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(71) Applicant: **HITACHI, LTD.**  
6, Kanda Surugadai 4-chome Chiyoda-ku  
Tokyo(JP)

(72) Inventor: **Kikuchi, Masayuki**  
1723-4, Oaza Arai Ohiramachi  
Shimotsuga-gun Tochigi-ken(JP)

(72) Inventor: **Murayama, Kouji**  
460-7, Oaza Ushiku Ohiramachi  
Shimotsuga-gun Tochigi-ken(JP)

(72) Inventor: **Arai, Hikohisa**  
441-1, Otsukicho  
Ashikaga-shi(JP)

(74) Representative: **Altenburg, Udo, Dipl.-Phys. et al,**  
**Patent- und Rechtsanwälte**  
**Bardehle-Pagenberg-Dost-Altenburg & Partner Postfach**  
**86 06 20**  
**D-8000 München 86(DE)**

(54) **Refrigerator.**

(57) A refrigerator comprises a cold storage box (2) and a cooling unit (1) both of which may be separated from each other and may be coupled by clamp means (3). The cooling unit (1) are provided with a cold air outlet (26) and a cold air inlet (27) which are, respectively, capable of being sealingly engaged with communication holes (33) and (34) of the cold storage box (2). A cooler (24) of the cooling unit (1) is surrounded by an insulating case (23) except for a motor (25b) for rotating a cold air feeding (25a) fan which serves to forcibly supply cold air to the cold storage box (2). An inverter (8) is provided in the cooling unit (1) so that either alternating current or direct current source may readily be used for the refrigerator.

FIG. 6

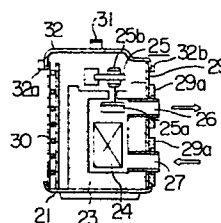
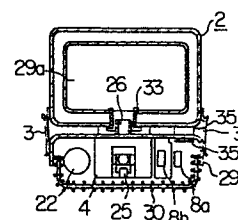


FIG. 7



## REFRIGERATOR

## 1 BACKGROUND OF THE INVENTION

## FILED OF THE INVENTION

The present invention relates to a refrigerator for being mounted on automotive vehicles and, more particularly, to a refrigerator with a cold box for storage of substances to be cooled and a cooling unit having a cooling system, in which the cold box and the cooling unit may readily be separated from each other.

## 10 BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a side elevational view of a prior art refrigerator for being mounted on automotive vehicles;

15 Fig. 2 is a perspective view of a cooling unit of the refrigerator shown in Fig. 1;

Fig. 3 is a plan view of the cold storage box of the refrigerator, showing a state in which the cover of the cold storage box is opened;

20 Figs 4 through 8 are various views showing one embodiment of the invention;

Fig. 4 is a perspective view of a refrigerator for mounting on automotive vehicles,

Fig. 5 is a perspective view showing a state

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1 in which the cooling unit is separated from the refrigerator;

Fig. 6 is a cross-sectional view taken along the line VI-VI of Fig. 5;

5 Fig. 7 is a cross-sectional view taken along the line VII-VII of Fig. 4; and

Fig. 8 is a circuit diagram for the refrigerator.

10 DESCRIPTION OF THE PRIOR ART

An automotive refrigerator of the prior art will now be described with reference to Figs. 1 through 3. Fig. 1 shows an entire structure thereof. A cooling unit 51 comprises a condenser 55, a compressor (not shown) and a cooler 54. A cold storage box 52 comprises 15 a box body 56 and an opening/closing cover 57. The cooling unit 51 and the cold storage box 52 are coupled to each other by clamp means 53. By releasing the clamp means, the two units 51 and 52 are separated from each other. The cooling unit 51 separated from the cold storage box 52 is, as shown in Fig. 2, composed of a unit body having the compressor, a radiator and the like and a direct cooling type cooler 54 which is independently formed and is to be located in the cold storage 20 box 52 upon the coupling. The cooler 54 is large in size in the form of an L-shape in cross section, which is substantially the same as the cold storage box 52 in 25

