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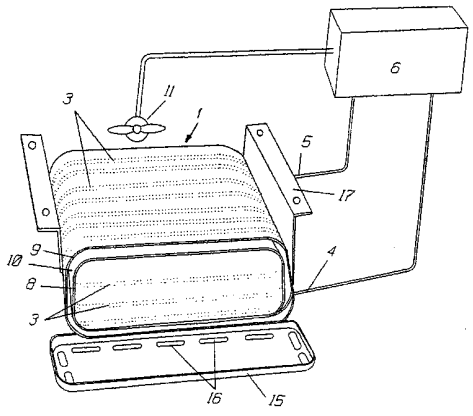
(54) Title: REFRIGERATOR, HAVING A FREEZER COMPARTMENT FOR MOBILE TRANSPORT MEANS, AND METHOD FOR THE MANUFACTURE OF SUCH REFRIGERATOR



(57) Abstract: A refrigerator apparatus having cold creating means (compressor 6, condenser and control means) and an evaporator, which apparatus is especially, but not exclusively, intended for use in mobile transport means like motor cars, busses, trucks, boats, caravans etc., and which is formed for creating a refrigerator tempered environment in a delimited space for storing of food etc., and which is also formed with a freezer compartment (8) for freezing of ice cubes etc., for temporary storing of frozen goods etc., in which the refrigerator apparatus has a cooling pack which is formed by an evaporator (1) having two cold emitting parts, both an inner space which is closed and which provides such cold that it acts as a freezer compartment (8) and an outer annular space (9) which, with the interior side thereof, surrounds the freezer compartment (8) and is arranged at a certain distance therefrom, and which, at the exterior surface thereof, has a cold emitting wall, and in which the freezer compartment (8) is arranged so that it can be closed, whereas the outer annular space provides a through channel (10) through which air can be blown (11), whereby cold air is distributed in the entire refrigerator space. The invention also relates to a method for the manufacture of an evaporator for a refrigerator apparatus of the above mentioned type.

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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.

REFRIGERATOR, HAVING A FREEZER COMPARTMENT, FOR MOBILE TRANSPORT MEANS, AND METHOD FOR THE MANUFACTURE OF SUCH REFRIGERATOR

The present patent application generally relates to a refrigerator apparatus, which is especially, but not solely, intended for use in mobile transport vehicles like motor cars, busses, boats, caravans etc., and which is adapted to create a tempered refrigeration environment in a delimited space for keeping food stuffs etc. refrigerated, and which further comprises a freezer compartment for freezing water into ice cubes, for temporary keeping frozen goods in freezed condition, etc.

The invention also relates to a method for the manufacture of a refrigerator apparatus of the above mentioned type, which is formed both with a freezer compartment and with means for giving the refrigerator compartment as a whole a well distributed, suitable chilliness using an air flow.

A general problem in refrigerators for mobile transport means is that said refrigerators normally have to be driven by the accumulator battery of the transport means/vehicle and that the supply of current in such applications is often restricted. This is in particular true in sailing boats, caravans and other transport means which are often kept still lying/standing with the drive engine stopped and in which the accumulator battery is only charged when the drive engine, or an eventually existing motor-generator, is running, or the transport means is connected to a mains connection. A refrigerator for this purpose therefore must be current-stingy but should still have a good refrigeration capacity.

There are different types of refrigerators for mobile transport means on the market. Conventional refrigerators of domestic refrigerator type having a refrigerator space and a

freezer compartment often require too much current for being useful in motor cars, busses, trucks, boats, caravans etc. which can only receive current only from the accumulator battery, which is charged by the drive engine.

There exist refrigerator systems comprising a eutectic refrigeration plate containing a cold creating medium. In a system cold is emitted from the eutectic plate, which cold sinks down and is distributed in the restricted cold compartment. In such systems there is no cold compartment for freezing water to ice and for temporary keeping frozen goods in frozen condition.

In other systems the refrigerator apparatus has been formed with flat evaporators having such surfaces that is has been possible to cover the walls of the cold compartment more or less completely with evaporator plates. Also in this type of system the cold is distributed in the entire refrigeration compartment and there is no possibility of providing a freezer compartment in the same system.

