(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 May 2019 (31.05.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/103604 A1

(51) International Patent Classification:
A47C 17/80 (2006.01) *B60H1/00* (2006.01)
A47C 21/04 (2006.01) *A47C 27/14* (2006.01)
B62D 33/06 (2006.01) *A47C 27/15* (2006.01)

(21) International Application Number:
PCT/NL2018/050777

(22) International Filing Date:
20 November 2018 (20.11.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2019946 21 November 2017 (21.11.2017) NL

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) **Title:** CLIMATE CONTROLLED RESTING UNIT FOR USE INSIDE A CAB OF A VEHICLE

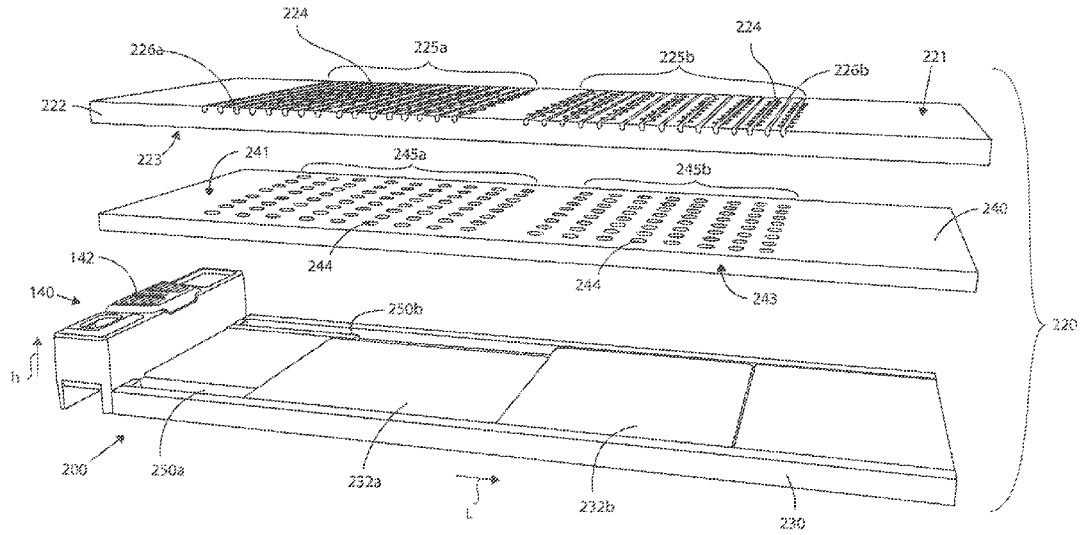


Figure 5

(57) **Abstract:** A climate controlled resting unit for use inside a cab of a vehicle, such as a truck, is described. The resting unit comprises a mattress and a control unit configured to control the climate inside the mattress. The mattress is built up by an upper comfort layer with a top surface and a bottom surface, the comfort layer being provided with air passage channels extending from the bottom surface to the top surface in selected areas of the comfort layer; and a lower support layer, configured to support the upper comfort layer and comprising at least one air collection space and entrance channels giving access to the at least one air collection space. The control unit is configured to be powered by vehicle battery power, and comprises a thermoelectric device configured to thermally condition air, an air transfer device configured to transfer the conditioned air into the entrance channels, and a controller configured to control the operation of the thermoelectric device and the transfer device.

[Continued on next page]

WO 2019/103604 A1

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)* **:** ARIPO (BW, GH, GM, KE, LR, LS, MW, *ML,* NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, Cl, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

CLIMATE CONTROLLED RESTING UNIT FOR USE INSIDE A CAB OF A VEHICLE

FIELD OF THE INVENTION

The invention relates to a climate controlled resting unit for use inside a cab of a vehicle, in particular the cab of a truck. The invention also relates to a cab of a vehicle, in particular a cab of a truck, comprising the resting unit.

BACKGROUND OF THE INVENTION

Drivers of a vehicle having a cab configured for prolonged resting, for instance an overnight sleep, need comfort to be able to take their rest efficiently, i.e. achieving a maximum level of fitness within a shortest possible time. A factor influencing the resting or sleeping quality is the climate within the cab, and this climate within the cab should preferably be able to promote an efficient rest. The temperature within the cab for instance may be held within given boundaries, which boundaries may at least partly depend on the sensibility of the driver. One driver will soon find the climate within the cab too warm, while another driver may experience difficulties in getting sleep because the climate is too chilly for him. Besides temperature, other climate factors like humidity for instance may also have an influence on the ability to take an efficient rest.

There is a need therefore for a driver to be able to control the climate within the vehicle's cab, and adjust this climate according to his or her needs. The available power in a vehicle is limited however, and state of the art solutions aiming to control the cab's climate tend to require too much energy. A typical battery of a vehicle for instance may provide 500 to 1200 amps at 12 volt which equals 6 to l4,4kW. This may be too low for a sustained climate control during a nights sleep. Other solutions, such as those requiring fuel are often found undesirable for cost reasons and are typically used for heating only.

It is an aim of the invention to provide for an efficient climate control within a cab of a vehicle, in particular the cab of a truck, achieving the comfort beneficial to an efficient rest of the driver of the vehicle, or other person present in the cab.

BRIEF SUMMARY OF THE INVENTION

The invention thereto provides a climate controlled resting unit according to claim 1. The climate controlled resting unit in accordance with the invention is configured for use inside a cab of a vehicle, such as a truck, and comprises a mattress and a control unit configured to control the climate inside the mattress, wherein the mattress comprises an upper comfort layer with a top surface and a bottom surface, the comfort layer being provided with air passage channels extending from the bottom surface to the top surface in selected areas of the comfort layer; and a lower support layer, configured to support the upper comfort layer and comprising at least one air collection space and entrance channels giving access to the at least one air collection space; wherein the control unit is configured to be powered by vehicle battery power, and comprises a thermoelectric device configured to thermally condition air, an air transfer device configured to transfer the conditioned air into the entrance channels, and a controller configured to control the operation of the thermoelectric device and the transfer device.

By providing climate control within the resting unit itself, power requirements are reduced considerably. Further, the claimed resting unit provides the desired climate right where it is needed, i.e. relatively close to the person's body laying on the mattress of the resting unit. The upper comfort layer in addition may be designed for maximum comfort to the person residing on the mattress.

It has further been established that the at least one air collection space provided within the lower support layer is instrumental in providing an efficient and comfortable climate control in that it acts as a kind of buffering space for the conditioned air. The buffered air is able, at least for a short amount of time, to interact with the environment, which also comprises the person's body on the mattress. Any fluctuations in the temperature of the conditioned air for instance may be levelled out somewhat, which adds to the level of comfort experienced by the person.

An embodiment of the invention relates to a resting unit wherein the mattress further comprises an air conveying layer interposed between the comfort layer and the support layer, the air conveying layer having a top surface and a bottom surface, and comprising

air passage channels extending from its bottom surface to its top surface in selected areas of the air conveying layer. The air conveying layer of the mattress helps in increasing the mattresses comfort level, and provides an efficient climate control inside the mattress.

The layers of the mattress may be permeable to conditioned air to some degree. Such permeability allows to fluid communication between the at least one air collection space and the comfort layer and/or of the air conveying layer. A particularly useful embodiment of the resting unit according to the invention provides that the air passage channels of the comfort layer and/or of the air conveying layer are positioned in direct fluid communication with the at least one air collection space.

The at least one air collection space may be one air collection space provided in the support layer. However, the support layer may also be provided with two or more of said air collection spaces. The at least one air collection space may be void but may also be filled with material, permeable to conditioned air. In an embodiment of the resting unit according to the invention, the at least one air collection space is provided with a spacer fabric. The spacer fabric is contained in the at least one air collection space. Such a spacer fabric has proven to provide a particularly efficient transfer of conditioned air in that an optimum combination may be achieved between the buffering of conditioned air and the easy release of such air towards the air conveying layer and/or upper comfort layer. Furthermore, the spacer fabric provides a stable air space which both gives comfort and does not collapse easily due to the weight of the user. A spacer fabric is also known as a 3D fabric or a 3D textile. Such a spacer fabric may have a 3D fiber structure, such as a 3D knitted structure. Said 3D fiber structure provides an elastic behavior towards pressure loads.
Preferably the spacer fabric has a thickness in the range between 3 mm and 30 mm.