1 width and height. For use as a refrigerator, the  
cooling unit 51 is coupled and fixed to the cold storage  
box 52 so that the cooler 54 is located in a predeter-  
mined position in the cold storage box 52, and the  
5 cooling unit 51 is operated by a D.C. power (for  
example, 12V) of the automotive vehicle. With such a  
construction, in case that the cooler 54 is mounted in  
the cold storage box 52, the cooling unit 51 which is  
very heavy as a whole must be lifted after opening the  
10 cover 57 of the cold storage box 52 and be inserted into  
the cold storage box 52 from the upper side. Also in  
separating the cooling unit from the cold storage box,  
the opposite operations are required. It is therefore  
very inconvenient in a restrictive space such as the  
15 passenger room of a vehicle and the like. Also, since  
the cooling of the cold storage box 52 is carried out by  
a direct cooling with the cooler 54, the interior of the  
cold storage box 52 is cooled by a natural convection.  
Therefore, the cooling speed is low and a temperature  
20 difference of the storage substance between a part adja-  
cent to the cooler 54 and a part far from the cooler is  
large; that is, a temperature is varied according to the  
location of each part of the storage substance. A long  
period operation is required for making the temperature  
25 difference small. Also, it is impossible to cool the  
cold storage box for a short period of time, par-  
ticularly for leisure use. Such serious disadvantages

1 are inherent to the refrigerator of the prior art.  
Furthermore, since the cooler 54 of the cooling unit 51  
separated from the cold storage box is exposed to the  
outside, there is a fear that drops of dew would be  
5 leaked or the connecting portion of the cooler 54 would  
be accidentally damaged. Since the refrigerator is  
operated only by the D.C. power, in the case that the  
substances to be cooled are cooled in advance at home,  
it is disadvantageous that another D.C. power source  
10 unit must be used.

#### SUMMARY OF THE INVENTION

A primary object of the invention is to provide a refrigerator in which a cold storage box may be  
15 simply separated from a cooling unit in the lateral  
direction thereof, the cooling speed is increased and a  
difference in temperature according to a position of the  
substance to be cooled is made small without fears that  
drops of dew would be occur out of a cooler of the  
20 cooling unit and that the coupling portion would be  
damaged after the cooling unit is separated from the  
cold storage box, and in which either D.C. source or  
A.C. source may readily be used.

This and other objects of the invention are  
25 achieved by providing a refrigerator comprising a cold  
storage box 2 in which a substance to be cooled is  
encased, a cooling unit 1 having a refrigerating cycle,

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1 and a clamp means 3 for detachably coupling the cold  
storage box and the cooling unit to each other, the  
refrigerator being characterized by the cooling unit 1  
incorporating a cooler 24, a radiator 30 and a  
5 compressor 22, the cooling unit 1 further comprising an  
insulating case 23 encasing therein the cooler 24 and a  
fan 25a, communication holes 33 and 34 being provided in  
a side surface of the cold storage box 2 so as to com-  
municate with a cold air outlet 26 of the insulating  
10 case 23 and a cold air inlet 27 thereof, and a cooling  
system 6 connected to a battery through an inverter 8  
for changing D.C. voltage to A.C. voltage and connector  
terminals 38.

#### 15 DESCRIPTION OF THE PREFERRED EMBODIMENTS

One embodiment of the invention will now be  
described with reference to Figs. 4 through 8. A  
cooling unit 1 comprises means for constituting a refri-  
gerating cycle, air feeding means, controlling means and  
20 the like. A cold storage box 2 in which a substance to  
be cooled is encased is composed of a box body 2a and an  
opening/closing cover 2b. The cooling unit 1 and the  
cold storage box 2 are coupled to each other by clamp  
means 3, and by releasing the clamp means 3, they are  
25 separated as shown in Fig. 5. The cooling unit 1 is  
constructed as follows. An A.C. compressor 22 is  
mounted on a base 21. A cooler 24 and a fan 25a are

1 surrounded by an insulating case 23 made of insulating  
material such as foamed styrene resin and urethane  
resin. The insulating case 23 is mounted on the base 21  
with an A.C. motor 25b for feeding air outside the insu-  
5 lating case. An air feeding means 25 is composed of the  
fan 25a and the motor 25b. An inverter 8 for boosting a  
D.C. low voltage (for example 12V) to a commercially  
available power A.C. voltage (for example, 100V) is  
separated into a signal portion 8a for converting a  
10 direct current to an alternating current and an output  
portion 8b for boosting the voltage and is mounted on an  
inverted L-shaped mounting plate 8c. The output portion  
8b is located on a corner stepped portion 23a of the  
insulating case 23. A radiator 30 is arranged on the  
15 base 21 substantially in the form of a U-shape as viewed  
from the upper side so as to surround the compressor 22,  
the insulating case 23 and the inverter 8. A back plate  
29 is formed in a U-shape and arranged so as to be con-  
nected to free edge portions of the radiator 30. In the  
20 insulating case 23, there are formed a cold air outlet  
26 and a cold air inlet 27 for forcibly feeding cold  
air, heat-exchanged in the cooler 24, into the cold  
storage box 2 by means of the air feeding means 25. The  
outlet 26 and the inlet 27 are extending from the back  
25 plate 29. Annular insulators 29a are attached to the  
outer periphery of the back plate 29 around the outlet  
26 and the inlet 27. On an upper portion of the cooling