A third system is formed with an evaporator in the form of a lamella pack, through which air is blown by means of a fan, so that the cooled air is distributed evenly in the entire refrigeration compartment. This system gives a good an even distribution of the cold, but also in this system there is no freezer compartment of the above mentioned type.

Several of the above mentioned priorly known systems also are relatively complicated and are expensive to manufacture and to install in refrigerators and other cold compartments.

Therefore the basis of the invention has been to solve the problem of providing a refrigerator of the above mentioned type which can preferably be used for mobile transport means, which is driven by an accumulator battery, which can be

enclosed in a refrigerator or any other cold compartment, which can be manufactured in a simple, low-cost and rational way, and which, in front of all, comprises both means for distributing cold of refrigeration temperature in the entire cold compartment, and also a freezer compartment for freezing water to ice, for keeping frozen goods in freezed condition for at least one or two days and nights, and in which said two means are combined in an integral unit.

According to the invention the refrigerator unit is formed with two different cold emitting parts, namely both an inner space which is closed and which provides such high cold as to serve as a freezer compartment, and also an outer, annular space which, with the inner surface thereof, encloses the inner space and which, at the outer surface thereof has a cold emitting wall in the form an evaporator, and in which the inner space is arranged for being closed whereas the annular outer space is in the form of a through channel through which air can be blown, whereby cold air is distributed in the entire cold compartment.

The invention also relates to a method of providing a refrigerator of the above mentioned type is a simple and low cost way. The basis of such a method is the use of a flat evaporator plate, which is wound in a type of spiral formation to provide a freezer compartment and cold channels for blowing cold air into the entire cold compartment, and in which the two main parts of the apparatus consequently provide a unitary, integral part of a starting piece for an evaporator.

Further characteristics of the invention and advantages thereof will be evident from following detailed specification in which reference will be made to the accompanying drawings.

In the drawings figure 1 shows a blank for an evaporator of the apparatus according to the invention, and figure 2 is a cross section along line II-II of figure 1; figure 3 shows a vertical cross section view through an evaporator in the refrigerator according to the invention, and figure 4 shows a horizontal cross section through the evaporator of figure 2; figure 5 is a perspective view of a refrigerator having a shutter for the freezer compartment shown opened; figure 6 shows the refrigerator in the same way as in figure 5 but with the shutter for the freezer compartment closed, and figure 7, finally, shows the refrigerator according to the invention seen from behind in a perspective view.

The blank 1, shown in figure 1, for the evaporator is of a type which is called ALUBOND®, and which comprises two aluminium plates 2 which are joined into contact with each other and which in between said plates enclosed sealed refrigerator channels 3 for a cold creating fluid. The refrigerator channels 3 can diagrammatically be shown having an inlet 4 and an outlet 5, which are connected to a likewise diagrammatically shown cold compressor 6 having a control system and a condenser of known type. The evaporator blank has a substantially rectangular shape with a cut out portion 7 provided almost halfway over the length of the blank, which portion 7 divides the blank into a freezer compartment part 8 and a refrigerator part 9 for blowing cold air into the refrigerator space.

When forming the freezer compartment part 8 and the refrigerator part 9 the freezer compartment 8 is firstly wound together to a substantially parallel-epipedical shape, preferably having rounded corners, and thereafter the refrigerator part 9 is wound together outside of said freezer compartment part 8 in a spiral formation to a likewise

parallelepipedical shape having substantially the same cross section shape as that of the freezer compartment part 8 and the refrigerator part 9 and arranged at some distance outside the freezer compartment 8. The freezer compartment part 8 and the refrigerator part 9 are wound mainly in a spiral formation, and between the exterior side of the freezer compartment part 8 and the interior side of refrigerator part 9 there is formed an air flow channel 10 through which air can be blown using a fan 11. To this end the refrigerator part 9 is formed with a closing wall 12 at or close to the outer edge/rear edge of the refrigerator part 9. The fan 11 is mounted in said rear wall 12 in flow connection to the air flow channels 10 so that air can be blown through the channels to distribute cold air in the refrigerator space. Also the freezer compartment 8 is formed with a rear wall 13 which closes said freezer compartment at the rear end thereof. Said rear wall 13 is connected to the rear edge 14 of the cut out part 7 of the evaporator blank 1 leaving a free space for the air flow channel 10 also at said rear wall 13. At the front part the refrigerator unit is formed with a shutter 15 for closing of the freezer compartment 8. At said part of the refrigerator unit the "front edges" of the freezer compartment 8 and the refrigerator part 9 extend along the same even line, and therefore the shutter 15 preferably is large enough as to cover the ends both of the freezer compartment part 8 and the refrigerator part 9. For making it possible to blow out cooled down air from the fan 11 through the flow channel 10 the shutter 15 is formed with several outlet bores or outlet slots 16 on plane with the air flow channels 10. The air slots 16 are of such size as to give the air passing through said slots a suitable temperature without lowering the temperature in the freezer compartment 8 to such low level that there may appear problems to freeze water to ice in the freezer compartment 8.