In a resting unit according to a preferred embodiment, the at least one air collection space is provided with a perforated cover bag, comprising the spacer fabric. Preferably, the perforated cover bag contains the spacer fabric.
The perforated cover bag may be made of flexible materials with low air permeability, such as plastics, non-woven materials or other types of fabric. The size of the bag in combination with the size of the spacer fabric shall be large enough to not collapse

under the weight of the user, preferably 300 mm x 300mm minimum, more preferably larger than the width of the body of the user, even more preferably extending substantially up to a full size of the mattress.

The perforations in the perforated cover bag are arranged for allowing air to escape at certain positions while supporting a pressure build-up inside the perforated cover bag. In this way, the pressure inside the perforated cover bag is substantially uniform. A person skilled in the art may suitably select the number, size and shape of the perforations to support a substantially uniform pressure inside the perforated cover bag. The perforations are located at zones at a top surface of the lower support layer where the escaping air from the perforations is directed into air passage channels of the layers of the mattress towards the body of the user. In particular, the perforations of the cover bag are located at the top surface of the lower support layer in positions which at least partially overlap with air passage channels of the contacting upper comfort layer or of the air conveying layer, which contacts the lower support layer.

In a particular example, an opening of the air passage channels of the upper comfort layer or the air conveying layer, respectively, is selected larger than an opening of the perforations. In this way, a considerable overlap between the perforations and the air passage channels is easily supported.

The support layer is configured to support at least the upper comfort layer and preferably further layers provided on top of it, such as the optional air conveying layer. According to a practical embodiment of the invented resting unit, the support layer comprises a structural foam in which the entrance channels and/or the at least one air collection space have been removed or excised. Removal may have been performed by any method known in the art, such as by cutting, sawing, hot wire cutting, milling, molding, and the like.

In embodiments, a part of the entrance channel is arranged directly beneath an air collection space. In this way an entrance to the air collection space may be arranged at any suitable position to the air collection space. In an example, each of the entrance channels gives access to a respective air collection space at a central position of the respective air collection space. The entrance channel is at least partially covered by (and arranged directly beneath) a respective air collection space.

A structural foam in the context of the present application may be a flexible foam of any type such as polyurethane, polyether, polyester, high resilience, viscoelastic foam or similar, and may be a spacer fabric. Flexible polyurethane foams according to the present application preferably have a density between 30 and 80 kg/m^3.

The hardness of the structural foam results in a high comfort for the user and provides sufficient strength to prevent collapsing of the entrance channels. Preferably the hardness of the structural foam is between 2,5 kPa and 6,0 kPa (measured as CLD - compression load deflection- hardness at 40% load according to IS03386-1).

In an embodiment, the upper comfort layer comprises a structural foam, which is a relatively softer type, wherein the support layer and / or the air conveying layer comprises a structural foam, which is a relatively harder type. Thus, the hardness of the comfort layer is lower than the hardness of the support layer and / or the air conveying layer.

The use of structural foam in the support layer may provide entrance channels with walls that are stiff enough to carry the loads on the support layer, including a person's weight. In a useful embodiment of the resting unit, the entrance channels are provided with a wall stiffening insert in order to at least avoid partial collapse of the walls of the entrance channels.

The structural foam may in an embodiment be a reticulated foam exhibiting a skin-core structure in which the skins are relatively solid and in which the core is foamed and contains air pockets. The skins may also contain air pockets but the porosity of the skins in structural foam is less than the porosity of the core. Structural foam may be made by a low pressure injection molding process where an inert gas is introduced into melted polymer in a mold. As the polymer flows through the mold, the surface cells collapse and solid skins are formed against the walls of the mold, while the core of the part remains structurally foamed.

The comfort layer may be made of any material suitable for its use. A particularly useful embodiment is provided by a resting unit wherein the comfort layer comprises viscoelastic foam.

The optional air conveying layer may also be made of any material suitable for its use. Yet a useful embodiment of the invention provides a resting unit wherein the air conveying layer comprises structural foam, such as a reticulated foam. Structural foams are known per se, and comprise a relatively porous, low density solid foam. Structural foam is an open foam and comprises few, if any, intact air pockets or cell windows. Most air pockets in a structural foam are open and it is substantially only the lineal boundaries where the air pockets meet (also referred to as Plateau borders) that remain.

Although not essential to the invention, an embodiment of the resting unit according to the invention has an air conveying layer that further comprises pocket springs.

The entrance channels in the support layer of the resting unit may extend in any direction needed for the purpose of introducing conditioned air in the air collection space or spaces. For instance, the lower support layer may have a top surface and a bottom surface, whereas the entrance channels may extend from the bottom surface towards or to the top surface in selected areas of the support layer. A useful embodiment that *inter alia* saves space provides a lower support layer with a top surface and a bottom surface, wherein the entrance channels extend substantially parallel to its bottom surface in selected areas of the support layer.

The wording substantially in the context of the present application is meant to denote a possible deviation of the value of a given entity of at most 20% of the value, more preferably of at most 15%, even more preferably of at most 10%, even more preferably of at most 5%, and most preferably of at most 1% of the value.

An embodiment of the resting unit that provides increased comfort to a person making use of it comprises a comfort layer that is further provided with air passage channels extending substantially parallel to its bottom surface in selected areas of the comfort layer. Such channels provide for a more even distribution of the conditioned air within the comfort layer and towards the person resting on top of the mattress.

In a preferred embodiment of the resting unit the parallel air passage channels extend substantially parallel to a head edge of the mattress.

Further improvement of the comfort level is achieved in an embodiment of the resting unit wherein the selected area of the comfort layer and/or of the air conveying layer is located in a shoulder and/or lower back area of the mattress and/or legs area of the mattress. The surficial area not covered by the selected area does not transfer or emit conditioned air towards the resting person to any substantial degree.

The control unit may be provided as a collection of separate items, at least comprising the claimed and powered thermoelectric device, the air transfer device, and the controller, as well as air transfer channels that connect to the entrance channels of the mattress. Some or all of the items may be incorporated in parts of the cab, such as spaces behind the walls of the cab, or under seats for instance. A preferred embodiment however provides a resting unit wherein the control unit items are accommodated in a housing. The housing for the control unit is in another preferred embodiment positioned against a head edge and/or against a foot edge of the mattress.

In embodiments, the housing comprises a structural foam, such as a closed cell foam. The structural foam is arranged for forming air channels inside the structural foam, such as by removing parts of the structural foam. Examples of suitable structural foams are expanded foams, such as expanded polystyrene (EPS) and expanded polypropylene (EPP). Said structural foams are light and strong and provide shock resistance and/or sound isolation properties and/or thermal isolation. In particular examples, spaces are formed in the structural foam, wherein the spaces are arranged for accommodating the thermoelectric device and the air transfer device, respectively. Additionally, channels are formed in the structural foam. In embodiments, the housing comprises two parts made of the structural foam; wherein the spaces and the channels are arranged at an interface between the two parts.

In a space-saving embodiment of the resting unit according to the invention, the housing extends over a height substantially higher than the height of the mattress. Preferably the height of the housing extends at least 5 cm higher than the height of the mattress. In this way it is prevented or at least discouraged that a part of the housing's upper side is covered by a pillow or for by the feet of a person resting on the mattress.

Another embodiment of the invention provides a resting unit wherein a side wall of the

housing is provided with a surplus air outlet for excessive air. When the housing of the control unit has the shape of a box with a long side extending along the head or foot edge of the resting unit and side walls extending substantially perpendicular to the long side, the surplus air outlet directs the excessive air in a direction substantially perpendicular to a side edge of the resting unit. This is beneficial in an embodiment wherein the resting unit is positioned within the cab between two walls (a head side wall and a foot side wall) of the cab, since the excessive air is then blown towards the inner space of the cab.

In a particular embodiment, at least one air intake opening is arranged at a side of the housing different from a side of a location of a surplus air outlet for excessive air. For example, said at least one air intake opening is arranged at one of an upper side and a side wall of the housing and the surplus air outlet for excessive air is arranged at another one of the upper side and a side wall of the housing. In this way, recirculation of the expelled excessive air, which is optionally heated or cooled by the thermoelectric device, such as a Peltier element, and expelled by the surplus air outlet, is prevented or at least minimized by the separated air flow.

The mattress of the resting unit according to an embodiment of the invention is provided within a cover. The cover is preferably permeable to air at the top side of the mattress. The cover may also be applied around part of the mattresses layers, such as around the comfort layer, around the support layer, around the optional air conveying layer, or around any combination of these layers.