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1 unit 1, there is provided an upper plate 32 having a  
grip 31 in the middle portion on the upper surface and  
couplings 32a and 32b on a front flanged portion and a  
rear flanged portion. In the cold storage box 2, there  
5 are formed communication holes 33 and 34 located in  
confronting relation with the cold air outlet and inlet  
26 and 27 of the cooling unit 1 and communicating  
therewith upon the coupling. When the cooling unit 1 is  
coupled to the cold storage box 2, cylindrical portions  
10 of the cold air outlet 26 and inlet 27 are engaged with  
the communication holes 33 and 34 of the cold storage  
box 2 and the adjacent portions to the engagements are  
sealed by compression of the annular insulators 29a  
attached to the back plate 29. Insulating caps 35 and  
15 36 are mounted on the communication passages 33 and 34  
for preventing leakage of cooling air from the cold  
storage box 2 in the case that the cold storage box 2  
cooled by the cooling unit 1 is used independently of  
the cooling unit 1. In Fig. 5, one insulating cap 35 is  
20 mountd on the hole 33. Upon cooling in a normal opera-  
tion, the insulating caps 35 and 36 are to be received  
in receiving portions 35a and 36a. Reference numeral 37  
denotes a shoulder belt.

Fig. 8 shows a power supply circuit for the  
25 automotive refrigerator. The inverter circuit 5 func-  
tions to convert into an A.C. commertial voltage (e.g.,  
100V) a supply voltage inputted to terminals a and b



1 from a D.C. power (e.g., 24V) of a truck, a bus, a  
cruiser and the like or a D.C. power (e.g., 12V) of a  
passenger car while boosting the latter voltage. The  
invertor circuit is adapted to be connected to the  
5 refrigerating system 6 through conector terminals 38.  
On the other hand, power terminals c and d of commer-  
tially available A.C. voltage (e.g., 100V) are connected  
to the refrigerating system 6 through the conector ter-  
minals 38.

10 With such a construction, the cold air is fed  
through the cold air outlet 26 into the cold storage box  
2 by the fan 25a of the air feeding means 25 to thereby  
cool the substance. The cold air used for cooling the  
substance is returned from the cold air inlet 27 back to  
15 the cooler 24 and is cooled again. Thus, since the  
cooling unit 1 serves to forcibly recirculate the cold  
air obtained through the refrigerating cycle, the  
cooling speed of the substance in the cold storage box 2  
is high in comparison with a conventional convection  
20 type refrigerator and a temperature difference according  
to the position of the substance may be made small.  
Furthermore, since only the fan 25a of the air feed  
means 25 is encased in the insulating case 23  
surrounding the cooler 24 and the motor 25b for air  
25 feeding is disposed outside of the insulating case 23,  
the invasion of heat from the outside is small to  
enhance the efficiency. Also, in the coupling between

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1 the cooling unit 1 and the cold storage box 2, since the  
cylindrical portions of the cold air outlet 26 and inlet  
27 of the cooling unit 1 are engaged with the com-  
munication holes 33 and 34 of the cold storage box 2 in  
5 the lateral direction and then, the coupling therebet-  
ween is locked by the clamp means 3, the manual opera-  
tion therefor may be extremely simplified. In this  
case, the coupling portions between the cooling unit 1  
and the cold storage box 2 are sealed by the insulators  
10 29a, the leakage of cold air therefrom is very small.  
Moreover, when after cooling the substance, the clamp  
means 3 is released and the cooling unit 1 is separated  
from the cooling unit 2, the cooler 24 is not exposed  
outside. The leakage of dew may be prevented and the  
15 damage of the cooler 24 may be also prevented. In case  
that the cold storage box 2 separated from the cooling  
unit 1 is carried, by mounting the insulating caps 35  
and 36 on the communication holes 33 and 34 of the cold  
storage box 2, the leakage of cold air may be prevented.  
20 Also in this case, the ability to keep cold the cold  
storage box 2 is improved. On the other hand, since the  
electric energy is supplied from the terminals a and b  
for the D.C. power of the automotive vehicle or the like  
and it is converted into the commercially available A.C.  
25 voltage through the inverter circuit 5 and supplied to  
the refrigerating system 6 for the commercial voltage,  
or otherwise the electric energy may readily be supplied

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1 from the power terminals c and d for the domestic A.C.  
voltage by simply changing over the connector terminals  
38, the refrigerator is very convenient for both D.C.  
and A.C. operations. In addition, the A.C. commercial  
5 voltage may be supplied to the refrigerating system 6.  
Therefore, it is unnecessary to employ and manufacture  
specifically designed compressor and air feeding motor  
for the refrigerating system instruments for general use  
may be used in the refrigerating system.