The air flowing through the channel 10 is cooled down both by the contact with exterior side of the freezer compartment 8 and by contact with the interior side of the refrigerator part 9. The air flow through the air channels 10 can be moderated by forming the air slots 16 larger or smaller, respectively. It may be suitable to provide a certain choking of the air flow for giving the air leaving said channels a suitable coldness. Also the exterior side of the refrigerator part 9 emits a certain amount of cold which flows downwards in the refrigerator space and thereby gives an addition of general cold in the refrigerator space.

For controlling the cold in the refrigerator space there is also a possibility of controlling the speed of the fan 11. By such arrangement it is possible to allow the compressor to operate constantly, eventually at a slightly lower efficiency than what is normal for a compressor of the type which is switched on and off. A constantly operating compressor is advantageous in being subjected to substantially less wear than a compressor of the type which switches on and off.

The entire refrigerator unit can, as usual, be mounted hanging in the upper part of the refrigerator space, for instance in a refrigerator or a cooling box. The mounting can be made using consoles 17 which keep the refrigerator unit on a suitable distance from the ceiling and the walls of the refrigerator space.

The invention also relates to a method for the manufacture of a refrigerator unit of the above mentioned type. In the method:

- a blank 1 for an evaporator of the refrigerator unit is cut out from a cooling panel of the type ALUBOND®;
- a rectangular piece 7 of the blank is cut off, the length of which at least substantially corresponds to the

circumference of a freezer compartment to be formed;

- the blank 1 is wound in a spiral formation, first for forming a closed freezer compartment part 8 and in directly succeeding step for forming a refrigerator part 9, whereby it is foreseen that an air flow channel 10 is formed between the freezer compartment part 8 and the refrigerator part 9;
- the inlet 4 and the outlet 5 of the evaporator are connected to a cold compressor 6 of known type;
- the rear side of the freezer compartment 8 is closed by means of a wall 13;
- the rear wall of the refrigerator part 9 is closed by a wall 12 mounted at a certain distance from the wall 13 of the freezer compartment 8;
- a fan 11 is mounted in the rear wall 12 of the refrigerator part 9;
- a shutter 15, which can be opened, is mounted over the front sides both of the freezer compartment 8 and of the refrigerator part 9; and
- slots 16 are provided in the shutter 15 at the extension of the air flow channel 10.

Reference numerals

1	blank for an evaporator
2	aluminum plates
3	cold channels
4	inlet
5	outlet
6	compressor
7	cut out part
8	freezer compartment part
9	refrigerator part of the refrigerator
10	air flow channel
11	fan

12 rear wall (of 9)
13 rear wall (of 8)
14 rear edge (of 7)
15 shutter
16 air slot
17 console

Claims

1. A refrigerator apparatus having cold creating means (compressor, condenser, guide and control means) and an evaporator, which apparatus is especially, but not exclusively, intended for use in mobile transport means like motor cars, busses, trucks, boats, caravans etc. and which is formed for creating a refrigerator tempered environment in a delimited space for storing of food etc., and which is also formed with a freezer compartment (8) for freezing of ice cubes, for temporary keeping frozen goods etc. in freezed conditions, **characterised** in that the refrigerator apparatus has a cooling pack which is formed in an integral piece and comprises an evaporator (1) having two cold emitting parts, namely both an inner space which is closed and which provides such cold that it acts as a freezer compartment (8) and an outer annular space (9) which at the interior side thereof surrounds the freezer compartment (8) and is arranged at a certain distance therefrom, and which at the exterior side thereof has a cold emitting wall, and in which the freezer compartment (8) is arranged so that it can closed, whereas the outer annular space provides a through channel (10) through which air can be blown, whereby cold air is distributed in the entire refrigerator space.