The resting unit according to the invention is particularly useful for accommodating in relatively small spaces, such as provided by a cab of a vehicle or truck in particular, which spaces may also be subject to large climatic variations and mechanical solicitations, such as vibrations. Besides in truck, such spaces may also be present in other vehicles, such as in passenger cars or vans, but also in train compartments, in tramways or busses. The resting unit may be any resting unit configured for use in such vehicles, such as a bed, a seat, a chair, a couch, a bench, a sofa, and the like. A resting unit is configured for use in a cab of a vehicle if its dimensions are such that the resting unit can be accommodated in the space of the cab allocated for such use.

An embodiment of the invention provides a resting unit that comprises a mattress

having a thickness of between 10 and 25 cm. The layered structure of the mattress comprising the claimed support layer allows for such relatively limited dimensions, and yet provides the desired level of comfort to a person resting on the mattress.

It is expressly stated that the embodiments of the invention described in this patent application can be combined in any possible combination of these embodiments, and that each embodiment can individually form the subject-matter of a divisional patent application.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be elucidated with reference to the following figures, without however being limited thereto. In the figures:

Fig. 1 is a schematic perspective view of a cab of a vehicle comprising a climate controlled resting unit according to an embodiment of the invention;
Fig. 2 is a schematic perspective view of a climate controlled resting unit according to an embodiment of the invention;
Fig. 3 is a schematic perspective view of a mattress of a climate controlled resting unit according to an embodiment of the invention;
Fig. 4 is a schematic perspective view of a control unit of a climate controlled resting unit according to an embodiment of the invention;
Fig. 5 is a schematic perspective view of a climate controlled resting unit according to an embodiment of the invention;
Fig. 6 is a schematic perspective view of a climate controlled resting unit according to another embodiment of the invention; and
Fig 7 is a schematic perspective view of a control unit of a climate controlled resting unit according to yet another embodiment of the invention.

DETAIFED DESCRIPTION OF THE INVENTION

Figure 1 shows a schematic perspective view of a cab of a vehicle comprising a climate controlled resting unit according to an embodiment of the invention. The cab 20 of the

vehicle 10, such as a truck, comprises the climate controlled resting unit 100. The climate controlled resting unit 100 comprises a mattress 120 and a control unit (not shown) configured to control the climate inside the mattress. The control unit is powered by vehicle battery power carried by the vehicle 10, which vehicle battery power is preferably accommodated outside the cab 20.

The climate controlled resting unit 100 including the mattress 120 may be arranged inside the cab 20 as a lower bed 100a and/or may be arranged inside the cab 20 as an upper bed 100b. Each of the lower bed 100a and upper bed 100b may be movably arranged individually to be pivotable about an axis between a horizontal operational resting position and a standby position, which is substantially vertical. In the operational resting position the climate controlled resting unit 100 functions as bed for resting. In the vertical standby position the climate controlled resting unit 100 occupies less foot print, thereby leaving more living space for personal of the cab 20 of the vehicle 10. The vehicle battery power may be typically in the range of 12V, 24V or alike voltage levels.

Fig. 2 is a schematic perspective view of a climate controlled resting unit according to an embodiment of the invention. The climate controlled resting unit 100 comprises a mattress 120 and a control unit 140. The mattress 120 has a top surface 121 being shaped substantially rectangular, wherein the mattress 120 has a head edge and a foot edge arranged at each end, respectively, of the top surface 121 along a length direction L of the mattress 120. The control unit 140 is arranged against the head edge or the foot edge of the mattress 120. The control unit 140 comprises a housing 144, which extends over a height in a direction as indicated by arrow h, which is substantially equal to a height of the mattress 120 in the direction h. The housing 144 further comprises at least one air intake opening 142 arranged for allowing taking in air into the control unit 140. Other components of the control unit 140 are further shown in relation to Figure 4.

Fig. 3 is a schematic perspective view of a mattress of a climate controlled resting unit according to an embodiment of the invention. The climate controlled resting unit 100 comprises the mattress 120. The mattress 120 comprises an upper comfort layer 122 with a top surface 121 and a bottom surface 123, the comfort layer 122 being provided with air passage channels 124 extending from the bottom surface 123 to the top surface

121 in selected areas l25a, l25b, l25c of the comfort layer 122. Additionally the mattress 120 comprises a lower support layer 130, configured to support the upper comfort layer 122 and comprising one air collection space 132 and at least one entrance channel 150 giving access to the one air collection space 132 from outside the support layer 130. The conditioned air is supplied by the control unit 140 as shown in Figure 4 towards the one air collection space 132 using the entrance channels 150. In an embodiment, using two entrance channels 150 instead of one entrance channel 150 improves the uniformity of the temperature of the conditioned air inside the air collection space 132. The air collection space 132 is shaped to connect to a major part of the bottom surface 123 of the comfort layer 122. In this way the conditioned air contained inside the air collection space 132 may be easily fed into the air passage channels 124 extending from the bottom surface 123 to the top surface 121 in the selected areas l25a, l25b, l25c of the comfort layer 122. As such, the air passage channels 124 of the comfort layer 122 are positioned in direct fluid communication with the one air collection space 132.

It has been established that the at least one air collection space 132 provided within the lower support layer 130 is instrumental in providing an efficient and comfortable climate control in that it acts as a kind of buffering space for the conditioned air. The buffered air is able, at least for a short amount of time, to interact with the environment, which also comprises the person's body on the mattress. Any fluctuations in the temperature of the conditioned air for instance may be levelled out somewhat, which adds to the level of comfort experienced by the person.

By providing climate control within the resting unit 100 itself, power requirements are reduced considerably. Further, the resting unit 100 provides the desired climate right where it is needed, i.e. relatively close to the person's body laying on the mattress 120 of the resting unit 100. The upper comfort layer 122 in addition may be designed for maximum comfort to the person residing on the mattress 120.

The selected areas (l25a, l25b, l25c) of the comfort layer 122 are located in a head area, back area and foot area of the mattress, respectively. The surficial area not covered by the selected areas (l25a, l25b, l25c) does not transfer or emit conditioned air towards the resting person to any substantial degree.

Alternatively, the selected area of the comfort layer 122 may be located in a shoulder and/or lower back area of the mattress 120.

The air collection space 132 in the embodiment shown in figure 3 is provided with a spacer fabric 133, which substantially fills the air collection space 132. Such a fabric 133 has proven to provide a particularly efficient transfer of conditioned air in that an optimum combination may be achieved between the buffering of conditioned air and the easy release of such air towards the upper comfort layer 122. In an example, the spacer fabric is shaped as a layer having a thickness of about 10 mm, but other thicknesses are also possible. The air collection space 132 in this example has a height of about 10 mm and is substantially completely filled by the spacer fabric.

Additionally, the air collection space 132 may be provided with a perforated cover bag 133, comprising the spacer fabric. The spacer fabric provides a stable air space which both gives comfort but does not collapse easily due to the weight of the user.
The perforated cover bag may be made of flexible materials with low air permeability, such as plastics, non-woven materials or other types of fabric. The size of the bag shall be large enough to not collapse under the weight of the user, preferably 300 mm x 300mm minimum, more preferably larger than the width of the body of the user, even more preferably extending substantially up to a full size of the mattress.
The perforations in the perforated cover bag are arranged for allowing air to escape at certain positions while supporting a pressure build-up inside the perforated cover bag. In this way, the pressure inside the perforated cover bag is substantially uniform. A person skilled in the art may suitably select the number, size and shape of the perforations to support a substantially uniform pressure inside the perforated cover bag.
The perforations are located at zones at a top surface of the lower support layer 130 where the escaping air from the perforations is directed into air passage channels 124 of the comfort layer 122 of the mattress 100 towards the body of the user. In particular, the perforations of the cover bag are located at the top surface of the lower support layer 130 in positions which at least partially overlap with air passage channels 124 of the contacting upper comfort layer 122, which contacts the lower support layer 130.
In a particular example, an opening of the air passage channels of the upper comfort layer 124 is selected larger than an opening of the perforations. In this way, a

considerable overlap between the perforations and the air passage channels 124 is easily supported.

The support layer 130 is configured to support at least the upper comfort layer 122 and preferably further layers provided on top of it, such as an optional air conveying layer. The support layer 130 comprises a structural foam in which the entrance channels 150 and the air collection space 132 have been removed or molded.

A suitable structural foam to be used in the support layer 130 is a flexible polyurethane foam having a density between 30 and 80 kg/m^3.

The use of structural foam in the support layer 130 may provide entrance channels 150 with walls that are stiff enough to carry the loads on the support layer 130, including a person's weight. In an alternative embodiment of the resting unit 100, the entrance channels 150 are provided with a wall stiffening insert in order to at least avoid partial collapse of the walls of the entrance channels 150.

