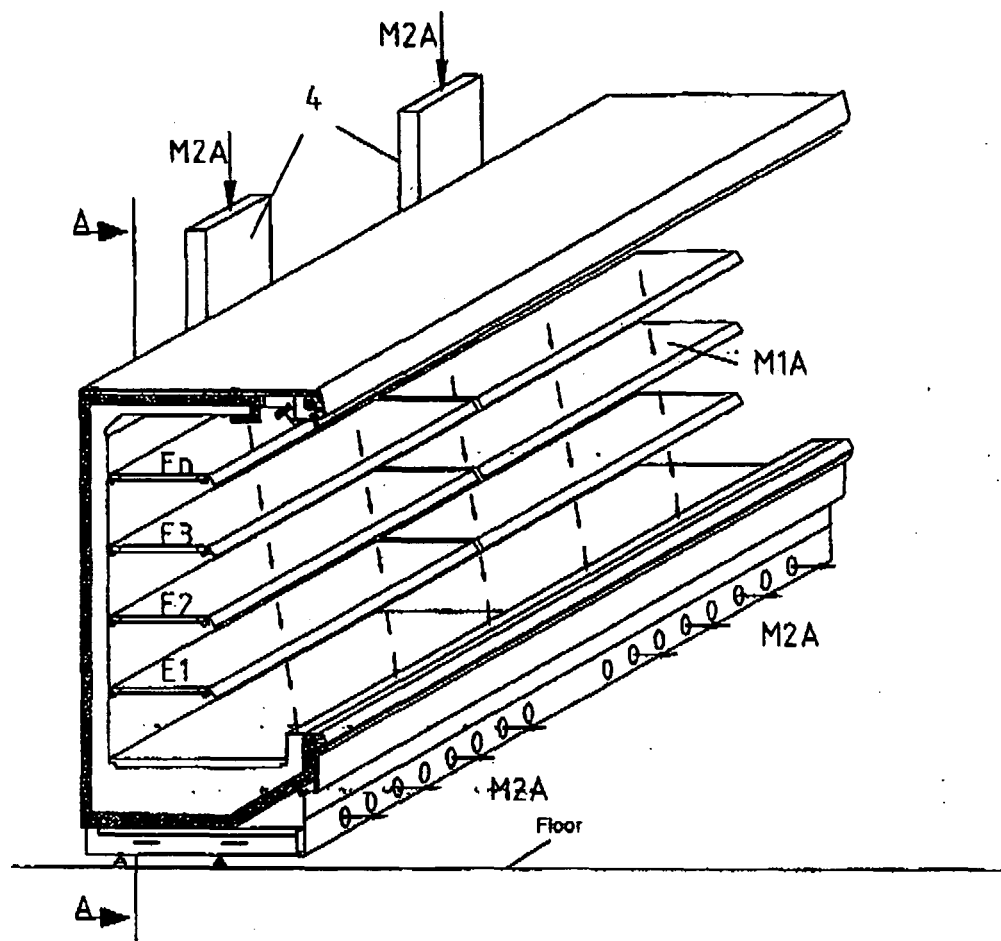


FIG. 1

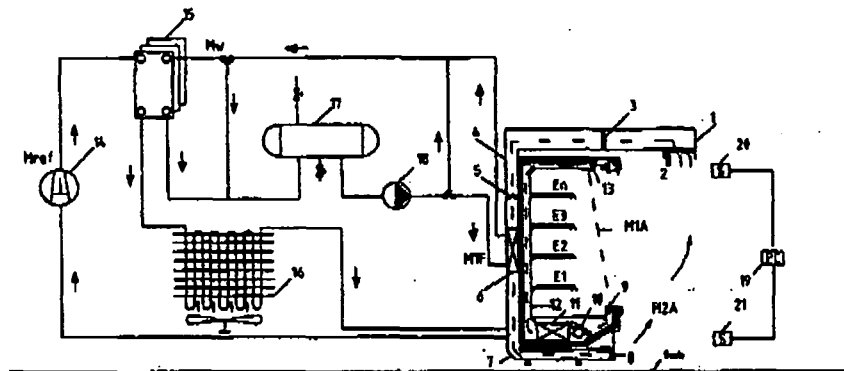


FIG. 2

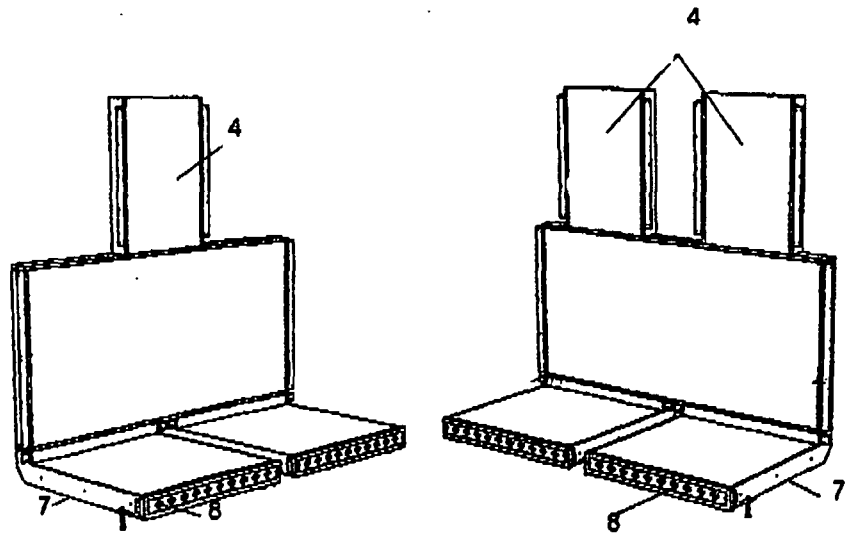


FIG. 3A

FIG. 3B

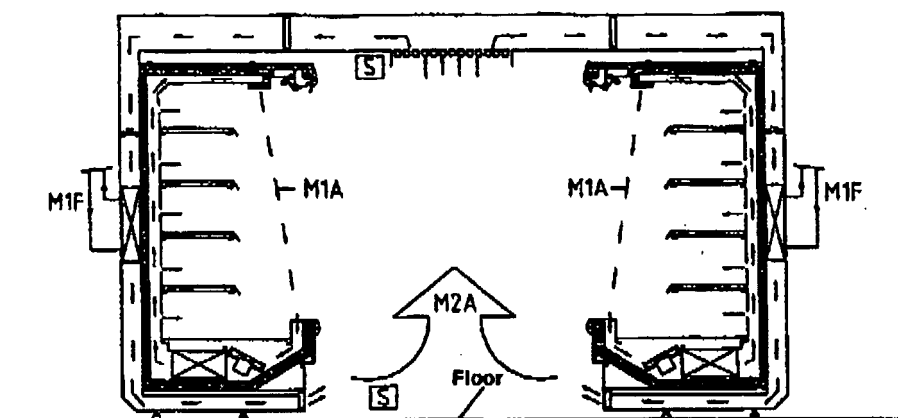


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2005/000555

A. CLASSIFICATION OF SUBJECT MATTER		
A47F 3/04 (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)		
A47F, F25D, F24F		
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)		
NONE lines the whole document CIBEPAT,EPODOC		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ES2167280 B1 (FROST-TROL, S.A.) 26.10.2000, column 1, lines 9-19; column 4, lines 36-41.	1-9
Y	US2004129018 A1 (RINI DANIEL et al) 08.07.2004, figures 9A and 9B.	1-9
Y	US3263745 A (JAMES HENRY) 02.08.1966, column 2, lines 56-61.	1-9
X	US2001003702 A1 (HALTON OY) 14.06.2001, column 1, lines 55-65.	1
A	US3759059 A (KENYON A) 18.09.1973, the whole document	1-9
A	US3025681 A (BOOTH JOHN) 20.03.1962, the whole document	1-9
☐ Further documents are listed in the continuation of Box C. ☒ See patent family 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 application or patent 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
23 JAN 2006 (23.01.2006)		01 FEB 2006 (01.02.2006)
Name and mailing address of the ISA/ S.P.T.O.		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

EP 1 929 902 A1

INTERNATIONAL SEARCH REPORT

International application No.

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