(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 647 922 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.10.2013 Bulletin 2013/41

(51) Int Cl.:
F24H 3/00 *(2006.01)* ***E01C 11/26*** *(2006.01)*

(21) Application number: **12163252.5**

(22) Date of filing: **04.04.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(54) Floor module and method for heating outdoor environments via said module

(57) A floor module (1) comprising a walking surface (2) provided with apertures (20) for the air passage, and a supporting structure (3) intended to support the walking surface (2) and to keep it elevated from the ground are described.

The module further comprises a pre-heating chamber (30) provided with an air inlet aperture (9) for drawing air from underneath the walking surface (2) and a heating device (10) for heating the drawn air; and further a heating chamber (31) provided with a second heating device (7) and in fluid communication with the pre-heating chamber (30) and with a space outside the module (1) through the apertures (20) of the walking surface (2), such to heat the air drawn from the pre-heating chamber (31) and to leave it out through the walking surface (2).

The heating chamber (31) and pre-heating chamber (30) are delimited at the top by the bottom (22) of the walking surface (2), said bottom (22) being made of a material with a thermal conductivity greater than the portion (210) of the walking surface intended to be walked on.

A method for heating a space by such floor module is also described.

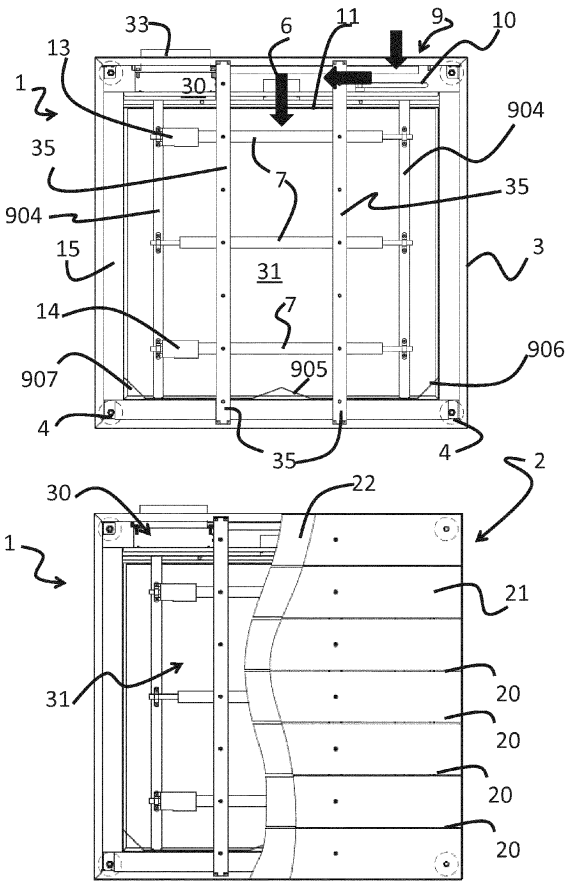

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of raised floors for outdoor spaces, and in particular to the field of platforms.

[0002] More in particular, the invention relates to the field of floors or platforms for heating or ventilating surrounding environments, in particular outdoor spaces. The invention further relates to a modular system assembleable to form a floor with one or more heating or ventilating platforms, particularly one or more platforms according to the preamble of claim 1.

STATE OF THE ART

[0003] Platforms are a type of raised flooring, wherein a walking surface composed of a plurality of boards is kept elevated with respect to the ground by a supporting structure.

[0004] Tipically platforms are used for outdoor spaces, in order to provide smooth floors if the ground is not smooth or only to raise, and therefore to insulate, the walking surface from the ground.

[0005] Due to the outdoor use, in order to avoid ice to form on the walking surface it is known from US2007/0102243 to provide the platforms with heating elements, which, once in contact with the walking surface, heat it when temperature goes below a specific threshold.

[0006] Then it is known from WO2011141189 that a platform can be used even for heating or ventilating an outdoor space. Such platform is provided with a walking surface provided with a plurality of apertures. Underneath the walking surface ducts are arranged which accomodate electric cables, which, once crossed by electric current, become hot by Joule effect and heat the air forced into the ducts by a fan unit. Each duct is provided with apertures through which the heated air comes out and reaches the apertures of the walking surface.

[0007] The platform known from WO2011141189 is provided with two separate fans; during the cooling phase (typically in summer) both fans are operated, keeping the heaters deactivated, while during the heating phase (typically in winter) only one fan is operated and heaters are activated.

[0008] Therefore WO2011141189 provides that, in each operating phase of the platform, a forced air flow is generated which arrives into the space to be cooled or heated from underneath the walking surface. This approach, actually, is the same used in air-conditioners for indoor spaces, which provide always to force, by suitable fans, the air into the space to be cooled or heated.

[0009] A drawback of these platforms is related to their high energy consumption, that is necessary, in summer, for operating the two fans, and in winter, for operating contemporaneously one fan and the heaters.

[0010] Moreover in the solution described in WO2011141189 it is not possible to have a uniform temperature all along the platform: the temperature reached by the air into the ducts is closely related to the time the air remains near the resistors, thus the air coming out from the nozzles arranged at the end of a duct has a temperature greater than the air leaving the nozzles arranged at the beginning of the same duct due to the different time it remains in the area of influence of resistors. A user can be hit by air that is too much hot or not enough hot, or he / she can be hit in different points of the body by air flows having temperatures considerably different one another. All this causes the user not to perceive an acceptable comfort under specific situations.

OBJECTS AND SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to overcome the drawbacks of the prior art set forth above.

[0012] In particular the object of the present invention is to improve the comfort of the existing heating platforms, guaranteeing a greater heating uniformity on the walking surface.

[0013] A further object of the present invention is to reduce energy consumption of a platform able to heat or ventilate the space wherein it is installed.

[0014] These and other objects are achieved by a floor module, in particular a self-bearing platform, having the characteristics of the annexed claims, which are an integral part of the present description.

[0015] The idea at the base of the present invention is to provide a floor module which, under the walking surface, has a pre-heating chamber and a heating chamber. The pre-heating chamber is provided with an air inlet aperture for drawing air in from underneath the walking surface and a heating device for heating the drawn air. The heating chamber is provided with a second heating device and it is in fluid communication with the pre-heating chamber and with the external environment. Thus the air drawn by the pre-heating chamber enters into the heating chamber, it is further heated and it goes out through the apertures of the walking surface (2). The heating and pre-heating chambers are delimited at the top by the bottom of the walking surface. This bottom is made of a material with a thermal conductivity higher than

the portion of the walking surface intended to be walked on.

[0016] This solution allows the comfort given by the floor module to be improved, since the bottom allows the heat to be transmitted to the whole walking surface, which on the contrary is generated in a substantially concentrated manner by the heating devices.

[0017] According to one embodiment, the bottom of the walking surface has apertures only at the heating chamber, such that the air heated in the pre-heating chamber does not come out through the walking surface and it goes all into the heating chamber.

[0018] This solution improves the performances of the floor module.

[0019] According to one embodiment, the walking surface comprises at least a first walking element, particularly a board, removably engaged to a metal plate (particularly made of aluminium) which acts as the bottom of the walking surface. The walking element comprises a body intended to be walked on and a base made of a material (preferably a metal) with a thermal conductivity higher than the portion intended to be walked on. The base and body intended to be walked on are fastened by a fastening element which is preferably a resin-based thixotropic paste.

[0020] In one embodiment, the heating chamber comprises a central flow deflector fastened to the centre of a first perimetric wall of the chamber. This first wall is opposite to a second wall having an aperture that puts the pre-heating chamber in fluid communication with the heating chamber. The central flow deflector has a deflecting surface symmetric with respect to a vertical plane passing by said flow deflector and the centre of the aperture that puts the pre-heating chamber in fluid communication with the heating chamber.

[0021] This solution allows the comfort given by the floor module to be improved, since the deflector allows air flows generated by a fan arranged in the aperture that puts in communication the heating and pre-heating chambers or by temperature differences inside the heating chamber (for example upon the operation of the resistors) to be deflected in a symmetric manner with respect to the chamber. Therefore the heat is distribuited in a more homogeneous way in the heating chamber.

[0022] Preferably, in addition to the central deflector two side flow deflectors are provided each one arranged such to cover the corner formed by said first side wall and a respective perimetric wall connecting said first wall to said second wall.

[0023] In one embodiment improving the performances of the floor module, the heating chamber and the pre-heating chamber are insulated at the bottom and at the four perimetric sides. Preferably the insulating material is further internally lined with a reflecting material, in particular an aluminium sheet.

[0024] The invention further relates to a method for heating or ventilating a space by a floor module of the type provided with at least:

- a walking surface provided with a plurality of apertures,
- a passage chamber for an air flow closed at the top by said walking surface,
- air flow generating means, intended to convey air into said passage chamber,
- air heating means at least partially arranged into said passage chamber.