In an example the comfort layer 122 of any of the embodiments shown in figures 1-5 comprises viscoelastic foam.

Fig. 4 is a schematic perspective view of a control unit of a climate controlled resting unit according to an embodiment of the invention. The control unit may be used in combination with the mattress 120 shown in Figure 3 or the mattress 220 shown in Figure 5. The control unit 140 comprises a housing 144. In the perspective view of Figure 4 a part of the housing 144 is not shown in order to show other components of the control unit 140. The housing 144 is arranged to accommodate an air conditioning unit comprising at least one thermoelectric device l46a, l46b and at least one air transfer device l48a, l48b in the form of blowers, and a controller (not shown). The at least one thermoelectric device l46a, l46b, such as a Peltier element unit, is configured to thermally condition air, including heating or cooling the air on demand. Each air transfer device l48a, l48b, such as a fan, is connected to a corresponding thermoelectric device l46a, l46b and configured to transfer air through the corresponding thermoelectric device l46a, l46b and to transfer conditioned air into one of the entrance channels l50a, l50b. Additionally, each of the at least one air transfer

device 148a, 148b and/or thermoelectric device 446a, 446b is connected to an air outlet channel 149 having an surplus air outlet arranged at a side wall of the housing 144 for expelling excessive air from the control unit 140, as is also shown in Figures 2 and 5. The housing 144 provides additional benefits including sound reduction of the air transfer device 148a, 148b and thermal insulation of the conditioned air between the thermoelectric device 146a, and 146b and the entrance channels 150a and 150b. Additionally, as shown in Figure 4, the housing 144 may be arranged to enclose air channels, which connect the thermoelectric device 146a, 146b to the corresponding entrance channels 150a and 150b.

The housing 144 of the control unit 140 has the shape of a box with a long side extending along the head or foot edge of the resting unit and side walls extending substantially perpendicular to the long side. The surplus air outlet directs the excessive air in a direction substantially perpendicular to a side edge of the resting unit 100. This is beneficial in an embodiment wherein the resting unit is positioned within the cab between two walls (a head side wall and a foot side wall) of the cab, since the excessive air is then blown towards the inner space of the cab.

The controller is configured to control the operation of the thermoelectric device 146a, 146b and the air transfer device 148a, 148b.
In alternative embodiments, other forms of air conditioning units, such as an air compressor system, may be used to condition the air delivered to the mattress 120, 220 shown in Figures 2 - 3 and 5.

The housing 144 may further accommodate a user interface for receiving an input from a user to the controller for controlling the control unit. Alternatively, the user may use a mobile device to provide an input to the controller for controlling the control unit 140. The housing 144 may further accommodate at least one low power outlet, such as an USB outlet.

Fig. 5 is a schematic perspective view of a climate controlled resting unit according to an embodiment of the invention. The climate controlled resting unit 200 comprises a mattress 220 and a control unit 140. The mattress 220 has a top surface 221 being shaped substantially rectangular, wherein the mattress 220 has a head edge and a foot

edge arranged at each end, respectively, of the top surface 221 along a length direction L of the mattress 220. The control unit 140 is arranged against the head edge or the foot edge of the mattress 220. The control unit 140 comprises a housing 144, which extends over a height in a direction as indicated by arrow h, which is substantially higher than a height of the mattress 220 in the direction h. Preferably, the height of the housing extends at least 5 cm higher than the height of the mattress. In this way it is prevented or at least discouraged that a part of the housing's upper side is covered, for instance for by a pillow, blanket or by the feet of a person resting on the mattress.

The housing 144 further comprises at least one air intake opening 142 arranged for allowing taking in air into the control unit 140. The at least one air intake opening 142 is arranged at an upper side of the housing 144.

Due to the height of the housing 144 with respect to the mattress 220, the at least one air intake opening 142 is not covered, for instance by a pillow, blanket or by the feet of a person resting on the mattress.

In exemplary embodiments, the at least one air intake opening 142 may include a replaceable or washable filter.

Other components of the control unit 140 are further shown in relation to Figure 4. The mattress 220 comprises an upper comfort layer 222 with a top surface 221 and a bottom surface 223, the comfort layer 222 being provided with air passage channels 224 extending from the bottom surface 223 to the top surface 221 in selected areas 225a, 225b of the comfort layer 222.

Additionally, the mattress 220 comprises a lower support layer 230, configured to support the upper comfort layer 222 and comprising two air collection spaces 232a, 232b and at two entrance channels 250a, 250b, each giving access to one of the two air collection spaces 232a, 232b from outside the support layer 230. The conditioned air is supplied by the control unit 140 as shown in Figure 4 towards each of the air collection spaces 232a, 232b individually using the entrance channels 250a, 250b, respectively.

Additionally, the mattress 220 further comprises an air conveying layer 240 interposed between the comfort layer 222 and the support layer 230, the air conveying layer 240 having a top surface 241 and a bottom surface 243, and comprising air passage channels 244 extending from its bottom surface 243 to its top surface 241 in selected areas 245a,

245b of the air conveying layer 240. The air conveying layer 240 of the mattress 220 helps in increasing the mattresses 220 comfort level, and provides an efficient climate control inside the mattress 220.

The comfort layer 222 and air conveying layer 240 of the mattress 220 may be permeable to conditioned air to some degree. Such permeability allows fluid communication between the at least one air collection space 232a, 232b and the comfort layer 222 and/or of the air conveying layer 240. The air passage channels 224 of the comfort layer and the air passage channels 244 of the air conveying layer are positioned in direct fluid communication with the at least one air collection space 232a, 232b, respectively.

Additionally, each of the air collection spaces 232a, 232b may be provided with a perforated cover bag, comprising a spacer fabric. The spacer fabric provides a stable air space which both gives comfort but does not collapse easily due to the weight of the user.

In an example, the spacer fabric may be a 3Mesh® product available from Mueller Textil Group. The skilled person may suitably select other spacer fabrics.

The perforated cover bag may be made of flexible materials with low air permeability, such as plastics, non-woven materials or other types of fabric. The size of the bag shall be large enough to not collapse under the weight of the user, preferably 300 mm x 300mm minimum, more preferably larger than the width of the body of the user, even more preferably extending substantially up to a full size of the mattress.

The perforations in the perforated cover bag are arranged for allowing air to escape at certain positions while supporting a pressure build-up inside the perforated cover bag. In this way, the pressure inside the perforated cover bag is substantially uniform. A person skilled in the art may suitably select the number, size and shape of the perforations to support a substantially uniform pressure inside the perforated cover bag.

The perforations are located at zones at a top surface of the lower support layer 130 where the escaping air from the perforations is directed into air passage channels 244 of the air conveying layer 240 of the mattress 100 towards the body of the user. In particular, the perforations of the cover bag are located at the top surface of the lower support layer 230 in positions which at least partially overlap with air passage channels 244 of the contacting air conveying layer 240, which contacts the lower support layer

230.

In a particular example, an opening of the air passage channels 244 of the contacting air conveying layer 240 is selected larger than an opening of the perforations. In this way, a considerable overlap between the perforations and the air passage channels 244 is easily supported.

The air conveying layer 240 may also be made of any material suitable for its use. For example, the air conveying layer comprises reticulated foam. The air conveying layer 240 may further comprise pocket springs.

Additionally, in this embodiment the entrance channels 250a, 250b extend substantially parallel to the length direction L of the mattress in selected areas of the support layer 230 from the head edge of the mattress 220 towards the at least one air collection space 232a, 232b, respectively. In particular, the lower support layer 230 has a top surface and a bottom surface, whereas the entrance channels 250a, 250b extends from the bottom surface towards or to the top surface in selected areas of the support layer 230. As such, the design of the mattress inter alia saves space.

Additionally, the comfort layer 222 is further provided with air passage channels 226a, 226b arranged at the top surface 221, which extend substantially parallel to its top or bottom surface 221, 223 in the selected areas 225a, 225b of the comfort layer. Such channels 226a, 226b provide for a more even distribution of the conditioned air within the comfort layer 222 and towards the person resting on top of the mattress. In the shown embodiment the parallel air passage channels 226a, 226b extend substantially parallel to the head edge of the mattress 220, which is arranged in a width direction substantially perpendicular to the length direction L.

