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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 November 2015 (19.11.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/174842 A1

(51) International Patent Classification:
B64D 11/06 (2006.01) *B60N 2/44* (2006.01)

(21) International Application Number:
PCT/NL2015/050343

(22) International Filing Date:
13 May 2015 (13.05.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2012814 14 May 2014 (14.05.2014) NL

(72) Inventors; and
(71) Applicants : **GRIJZENHOUT, Troy** [NL/NL]; Verzetslaan 107, NL-1318 BT Almere (NL). **RANACHOWSKI, Grzegorz** [PL/NL]; Meerlaan 9A, NL-1394 AA Nederhorst den Berg (NL). **DE MOOR, René** [NL/NL]; Heereweg 117, NL-2161 BA Lisse (NL).

(74) Agent: **NEDERLANDSCH OCTROOIBUREAU**; Anna van Buerenplein 21 a, 2595 DA The Hague (NL).

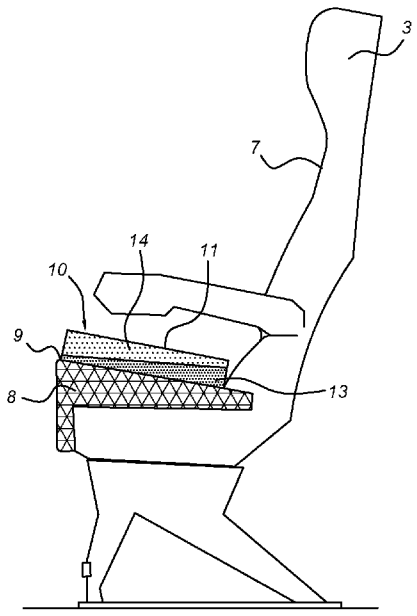
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, 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.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, 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, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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

(54) Title: ASSEMBLY OF TWO AIRCRAFT SEATS AND SEAT CUSHION FOR USE WITH THIS ASSEMBLY

Fig. 2



(57) Abstract: The invention relates to an aircraft seat assembly (1) comprising a spaced-apart front seat (2) and back seat (3), the front seat (2) comprising a first backrest (4) having a rearward face (5) and a first seat member (6), and the back seat (3) comprising a second backrest (7) and a second seat member (8) with a seat surface (9) for supporting a passenger; wherein a seat cushion (10) is disposed on the seat surface (9), the seat cushion (10) comprising a cushion seat surface (11) for supporting the passenger and a cushion contact surface (12) contacting the seat surface (9), wherein near the second backrest (7), when a passenger is seated on the seat cushion (10), the seat cushion (10) is configured for causing the cushion seat surface (11) to diverge with respect to the cushion contact surface (9) towards the second backrest (7).

WO 2015/174842 A1

Assembly of two aircraft seats and seat cushion for use with this assembly

Field of the invention

The present invention relates to an assembly of two aircraft seats and a seat cushion for use therewith is provided according to the preamble defined above. The aircraft seat assembly comprises two aircraft seats, a front seat and a back seat, spaced-apart in a longitudinal direction of the aircraft over a pitch distance, the front seat comprising a first backrest having a rearward facing leg zone and a first seat member, and the back seat comprises a second backrest and a second seat member with a seat surface for supporting a seated passenger, wherein a detachable seat cushion is disposed on the seat surface, the seat cushion comprising a cushion seat surface for supporting the passenger and a cushion contact surface contacting the seat surface.

Background of the invention

Cushions are generally known in the art. Such cushions are usually intended for providing a person sitting on it with a more comfortable seating position, such as on a couch, a car seat, et cetera. These cushions can of course also be provided to passengers aboard an aircraft to provide a more comfortable flight experience. Generally, such cushions elevate the passenger's pelvis basically causing his or her body to be elevated as a whole.

A disadvantage of such cushions is that, especially with tall people, the knees of the passenger will be elevated also, causing the knees to be pushed into the rearward facing leg zone of the first backrest. In relation thereto, it should also be noted that airlines generally seek to exploit aircraft with preferably low pitch distances, to be able to transport more passengers in a single aircraft. This proves to be particularly hard due to the abovementioned lack of space for the passenger's knees.

Another disadvantage is that, after supporting the passenger for a certain time, the cushion may be compressed more in the pelvis region thereof as compared to the more forward regions of the cushion, causing the passenger to experience lower back pain due to the passenger having an increasingly less hollow lower back.

Therefore, it is an object of the invention to provide an assembly of two aircraft seats, wherein a detachable seat cushion is disposed on the seat surface, wherein the pitch distance between the front and back seats can be decreased if desired.

It is a further object of the invention to enable the passenger to keep his or her lower back in an as hollow position as possible to improve passenger comfort especially on longer flights.

DE 101 49 029 A1 describes a seat cushion for supporting the upper legs of a person. This publication, however, does not seek to provide the person with a more hollow lower back.

US 4 755 411 A describes a generic foam cushion and a method to produce such a foam cushion. This publication does not in any way address the specific problems encountered by tall people sitting in an aircraft seat.

FR 2 609 702 A1 describes a cushion for improving the posture of a person sitting on a generic chair in a typical household situation, such as when the person sits at a kitchen table. This publication also does not relate to the situation as found in aircraft, where relatively small seat pitches and the like are to be dealt with. The same holds for DE 297 10 709 U1.

US 6 009 578 A describes a cushion for use in a wheelchair. Supporting a person sitting in a wheelchair concerns a situation totally different from a person to be supported in an aircraft seat. For instance, a wheelchair seat, and the cushion to be used therewith, is more geared towards allowing the person to move himself or herself by driving the wheels with his or her arms.