[0025] The method comprises a cooling phase wherein said air flow generating means are operated and said heating means are deactivated and a heating phase wherein said air flow generating means are not in operation and said heating means are operated.

[0026] The Applicant, after several laboratory tests, has noted that, surprisingly, the homogeneity level of the temperature of the air supplied considerably improves when the condition with air flow generating means not in operation and with heating means in operation is contemporaneously met.

[0027] These effects are further considerably enhanced if the floor module is of the type mentioned above with a heating chamber and a pre-heating one in fluid communication and closed at the top by a walking surface having a bottom with a good thermal conductivity.

[0028] Further objects and advantages of the present invention will be more clear from the following description of some embodiments given only by way of example and not as a limitation of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The invention will be described below with reference to non-limitative examples, given for illustrative and not limitative purposes in the annexed drawings. These drawings show different aspects and embodiments of the present invention and, where considered appropriate, reference numerals illustrating like structures, components, materials and/or elements in different figures are labeled similarly.

Figure 1 is two views of a thermal platform according to the present invention, in one of which the walking surface is removed which otherwise is provided in the other one.

Figure 2 is a sectional view taken along the plane AA of figure 1.

Figure 3 is a sectional view of the platform of the previous figures provided with a first improvement.
Figure 4 is a plan view of a detail of the walking surface of the previous figure.
Figure 5 is a top view of a floor comprising a plurality of platforms according to the present invention;
Figure 6 is the platform 1 without some boards.
Figure 7 is a view of a detail of the platform of figure 1.
Figure 8 is a floor comprising a plurality of platforms according to the present invention.
Figure 9 is a table with the temperatures taken at different locations of the walking surface of a platform according to the present invention.
Figure 10 is two tables with the temperatures taken at different locations of the walking surface of a platform according to the present invention when under conventional operation by operating the fans in the heating phase.
Figure 11 is a sectional view of a platform according to an embodiment of the present invention.
Figure 12 is a platform according to a further embodiment of the present invention.
Figure 13 is an embodiment of the boards of a walking surface according to one alternative embodiment to that of figure 7.
Figure 14 is a sectional view of a platform according to one alternative embodiment to that of figure 11.

DETAILED DESCRIPTION OF THE INVENTION

[0030] While the invention is susceptible of various modifications and alternative forms, certain illustrated embodiments thereof are shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the invention to the specific embodiment disclosed, but, on the contrary, the intention of the invention is to cover all modifications, alternative forms, and equivalents falling within the scope of the invention as defined in the claims.

[0031] In the following description and in the figures, like elements are identified with like reference numerals. The use of "for example", "etc", "or" indicates non-exclusive alternatives without limitation unless otherwise noted. The use of "including" means "including, but not limited to," unless otherwise noted.

[0032] In the following of the present description, the term thermal platform is used for denoting a platform provided with means for heating and/or ventilating the space where it is situated.

[0033] Figures 1 and 2 show, according to two different views, a thermal platform according to the present invention, generally denoted by reference numeral 1. The thermal platform comprises, in a manner known per sé, a self-bearing structure supporting and raising a walking surface 2 with respect to the ground. As it is better described in the following description, a heating chamber 31 and a pre-heating chamber 30 are provided underneath the walking surface 2 and are delimited at least partially by the supporting structure; such chambers are in fluid communication through an aperture 12 occupied by a fan unit 6. When in operation the fan unit 6 draws air from the pre-heating chamber and sends it into the heating one, while when it is not in operation the air passes through its blades. The walking surface 2 is provided with a plurality of apertures 20, arranged throughout its surface, in order to put the heating chamber 31 in fluid communication with the outer environment; as it will be seen better below, air, in a forced manner due to the fan unit 6, or naturally by convection, is drawn from outside the platform, passes through the pre-heating chamber 30, enters in the heating chamber 31 and goes out from the walking surface 2 through the apertures 20.

[0034] In the embodiment shown with reference to figures 1 to 7, the walking surface 2 is composed of seven boards 21 (the number is not limitative) arranged in thermal contact with each other by a metal element, preferably a perforated aluminium sheet 22 (which can be well seen in figures 3 and 4), that constitutes the top of the heating chamber 31 and of the pre-heating chamber 30. As an alternative to the aluminium sheet it is possible to use sheets made of other metal material, or even only elements that are good heat conductors. One of the functions of the aluminium sheet 22 is to make the temperature of the walking surface uniform causing the heat, generated in any manner under it, to be quickly diffused on the whole sheet and, from here, equally, on all the boards in contact thereto. The choice of a metal material, instead for instance of a thermal gel layer, however guarantees a second and further function for the aluminium sheet, namely it is a structural element of the platform. Such sheet helps in distributing on the whole platform forces or bending moments due to concentrated loads.

[0035] Boards 21 are arranged one near the other, but they are not immediately adjacent one another, thus a continuous free space is left between one board and another extending substantially for one whole plan dimensions of the surface 2, for example for the whole length thereof; such free spaces between one board 21 and another one, in this example, are the apertures 20 mentioned above.

[0036] In one embodiment, each board 21 has a sandwich structure, composed of three layers: a first layer (the outermost since it is intended to be outside the platform) 210 made of stone, a second layer (the innermost since it is intended to remain inside the platform) made of aluminium 211 and an intermediate layer 212 made of a resin whose function is to keep together the other two layers guaranteeing a good transmission of the heat between the inner layer 211 and the outer one 210. As an alternative to stone (preferably Pietra Serena), the outer layer of the boards 21 can

be made of any other material resistant to the action of the outer environment, for example concrete, wood (suitably treated), plastic material or the like. Preferably, this layer of the board is made of a material that in addition to a good resistance to weathering agents has also a good thermal conductivity (preferably greater than or equal to 0,8W/mK, and more preferably ranging from 1 to 1,5 W/mk), and therefore able to diffuse heat.

[0037] A preferred stone has the following properties:

Pietra serena	
General properties	
State of matter (in s.c.)	solid
Chemical-physical properties	
Density (g/cm^3, in s.c.)	2650
Imbibition coefficient	0,012%
Coefficient of linear thermal expansion (K^{-1})	0,004
Mechanical properties	
Compressive strength (kg$_f$/m^2)	1000
Flexural strength (kg$_f$/m^2)	56

[0038] As an alternative to aluminium, the inner layer can be made of another material provided that it is a good heat conductor and thus it is able to transmit heat from the aluminium sheet 22 to the stone of the board.

[0039] As regards the resin, preferably it is a two-component, extra-strong epoxy glue in vertical thixotropic paste, preferably having the following properties:

- Hardness ShoreD (1) ASTM D 2240 higher than or equal to 70;
- Peeling test with glass fiber on marble (1)(ASTM D3167) higher than or equal to 1,3 N/mm;
- Adhesion force on marble (ASTM D4541) higher than or equal to 12 Mpa

[0040] A particularly preferred resin is the one having the properties shown in the following table:

Viscosity part A cps 25°C	Thixotropic paste
Viscosity part B cps 25°C	Thixotropic paste
Resin / Hardener density at 25°C gr / cm^3	1.3 / 1.3
Aspect part A	Ivory paste
Aspect part B	White paste
Resin aspect	White hard
Resin colour in GARDNER ASTM	NA
D1544	
Hardener colour in GARDNER ASTM D1544	NA
Mixing ratio by weight	100 + 100= tot 200
Gel time in bulk 25°C	About 2h30 min
Tack-free time at 25°C with 50% relative humidity	about 4 h
Tack-free time at 40°C with 10% relative humidity	about 3h
Hardness ShoreD (1) ASTM D 2240	81
Glass transition temperature Tglass (ASTM E1545) (1)	62°C
Peeling test with glass fiber on marble (1)(ASTM D3167)	1,5 N/mm
Adhesion force on marble (ASTM D4541) (1)	15 Mpa

(continued)

Adhesione force on glass (ASTM D4541) (1)	15 Mpa
Weathering test in climatic chamber Qsun, (ASTM D904), 3 years of outdoor condition, (light + rain + thermal shock)	It passes the test, no detachment of the resin from the support
Sun yellowing at Xenon test 3 years (ISO11341	Very high
Minimum reaction temperature	+5°C
Minimum temperature of use after hardening	-25°C
Maximum temperature of use after hardening	+60°C
Working time at 25°C (minimum time for polishing and cutting)	24 hours
1) : after post-curing 50°C for 12 hours	

[0041] As an alternative, it has to be noted right now, that the choice of the boards is not binding and it would be possible to use also walking surfaces 2 that, even if provided with apertures 20, are not composed of boards 21, but having the sandwich structure with the layers mentioned above.

[0042] The platform 1 comprises also a supporting structure 3, with the walking surface resting thereon, and upon which mechanical attachment means are provided for fastening a platform to an adjacent one if it is used for making a floor like the one of figure 8. For instance, the structure can provide threaded holes for receiving screws fastening a plate used for connecting two platforms.