It is noted that an air passage channel 224, which extends from the bottom surface 223 to the top surface 221 in selected areas 225a, 225b of the comfort layer 222, may end at the top surface 221 in a location wherein no air passage channel 226b is arranged, which extends substantially parallel to its top or bottom surface 221, 223. Alternatively, an air passage channel 224, which extends from the bottom surface 223 to the top surface 221 in selected areas 225a, 225b of the comfort layer 222, may end at the top

surface 221 in a location wherein an air passage channel 226a is arranged, which extends substantially parallel to its top or bottom surface 221, 223. In that case, such as illustrated in FIG. 5, the air passage channel 224 is in direct fluid communication to the air passage channel 226a. Both described embodiments for air passage channels 224 may be combined in a mattress. In further embodiments, some of the air passage channels 226b, which extend substantially parallel to its top surface 221 at the top surface 221, may be unconnected to an air passage channel 224, as is also shown in FIG. 5.

Fig. 6 is a schematic perspective view of a climate controlled resting unit according to another embodiment of the invention. The climate controlled resting unit 300 comprises a mattress 320 and a control unit 440, shown in figure 7 in more detail. The mattress 320 has a top surface 321 that is shaped substantially rectangular, wherein the mattress 320 has a head edge and a foot edge arranged at each end, respectively, of the top surface 321 along a length direction L of the mattress 320. A control unit 440 as shown in FIG. 7 is arranged against the head edge and/or the foot edge of the mattress 320.

The mattress 320 comprises an upper comfort layer 322 with a top surface 321 and a bottom surface 323, the comfort layer 322 being provided with air passage channels 324 extending from the bottom surface 323 to the top surface 321 in selected areas 325 of the comfort layer 322. The selected areas 325 are a lower back area and/or a legs area of the mattress. Area 326 is a comfort area for the shoulders.

Additionally, the mattress 320 comprises a lower support layer 330, configured to support the upper comfort layer 322 and comprising two air collection spaces 332a, 332b and two entrance channels 350a, 350b, each giving access to one of the two air collection spaces 332a, 332b from outside the support layer 330. The conditioned air is supplied by the control unit 440 as shown in Figure 7 towards each of the air collection spaces 332a, 332b individually using the entrance channels 350a, 350b, respectively. A part of the entrance channel 350a, 350b is arranged directly beneath the corresponding air collection space 332a, 332b. In particular, each of the entrance channels 350a, 350b gives access to a respective air collection space 332a, 332b at a central position of the respective air collection space 332a, 332b.
Each of the air collection spaces 332a, 332b may be provided with a perforated cover

bag, comprising a spacer fabric. The spacer fabric provides a stable air space which both gives comfort but does not collapse easily due to the weight of the user.

In exemplary embodiments, the entrance channels l50a, l50b, 250a, 250b and 350a, 350b shown in Figure 3, Figure 5 and Figure 6 respectively, are configured to provide thermal insulation of the conditioned air along the entrance channels l50a, l50b, 250a, 250b and 350a, 350b when moving the conditioned air to the corresponding air collection space 132, 232a, 232b, 323a, 323b.

In all of the embodiments shown in figures 1-6, the mattress may be provided with a cover. The cover may be a knitted textile at the contact surfaces with the user; mainly the top and the sides of the mattress. This knitted fabric on the top of the mattress can be a circular knitted but also a flat knitted, a non-woven or other product. Preferably the cover is air permeable (should not block the air flow). Furthermore, the micro climate features of the fabric may result in a high comfort layer supporting the air flow and climate for the user.
The sides can be identical to the top surface but can also be a more cost efficient solution such as non-woven or woven fabric. Such fabric does not have to have good air permeability properties.

Fig. 7 is a schematic perspective view of a control unit 440 of a climate controlled resting unit according to another embodiment of the invention. The control unit 440 may be used in combination with the mattress 120 shown in Figure 3 or the mattress 220 shown in Figure 5 or the mattress 320 shown in Figure 6. The control unit 440 is a modified control unit compared to the control unit 140 shown in Fig. 4. The control unit comprises a housing 444. In the perspective view of Figure 7 a part of the housing 444 is not shown in order to show other components of the control unit 440. The housing 444 is arranged to accommodate an air conditioning unit comprising at least one thermoelectric device 446a, 446b and at least one air transfer device 448a, 448b in the form of blowers, and a controller (not shown). The at least one thermoelectric device 446a, 446b, such as a Peltier element unit, is configured to thermally condition air, including heating or cooling the air, on demand. Each air transfer device 448a, 448b, such as a fan, is connected to a corresponding thermoelectric device 446a, 446b via channels 447 and configured to transfer air from the air intake openings 442, which

allow air entering into the control unit 440, through the corresponding thermoelectric device 446a, 446b and via channels 450 to transfer conditioned air into one of the entrance channels of a mattress. Additionally, each of the thermoelectric device 446a, 446b is connected to an air outlet channel 449 having an surplus air outlet arranged at a side wall of the housing 444 for expelling excessive air from the control unit 440. The housing 444 provides additional benefits including sound reduction of the air transfer device 448a, 448b and thermal insulation of the conditioned air between the thermoelectric device 446a, and 446b and the entrance channels.

Additionally, as shown in Figure 7, the housing 444 may be arranged to enclose air channels 447, which connect the thermoelectric device 446a, 446b to the corresponding entrance channels.

The housing 444 comprises a structural foam in which spaces are formed arranged for accommodating the thermoelectric device 446a, 446b and the air transfer device 448a, 448b, respectively, and in which channels 447, 449, 450 are arranged for providing a fluid connection between the air transfer device 446a, 446b and the corresponding thermoelectric device 448a, 448b, arranged for providing a fluid connection to the at least one entrance channel of the support layer of the corresponding mattress and/or arranged for providing a fluid connection to the surplus air outlet for flushing out excessive air.

In particular examples, a cross section of channels 447, 450 is shaped substantially rectangular, wherein one side is considerably smaller than another side of the cross section of the channel. In this way, a flush out of the air at the outlet of the channel is enhanced and a transfer of conditioned air to the entrance channel of the mattress is enhanced. Each of the channels 447, 450 has a substantially constant cross section area along its length to minimize a loss of air speed inside the channels 447, 450.

In particular, the housing 444 comprises two parts 444a, 444b made of the structural foam, wherein the spaces and the channels 447, 449, 450 are arranged at an interface between the two parts 444a, 444b.

The housing 444 of the control unit 440 has the shape of a box with a long side

extending along the head or foot edge of the resting unit and side walls extending substantially perpendicular to the long side. The surplus air outlet directs the excessive air in a direction substantially perpendicular to a side edge of the resting unit. This is beneficial in an embodiment wherein the resting unit is positioned within the cab between two walls (a head side wall and a foot side wall) of the cab, since the excessive air is then blown towards the inner space of the cab. Additionally or alternatively, the surplus air outlet may be connected to tubing means arranged for transporting the excessive air to outside the cab.

The controller is configured to control the operation of the thermoelectric device 446a, 446b and the air transfer device 448a, 448b.

In alternative embodiments, other forms of air conditioning units, such as an air compressor system, may be used to condition the air delivered to the mattress 120, 220 and 320 shown in Figures 2 - 3 and 5 - 6.

The housing 444 may further accommodate a user interface for receiving an input from a user to the controller for controlling the control unit. Alternatively, the user may use a mobile device to provide an input to the controller for controlling the control unit 440. The housing 444 may further accommodate at least one low power outlet, such as an USB outlet.

The control unit 140, 440 is configured to be powered by a vehicle battery power. The vehicle battery power may be typically in the range of 12V, 24V or alike voltage levels. Each of the electrical components of the control unit 140, 440 is configured to be powered by the vehicle battery power.

CLAIMS

1. A climate controlled resting unit for use inside a cab of a vehicle, such as a truck, the resting unit comprising a mattress and a control unit configured to control the climate inside the mattress, wherein the mattress comprises:

an upper comfort layer with a top surface and a bottom surface, the comfort layer being provided with air passage channels extending from the bottom surface to the top surface in selected areas of the comfort layer; and

a lower support layer, configured to support the upper comfort layer and comprising at least one air collection space and at least one entrance channel giving access to the at least one air collection space;

wherein the control unit is configured to be powered by vehicle battery power, and comprises a thermoelectric device configured to thermally condition air, an air transfer device configured to transfer the conditioned air into the at least one entrance channel, and a controller configured to control the operation of the thermoelectric device and the transfer device; wherein the control unit including a housing for the control unit is positioned against a head edge or against a foot edge of the mattress.

2. Resting unit according to claim 1, wherein the mattress further comprises an air conveying layer interposed between the comfort layer and the support layer, the air conveying layer having a top surface and a bottom surface, and comprising air passage channels extending from its bottom surface to its top surface in selected areas of the air conveying layer.