10 As described above, according to the present  
invention, since without lifting the cooling unit, the  
cold storage box may be separated simply in the lateral  
direction apart from the cooling unit, it is very easy  
to handle the refrigerator. Also, since the cold air is  
15 forcibly recirculated in the cold storage box, the  
cooling speed is extremely increased so that the tem-  
perature difference according to the positions of the  
substance to be cooled may be reduced. Furthermore,  
since the cooler is not exposed outside, there is no  
20 fear that the dew would be leaked to the outside and the  
coupling portions would be damaged. Furthermore, since  
the refrigerator may readily be operated by either D.C.  
source or A.C. source, generally designed A.C. power  
instruments may be used in the cooling system.

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C L A I M S

1. A refrigerator comprising a cold storage box (2) in which a substance to be cooled is encased, a cooling unit (1) having a refrigerating cycle, and a clamp (3) means for detachably coupling said cold storage box and said cooling unit to each other: characterized by said cooling unit (1) incorporating a cooler (24), a radiator (30) and a compressor (22); said cooling unit (1) further comprising an insulating case (23) encasing therein said cooler (24) and a cold air feeding fan (25a); communication holes (33) and (34) being provided in a side surface of said cold storage box (2) so as to communicate with a cold air outlet (26) and a cold air inlet (27) of said insulating case (23); and a cooling system (6) connected to a power source through an inverter (8) for converting a D.C. voltage to an A.C. voltage and connector terminals (38).

2. A refrigerator as claimed in claim 1, said cooling unit 1 further including a motor (25b) for said cold air feeding fan (25a), said motor being disposed outside of said insulating case (23).

3. A refrigerator as claimed in claim 1, wherein said cold air outlet (26) and said cold air inlet (27) of said cooling unit (1) are engaged with said communication holes (33) and (34) of said cold storage box (2), and insulators (29a) are interposed at the coupling

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portions between said cooling unit (1) and said cold storage box (2).

4. A refrigerator as claimed in claim 1, wherein said inverter (8) is composed of separate components of a signal portion (8a) for converting a direct current to an alternating current and an outlet portion (8b) for boosting a voltage.