[0043] The structure 3 can be made of a bent sheet or other materials such as synthetic polymers or a part thereof with metals of different alloys.

[0044] The supporting structure 3 at the bottom is connected to a plurality of supporting feet 4 extending to the ground and can be height-adjusted, they being provided with a screw body or other similar means, such to horizontally adjust the walking surface 2.

[0045] Such supporting structure 3 preferably extends along the edges of the walking surface 2, like a frame; advantageously, in order to strengthen the platform 1 transverse stiffening beams 35 can be provided which extend underneath the walking surface 2.

[0046] Such beams 35 reduce the tendency of the walking surface 2 to bend, especially when the latter is made of not particularly rigid materials; the position and the shapes of such beams 35 can vary depending on needs without departing from the teachings of the present invention. In a preferred embodiment, beams 35 allow the platform to have an overall compressive strength equal to at least 600 Kg.

[0047] In a preferred embodiment, beams 35 comprise threads intended to receive screws situated into the boards 21 and passing through respective holes 220 provided in the aluminium sheet 22. Thus the screws fastening the boards to the beams contemporaneously fasten the aluminium sheet 21 to the beams 35 and so to the supporting structure 3 of the platform.

[0048] With reference again to the structure 3, it defines at least partially a main heating chamber 31 wherein a plurality of air heaters 7 are housed, for example electrical resistors, and particularly finned resistors, that get heated by the Joule effect when they are passed by electric current. In the embodiment described herein, near two of the three heaters 7 there are provided temperature sensors 13 and 14 detecting the air temperature near the resistors. The choice of using two sensors is essentially due to safety resons, a sensor is used for monitoring the operation of the platform 1, while the other one serves as a backup if the first one fails. Obviously other embodiments are possible and provide the use of only one temperature sensor or more sensors.

[0049] The heating chamber 31 on the top is delimited by the aluminium sheet 22, that due to this reason has apertures 221 (in this embodiment slots) allowing air to pass from the heating chamber 31 to the apertures 20 of the walking surface. Thus apertures 221 are preferably arranged in the sheet 22 such that, once it is in position, the apertures 221 are at the top of the heating chamber 31. Preferably apetures 221 are not provided at the top of the pre-heating chamber.

[0050] According to one embodiment, apertures 221 are at least partially at the apertures 20 in the walking surface, such that, when the walking surface 2 is assembled, the boards do not completely hinder the apertures 221 thus blocking the air passage from the heating chamber to the outside of the thermal platform 1.

[0051] With reference again to the structure 3, this is a box-like structure defining at least three perimetric side walls and the bottom wall of the chamber 31, wherein the heaters 7 are housed: thus between the heaters 7 and the walking surface 2 there are no nozzles (unlike known solution WO201141189) but, on the contrary, heaters 7 operate in the

same chamber 31 delimited on the top by the surface 2 (made of sheet 22 and boards 21), making the manufacturing of the assembly easier and solving the drawbacks related to the presence of the air flow conveyed into the ducts under the surface 2 as in the known solution.

[0052] The chamber 31 preferably occupies from 75% to 90% of the plan extension of the walking surface 2 and the air flowing into the heating chamber 31 remains for a certain time in contact with the heaters 7.

[0053] The fan unit 6, that act for generating the air flow 6 for ventilating the outodoor space, is arranged under the walking surface at the entrance of the chamber 31. In the example described herein and shown in figure 2, the fan unit comprises only one fan, however in one embodiment it is possible to provide the use of two or more fans.

[0054] The pre-heating chamber 30 placed upstream of the heating chamber 31 is in fluid communication with the outer space by at least one intake duct 9 and it is in fluid communication with the heating chamber 31 via the fan unit 6 described above.

[0055] In one embodiment, the intake duct 9 has a protection grid, preferably with meshes of about 1 sq. cm, preventing animals from entering within the pre-heating chamber.

[0056] In the preferred embodiment described herein with reference to figures 1 to 7, the pre-heating chamber is completely contained into the structure 3, under the walking surface 2 of the platform.

[0057] Within the pre-heating chamber 30 there is provided a pre-heater 10, for example a resistor, raising the temperature of the ambient air drawn in by the duct 9, such that, when it enters into the heating chamber 31 it has already a value higher than the ambient air.

[0058] Advantageously the pre-heating chamber 30 is immediately adjacent to the heating chamber 31 and a partition wall 11 is arranged therebetween having a passage aperture 12. The wall 11 is suitably insulated in order to prevent heat passage between the two chambers except for the air passing through the aperture 12. Preferably the wall 11 is made by a load-bearing plate (e.g. made of metal or plastic material) upon which at least one face of the insulating material is superimposed (eg. polystyrene). More preferably, the insulating material is a plate or sheet having a length equal to the length of the pre-heating chamber, and a width greater than the height of the pre-heating chamber; thus once the sheet 22 is fastened to the structure 3, the sheet 22 presses and J or bends the insulating layer guaranteeing the sealing effect of the chamber.

[0059] The pre-heating chamber 30 is also housed within the structure 3, under the walking surface 2 and preferably only at one side of the heating chamber 31. As said above, the pre-heating chamber is delimited at the top by the sheet 22, and unlike the heating chamber 31, the top of the chamber 30 is completely closed and it does not have apertures, such that all the air flowing into the pre-heating chamber 30 is conveyed into the heating chamber 31.

[0060] In the embodiment of figure 1, the pre-heating chamber 30 extends for all the length of a side of the structure 3 and has a width smaller than that of one board. Thus the apertures 221 are all outside the pre-heating chamber. In order to facilitate the installation, the sheet 22 has holes 222 allowing the sheet 22 to be positioned and centered on the structure 3.

[0061] More in detail, as shown in figure 6, the holes 222 are arranged at the legs 4a of the feet 4. The legs of the feet substantially provide a male female screw coupling with an element integrated or associated to the structure 3. The holes 222 allow the screw of the foot to be kept exposed, such that, by a socket head screw or a screw driver it is possible to act on the screw in order to adjust the height of the foot without the need of removing the aluminium sheet 22.

[0062] The overall arrangement of the platform 1 provides the perimetric side walls and preferably even the bottom wall of the structure 3 to be insulated with a layer 15 of polystyrene or the like: thus losses of heat outside the inner volumes (pre-heating and heating chambers) heated by the resistors 7 and 10 are avoided. Advantageously, then, the insulating layer 15 is covered with an aluminium sheet such to improve the energy efficiency and the heating of the air inside the heating chamber 31.

[0063] The platform 1 is further provided with a control unit 33 operatively connected to the fans 6 and/ or to the resistors 7 and 10.

[0064] The platform 1 optionally comprises also temperature sensors arranged within the chamber 30 and/or 31 such to monitor temperatures of the air therein; such sensors in this case are connected to the control unit 33 that controls the operation of the fans and/or the resistors 7, 10 such to maintain the temperature inside the chambers 30 and 31 under control.

[0065] In a preferred embodiment, the control unit 33 is configured so as to operate the platform in a "summer" mode, that is in order to ventilate the above space without heating it. In this operating mode, resistors are kept in the deactivated condition and the fan unit 6 is controlled in order to force air into the chamber 31 (that acts as a passage chamber); the air forced into the chamber 31 goes out through the apertures 20 defined in the walking surface and it cools the outer space. In this operating mode, if the fan unit holds a plurality of fans, it is possible to operate all of them or only some of them, such to vary the air flow directed above the walking surface.

[0066] In order to make the air flow above the walking surface 2 uniform, there are preferably arranged flow deflectors into the heating chamber, that is geometrical structures able to deflect air flows, generated by the fan unit 6 or by convective flows, such to uniformly hit the whole base of the walking surface.

[0067] Figure 7 shows a view of an element 900, so called core, of the platform 1.

[0068] The core 900 is substantially a metal structure fitted into the structure 3 (defining the outermost perimeter of the platform body placed under the walking surface 2) and bolted thereto.

[0069] The core 900 comprises a wall 901 constituting the load-bearing plate of the partition wall 11 dividing the chambers 30 and 31 of figure 1.

[0070] The heating resistor 10, the fan unit 6, in this embodiment composed of a single fan, and the electric box 902 comprising the control unit 33 and arranged for receiving a connector for the connection to a power supply line are mounted on the wall 901. Electric lines powering the heating resistors 7 and 10 come out from the box 902.

[0071] A deflector supporting bar 903 is connected to the wall 901 (at the side opposite to that for mounting the resistor 10) by two crosspieces 904 that support the heating resistors 7.

[0072] The deflector supporting bar 903 supports a central deflector 905 and two side deflectors 906 and 907.

[0073] The central deflector 905 has a V shape and has a corner aligned with the fan 6, such to divide the air flow generated by the fan 6 into two substantially equal flows.