3. Resting unit according to claim 1 or 2, wherein the air passage channels of the comfort layer and/or of the air conveying layer are positioned in direct fluid communication with the at least one air collection space.

4. Resting unit according to any one of the preceding claims, wherein the at least one air collection space is provided with a spacer fabric.

5. Resting unit according to claim 4, wherein the at least one air collection space is provided with a perforated cover bag, comprising the spacer fabric.

6. Resting unit according to any one of the preceding claims, wherein the support layer comprises a structural foam in which the entrance channels and/or the at least one air collection space have been removed or excised.

7. Resting unit according to claim 6, wherein a part of the entrance channel is arranged directly beneath an air collection space.

8. Resting unit according to claim 6 or claim 7, wherein the entrance channels are provided with a wall stiffening insert.

9. Resting unit according to any one of the preceding claims, wherein the comfort layer comprises viscoelastic foam.

10. Resting unit according to any one of the preceding claims, wherein the air conveying layer comprises reticulated foam.

11. Resting unit according to claim 10, wherein the air conveying layer further comprises pocket springs.

12. Resting unit according to any one of the preceding claims, wherein the comfort layer is further provided with air passage channels extending substantially parallel to its bottom surface in selected areas of the comfort layer.

13. Resting unit according to claim 12, wherein the parallel air passage channels extend substantially parallel to a head edge of the mattress, wherein preferably the air passage channels are arranged near a head and/or legs edge of the mattress.

14. Resting unit according to any one of the preceding claims, wherein the selected area of the comfort layer and/or of the air conveying layer is located in a shoulder and/or lower back area of the mattress and/or legs area of the mattress.

15. Resting unit according to any one of the preceding claims, wherein each of the entrance channels gives access to a respective air collection space at a central position of the respective air collection space.

16. Resting unit according to any one of the preceding claims, wherein the housing extends over a height higher than the height of the mattress.

17. Resting unit according to claim 16, wherein the height of the housing extends at least 5 cm higher than the height of the mattress.

18. Resting unit according to any one of the preceding claims, wherein a side wall of the housing is provided with a surplus air outlet for excessive air.

19. Resting unit according to any one of the preceding claims, wherein at least one air intake opening for allowing taking in air into the control unit is arranged at a side of the housing different from a side of a location of a surplus air outlet for excessive air.

20. Resting unit according to any one of the preceding claims, wherein the housing comprises a structural foam in which spaces are arranged for accommodating the thermoelectric device and the air transfer device, respectively, and in which channels are arranged for providing at least one of a fluid connection between the air transfer device and the thermoelectric device, a fluid connection to the at least one entrance channel of the support layer and/or a fluid connection to the surplus air outlet for flushing out excessive air.

21. Resting unit according to claim 20, wherein the housing comprises two parts made of the structural foam; wherein the spaces and the channels are arranged at an interface between the two parts.

22. Resting unit according to any one of the preceding claims, wherein the mattress is provided within a cover.

23. Resting unit according to any one of the preceding claims, comprising a mattress having a thickness of between 10 and 25 cm.