Summary of the invention

Thereto, the aircraft seat assembly according to the invention is characterized in that, near the second backrest, when a passenger is seated on the seat cushion, the seat cushion is configured for causing the cushion seat surface to substantially diverge with respect to the cushion contact surface in a direction towards the second backrest, wherein the angle of divergence is lower than 30^{o} and the thickness of the cushion near the second backrest is lower than 15 cm.

Thus, a seated passenger's pelvis is elevated and rotated forwards near the second backrest, thereby enabling an upper leg of the passenger to be supported by the seat cushion in a more horizontal or downward orientation. As a result, the passenger's knee is free from pressure points imposed by the rearward facing leg zone and the passenger's lower leg can be positioned below the first seat member of the front seat. This allows the pitch distance to be decreased, if desired. The smaller pitch distance

between two aircraft seats improves the overall economics of the seat arrangement whilst improving the ergonomics of a seated passenger. Also, a more pronounced anterior tilt of a passenger's pelvis is facilitated, hence providing the passenger with a more hollow lower back and a more active seating position.

Known aircraft seat assemblies tend to be adapted to an average passenger size according to anthropomorphic studies and research. However, in many cases the pitch distance between aircraft seats is not suitable for accommodating certain passengers, such as tall passengers. While seated, such a passenger tends to experience a high level of discomfort caused by knee and/or shin bone pressure points imposed by the front seat, as well as a pronounced posterior tilt of the pelvis causing back aches and difficulty breathing. There has thus been a long felt need to improve the overall economics of aircraft seat arrangements whilst providing and improving an ergonomically sound seating position for a wider range of passengers, especially for taller passengers. The aircraft seat assembly according to the invention provides this.

In an embodiment, the seat cushion comprises a cushion layer having an increasing thickness or a decreasing deformability in the direction towards the second backrest when no passenger is supported by the seat cushion. The increasing thickness or decreasing deformability of the cushion layer provides an anterior tilt of the pelvis and avoids backaches as well as breathing difficulties.

In an embodiment, the seat cushion comprises a substantially rectangular cross-section in a plane perpendicular to the floor and aligned with the longitudinal direction and an upper layer and a lower layer, wherein the cushion layer is formed by the lower layer and a thickness of the upper layer increases and a thickness of the lower layer decreases in a direction away from the second backrest. The upper layer is primarily adapted to meet requirements relating to passenger's seating comfort and stability, whereas the lower layer is primarily adapted to meet requirements relating to the seating posture, such as an anterior tilt or active seating position.

In an embodiment, the upper and the lower layer each comprise a substantially triangular cross section in the plane perpendicular to the floor and aligned with the longitudinal direction. The triangular cross section provides a gradual and progressive change in cushion characteristics and avoids sudden changes in compressibility and deformability. This embodiment therefore minimizes sudden changes in seating characteristics and circumvents that a seated passenger starts to develop pressure sores.

In view of the present invention, the term "compressibility" should be construed as meaning the Indentation Load Deflection (ILD) or Indentation Force Deflection (IFD), which are terms well-known to a person skilled in the art. The terms ILD and IFD may be used interchangeably and may provide an indication of firmness and level of seating comfort provided by the seat cushion. For example, a higher firmness (higher ILD) is often experienced as providing lower seating comfort, but is more useful for supporting larger loads, and a lower firmness (lower ILD) is often experienced as providing higher seating comfort.

In a further embodiment, the substantially triangular cross section of each of the upper and the lower layer is a substantially right-angled triangular cross section. It is important that the seat cushion can be used for many different aircraft seats, in particular with respect to a transition zone from the seat surface toward the backrest. Advantageously, the right-angled triangular cross sections of the upper and lower layer provide a snug fit of the seat cushion against the seat surface as well as the backrest, in particular the transition zone between the seat surface and a lower part of the backrest near the seat surface.

In an embodiment, the upper layer is of a first foam material and the lower layer is of a second foam material. If desired, however, the cushion can be made of a single homogenous layer of foam material. Alternatively, instead of a foam material, the use of other elastically deformable materials is also conceivable, such as solid elastomers or fiber structures.

Therein, the first and second foam material may have different densities. In a specific embodiment, the density of the second foam material lies between 60 and 90 kg/m3, and the density of the first foam material lies between 10 and 50 kg/m3.

In another embodiment, the first foam material has a higher compressibility than a compressibility of the second foam material. Having different compressibilities for the first and second foam material is particularly advantageous for meeting requirements relating to comfort as well as seating posture. The first foam material compressibility can be geared toward softness or deformability. The second foam material compressibility can be geared toward stiffness and seating height changes. The deformability of the first foam material provides a snug engagement of the seat cushion with a seated passenger. The compressibility or ILD of the foam material of the upper

layer and/or lower layer may be 100-500 N, more preferably 150-450 N, for instance 300 N, depending on the desired properties of the respective layer.

Safety in aircraft is a high priority issue. To that end there is an embodiment wherein the upper and the lower layer each comprise fire retardant material. Also, to avoid that a seated passenger slides from the aircraft sets during take off of landing, the lower layer may comprise anti-slip material for immobilising the seat cushion in a direction substantially parallel to the seat surface. The seat cushion will also be mobilised when subjected to general movements of a seated passenger.

