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(71) Applicant: **ARCELIK ANONIM SIRKETI** [TR/TR]; E5
Ankara Asfalti Uzeri, Tuzla, 34950 ISTANBUL (TR).

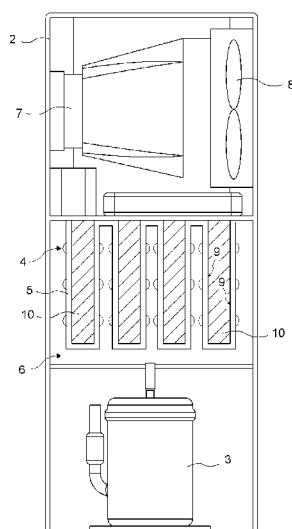
(72) Inventors: **KURULAR, Semih**; E5 Ankara Asfalti Uzeri,
Tuzla, 34950 Istanbul (TR). **BALIOGLU, Onder**; E5
Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **AKSOY,**
Adem; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul
(TR). **ERDEM, Funda**; E5 Ankara Asfalti Uzeri, Tuzla,
34950 Istanbul (TR). **COBAN, Burak**; E5 Ankara Asfalti
Uzeri, Tuzla, 34950 Istanbul (TR).

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(54) Title: PORTABLE AIR-CONDITIONING DEVICE

Figure 1



(57) Abstract: The invention relates to a portable air-conditioning device (1) comprising a body (2), a compressor (3) provided in the body (2) which enables the cooling cycle, a condenser (5) comprising a flow channel (4) through which a cooling fluid pressurized by the compressor (3) circulates and enabling heat dissipation to the outer environment by condensing the cooling fluid, a condenser chamber (6) in which the condenser (5) is placed, an evaporator (7) drawing heat from the ambience by evaporating the cooling fluid and enabling cooling of the ambient air, an evaporator fan (8) delivering the air cooled by the evaporator (7) to the outer ambience where the user is, and a condenser fan discharging to the outer environment air drawn from the outer environment and heated by passing it via the condenser (5) and heating it by means of the heat dissipated by the condenser (5).

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Description**PORTABLE AIR-CONDITIONING DEVICE**

- [0001] Present invention relates to a portable air-conditioning device comprising a condenser, which enables storing of heat discharged from said condenser.
- [0002] In general, air-conditioning devices comprise an internal unit and an external unit, and the heat drawn from the internal unit during cooling is discharged to the outer environment by the external unit. In portable (transportable) air-conditioning devices, cooling is usually performed by discharging the heat drawn from the ambience to the outer environment by means of a vent which extends outdoors through an aperture opened on a window or a wall. However, the vent structure that enables heat to be discharged to the outer environment, restricts transportability of the air-conditioning device. In addition, many users do not prefer portable air-conditioners since an aperture suitably formed for the vent needs to be opened on a window or a wall, in order to obtain an efficient cooling performance by providing insulation between the ambience that requires cooling and the outer environment. This problem can be eliminated with applications in which a part of such residual heat is stored in a thermal storage member without discharging. Storage of residual heat which should be discharged the outer environment, by using phase change material (PCM) with high heat storage capacity in portable air-conditioning devices with thermoelectric module, is known. However, there occurs a heat transfer problem between the condenser which is the heated part of the portable air-conditioning device and the phase change material (PCM) and difficulty of use.
- [0003] International patent application No. WO2015189450 relates to a thermal storage system and a method for charging and discharging this system.
- [0004] The aim of the present invention is to provide a portable air-conditioning device in which thermal energy drawn from the cooled environment and discharged outside is stored, and which allows ease of use.
- [0005] The portable air-conditioning device provided to achieve the aim of the present invention is disclosed in the claims.
- [0006] The portable (transportable) air-conditioning device of the invention

comprises a condenser manufactured by Rollbond production method and made of metal plates with high capacity of shaping and thermal conduction such as aluminum or copper. The condenser has a single-sided coolant flow channel, and the flow channel is preferably formed on a single surface of adjacent metal plates by single sided inflation method. The condenser has at least two flat surfaces parallel to one another, on which the flow channel does not protrude, and PCM packages obtained by packing phase change material (PCM) having high heat storage capacity in a container, are placed between said flat surfaces. The PCM packages contacting the flat surfaces of the condenser, transferring and storing the heat of the condenser by way of conduction, increase the heat transfer capacity from the condenser to the PCM packages. The PCM packages are detachable, are easily removed from the device after completing the efficient usage period, and are placed in a cooler/freezer device for regeneration.