24. Cab of a vehicle, such as a truck, comprising a resting unit according to any one of the preceding claims.

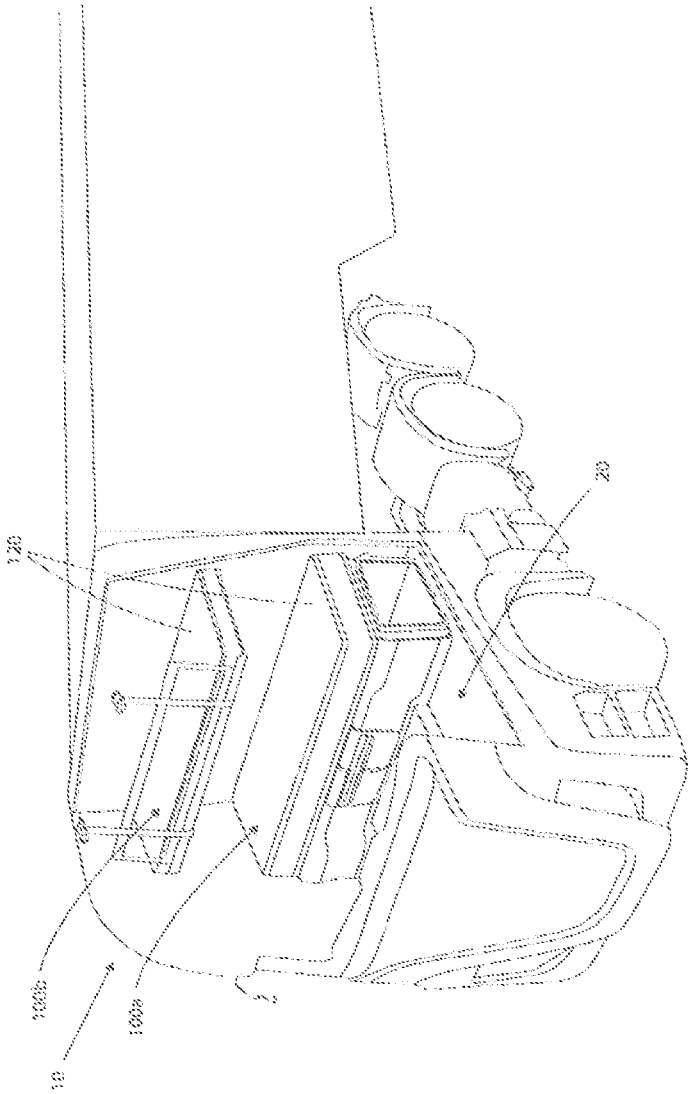


Figure 1

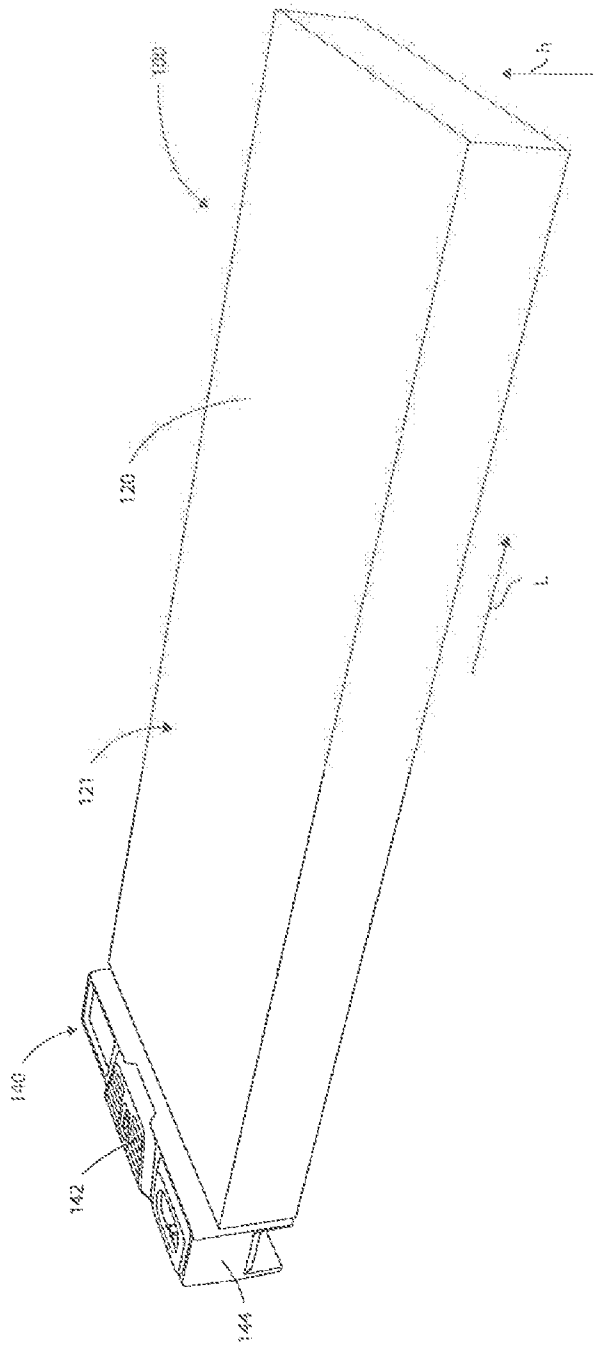


Figure 2

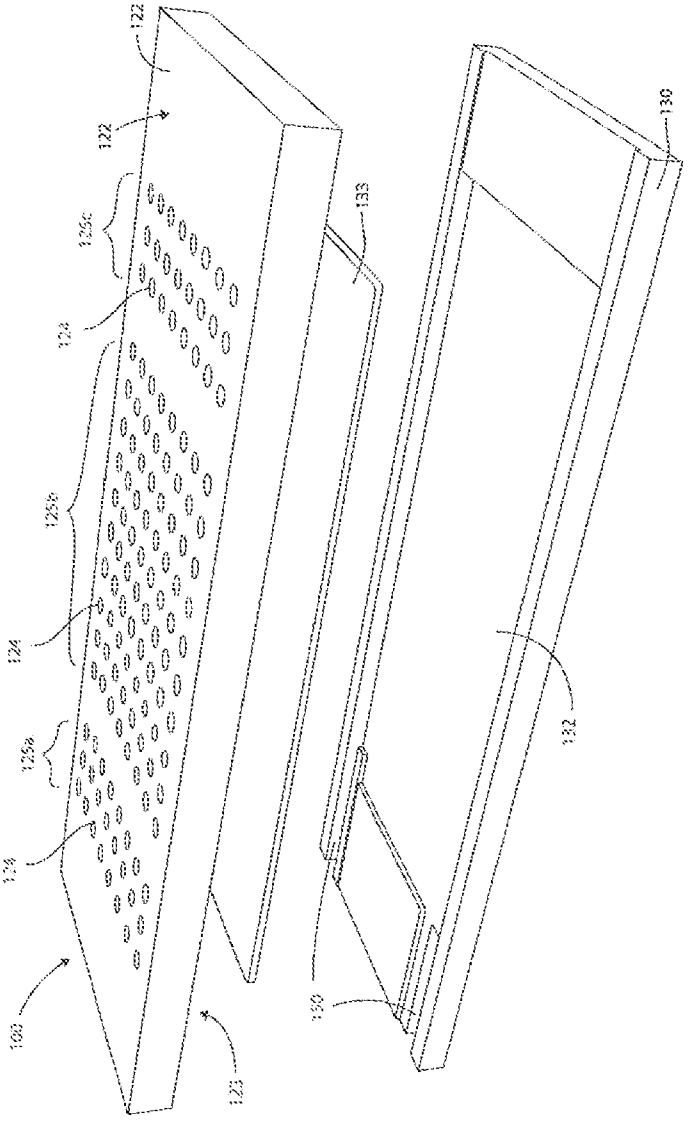


Figure 3

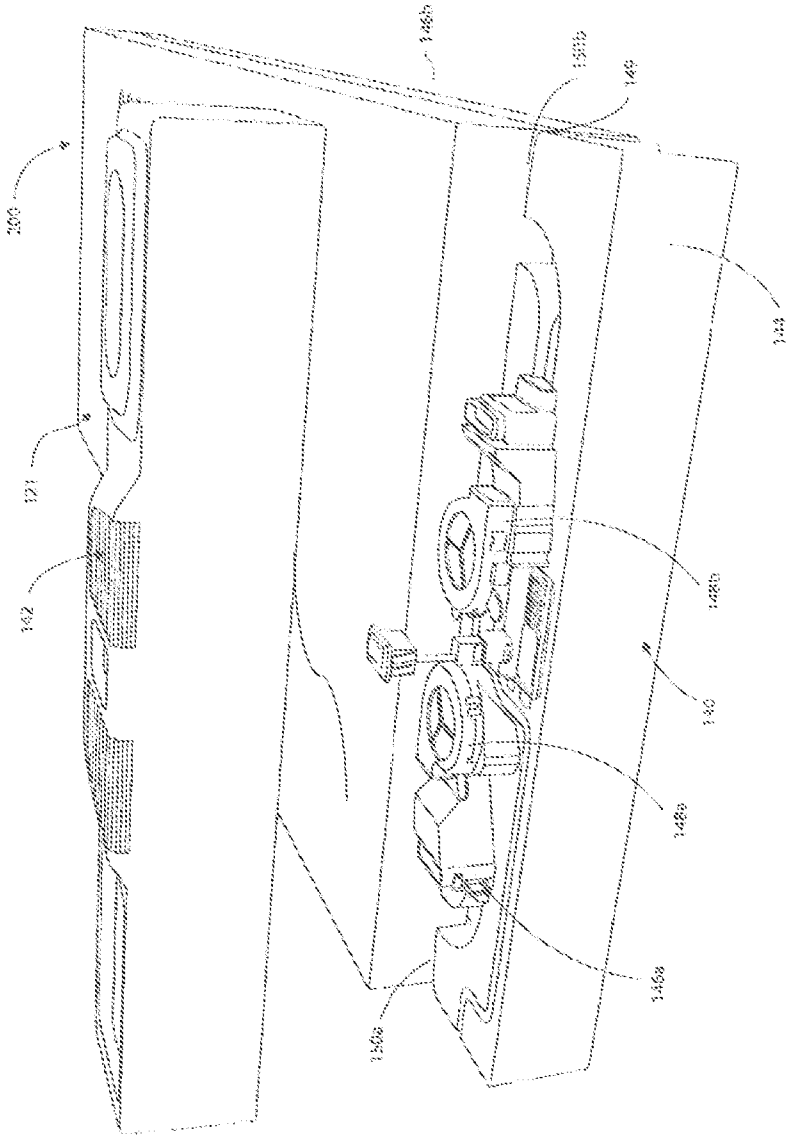
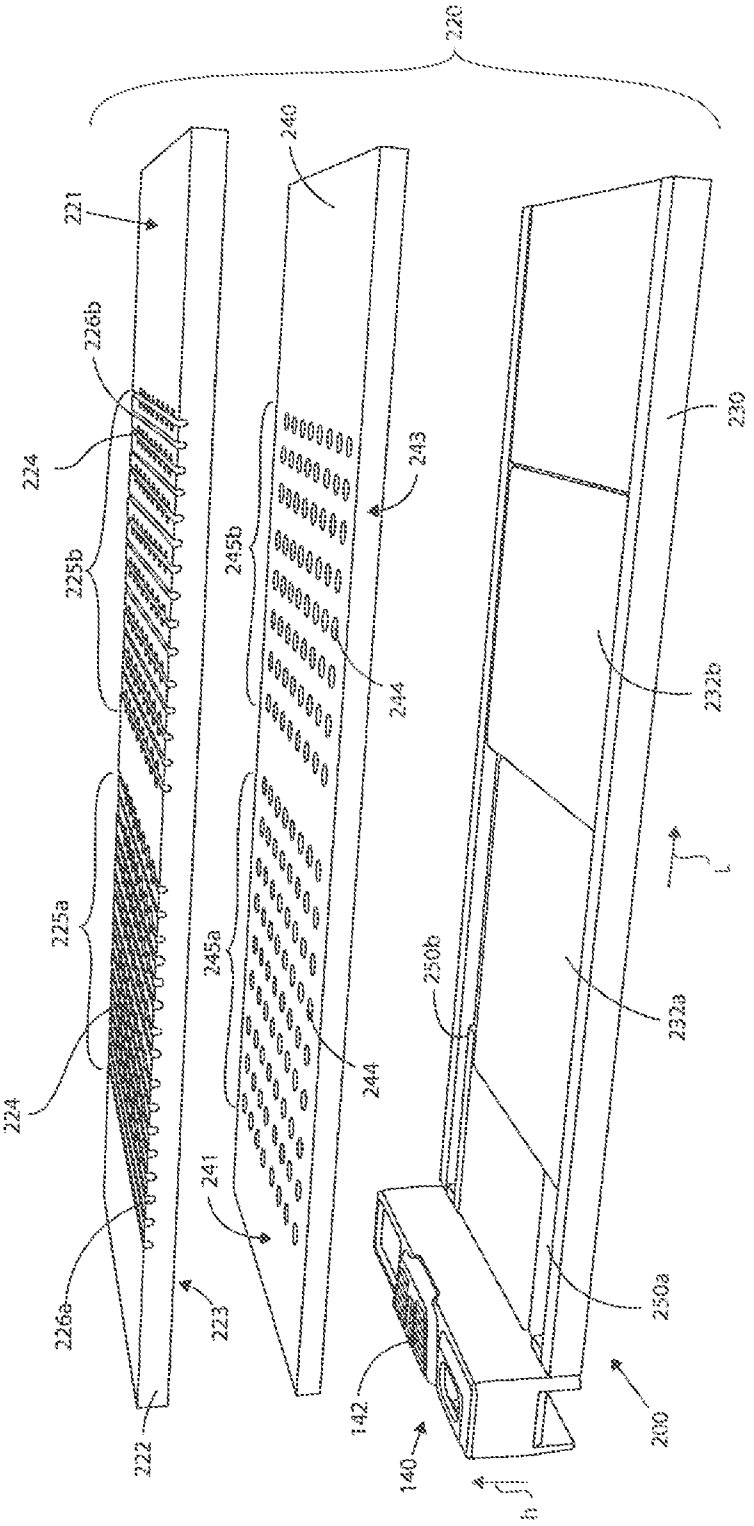