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FIG. 1

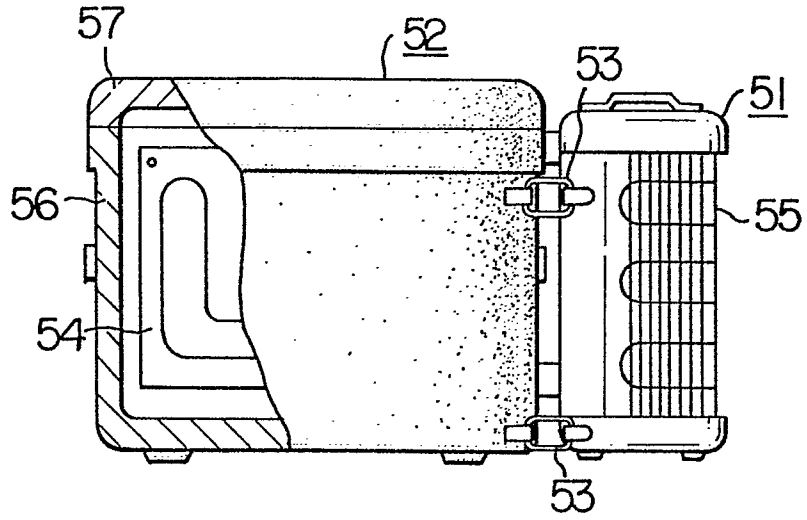


FIG. 2

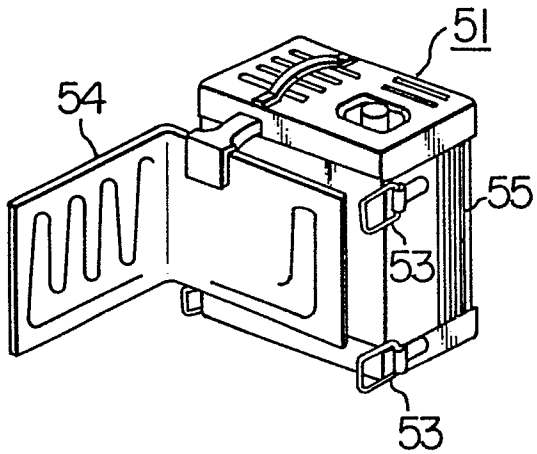


FIG. 3

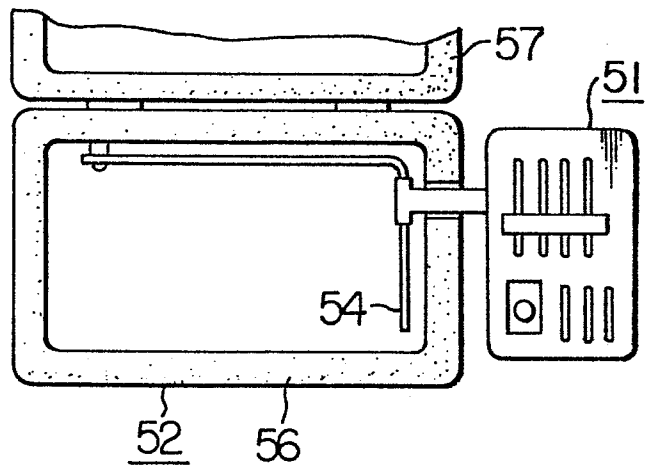
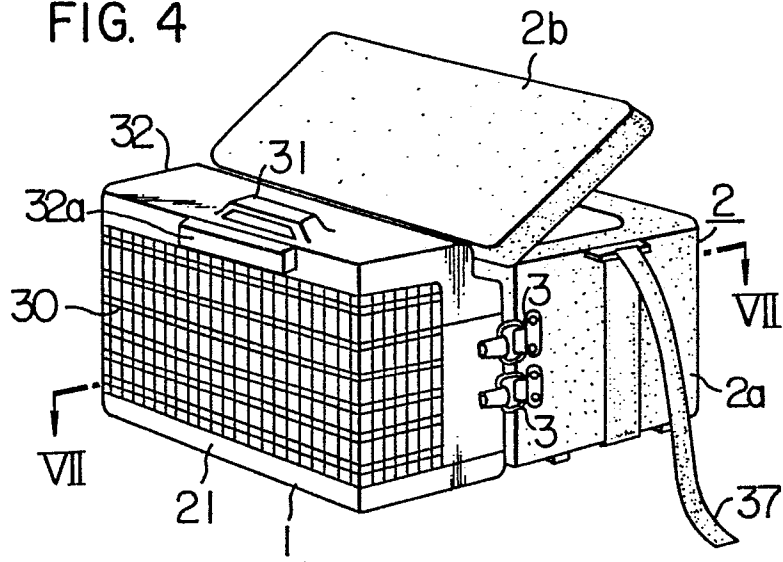