[0074] The side deflectors 906 and 907 are plates mounted on the deflector supporting bar such that when the core 900 is fitted and fastened to the structure 3, such plates are perpendicular to the bottom wall of the chamber 31 and inclined by 45° with respect to the plane of the wall of the chamber 31 opposite to the aperture 12 that puts in fluid communication the chamber 31 with the pre-heating one 30. As an alternative, the deflectors 906 and 907 can be curved plates and can have a concavity towards the centre of the chamber 31.

[0075] In addition to "summer" mode, the platform can be operated in the "winter" mode. While in the cooling phase, for example in summer, the fan unit 6 is in operation and the heaters 7 and 10 are not in operation, in the "winter" mode the fan unit 6 deactivated and at least heaters 7 are operated, preferably both the heaters 7 and 10. Obviously, "summer" and "winter" modes can be activated according to needs, regardless of the season. In the winter mode, the cold outer air enters into the pre-heating chamber 30 as a consequence of the greater temperature due to the resistor 10. Here air gets warm and it finds, as the only outlet, the passage provided by the fan unit 6. Therefore air passes into the heating chamber 31 where it is further heated and it goes out, after having transferred a part of the heat to the aluminium sheet 22, from the apertures 20.

[0076] On this version of air-conditioning platform tests have been carried out during the heating phase, obtaining the results shown in figure 9, where each one of the seven boards (numbered in an increasing manner moving away from the air inlet 9) has been divided into three areas, whose temperature has been measured: as it can be observed the uniformity is considerable, showing that the method according ot the invention is effective.

[0077] As a confirmation of the surprising efficacy of the heating method, figure 10 shows two tables with the temperatures measured on the boards when the platform is operated in the traditional manner, by forcing the air with the fans on the heated resistors 7; the two tables relate to measurements taken at different temperatures of the outer environment.

[0078] The passage from the summer mode to the winter one can occur automatically or on command by the user. In a preferred embodiment, the control unit of the thermal platform 1 automatically passes from a heating phase (winter mode) to a cooling phase (summer mode) if there is a warning for the platform operation, particularly when the temperature inside the heating chamber exceeds a predetermined threshold or when a sensor of the temperature inside the heating chamber is disconnected.

[0079] In one embodiment, the control unit 33 is provided with a receiver, preferably a radiofrequency one, able to receive control signals transmitted by a user by means of a suitable controller (eg. a remote control). Thus the user can set different operating parameters of the platform, for example, the user can vary the air flow directed towards the outside of the platform or the temperature expected in the environment. This is possible by regulating the number of resistors or of fans that are operated by the control unit according to "summer" and "winter" modes described above.

[0080] Further, in a preferred embodiment, the control unit is provided with a port for the connection to a communication line, for example a data line of an ethernet network. Thus the platform can be connected to a data network and can be controlled from a remote location, for example placed in a location different than the one where the platform is installed. In one embodiment, such remote location can be the control station of a domotic network. In this embodiment, the control unit 33 is programmed so as to receive commands from the control station of the domotic network, for example commands for the activation at specific times, or deactivation commands when too high electric consumption is reached within the overall domotic network. Preferably the platform is provided with a wireless transceiver, such to be put into a wirless data network and such not to require wires.

[0081] The platform 1 comprises also power supply means, such as outlets, of the type known per se and no further details are given herein. In one embodiment, the control unit 33 is provided with a power line communication modem for the communication over the electric network. Thus, without the need of particular wiring modifications, it is possible to control the platform by means of a computer connected to a different outlet through a corresponding power line communication modem.

[0082] Obviously the platform 1 can be installed alone and so can heat a small area, or, advantageously, it is a part of a modular paving P such as shown in figure 8.

[0083] In this case the paving P comprises a plurality of platforms 1 such as the one just described which are adjacent one another in order to realize the preferred embodiment.

[0084] Platforms 1 in this case can be powered in series or in parallel, depending on needs and on simplicity of installation. In the preferred embodiment, the platform 1 is equipped with suitable electrical connectors that allow to receive an input power supply voltage (eg. 230V @50Hz or 110V @60Hz) and to supply the same output voltage. Thus two platforms can be powered without the need of long power supply lines between each platform and the mains. A first module is connected to the mains, while the following ones receive the power supply directly from the adjacent modules.

[0085] In one embodiment, the same connection is provided for the data line, therefore each platform 1 is equipped with a data module able to receive data from a data line and to transmit again them (with or without regeneration) to a next module. Several variants and improvements to what described up to now are further possible.

[0086] In the embodiment of figure 13, boards 21 have a trapezoidal section, such that the cross-section of the apertures 20 increases, in the direction from the chamber 31 towards the outside, and in particular a "V" shaped cross-section, such as shown in the annexed figure 7.

[0087] As an alternative boards can have two flat parallel surfaces (the smallest one intended to be walked on) connected by sides following an exponential or parabolic profile. Thus apertures formed in this way define a volume that, as in the case of boards with a trapezoidal section, increases as it proceeds away from the heating chamber 31.

[0088] In the case of exponential or parabolic profile, in order to improve the air distribution, the angle subtended between the side and the lower face of the board (that is the one not intended to be walked on) is preferred to be more than 90°, such that the apertures 20 have a channel that, for an initial portion, is almost straight, widening more clearly in the proximity of the outside of the platform. This characteristic improves the distribution of the air towards the outside and allows a kind of "air cushion" to be maintained inside the chamber 31, due to the pressure drop of the air flow at the output area and at the progressively wider cross-sectional area.

[0089] Figure 11 shows another one of such improvements: in order to avoid dirt falling on the walking surface 2 from clogging the apertures 20, the latter have a specific width, preferably ranging from 1 mm to 8 mm, and even more preferably ranging from 3 to 5 mm.

[0090] Thus dirt particles falling on the walking surface 2 fall inside the chamber 31 without clogging the apertures.

[0091] In order to prevent the chamber 31 from being progressively filled with the dirt falling therein, in one embodiment the bottom wall 36 of the chamber 31 is made as a pivoting one, such that is can be inclined as in figure 11 for the dirt particles to fall outside.

[0092] To this end the bottom wall 36 is hinged only at one side to one of the peripheral walls of the structure 3 and it can be moved from a closed position, where it is substantially horizontal and it closes the underside of the chamber 31 , to a distant position (the one shown in figure 11) where it is inclined and it opens a path for discharging the dirt accumulated thereon and that is discharged outside the chamber 31 due to the slope created. In one embodiment, the bottom wall 36 is hinged to the structure 3 such to be always inclined; a slit of few millimetres, particularly lower than 5 mm and preferably 3 mm, is left open, such that dirt or cleaning water entering into the apertures 20 can go out. Even in this solution it is possible to provide a mechanism for moving the bottom wall in a more opened position.

[0093] The operation of the bottom wall 36 in the two positions can be performed in different ways, for example by means of a worm screw that can be actuated by an electric motor or manually, or by means of a lever with a mechanical attachment and linkages.

[0094] All such solutions for operating the wall 36 are within the knowledge of the person skilled in the art in the light of the teachings provided herein and therefore without any need for a closer description.

[0095] If necessary, the operation of the bottom wall can be also controlled by the control unit of the individual platform and/or in a centralized manner by the remote controller mentioned above.

[0096] The fact that it is possible to open the bottom of the chamber 31, is useful even in case of rain or flood. By tilting the bottom 36, the water does not stagnate into the chamber and it goes out therefrom.

[0097] Figure 14 shows a sectional view of a platform according to an alternative embodiment to the one of figure 11, wherein the bottom wall 36 is composed of two half-walls 360 and 361 mounted as facing and inclined towards the centre of the bottom chamber. Both the half-walls 360 and 361 are then inclined such to form a slope towards the wall 11 dividing the heating chamber from the pre-heating one. At the wall 11 the bottom chamber has an aperture 362.

[0098] Finally, another optional characteristic of the platform 1 is shown in figure 12.

[0099] In this case the platform 1 comprises a removable peripheral wall 40 associated to the structure 3.

[0100] Such peripheral wall 40 extends vertically, substantially perpendicular to the walking surface 2 and at least at one side thereof and it is designed for reducing a possible loss of heat from the sides of the platform 1.

[0101] In general the peripheral wall 40 can be arranged at one or both the sides of the structure depending on installation needs of the individual platform 1 and/or whether the latter is one of the corner platforms in the case of the paving P of figure 8.

[0102] The vertical wall 40 is connected to a body 41 which is fastenable to the structure 3 of the platform 1 by coupling means 42, for example a hook intended to engage a pin of the structure 3; the body 42 further rests on the ground by

means of feet 43. Even in this case the fastening modes can vary depending on manufacturing or installation needs and, in general, since they are of a type known per se, there is no need for a closer explanation.

[0103] The vertical extension of the wall 40 changes depending on the use, and it can range from a few tens of centimetres to two, three metres, depending on the field of application of the platform 1.

[0104] For example if the platform 1 is a part of a paving P used for a gazebo intended to be closed on the sides, then the side wall 40 will have such an height to form at least a part of the side wall of the gazebo.