Figure 4


220
240
221
226b
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225b
245b
243
244
230
232b
225a
245a
224
244
241
230b
232a
226a
223
230a
222
142
140
200

Figure 5

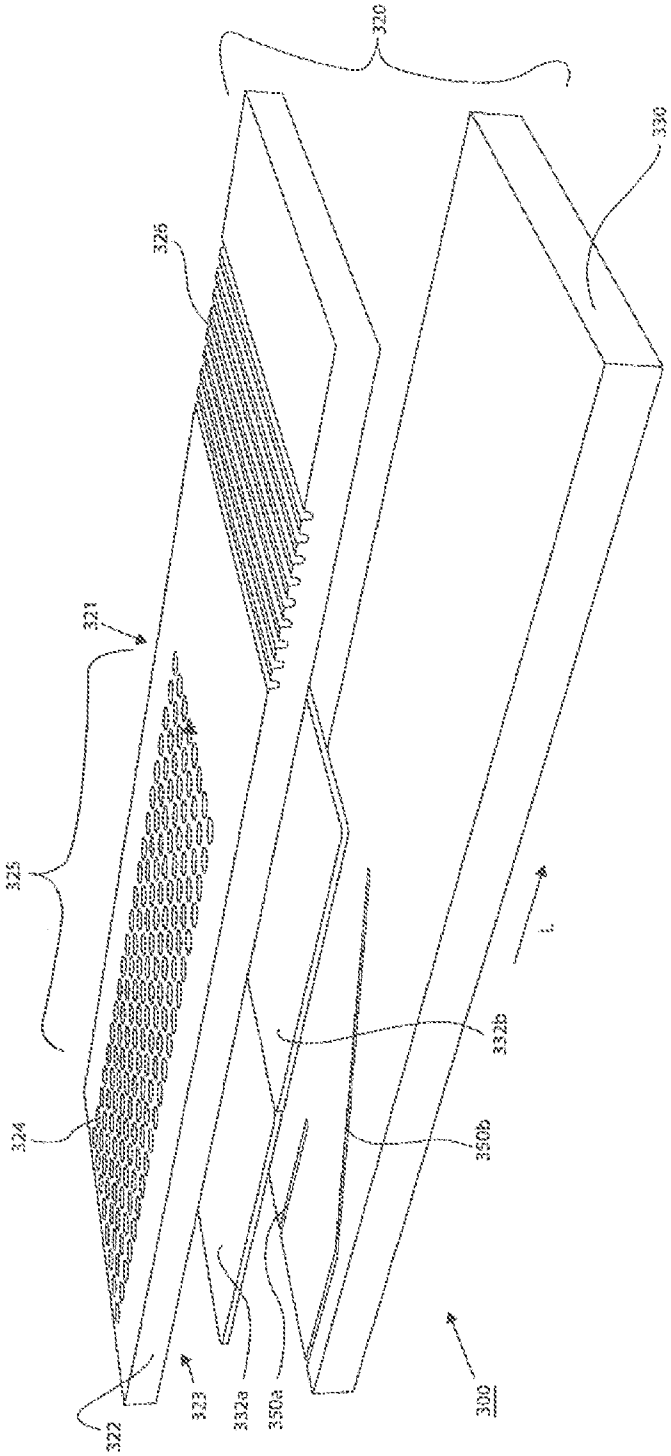

Figure 6

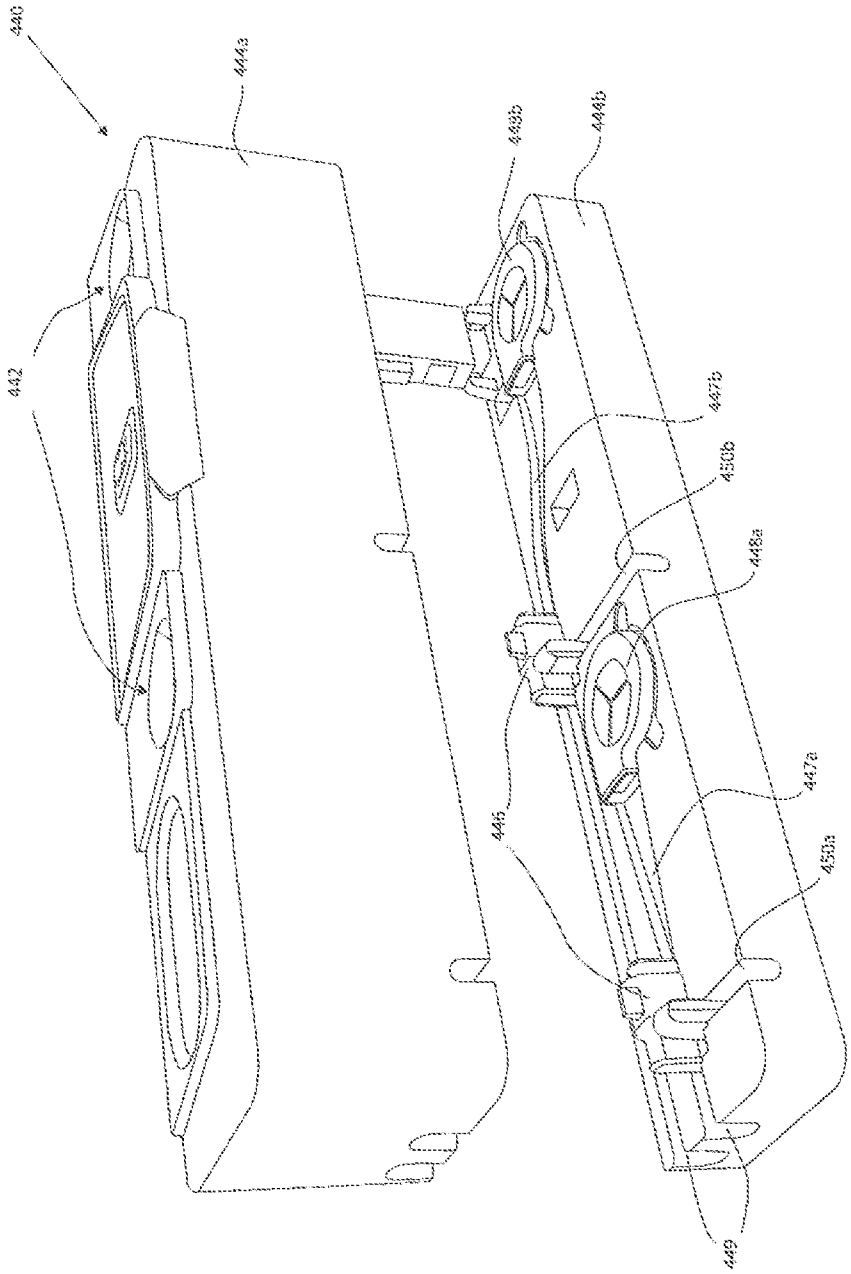

Figure 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/N L20 18/050777

A. CLASSIFICATION OF SUBJECT MATTER
I NV . A47C 17/80 A47C2 1/04 B62D33/06 B60H 1/00 A47C27/ 14
A47C27/ 15
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)
A47C B62D B60H

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 - I nterna l , WP I Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 9 756 952 B2 (BEDGEAR LLC [US]) 12 September 2017 (2017-09-12)	1-3,9, 11-15, 18,20-23
Y	column 2, line 39 - column 12, line 38; figures 1-19	24

X	US 2017/164757 A1 (THOMAS PETER M [US] ET AL) 15 June 2017 (2017-06-15)	1-3,6,7, 12-15, 18-23
Y	paragraphs [0048], [0049]; claims 19-21; figure 14	24

X	US 2010/011502 A1 (BRYKALSKI MICHAEL J [US] ET AL) 21 January 2010 (2010-01-21)	1-15, 20-23
Y	paragraph [0091] - paragraph [0308]; figures 1-32	24

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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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
2 April 2019	08/04/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kus, Slawomir

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2018/050777

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP H07 3403 U (-) 20 January 1995 (1995-01-20) paragraphs [0014], [0016]; figures 1,2 -----	24

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Information on patent family members

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