- [0007] The portable air-conditioning device provided to achieve the aim of the present invention is illustrated in the accompanying drawings, wherein:
- [0008] Figure 1 is a schematic view of the portable air-conditioning device of the invention.
- [0009] Figure 2 is a perspective view of a condenser arranged in the portable air-conditioning device.
- [0010] Figure 3 is a perspective view of a PCM package.
- [0011] Figure 4 is a perspective view of a condenser chamber in which the condenser and the PCM packages are placed.
- [0012] Figure 5 is a schematic view of the C-shaped condenser and PCM packages
- [0013] placed in the condenser chamber.
- [0014] Figure 6 is a schematic view of two condensers of planar type and PCM packages
- [0015] placed in the condenser chamber.
- [0016] Figure 7 is a perspective view of a conductive bridge.
- [0017] Figure 8 is a schematic view of a PCM package and the conductive bridge placed inside the same.
- [0018] Figure 9 is a perspective view of a PCM package and the conductive

bridge placed inside the same.

[0019] The elements illustrated in the figures are numbered as follows:

[0020] 1. Portable air-conditioning device

[0021] 2. Body

[0022] 3. Compressor

[0023] 4. Flow channel

[0024] 5. Condenser

[0025] 6. Condenser chamber

[0026] 7. Evaporator

[0027] 8. Evaporator fan

[0028] 9. Flat surface

[0029] 10. PCM package

[0030] 11. Rail

[0031] 12. Slide

[0032] 13. Conductive bridge

[0033] The portable air-conditioning device (1) comprises a body (2), a compressor (3) provided in the body (2) enabling the cooling cycle, a condenser (5) comprising a flow channel (4) through which a cooling fluid pressurized by the compressor (3) circulates and enabling heat dissipation to the outer environment by condensing the cooling fluid, a condenser chamber (6) in which the condenser (5) is placed, an evaporator (7) drawing heat from the ambience by evaporating the cooling fluid and enabling cooling of the ambient air, an evaporator fan (8) delivering the air cooled by the evaporator (7) to the outer ambience where the user stands, and a condenser fan (not shown) discharging to the outer environment air drawn from the outer environment and heated by passing it via the condenser (5) by means of the heat dissipated by the condenser (5).

[0034] The portable air-conditioning device (1) of the invention comprises,
- a condenser (5), manufactured by Rollbond method and made of metal plates with high capacity of shaping and thermal conduction such as aluminum or copper, having a single-sided flow channel (4) preferably formed on a single surface of adjacent metal plates by single sided inflation method and at least two flat surfaces (9) parallel to one another,

on which the flow channel (4) does not protrude, and being placed in the condenser chamber (6) so that the flat surfaces (9) face each other and - at least one phase change material (PCM) package (10) (PCM package (10) for short) obtained by packing phase change material (PCM) having high heat storage capacity in a container (not shown), being placed between the flat surfaces (9) of the condenser (5), and transferring and storing the heat of the condenser (5) by way of heat conduction through contacting said flat surfaces (9) (Figure 1).