2. A refrigerator apparatus according to claim 1, **characterised** in that the refrigerator pack is made from a flat evaporator blank (1) of mainly rectangular shape, which blank is wound in a spiral formation so as to form a closed inner part acting as the freezer compartment part (8) and an annular, closed outer part acting as an air cooling part (9) for the refrigerator space, and in which the air cooling part (9) is arranged on a certain distance outside of the freezer compartment part (8) so that there is formed an air flow

channel (10) between said two parts (8, 9).

3. A refrigerator apparatus according to claim 2, **characterised** in that the evaporator blank (1) has a cut out portion (7) over about half the length of the blank (1) and a slight distance towards the centre from a longitudinal edge, which cut out part (7) provides a withdrawn rear end of the freezer compartment part (8) in relation to the rear end of the air cooling part (9).

4. A refrigerator apparatus according to claim 2 or 3, **characterised** in that the rear end of the freezer compartment (8) is closed by a rear wall (13), and in that the rear end of the air cooling part (9) is closed by a rear wall (12) mounted at a certain distance from the rear wall (13) of the freezer compartment (8), so that there is formed an air flow channel (10) between the freezer compartment (8) and the air flow part (9) both behind and around the sides of the air flow part (9).

5. A refrigerator apparatus according to claim 4, **characterised** in that an air fan (11) is mounted in the rear wall (12) of the air cooling part (9).

6. A refrigerator apparatus according to any of claims 2 - 5, **characterised** in that the front end of both the freezer compartment part (8) and the air flow part (9) is closed by a shutter (15).

7. A refrigerator apparatus according to claim 6, **characterised** in that the shutter (15) is formed with air slots (16) on line with the air flow channel (10), which slots can give a suitable choking of the air flow through the channel (10) and through the slots (16) out into the refrigerator space.

8. A method for the manufacture of an evaporator for a refrigerator apparatus of the type indicated in claims 1-7, **characterised** in

- cutting a blank (1) for an evaporator of the refrigerator apparatus to a piece of a cooling panel of the type ALUBOND®;
- cutting out a rectangular piece (7) of said blank, the length of which substantially corresponds to the circumference of a freezer compartment (8) to be formed;
- winding the evaporator blank (1) in a spiral formation, firstly to form a closed freezer compartment part (8) and in direct connection thereto to form a refrigerator part (9), whereby it is foreseen that one or more air flow channels (10) are formed between the freezer compartment part (8) and the refrigerator part (9);
- connecting the inlet (4) and the outlet (5) of the evaporator (1) to a cold creating means like a cold compressor (6) of known type;
- closing the rear end of the freezer compartment (8) by a wall (13);
- closing the rear end of the refrigerator part (9) by a wall (12) arranged a at certain distance from the rear wall (13) of the freezer compartment (8);
- mounting a fan (1) in the rear wall (12) of the refrigerator part (9);
- mounting a shutter (15), which can be opened, over the front side of both the freezer compartment (8) and the refrigerator compartment (9); and
- forming slots (16) in the shutter (15) in the elongated direction of the air flow channel or channels (10).