Another embodiment relates to an aircraft seat assembly, wherein, when a passenger is seated on the seat cushion, the seat cushion is configured for causing the cushion seat surface to substantially converge with respect to the cushion contact surface in a direction away from the second backrest. The provides a cushion that fits well to the seat member below and allows the passenger's upper leg to pass smoothly over the forward region of the seat member.

In another embodiment, the cushion seat surface and the cushion contact surface converge in such a way that, when seen in the cross-sectional plane perpendicular to the floor and aligned with the longitudinal direction, an essentially wedge-shaped cushion is obtained when a passenger is seated on the seat cushion.

Preferably, the angle of convergence or the angle of divergence, lies between 2-25°, more preferably lies between 3-15°, most preferably is around 7° to allow the passenger to obtain optimal pelvis elevation and anterior tilt.

In a further aspect the present invention relates to a seat cushion for use in an aforementioned aircraft seat assembly, wherein the seat cushion can be detachably disposed on the seat surface, the seat cushion comprising a cushion seat surface for supporting the passenger and a cushion contact surface for contacting the seat surface, near the second backrest, wherein, when a passenger is seated on the seat cushion, the seat cushion is configured for causing the cushion seat surface to substantially diverge with respect to the cushion contact surface in a direction towards the second backrest, wherein the angle of divergence is lower than 30° and the thickness of the cushion near the second backrest is lower than 15 cm, preferably lower than 10 cm, such as approximately 9 cm. The advantages of the seat cushion of the present invention are identical to those for the aircraft seat assembly and the seat cushion used therewith.

Again, an embodiment relates to a seat cushion, comprising a stacked arrangement of an upper layer and a lower layer fixedly adjoined thereto, the upper layer being arranged for supporting a seated passenger, wherein a thickness of the upper layer increases and a thickness of the lower layer decreases in a direction away from the second backrest when no passenger is supported on the cushion.

In an embodiment, the upper and lower layer each comprise a substantially triangular cross section when seen in a cross-sectional plane perpendicular to the floor and aligned with the longitudinal direction for providing a gradual and progressive change of seat cushion characteristics, e.g. stiffness, deformability, compressibility etc. In a further embodiment, the substantially triangular cross section of each of the upper and the lower layer is a substantially right-angled triangular cross section. As disclosed above, the right-angled triangular cross sections of the upper and lower layer provide a snug fit of the seat cushion against a seat surface as well as a back rest, in particular a transition zone between the seat surface and a lower part of the backrest near the seat surface.

The upper layer can be of a first foam material and the lower layer can be of a second foam material. The first and second foam material may have different densities. Different densities of the first and second foam material allow to differentiate between layer characterising so as to meet seating requirements.

In another embodiment, the first foam material has a higher compressibility than a compressibility of the second foam material.

The compressibility or ILD of the foam material of the upper layer and/or lower layer may be 100-500 N, more preferably 150-450 N, for instance 300 N, depending on the desired properties of the respective layer.

It should be noted that from the international patent publication WO 03/059682 A2 a portable aircraft cushion is known that may be selectively used by passengers seated in standard aircraft seats to provide greater back, head, and neck support so that the passengers may sleep easier. In the preferred embodiment, the cushion comprises a lower body support section made of a plurality of transversely aligned, interconnected air chambers which are filled with air using a supplied pump or the aircraft air ventilation system. When inflated, the top air chambers in the body support section are positioned approximately level with the top edge of the seat when fully reclined. Located above the body support section is an inflatable head and neck support section

that extends above the top edge of the seat when inflated to support the user's head and neck. In the preferred embodiment, the head and neck support section comprises two lateral support chambers separated by non-inflating webbing material. During use, the body support section and the head and neck support sections are integrally formed so that when the passenger slowly sits back on the cushion air initially placed in the cushion is forced upward around the passenger's body and his or her neck and head.

However, the above assembly merely provides a portable, back and neck support cushion that can be selectively used with standard passenger aircraft seats with limited row spacing that positions and supports passengers in a more comfortable sleeping position when flying.

Short description of drawings

The present invention will be discussed in further detail hereinafter based on a number of exemplary embodiments with reference to the drawings, wherein:

Figure 1 shows an exemplary embodiment of assembly of two aircraft seats according to the present invention;

Figure 2 shows a detailed view of an embodiment of an aircraft seat assembly and seat cushion used therewith according to a present invention;

Figure 3a and 3b show detailed views of a seat cushion according to a present invention embodiment; and

Figure 4a and 4b show exemplary embodiments of pelvic seating positions according to an embodiment of the present invention.

Detailed description of exemplary embodiments

Figure 1 shows an exemplary assembly 1 of two aircraft seats 2, 3 according to a present invention embodiment. The assembly 1 comprises a front seat 2 and a back seat 3 spaced-apart in a longitudinal direction of an aircraft (not shown) over a pitch distance (L). In typical embodiments the front and back seat 2, 3 are of the known type. The pitch distance (L), also known as the “seat pitch”, is typically 75 to 82 cm for various economy class seating arrangements in aircraft around the world. The pitch distance (L) typically refers to the distance between a point on one seat (e.g. the back seat 3) and the same point on a seat in front of it (e.g. the front seat 2). The pitch

distance (L) may be an indicator for leg room, but it generally does not provide a direct measure as such, mostly because a back rest and thickness thereof may vary somewhat.

The front seat 2 comprises a first backrest 4 or first back support 4 having rearward facing leg zone 5, wherein the leg zone 5 is typically adapted for accommodating a knee 21 and lower leg 22 of a seated passenger in the back seat 3. The front seat 2 also comprises a first seat member 6. The back seat 3 comprises a second backrest 7 and a second seat member 8 with a seat surface 9 for supporting a seated passenger.