FIG. 4



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FIG. 5

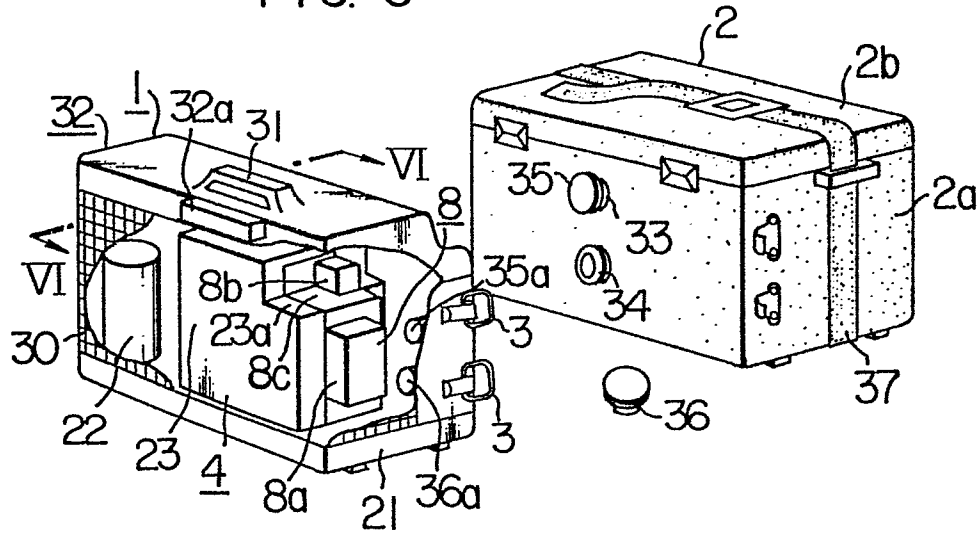


FIG. 6

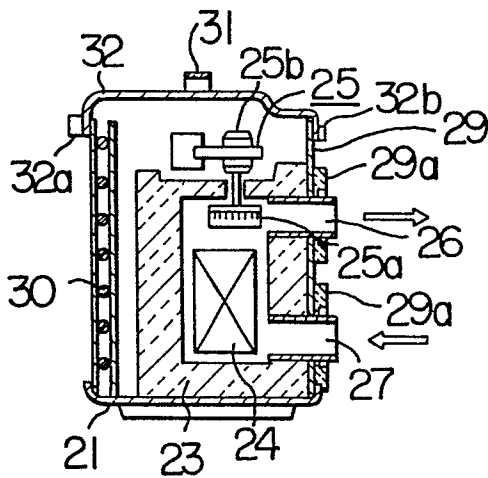


FIG. 7

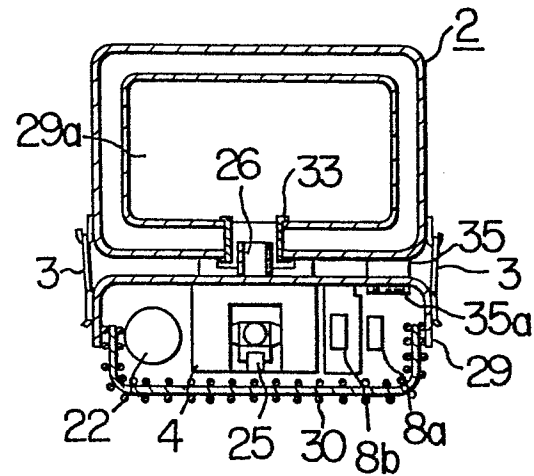
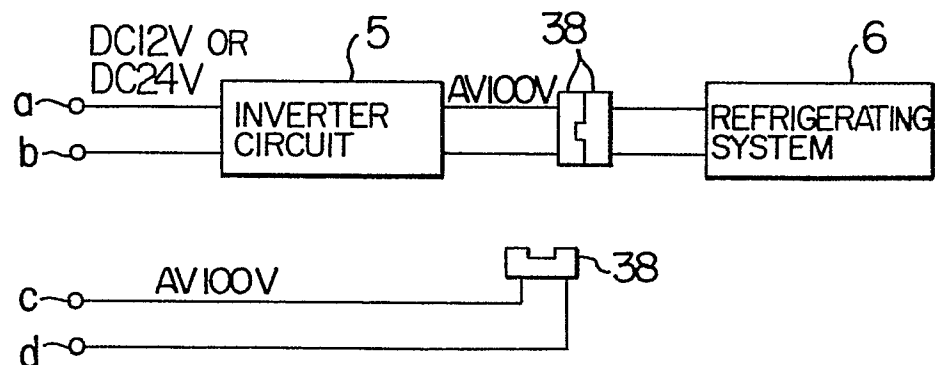


FIG. 8



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# EUROPEAN SEARCH REPORT

Application number

EP 83 10 6826

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. 3)
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A	FR-A-1 134 818 (FROIMOBILE) * Page 1, right-hand column, paragraph 9 - page 3, right-hand column, paragraph 7; figures 1-9 *	1,3	F 25 D
A	CH-A- 491 345 (SCHWEGLER) * Column 1, line 36 - column 3, line 6; figures 1-3 *	1,3	
<p>--- -/-</p>			
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11-11-1983	Examiner BOETS A.F.J.
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>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</p> <p>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 &amp; : member of the same patent family, corresponding document</p>			





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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. <sup>3</sup> )
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A	FR-A-1 299 903 (INDES) * Page 1, right-hand column, paragraph 1 - page 2, left-hand column, paragraph 1; figures 1-4 *	4	
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A	GB-A-1 398 943 (EMAIL)		
A	DE-A-2 327 354 (SCHIRP)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl. <sup>3</sup> )
Place of search THE HAGUE		Date of completion of the search 11-11-1983	Examiner BOETS A.F.J.
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>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</p> <p>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  &amp; : member of the same patent family, corresponding document</p>			