[0105] If, on the contrary, the platform 1 is a part of a paving P exposed on the sides, it will have a reduced height of a few tens of centimetres.

[0106] The main function of the wall 40 is to prevent adverse climatic conditions (eg. the wind) from easily spreading hot air coming out from the apertures 20 and it helps in maintaining the space above the walking surface 2 warm.

[0107] The wall 40 in addition to being removable can vertically slide, for example retractable into the body 42 (if having the proper height) or can be laterally tiltable, such that it can take its operating position (vertical or perpendicular to the surface 2) only when necessary.

[0108] A further advantage of the platform 1 according to the present invention is the fact that each platform 1 is an independent module: it is equipped with its own heaters, inlet and outlet air vents, fans and control unit; the side walls, if any, can be fastened or not on each side of the platform 1 (provided that suitable fastening means are arranged).

[0109] Thus a paving P of the modular type can be made, simply by placing side by side a plurality of platforms 1, equal one another, and by placing walls 40, if any, only where necessary, by electrically connecting each platform to the power supply line or to the adjacent platforms as described above. Obviously, in some cases, the paving P can comprise both heating platforms 1, and similar non-heating modules, which are only provided with the structure 3 and the walking surface 2. Thus it is possible to reduce the paving costs. Preferably, however, also the non-heating platforms are equipped with a pivoting bottom such to allow them to be cleaned and to allow water to go out in case of rain or flood.

[0110] Therefore such a modular paving P is very simple to be made and it does not require too much time and too high costs.

[0111] While in the embodiments described above the platform 1 has a horizontal walking surface, it is clear that such characteristic is not to be intended as limitative of the present invention. The walking surface can be inclined or can have a slope portion connected to a horizontal portion. The use of inclined walking surfaces allows a ramp to be made for objects or wheelchairs to climb on the platform and/ or on the paving P obtained by assembling several platforms. Thus the objects mentioned in the preamble of the present description are accomplished.

[0112] It is clear that, within the scope of the present invention as defined by the annexed claims, many variants are possible for the person skilled in the art.

[0113] For example, under the walking surface, and preferably within the chamber 31, it is possible to arrange lights and fragrance diffusers.

[0114] Lights allow the outdoor space to be illuminated and are, to this end, placed in the proximity of the apertures of the walking surface. For example, in a preferred embodiment, it is possible to provide LED strips or neon lamps, running along the apertures 20 defined by the boards 21.

[0115] Fragrance diffusers are preferably arranged in the proximity of the resistors 7 and to this end they are mounted on the same brackets supporting the resistors. These brackets allow the diffusers to be kept raised with respect to the bottom 36 of the chamber 31, so in case of flood their contents is preserved while water goes out from the suitably inclined bottom 36.

[0116] In the preferred embodiment, the platform 1 has a walking surface 2 having a size smaller or equal to 1 sq. m., in particular the surface is smaller than 950 mm x 950 mm, so that it can be transported on pallets of standard dimensions. Preferably the height of the platform is not excessive and is lower than 25 cm, more preferably the height is lower than 20 cm. This allows a heating chamber with compact dimensions to be provided while guaranteeing the space necessary to pivot the bottom of the chamber. The compactness of the heating chamber allows the thermal efficiency of the platform to be improved.

Claims

1. Floor module (1) comprising:

- a walking surface (2) provided with apertures (20) for the passage of air,
- a supporting structure (3) adapted to support the walking surface (2) and to keep it elevated from the ground,
- a pre-heating chamber (30) provided with an air inlet aperture (9) for drawing air from underneath the walking surface (2) and a heating device (10) for heating the drawn air,
- a heating chamber (31) provided with a second heating device (7) and in fluid communication with the pre-heating chamber (30) and with a space outside the module (1) through the apertures (20) of the walking surface

(2), so as to heat the air drawn from the pre- heating chamber (31) and to leave it out through the walking surface (2),
wherein the heating chamber (31) and pre- heating chamber (30) are delimited at the top by the bottom (22) of the walking surface (2), said bottom (22) being made of a material with a thermal conductivity greater than the portion (210) of the walking surface intended to be walked on.

2. Module according to claim 1, wherein said bottom (22) has apertures (221) only at the heating chamber, such that the air heated in the pre-heating chamber does not go out through the walking surface (2).

3. Module according to claim 2, wherein said walking surface comprises at least a first walking element (21), particularly a board, removably engaged to said bottom (22), and wherein said first walking element (21) comprises:

- a body (210) intended to be walked on and to constitute a part of or the whole portion (210) of the walking surface intended to be walked on,
- a base made of a material with a thermal conductivity greater than said body,
- a fastening element intended to fasten said base to said body (210).

4. Module according to claim 3, wherein said fastening element is a paste, particularly a thixotropic paste, preferably a resin-based one.

5. Module according to claim 3 or 4, wherein said bottom (22) is a metal plate, preferably an aluminium sheet with a thickness preferably ranging from 0,5 mm to 2 mm.

6. Module according to claim 3 or 4 or 5, wherein said base is made of metal, preferably aluminium.

7. Module according to claim 3 or 4 or 5 or 6, wherein said walking surface (2) comprises a plurality of walking elements (21) arranged side by side and separated on said bottom (22), such that the gap between two adjacent walking elements is one of said apertures (20) of the walking surface.

8. Module according to any of claims 1 to 7, wherein said heating chamber (31) further comprises at least one central flow deflector (905) fastened to the centre of a first perimetric wall of the heating chamber (31), wherein said first wall being opposite to a second wall having an aperture that puts the pre-heating chamber (30) in fluid communication with the heating chamber (31), and wherein said central flow deflector (905) has a deflecting surface symmetric with respect to a vertical plane passing by said flow deflector and the centre of the aperture that puts the pre-heating chamber in fluid communication with the heating chamber.

9. Module according to claim 8, further comprising two side flow deflectors (906, 907) each one arranged such to cover the corner formed by said first side wall and a respective perimetric wall connecting said first wall to said second wall.

10. Module according to any of the claims 1 to 9, wherein the heating chamber (31) is insulated on the bottom and on the four perimetric sides, and wherein the insulating material is internally lined with a reflecting material, particularly an aluminium sheet.

11. Module according to any of the claims 1 to 10, further comprising an electric box holding connectors and electric cables, wherein said electric box is arranged into the pre-heating chamber at one end opposite to that where the heating device (10) of the pre-heating chamber is arranged.

12. Module according to any of the claims 1 to 9, further comprising air flow generating means (6) arranged between said heating chamber and said pre-heating chamber for drawing air from the heating chamber and for sending it into the heating chamber.

13. Method for heating or ventilating a space by a floor module (1) of the type provided with at least:

- a walking surface (2) provided with a plurality of apertures (20),
- a passage chamber (31) for an air flow closed at the top by said walking surface (2),
- air flow generating means (6), intended to convey air into said passage chamber (31),
- air heating means (7, 10) arranged at least partially into said passage chamber (31),

wherein in order to cool the space said air flow generating means (6) are operated and said heating means (7,

10) are deactivated and
wherein in order to heat the space said air flow generating means (6) are deactivated and said heating means (7, 10) are operated.

14. Method according to claim 13, wherein the passage from a heating phase to a cooling phase is automatically made if there is a warning for the floor module operation, particularly when the temperature inside the heating chamber exceeds a predetermined threshold or when a sensor of the temperature inside the heating chamber is disconnected.

15. Method according to claim 13 or 14, wherein said floor module is a module according to any of the claims 1 to 12, and wherein said heating means are arranged into said heating chamber and into said pre-heating chamber respectively.