[0035] In the portable air-conditioning device (1), heat drawn from the environment by the evaporator (7) is partially or fully transferred to the PCM packages (10) by means of the condenser (5). The PCM packages (10) are placed so that they are interposed between the flat surfaces (9) of the condenser (5) manufactured by Rollbond method, which face each other and on which the flow channel (4) does not protrude. The condenser (5) transfers heat by way of conduction to the PCM packages (10) by means of its flat surfaces (9). The condenser (5) also transfers heat by way of convection to the air directed by the condenser fan and passed via the condenser (5) by means of its "non-flat" surfaces on which the flow channel (4) protrudes. A portion of the heat drawn by the evaporator (7) from the environment that requires cooling, is stored by means of the condenser (5) in the PCM packages, and the portion which is not stored is discharged back to the outer environment by means of the condenser fan. A housing to place the PCM packages (10) is formed by the space between each pair of flat surfaces (9) of the condenser (5) which are spaced from each other, and the PCM packages (10) are thus easily attached to and detached from the portable air-conditioning device. This eliminates the necessity to spare a separate chamber to place the PCM packages (10) in the body (2). The PCM packages (10) are removed from the body (2) and placed in a cooler device after they store heat drawn from the condenser (5), and they are thus regenerated to be reused in the portable air-conditioning device (1).

[0036] In an embodiment of the invention, the condenser (5) is made of metal having serpentine structure and comprises at least two pairs of flat

surfaces (9) provided on the side where the flow channels (4) does not protrude. In the condenser (5) with serpentine structure, at least two PCM packages (10) are placed between the pairs of flat surfaces (9) (Figures 2 and 4).

- [0037] In another embodiment of the invention, the portable air-conditioning device (1) comprises at least one rail (11) made of metal with high heat conduction capacity, extending on the flat surface (9) of the condenser (5) in the direction in which the PCM package (10) is mounted, and at least one slide (12) made of metal with high heat conduction capacity, provided on the outer surface of the PCM package (10), mounted on the rail (11) by engagement and longitudinally contacts said rail (11). The rail (11) and slide (12) pair improve heat transfer from the condenser (5) to the PCM package (10), and by acting as a guide enable sliding of the PCM package (10) between two flat surfaces (9) to be easily attached to the condenser (5), and to be easily detached from the condenser (5) for regeneration (Figures 2 and 3).
- [0038] In another embodiment of the invention, the portable air-conditioning device (1) comprises at least one conductive bridge (13) of a grid or mesh structure made of metal with high thermal conduction capacity, placed inside the PCM package (10), contacting the slides (12) provided on the mutual surfaces of the PCM package (10) and extending inside the PCM package (10) in a direction perpendicular to the slides (12). The conductive bridge (13) enables homogenous distribution of heat transferred from the condenser (5), inside the PCM package (10), and improvement of heat transfer (Figures 7, 8 and 9).
- [0039] In another embodiment of the invention, the portable air-conditioning device (1) comprises a condenser (5) placed in the condenser chamber (6), manufactured by bending metal plates to form a C-shape so as to have a C-shaped cross-section, the flat surfaces (9) being arranged on the concave side of the C-shape, and the PCM package (10) being placed inside thereof so as to be surrounded by its flat surfaces (9) (Figure 5).
- [0040] In another embodiment of the invention, the portable air-conditioning device (1) comprises at least two condensers (5) of planar type placed

horizontally or vertically or biased in the condenser chamber (6) so that their flat surfaces (9) face each other, on which are provided flow channels (4) independent of each other, and at least one PCM package (10) placed between the flat surfaces (9) of said two condensers (5) (Figure 6).

[0041] In the portable air-conditioning device of the invention (1) heat transfer capacity from the condenser (5) to the PCM packages (10) is increased. The PCM packages (10) are easily attached to and detached from the portable air-conditioning device (1) by the user. The necessity to spare a separate chamber for the PCM packages (10) is eliminated. The condenser (5) and the PCM packages (10) are placed in a single condenser chamber (6) and a compact structure occupying minimal space is thus obtained.