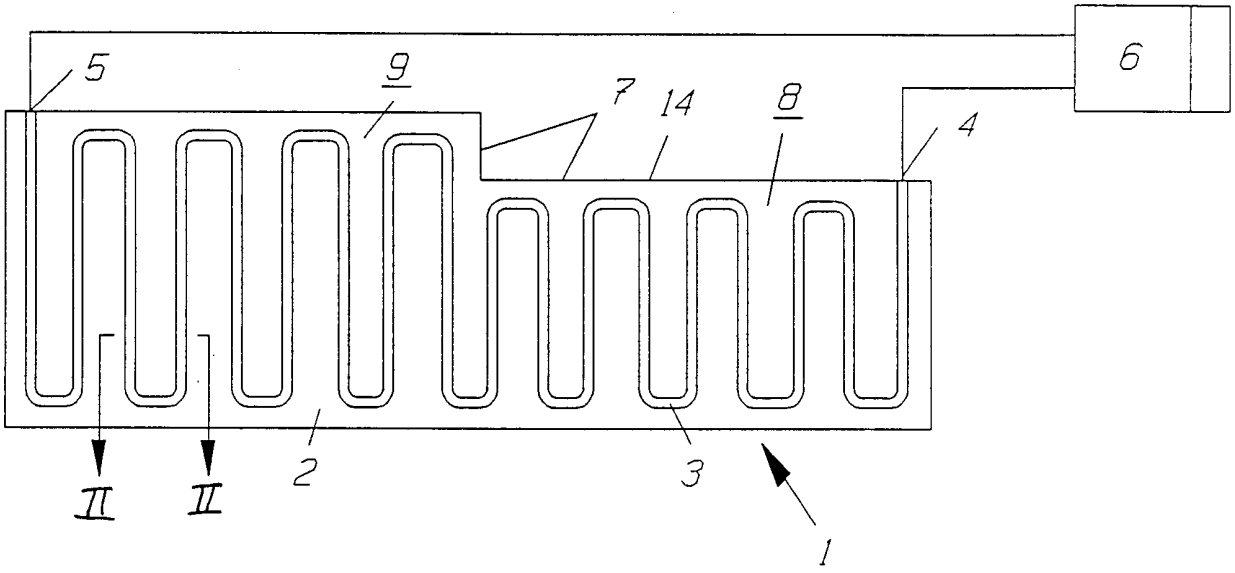

Fig. 1

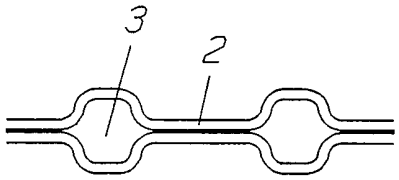

Fig. 2

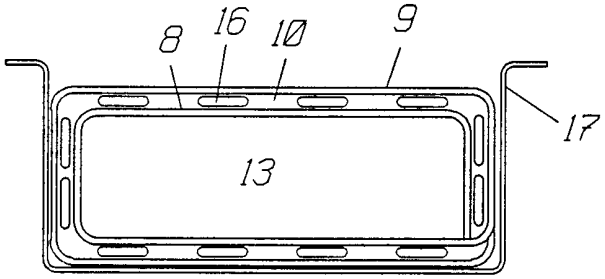

Fig. 3

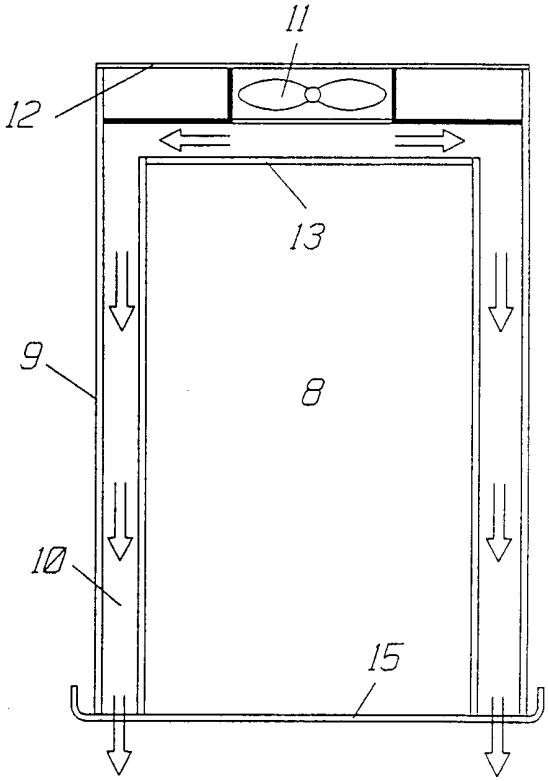

Fig. 4

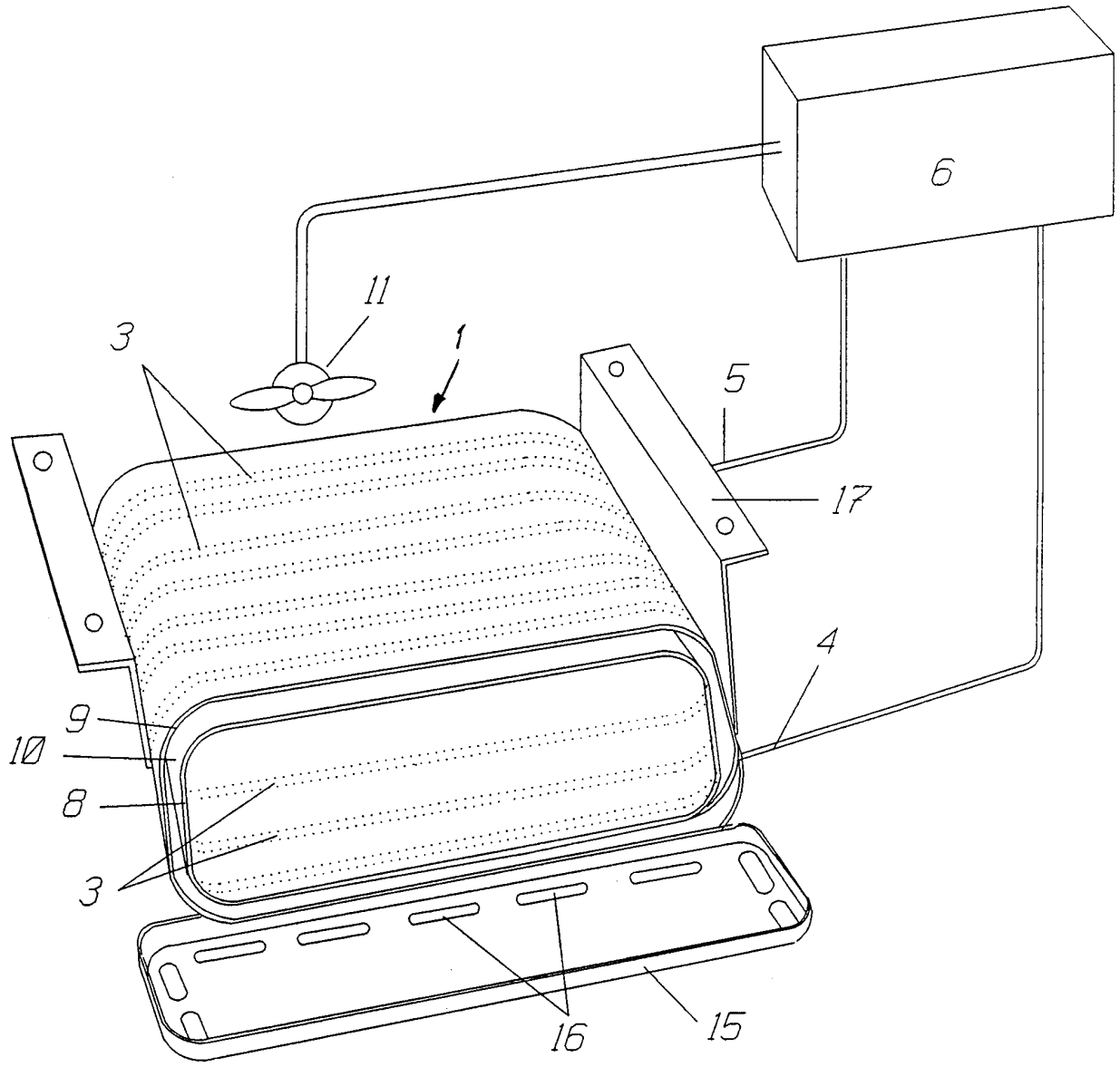

Fig. 5

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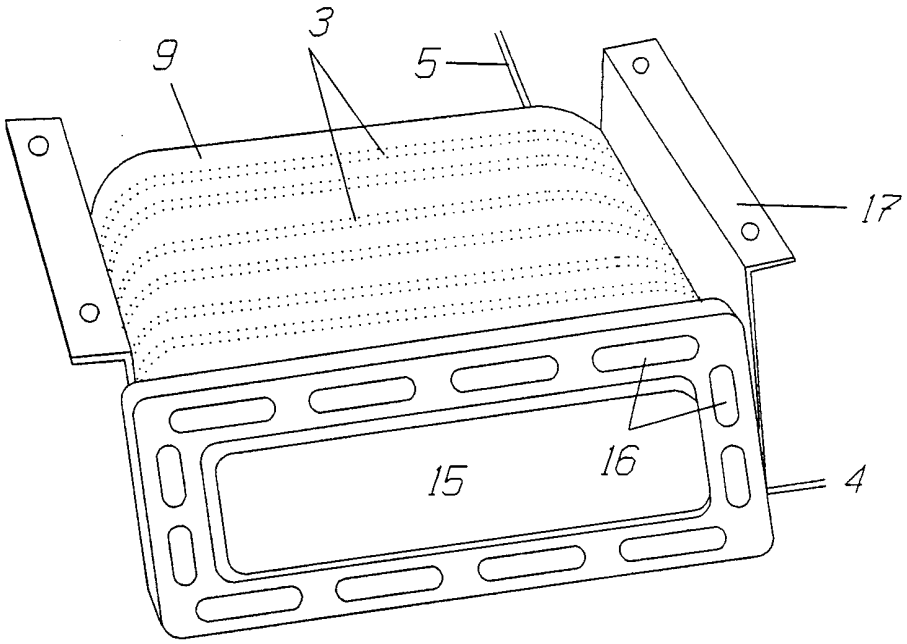

Fig. 6

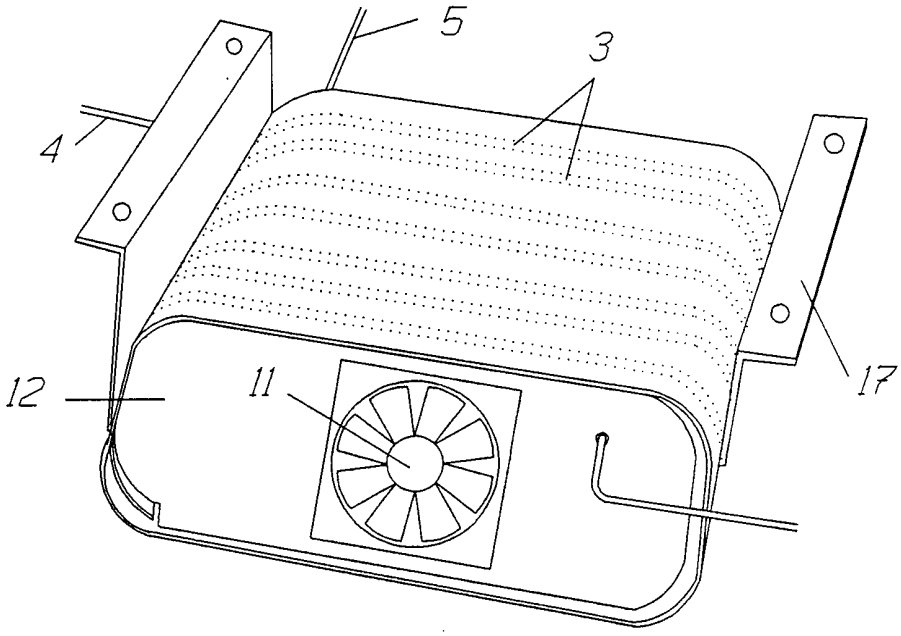

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/02163

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F25D 11/02, F25D 17/06, F25B 39/02, B60H 1/32
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)

IPC7: F25B, F25D, B60H

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

SE,DK,FI,NO classes as above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4483151 A (FUJIOKA ET AL), 20 November 1984 (20.11.84), column 4, line 37 - column 5, line 56, figures 5-7 --	1-7
A	DE 19631702 A1 (AEG HAUSGERÄTE GMBH), 12 February 1998 (12.02.98), column 3, line 22 - column 4, figures 1-4 --	1-8
A	DE 1501126 A (SIEMENS-ELECTROGERÄTE-GMBH), 23 October 1969 (23.10.69), whole document --	1-7
A	US 2108744 A (L.M. CROSLEY ET AL), 15 February 1938 (15.02.38), whole document --	1-7

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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"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
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"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
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 March 2001	27 -03- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Inger Löfving / JA A Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/02163

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4705099 A (TANIGUCHI ET AL), 10 November 1987 (10.11.87), whole document --	1-7
A	US 5168718 A (BERGMANN), 8 December 1992 (08.12.92), whole document -- --------	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

25/02/01

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