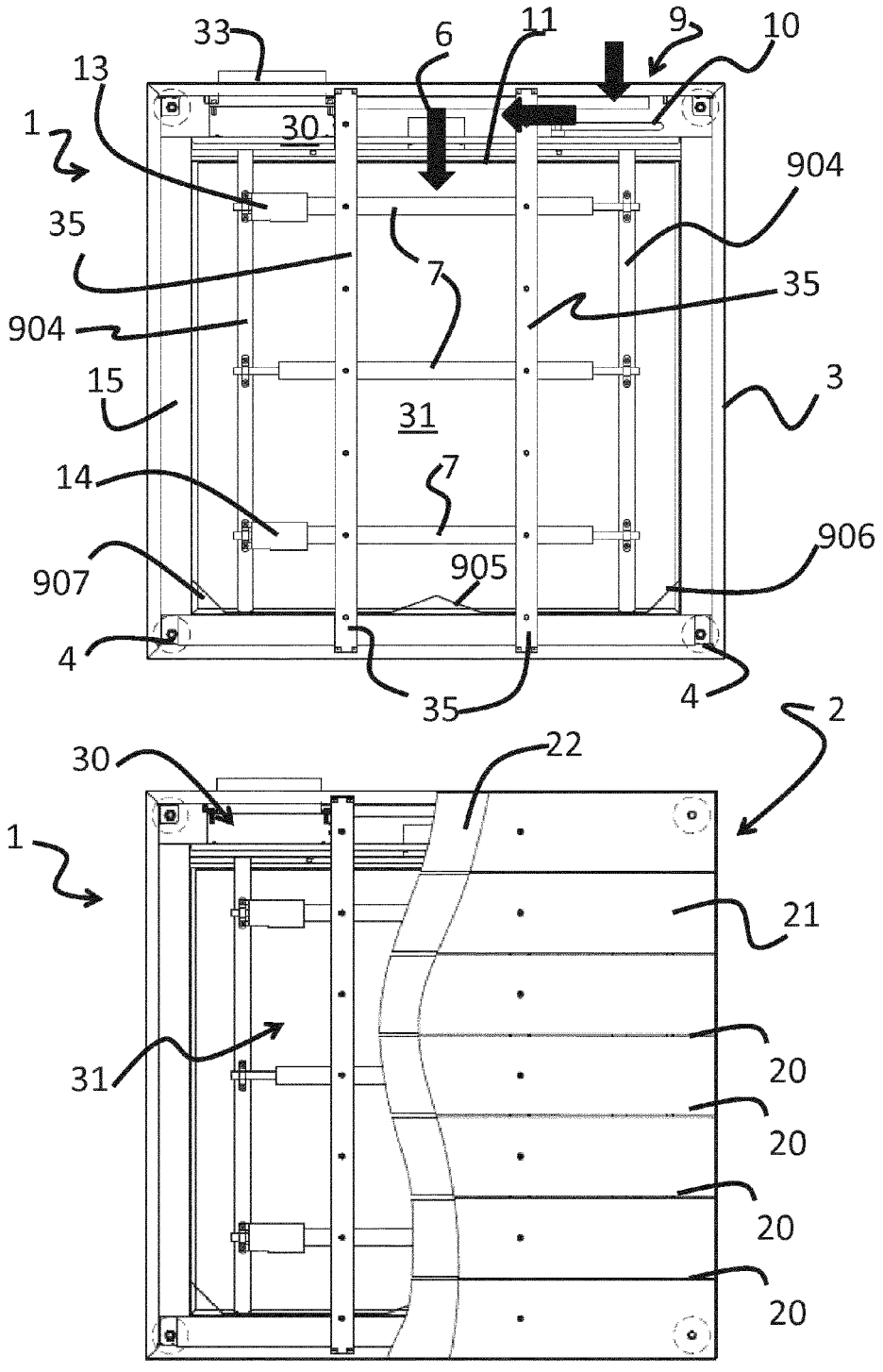
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Fig. 1

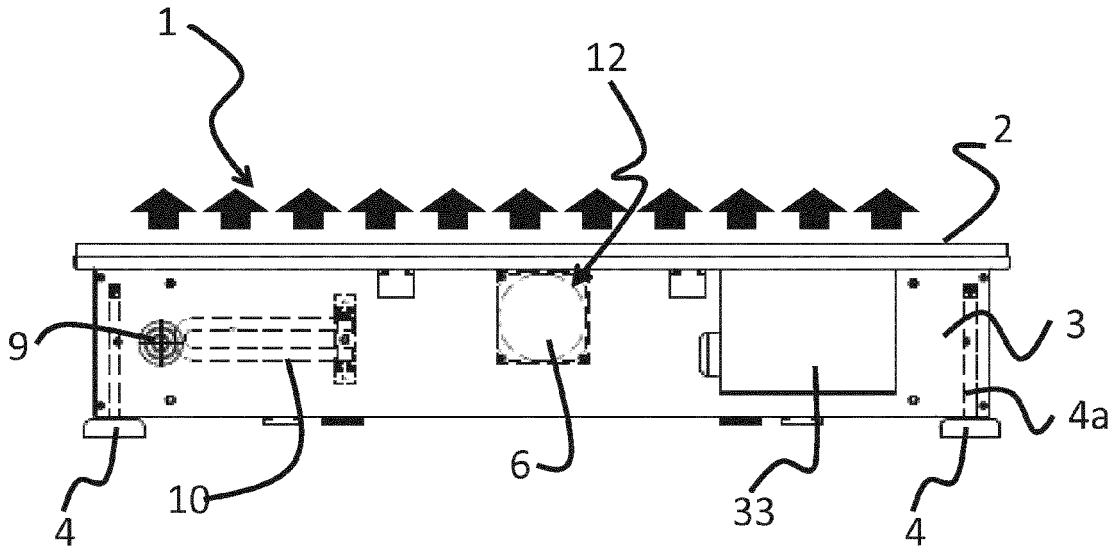

Fig. 2

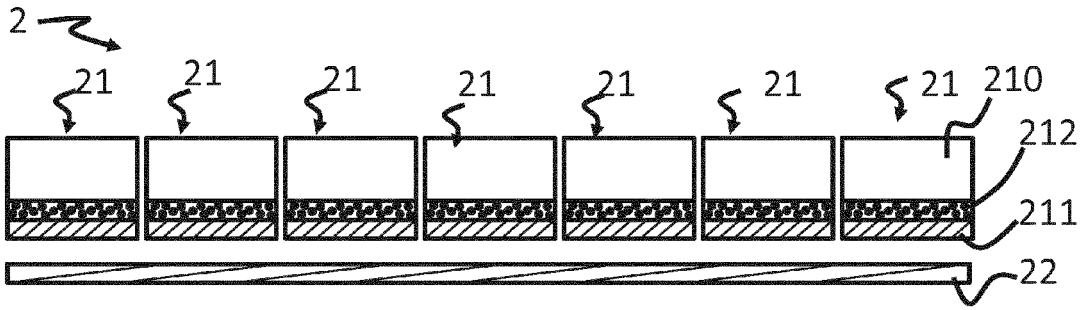
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Fig. 3

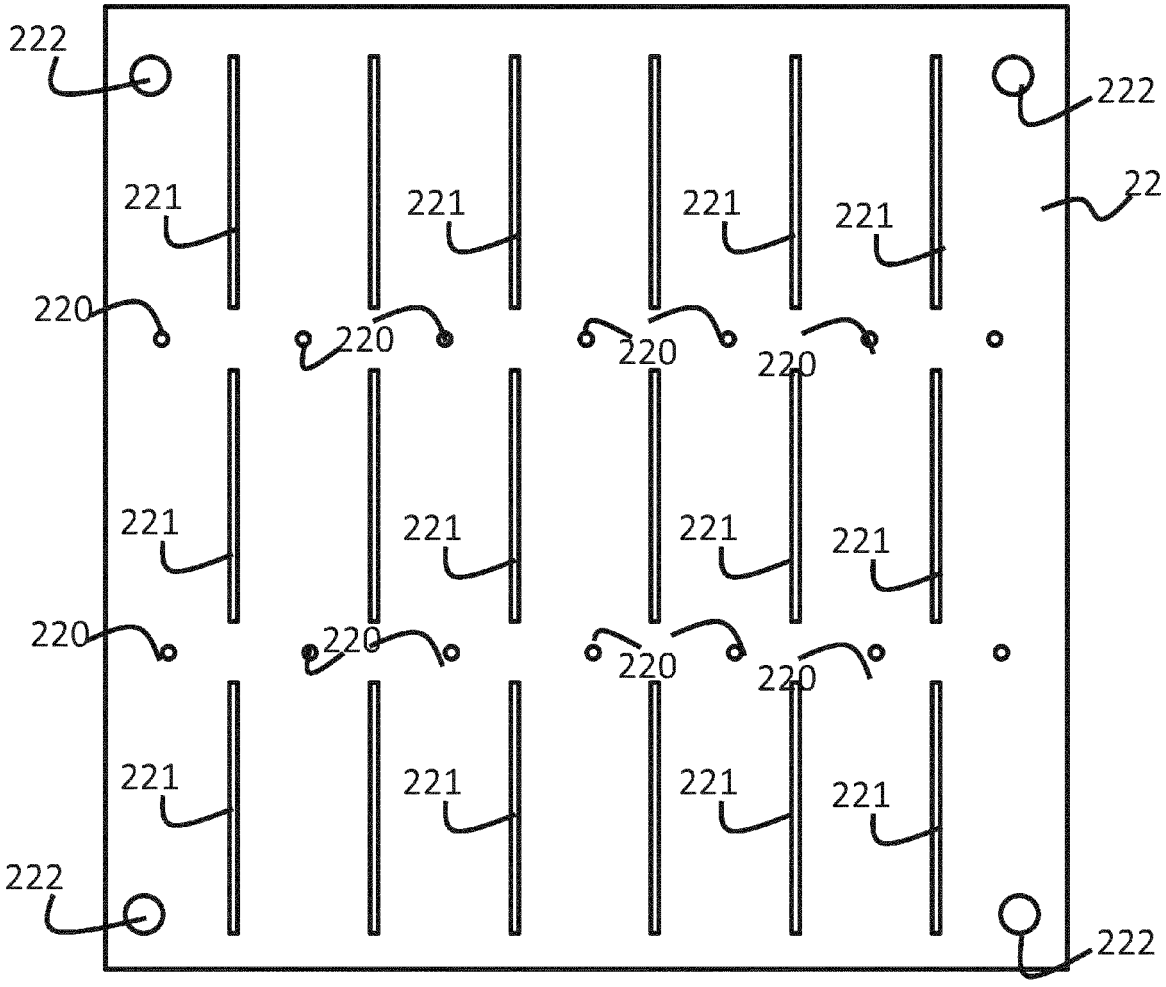
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Fig. 4