According to the present invention, the assembly further comprises a detachable seat cushion 10 disposed on the seat surface 9, wherein the seat cushion 10 comprises a cushion seat surface 11 for supporting the passenger and a cushion contact surface 12 contacting the seat surface 9. Near the second backrest 7, when a passenger is seated on the seat cushion 10, the seat cushion 10 is configured for causing the cushion seat surface 11 to substantially diverge with respect to the cushion contact surface 9 in a direction towards the second backrest 7. The angle of divergence is lower than 30^{o} and the thickness of the cushion 10 near the second backrest 7 is lower than 15 cm, such as 9 cm. The seat cushion 10 is thus configured for increasing a distance between the seat surface 11 and the cushion contact surface 9 in a direction towards the second backrest 7. In essence, the seat cushion 10 exhibits a wedge-like profile when subjected to a passenger's distributed seating load, wherein the width of the wedge increases in a direction toward the second backrest 7.

Increasing the diversion of the cushion seat surface 11 in a direction toward the second back rest 7 is surprisingly advantageous for improving the ergonomics of a seated passenger, typically taller passengers, such as a passenger having a total length of e.g. 190 centimetre or taller. Furthermore, near the second back rest 7 a seated passenger's pelvis is elevated and rotated such that an upper leg 20 of the passenger is supported by the seat cushion 10 in a more horizontal or downward orientation as depicted with the solid line in Figure 1. The passenger's knee 21 is lowered and the lower leg 22 can be positioned below the seat member 6 of the front seat 2 and displaced over a distance ΔX. In known seating positions as shown by the dashed line, pressure points 5a, 5b imposed by the rearward facing leg zone 5 on the knee 21 and/or lower leg 22 are often observed. The seat cushion 10 according to the invention eliminates these problems.

An additional advantageous effect of the aircraft seat assembly 1 and the seat cushion 10 used therewith, is that the overall economics of aircraft seat assemblies can now be improved without sacrificing ergonomics for seated passengers. That is, the pitch distance (L) may be further decreased without sacrificing an ergonomically sound seating position. Decreasing the pitch distance (L) increases the passenger carrying capacity of e.g. a commercial aircraft. As a result, aircraft utilization increases and flight costs per seated passenger decreases. The seat cushion 10 according to the invention elevates and rotates a passenger's pelvis for increasing an angle between the upper and lower leg 20, 22, hence lowering the knee 21 and allowing the lower leg 22 to be positioned further below the first seat member 6.

To further explain the effect of the inventive seat cushion seat 10, Figure 4a and 4b each show an exemplary embodiment of a pelvic seating position. The seat cushion 10 is configured for promoting an anterior tilt of a passenger's pelvis as shown in Figure 4a. The anterior tilt is sometimes referred to as an "active seating position", because it facilitates a "hollow" posture of the spinal cord which in turn improves breathing movements of the chest. Without the seat cushion 10, however, a posterior tilt as depicted in Figure 4b is commonly observed for taller passengers in an attempt to lower the knees 21 and to place the lower legs 21 below the first seat member 6 of the front seat 2. The posterior tilt often causes back aches as well as breathing difficulties as the chest cavity tends to collapse to a smaller volume in this pelvic position.

Figure 2 shows a detailed embodiment of the back seat 3 and the seat cushion 10 used therewith according to the present invention. In the embodiment shown, the seat cushion 10 comprises a cushion layer 13 having an increasing thickness or a decreasing deformability in the direction toward the second backrest 7 when no passenger is supported by the seat cushion 10. The increasing thickness and decreasing deformability facilitates elevation and (anterior) rotation of a passenger's pelvis once seated. This particular feature of the seat cushion 10 is rather counter-intuitive in view of tight cabin spaces of e.g. commercial aircraft. For example, instead of reclining a backrest 7 of a known aircraft seat 3 for gaining more leg room, the seat cushion 10 of the present invention elevates a seated passenger to acquire a more stretched posture of the upper and lower leg 20, 22 as depicted in Figure 1. Even though a passenger gains a higher seated position, known aircraft cabins do provide sufficient head room. Reclining the back seat 3 may therefore not be desirable at times when a seated

passenger wishes to e.g. eat or read in an active seating position. To acquire sufficient leg room, the aircraft seat assembly and the detachable seat cushion 10 used therewith provides the needed anterior tilt for doing so.

In the embodiment shown in Figure 2, the seat cushion 10 comprises a substantially rectangular cross section and an upper 14 and a lower layer 13, wherein the cushion layer 13 is formed by the lower layer 13 and a thickness of the upper layer 14 increases and a thickness of the lower layer 13 decreases in a direction of flight. In a typical embodiment the increase and decrease of thicknesses comprise a gradual increase and decrease of thicknesses. The gradual increase and decrease of the thicknesses of the upper 14 and lower layer 13 avoid concentrated pressure points on a seated passenger and maintain comfort.

In an advantageous embodiment, the upper and the lower layer 14, 13 each comprise a substantially triangular cross section. Each of the triangular cross sections provide a gradual change in deformability and thickness of each of the upper 14 and lower layer 13 for imposing an anterior tilt whilst maintaining a comfortable seating position free from concentrated pressure points. That is, the triangular cross sections of each of the upper 14 and lower layer 13 provide a gradual distributed pressure on a seated passenger for achieving anterior tilt of a passenger's pelvis whilst avoiding uncomfortable pressure points.