Claims

1. A portable air-conditioning device (1) **comprising**, a body (2), a compressor (3) provided in the body (2) which enables the cooling cycle, a condenser (5) comprising a flow channel (4) through which a cooling fluid pressurized by the compressor (3) circulates, a condenser chamber (6) in which the condenser (5) is placed, an evaporator (7) ensuring the cooling of the ambient air, and an evaporator fan (8),
characterized in that,
 - the condenser (7), being manufactured by Rollbond method, having a single-sided flow channel (4) and at least two flat surfaces (9) parallel to one another, on which the flow channel (4) does not protrude, and being placed in the condenser chamber (6) so that the flat surfaces (9) face each other and
 - at least one phase change material (PCM) package (10), being placed between the flat surfaces (9) of the condenser (5), and transferring and storing the heat of the condenser (5) by way of heat conduction through contacting said flat surfaces (9).
2. The portable air-conditioning device (1) according to claim 1, **characterized in that**, the condenser (5) comprises a flow channel (4) formed by single sided inflation method.
3. The portable air-conditioning device (1) according to claim 1, **characterized in that**, the condenser (1) made of metal having serpentine structure comprises at least two pairs of flat surfaces (9) provided on the side where the flow channel (4) does not protrude, and at least two PCM packages (10) are placed between the flat surface (9) pairs.
4. The portable air-conditioning device (1) according to any of the preceding claims, **characterized in that**, at least one rail (11) made of metal, extends on the flat surface (9) of the condenser (5) in the direction in which the PCM package (10) is mounted, and at least one slide (12) made of metal, provided on the outer surface of the PCM package (10), is mounted on the rail (11) by engagement and longitudinally contacts said rail (11).
5. The portable air-conditioning device (1) according to any of the preceding claims, **characterized in that**, at least one conductive bridge (13) of a grid or mesh structure made of metal with high thermal conduction capacity, arranged

inside the PCM package (10) contacts the slides (12) provided on the mutual surfaces of the PCM package (10) and extends inside the PCM package (10) in a direction perpendicular to the slides (12).

6. The portable air-conditioning device (1) according to claim 1, **characterized in that**, said condenser (5) placed in the condenser chamber (6), has a C-shaped cross-section with its flat surfaces (9) on the concave side of the C-shape, and the PCM package (10) is arranged inside thereof so as to be surrounded by its flat surfaces (9).
7. The portable air-conditioning device (1) according to claim 1, **characterized in that**, at least two condensers (5) of planar type are placed horizontally or vertically or biased in the condenser chamber (6) so that their flat surfaces (9) face each other, on which are provided flow channels (4) independent of each other, and at least one PCM package (10) is placed between the flat surfaces (9) of said two condensers (5).