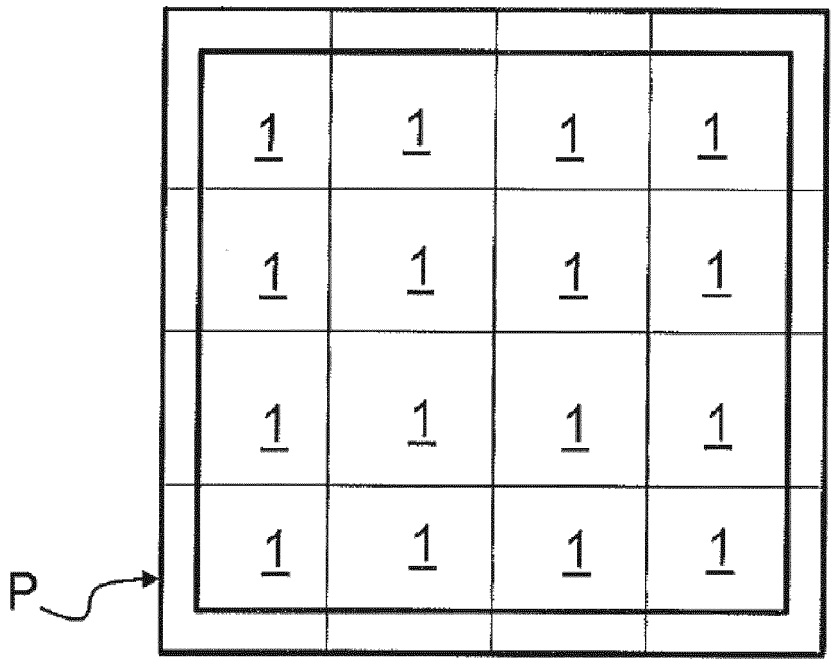

Fig.8

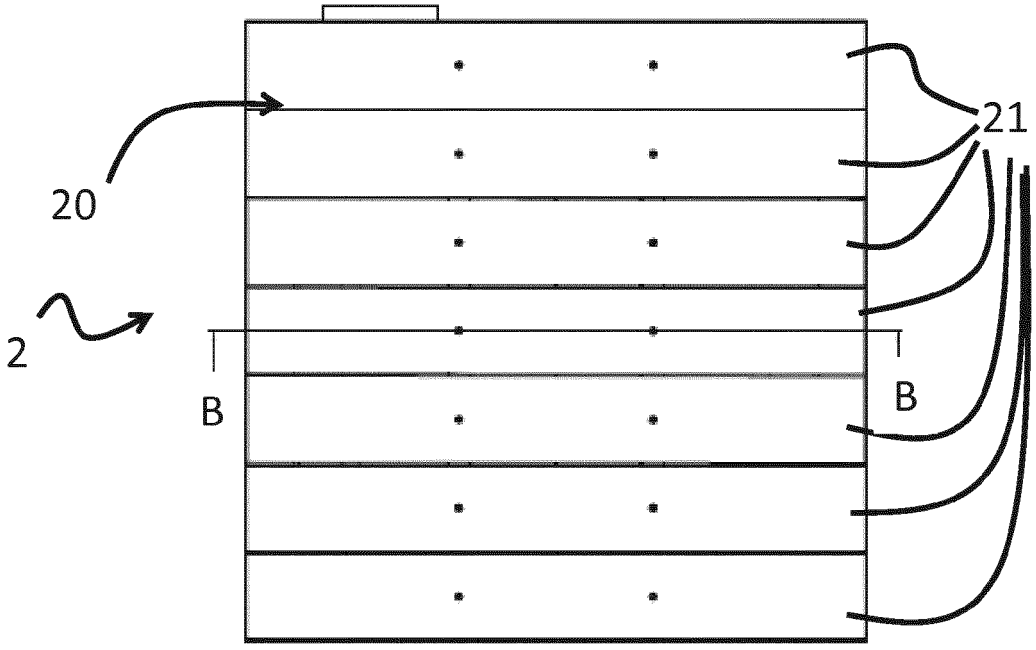

Fig. 5

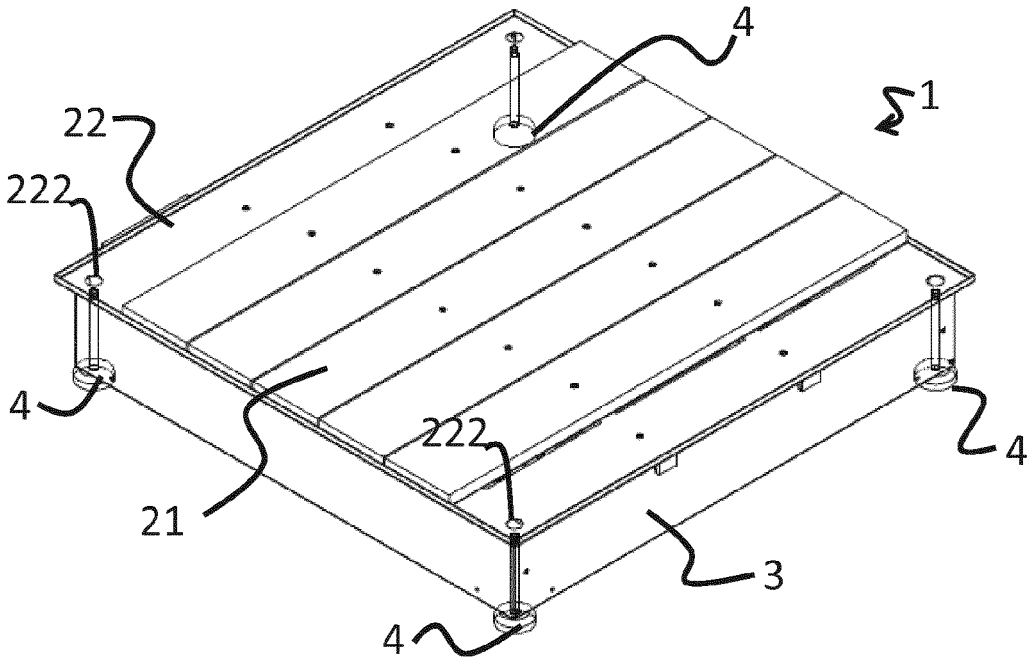

Fig. 6

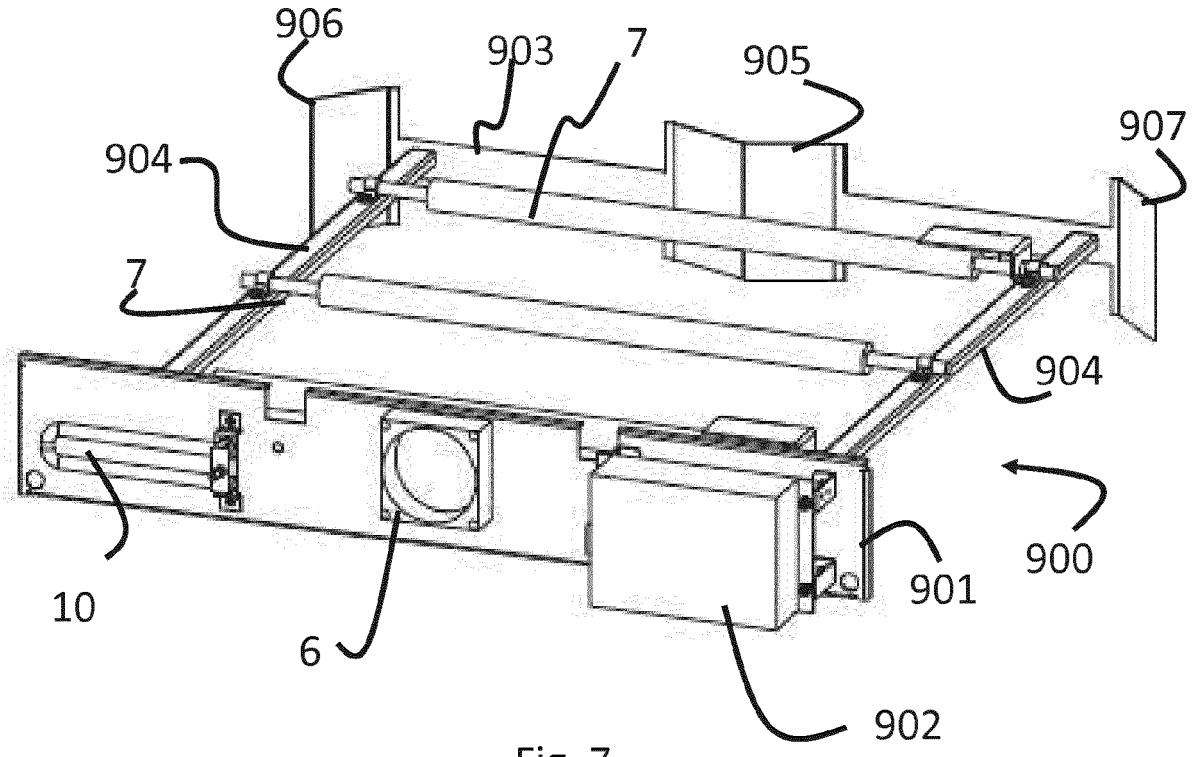

Fig. 7

7°	29,85	31,30	28,80	Ambient T.= 1,8° C
6°	35,60	44,00	35,55	
5°	34,90	44,60	34,85	
4°	38,80	50,20	38,70	
3°	35,60	44,90	35,65	
2°	37,70	46,45	37,60	
1°	33,40	34,20	27,50	

Fig.9

7°	31,95	36,90	31,75	Ambient T= 14,85° C
6°	37,50	48,50	39,40	
5°	35,70	43,80	37,00	
4°	34,35	40,25	33,80	
3°	33,80	37,50	31,85	
2°	32,50	34,35	31,65	
1°	24,85	26,95	25,30	

7°	20,00	27,70	22,40	Ambient T.= 1,2° C
6°	30,35	41,70	31,65	
5°	32,40	42,10	32,00	
4°	29,80	36,70	29,60	
3°	30,20	38,50	29,95	
2°	26,85	30,95	28,30	
1°	15,45	17,55	17,90	

Fig.10

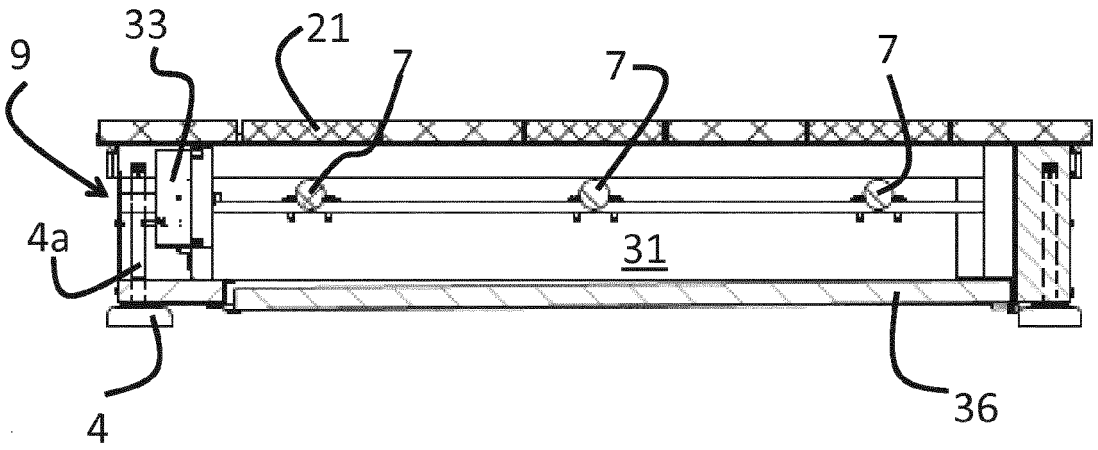

Fig. 11

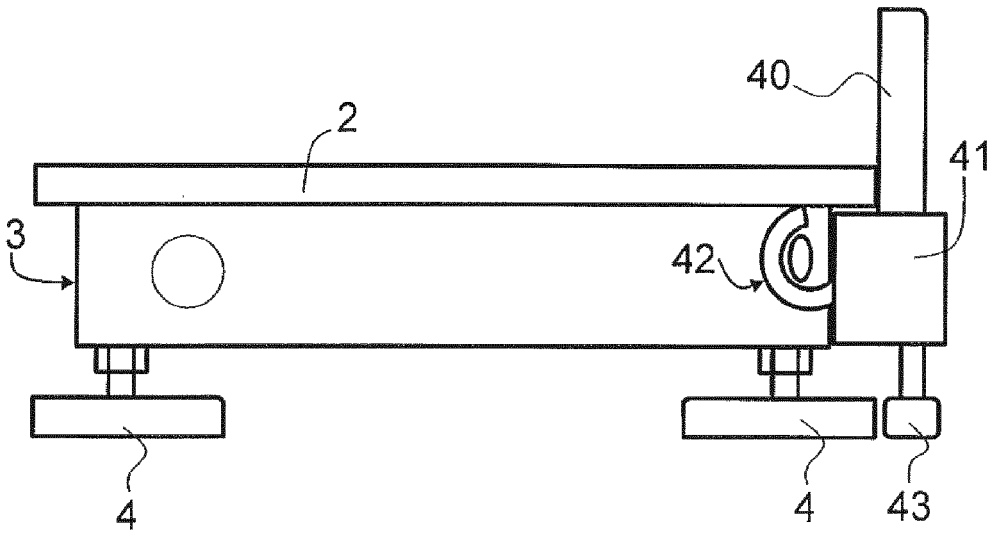

Fig. 12

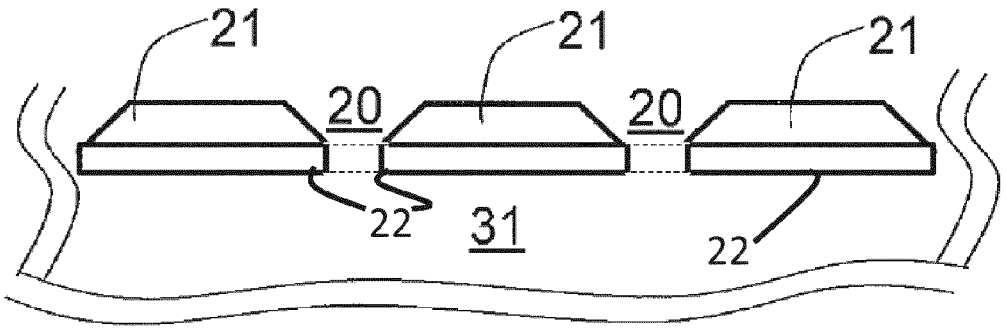