Commercial aircraft across the globe may use different aircraft seats, wherein flatness of the seat surface 9 and a transition angle between the seat surface 9 and backrest 7 may vary on an aircraft-to-aircraft basis. It is therefore desired to provide a detachable seat cushion 10 which can be used with a host of different aircraft seat assemblies. To that end, in an embodiment the substantially triangular cross section of each of the upper 14 and the lower layer 13 is a substantially right-angled triangular cross section. The right-angled triangular cross sections provide a substantial rectangular cross section of the seat cushion 10, wherein the rectangular cross section provides a snug fit of the seat cushion 10 on the seat surface 9 and against a backrest 7 of most aircraft seats.

In a further embodiment of the aircraft seat assembly 1, the upper layer 14 is made of a first foam material and the lower layer 13 is made of a second foam material. The first and second foam material may have different densities or compressibilities (ILD). Having different compressibilities for the first and second foam material makes

it possible to simultaneously satisfy criteria relating to seating stability and comfort as well as seating posture requirements, in particular the anterior tilt of a passenger's pelvis. For example, the compressibility of the first foam material can be adapted to meet requirements for seating stability and comfort whereas the second foam material can be adapted to meet requirements for seating posture, in particular anterior tilt. In an advantageous embodiment, the first and second foam material are foam materials for providing a snug engagement of the cushion seat surface 11 with a seated passenger as well as a snug engagement of the cushion contact surface 12. In an even further advantageous embodiment, in particular in view passenger comfort and seating stability, the first foam material is a visco-elastic material, "memory foam" and the like. Memory foam in particular is capable of providing a very snug and stable engagement under the influence body heat, thus wherein the cushion seat surface 11 is subjected to heat radiated from a seated passenger.

In view of the above, in an embodiment the density of the first foam material is higher than the lower layer material. The first foam material will in this embodiment respond faster to e.g. body heat radiated from a seated passenger than the second foam material. In a particular embodiment, the density of the first foam material lies between 60 and 90 kg/m3, and the density of the second foam material lies between 10 and 50 kg/m3.

In a further embodiment, the first foam material has a higher compressibility than a compressibility of the second foam material, so that the upper layer 14 adjusts its shape with respect to a seated passenger and wherein the second foam material exhibits less compressibility for providing a desired seating posture, in particular an anterior tilt of the passenger's pelvis.

From a safety point of view, in most embodiments the aircraft seat assembly, the upper and the lower layer 14, 13 each comprise a fire resistant or fire retardant material, thereby minimizing the possible development of a fire.

According to the present invention, the seat cushion 10 is a detachable seat cushion 10 that can be handed out to boarding passengers for those who request such a seat cushion. To ensure that the seat cushion 10 remains firmly positioned on the seat surface 9, the lower layer 13 comprises anti-slip material for immobilising the seat cushion 10 in a direction substantially parallel to the seat surface 9, which is advantageous during flight. Furthermore, also when a passenger wishes to recline the

back seat 7, the anti-slip material resists force components imposed by the seated passenger in a direction substantially parallel to the seat surface 9. In advantageous embodiments, the anti-slip material comprises hook-and-loop fasteners, such as "Velcro®". In a further embodiment, the anti-slip material is comprised by the second foam material, thus wherein the second materiel exhibits a high coefficient of friction.

Figure 3a and 3b show a top view and cross sectional view respectively of a seat cushion 10 according to present invention embodiments. The depicted arrows in these figures denotes the direction of flight in correspondence with the orientation of the aircraft seats 2, 3 shown in Figure 1 and 2.

Figure 3a shows a top view of the detachable seat cushion 10 of the present invention, comprising a cushion seat surface 11 for supporting a seated passenger. The seat cushion 10 further comprises a plurality of cushion sides 16, 17, 18, 19, in particular a front side 16 and a back side 17, the back side 17 being configured for providing a snug fit against the backrest 7. For an improved fit against the backrest 7, the seat cushion 10 may further comprise a plurality of transition sides 18a, 19a for providing a wedged engagement of the seat cushion 10 against the backrest 7, wherein the wedged arrangement provides lateral support for the seat cushion 10. The transition sides 18a, 19a further provide alignment of the seat cushion 10 with respect to the seat surface 9 of the back seat 7.

In an embodiment, the seat cushion 10 is a substantially rectangular seat cushion as seen from above in Figure 3a. In particular, the seat cushion 10 is in many embodiments a substantially square seat cushion 10. The seat cushion 10 comprises a width d_2 and length d_1, wherein the width d_2 and length d_1 may or may not be equal. Advantageously, the width d_2 and length d_1 may be adapted to provide a snug fit of the seat cushion 10 on the seat surface 9 and against the back rest 7 for a majority of aircraft seats used by (commercial) aircraft.

Figure 3b shows a cross sectional view of the seat cushion 10 for use with the aircraft seat assembly 1 according to a present invention embodiment. The seat cushion 10 comprises a stacked arrangement of an upper layer 14 and a lower layer 13 fixedly adjoined thereto, for example by means of gluing and/or welding, fusing and so forth. The upper layer 14 is arranged for supporting a seated passenger. Further, the seat cushion 10 comprises a substantially rectangular cross section and wherein a thickness of the upper layer 14 increases and a thickness of the lower layer decreases in a

direction of flight. The decreasing thickness of the lower layer 13 provides a progressive elevation of a seated passenger toward the backrest 7, yielding an anterior tilt of the pelvis. The increasing thickness of the upper layer 14 provides a progressively increasing compressibility in the direction of the popliteal area of a seated passengers, thereby providing a lowered position of a passenger's knee and hence a downward sloping upper leg from the knee to the pelvis. As a result, the use of the seat cushion 10 with the aircraft seat assembly 1 also the pitch distance (L) to be lowered whilst improving the ergonomics of the seating position of a passenger

In an embodiment, the upper and the lower layer 14, 13 each comprise a substantially triangular cross section. The triangular cross section of the upper layer 14 provides a progressively increasing thickness in the direction of flight, and the triangular cross section of the lower layer 13 provides a progressively decreasing thickness of the lower layer 13 in the direction of flight. The triangular cross sections further avoid pressure points along the length d_1 of the seat cushion 10, so that a seated passenger experiences a comfortable pressure distribution on the upper legs.