Figure 1

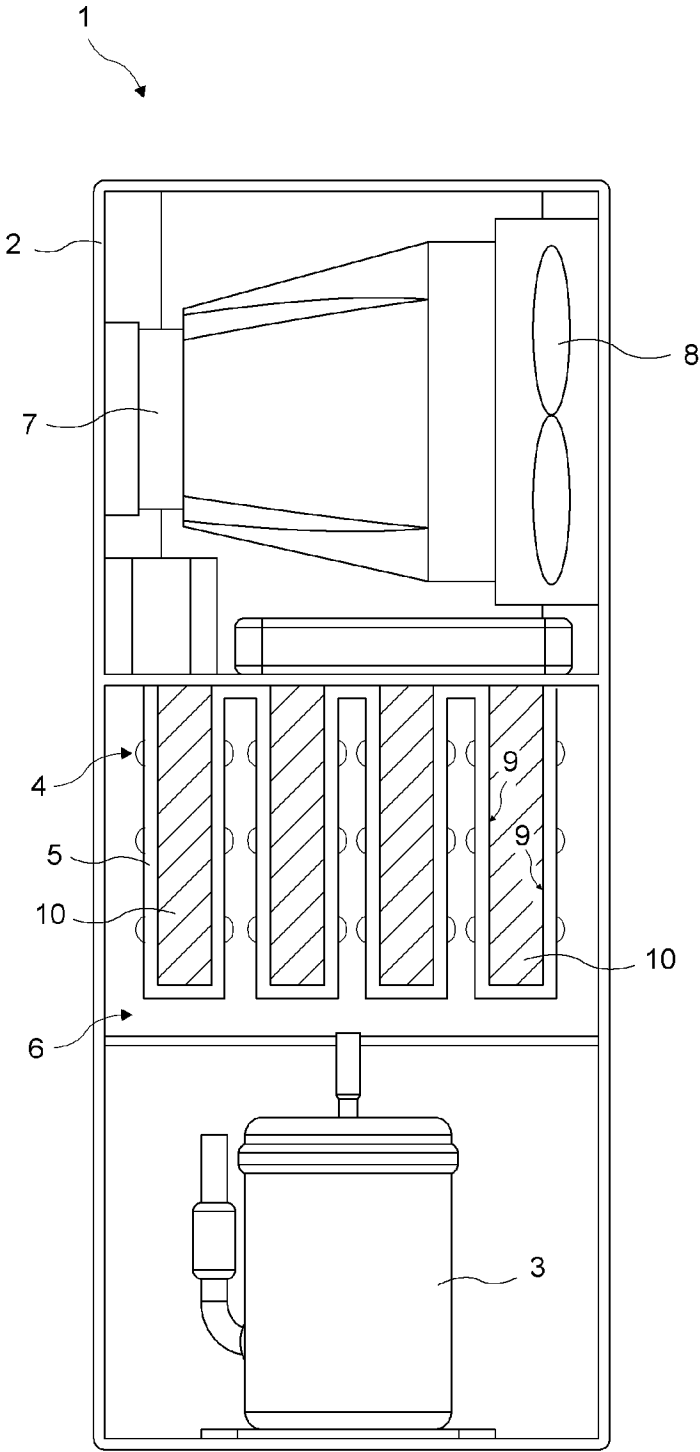


Figure 2

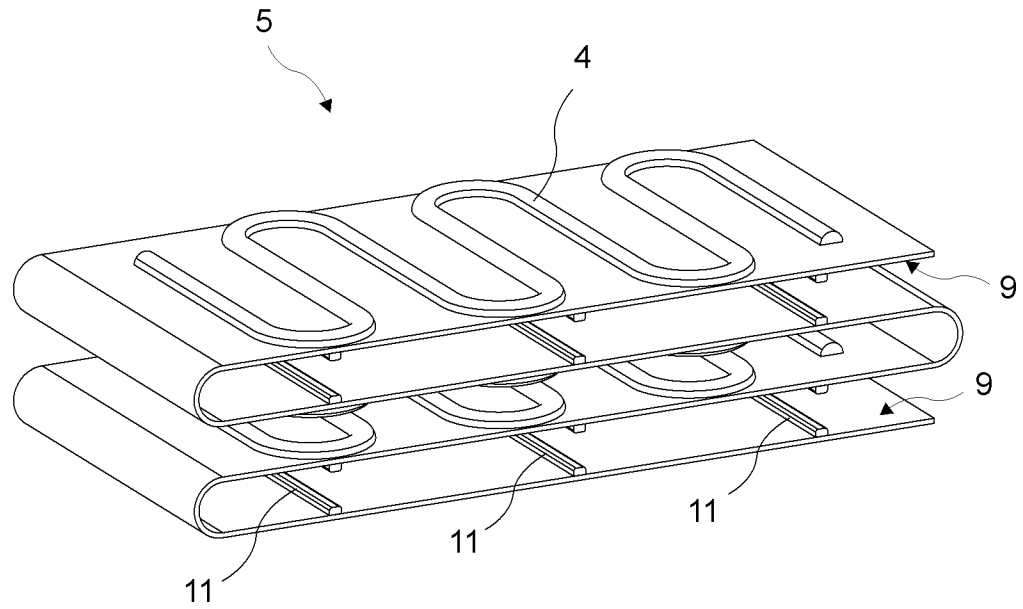


Figure 3

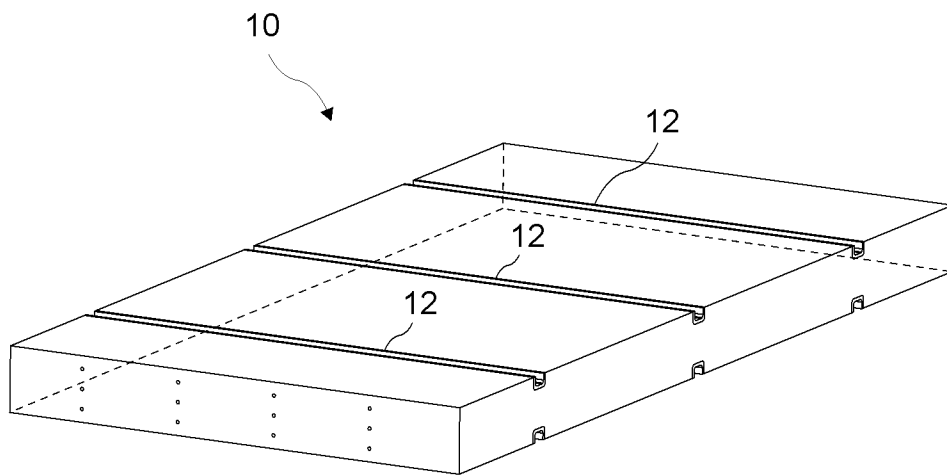


Figure 4

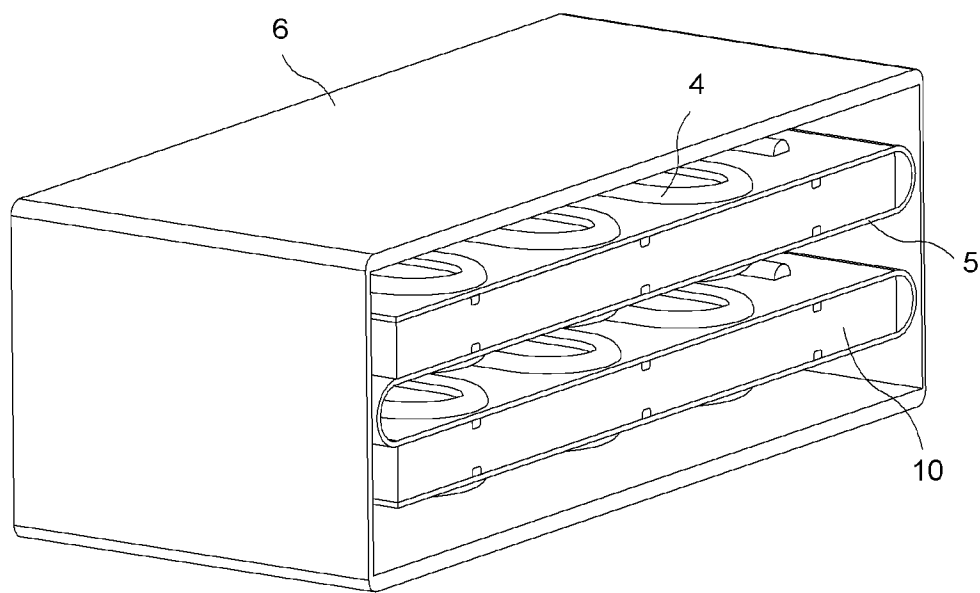


Figure 5

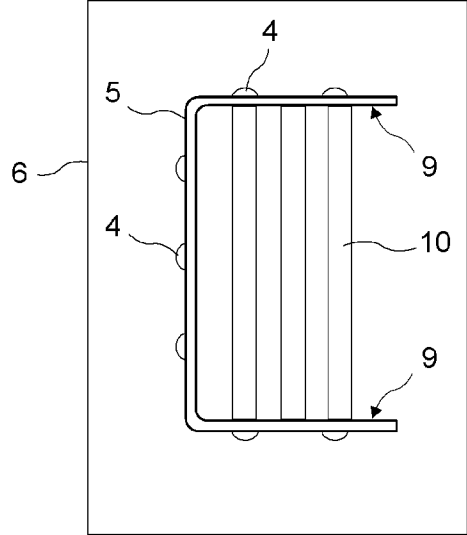


Figure 6

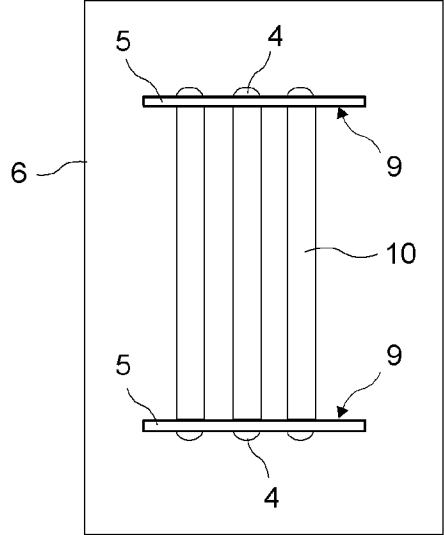


Figure 7

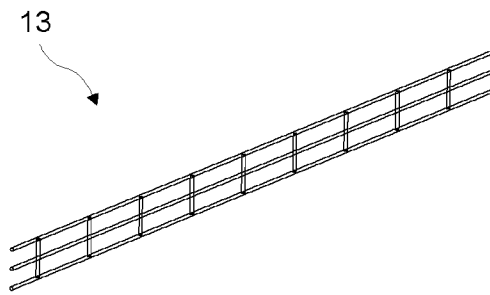


Figure 8

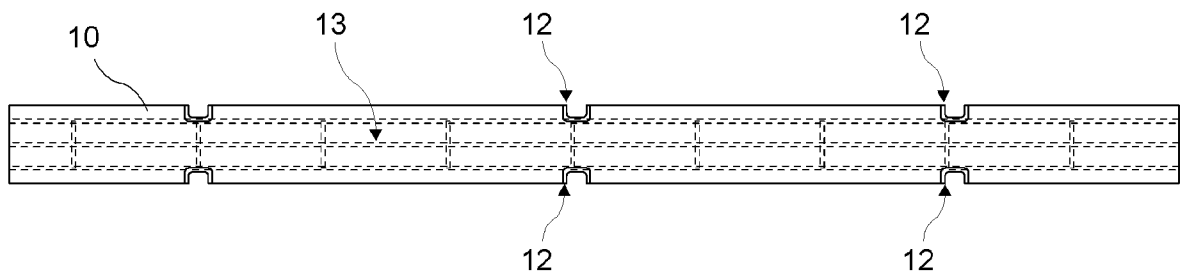
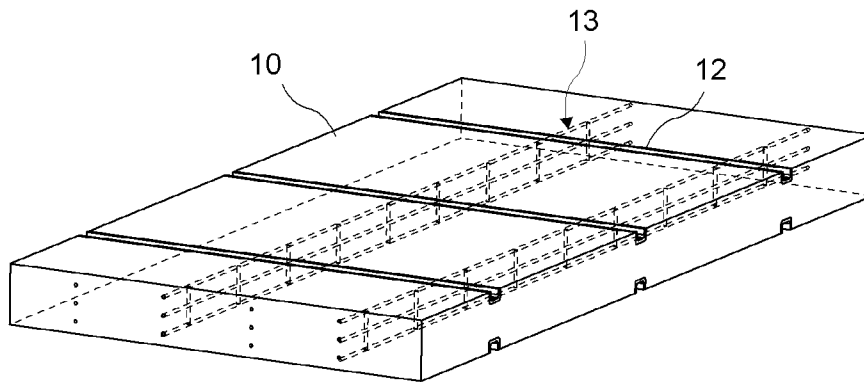


Figure 9



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/064382

A. CLASSIFICATION OF SUBJECT MATTER

INV. F24F1/02 F24F5/00 F28F3/14 F28D1/047 F28D20/02
F28D20/00 F28D21/00

ADD.

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)

F24F F28F F28D 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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 097 897 A (WATANABE MASATAKA [JP] ET AL) 24 March 1992 (1992-03-24) the whole document -----	1-7
A	US 2 779 173 A (WURTZ CLIFFORD H) 29 January 1957 (1957-01-29) column 1, line 40 - column 2, line 35 -----	1-7
A	WO 2015/189450 A1 (ABENGOA SOLAR NEW TECH SA [ES]) 17 December 2015 (2015-12-17) cited in the application abstract; figures -----	1
A	US 5 239 839 A (JAMES TIMOTHY W [US]) 31 August 1993 (1993-08-31) abstract; figures ----- -/-	1



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Mattias Grenbäck

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/064382

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NL 7 711 003 A (BARRY WEHMILLER CO) 18 April 1978 (1978-04-18) abstract; figures -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/064382

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