Fig.13

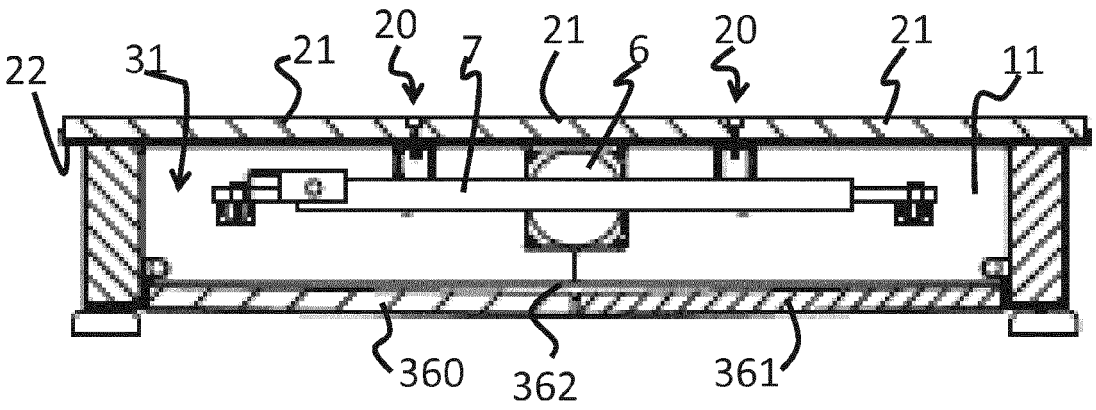

Fig.14

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EUROPEAN SEARCH REPORT

Application Number
EP 12 16 3252

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 20 2010 017267 U1 (DOLL ULRICH [DE]; KANNEGIESER JUERGEN [DE]) 26 August 2011 (2011-08-26) * abstract * * paragraph [0038] - paragraph [0046]; figures 1-5 *	1-6,12	INV. F24H3/00 E01C11/26
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A	DE 10 35 678 B (ROBERT VON LINDE DIPL ING) 7 August 1958 (1958-08-07) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)
F24H
E01C
F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 October 2012	Beucher, Stefan

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12-10-2012

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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