In an embodiment, the triangular cross section of the upper layer 14 is a substantially mirror image of the triangular cross section of the lower layer 13, wherein the upper layer 14 and lower layer 13 are in a stacked arrangement and mutually connected through an internal sloping surface 15. In an embodiment, the substantial triangular cross section of each of the upper 14 and lower layer 13 is a right-angled triangular cross section. In this embodiment, as depicted in Figure 3b, the internal sloping surface 15 comprises the hypotenuse of each of the right-angled triangular cross section of the upper 14 and lower layer 13.

Completely analogous to the disclosure of the seat cushion 10 used with the aircraft seat assembly 1, the upper layer 14 is made of a first foam material and the lower layer 13 is made of a second foam material, wherein the first and second foam material have different densities or compressibilities. In a further embodiment, the first foam material has a higher compressibility than a compressibility of the second foam material. The higher compressibility of the first foam material is geared toward satisfying requirements related to comfort and seating stability, whereas the lower compressibility of the second foam material with respect to the first foam material is geared toward satisfying requirements relating to seating posture, in particular the anterior tilt of the pelvis.

CLAIMS

1. Aircraft seat assembly (1), comprising two aircraft seats, a front seat (2) and a back seat (3), spaced-apart in a longitudinal direction of the aircraft over a pitch distance (L),
the front seat (2) comprising a first backrest (4) having a rearward facing leg zone (5) and a first seat member (6), and the back seat (3) comprising a second backrest (7) and a second seat member (8) with a seat surface (9) for supporting a seated passenger; wherein a detachable seat cushion (10) is disposed on the seat surface (9), the seat cushion (10) comprising a cushion seat surface (11) for supporting the passenger and a cushion contact surface (12) contacting the seat surface (9), **characterized in that**
near the second backrest (7), when a passenger is seated on the seat cushion (10), the seat cushion (10) is configured for causing the cushion seat surface (11) to substantially diverge with respect to the cushion contact surface (9) in a direction towards the second backrest (7), wherein the angle of divergence is lower than 30^{o} and the thickness of the cushion (10) near the second backrest (7) is lower than 15 cm.

2. Aircraft seat assembly (1) according to claim 1, wherein the seat cushion (10) comprises a cushion layer (13) having an increasing thickness or a decreasing deformability in the direction towards the second backrest (7) when no passenger is supported by the seat cushion (10).

3. Aircraft seat assembly (1) according to claim 1 or 2, wherein the seat cushion (10) comprises a substantially rectangular cross-section in a plane perpendicular to the floor and aligned with the longitudinal direction, and an upper layer (14) and a lower layer (13), wherein the cushion layer (13) is formed by the lower layer (13) and a thickness of the upper layer (14) increases and a thickness of the lower layer (13) decreases in a direction away from the second backrest (7).

4. Aircraft seat assembly (1) according to claim 3, wherein the upper and the lower layer (13, 14) each comprise a substantially triangular cross-section in the plane perpendicular to the floor and aligned with the longitudinal direction.

5. Aircraft seat assembly (1) according to claim 4, wherein the substantially triangular cross-section of each of the upper and lower layer (13, 14) is a substantially right-angled triangular cross section.

6. Aircraft seat assembly (1) according to any one of claims 3-5, wherein the upper layer (14) is of a first foam material and the lower layer (13) is of a second foam material.

7. Aircraft seat assembly (1) according to claim 6, wherein the first and second foam material have different densities.

8. Aircraft seat assembly (1) according to claim 6 or 7, wherein the compressibility of the first foam material is higher than the compressibility of the second foam material.

9. Aircraft seat assembly (1) according to any one of claims 6-8, wherein the density of the second foam material lies between 60 and 90 kg/m3, and the density of the first foam material lies between 10 and 50 kg/m3.

10. Aircraft seat assembly (1) according to claim 8 or 9, wherein the compressibility (ILD) of the upper layer and/or lower layer is 100-500 N, more preferably 150-450 N, for instance 300 N.

11. Aircraft seat assembly (1) according to any one of claims 1-10, wherein the upper and the lower layer (14, 13) each comprise fire retardant material.

12. Aircraft seat assembly (1) according to any of claims 1-11, wherein the lower layer (13) comprises anti-slip material for immobilising the seat cushion (10) in a direction substantially parallel to the seat surface (9).

13. Aircraft seat assembly (1) according to any of the preceding claims, wherein, when a passenger is seated on the seat cushion (10), the seat cushion (10) is configured

for causing the cushion seat surface (11) to substantially converge with respect to the cushion contact surface (9) in a direction away from the second backrest (7).

14. Aircraft seat assembly (1) according claim 13, wherein the cushion seat surface (11) and the cushion contact surface (9) converge in such a way that, when seen in the cross-sectional plane perpendicular to the floor and aligned with the longitudinal direction, an essentially wedge-shaped cushion (10) is obtained when a passenger is seated on the seat cushion (10).

15. Aircraft seat assembly (1) according any one of the preceding claims, wherein, when dependent on claim 14, an angle of convergence, or, when dependent on any of the preceding claims, the angle of divergence, lies between 2-25°, more preferably lies between 3-15°, most preferably is around 7°.

16. Seat cushion (10) for use in an aircraft seat assembly (1) according to any one of the preceding claims, wherein the seat cushion (10) can be detachably disposed on the seat surface (9), the seat cushion (10) comprising a cushion seat surface (11) for supporting the passenger and a cushion contact surface (12) for contacting the seat surface (9), near the second backrest (7), wherein, when a passenger is seated on the seat cushion (10), the seat cushion (10) is configured for causing the cushion seat surface (11) to substantially diverge with respect to the cushion contact surface (9) in a direction towards the second backrest (7), wherein the angle of divergence is lower than 30° and the thickness of the cushion (10) near the second backrest (7) is lower than 15 cm.

17. Seat cushion (10) according to claim 16, comprising a stacked arrangement of an upper layer (14) and a lower layer (13) fixedly adjoined thereto, the upper layer (14) being arranged for supporting a seated passenger, wherein a thickness of the upper layer (14) increases and a thickness of the lower layer (13) decreases in a direction away from the second backrest (7) when no passenger is supported on the cushion (10).

18. Seat cushion (10) according to claim 17, wherein the upper and lower layer (14, 13) each comprise a substantially triangular cross section when seen in a cross-sectional plane perpendicular to the floor and aligned with the longitudinal direction.

19. Seat cushion (10) according to any one of claims 17-18, wherein the upper layer (14) is of a first foam material and the lower layer (13) is of a second foam material.

20. Seat cushion (10) according to claim 19, wherein the first and second foam material have different densities.

21. Seat cushion (10) according to claim 19 or 20, wherein the first foam material has a higher compressibility than a compressibility of the second foam material.

Fig. 1

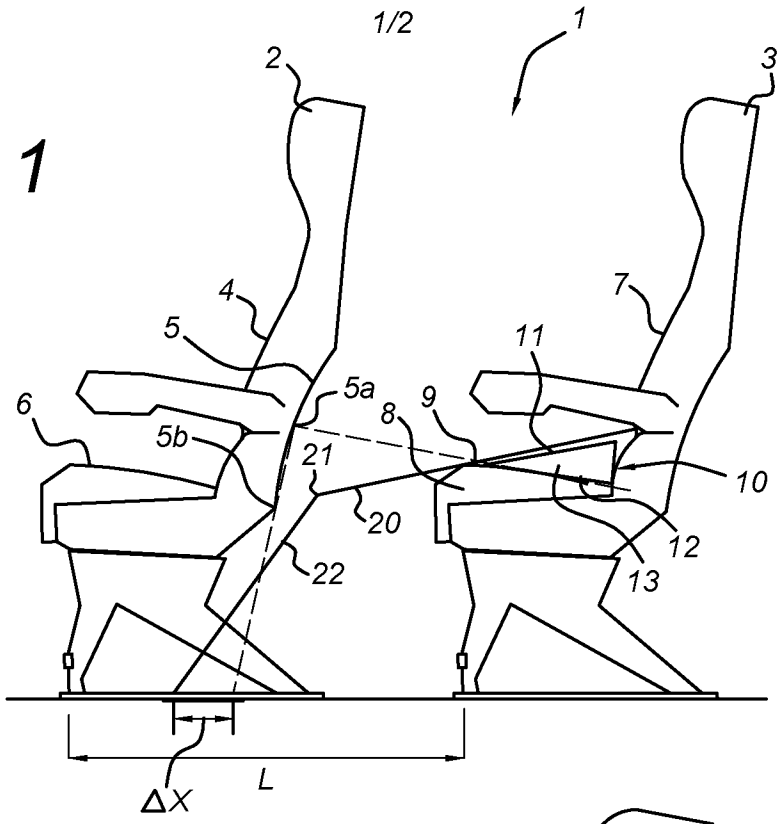


Fig. 2

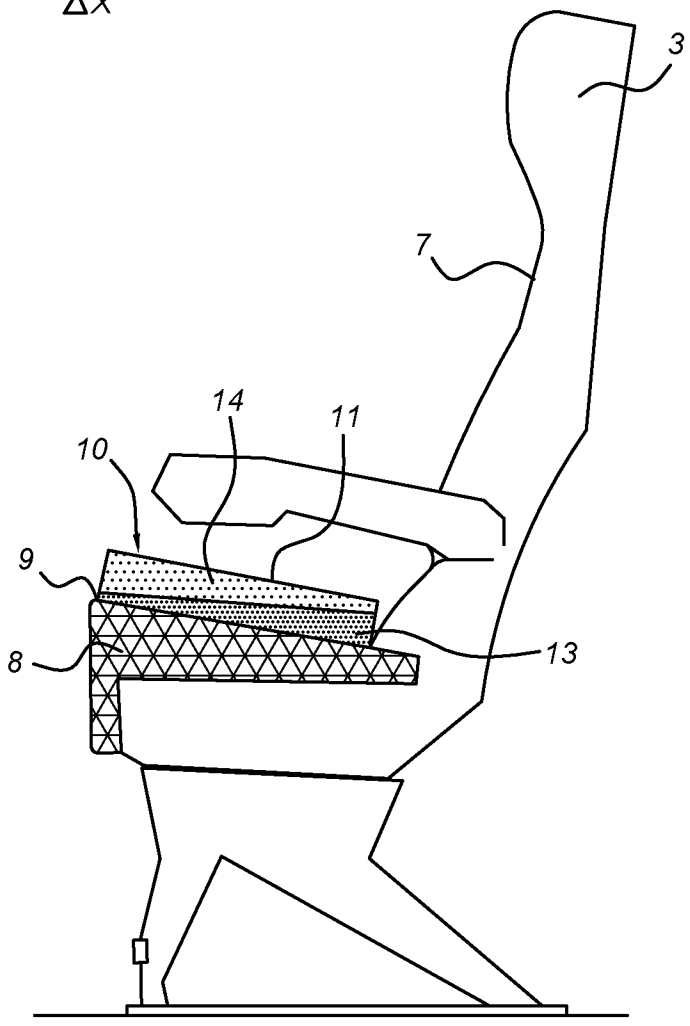


Fig. 3a

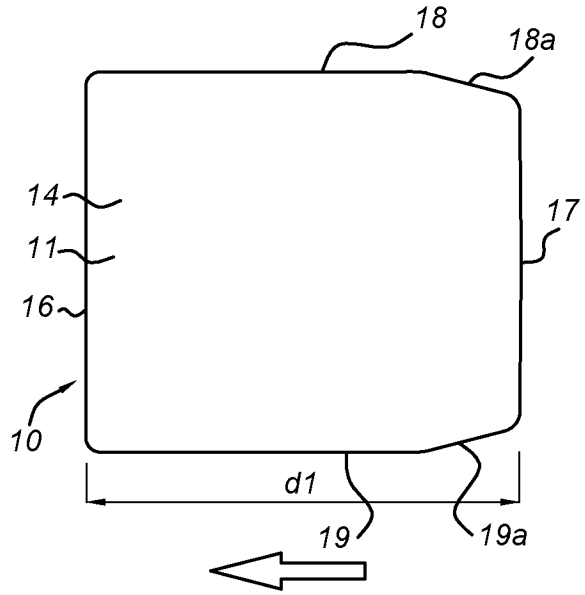


Fig. 3b

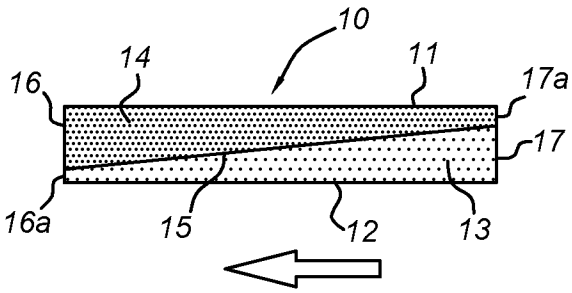


Fig. 4a

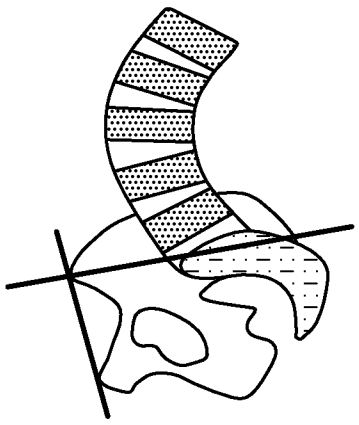
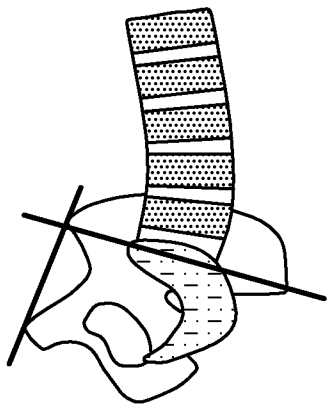


Fig. 4b



INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2015/050343

A. CLASSIFICATION OF SUBJECT MATTER
INV. B64D11/06 B60N2/44
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)
B64D B60N A47C

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 101 49 029 A1 (METZELER SCHAUM GMBH [DE]) 24 April 2003 (2003-04-24) paragraphs [0005] - [0007], [0009] - [0011], [0015] - [0017], [0030] - [0033]; figures 1b,3a,3b,3c	1-21
X	US 4 755 411 A (WING WILLIAM W [US] ET AL) 5 July 1988 (1988-07-05) column 4, lines 28-34; figure 22 column 6, line 30 - column 7, line 2	16-21
X	FR 2 609 702 A1 (KOGAN HENRY [FR]) 22 July 1988 (1988-07-22) the whole document	16

-/--

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

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 August 2015	12/08/2015

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	Dorpema, Huijb

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2015/050343

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 297 10 709 U1 (MEINHARDT MICHAEL [DE]) 14 August 1997 (1997-08-14) page 3, paragraph 6 - last paragraph; figures 1,2 -----	16
X	US 6 009 578 A (DAVIS STEVE [US]) 4 January 2000 (2000-01-04) figure 2 -----	16

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2015/050343

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10149029 A1	24-04-2003	DE 10149029 A1	24-04-2003
		DE 20122931 U1	12-08-2010
US 4755411 A	05-07-1988	CA 1306554 C	18-08-1992
		DE 3882071 D1	05-08-1993
		EP 0287903 A2	26-10-1988
		JP H01164309 A	28-06-1989
		US 4755411 A	05-07-1988
FR 2609702 A1	22-07-1988	NONE	
DE 29710709 U1	14-08-1997	NONE	
US 6009578 A	04-01-2000	NONE	