



(43) International Publication Date
26 November 2015 (26.11.2015)

(51) International Patent Classification:
A42B 3/06 (2006.01)

(21) International Application Number:

PCT/IB2015/053735

(22) International Filing Date:

21 May 2015 (21.05.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1409041.9 21 May 2014 (21.05.2014) GB

(71) Applicant: **LEATT CORPORATION** [US/US]; 26320 Diamond Place, Unit 30, Santa Clarita, California 91350 (US).

(72) Inventor; and

(71) Applicant (*for NA only*): **LEATT, Christopher James** [ZA/ZA]; Leatt Corporation, 50 Kiepersol Close, Atlas Gardens, 7550 Durbanville (ZA).

(72) Inventors: **KEEVY, Pieter André**; Leatt Corporation, 50 Kiepersol Close, Atlas Gardens, 7550 Durbanville (ZA). **STEFFENS, Jörn Peter**; Henkenweg 27, 26135 Oldenburg (DE).

(74) Agent: **TRUTER, Kenneth Colin**; Brian Bacon Inc., 2nd Floor, Mariendahl House, Newlands on Main, Main Road, 7700 Newlands (ZA).

(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: HELMET

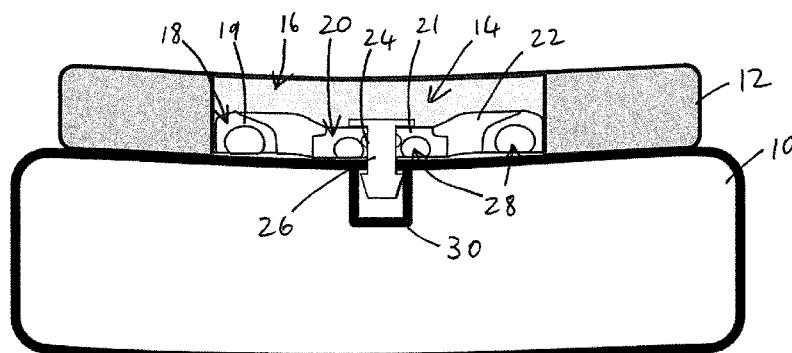


FIGURE 4

(57) Abstract: A helmet comprises an outer shell, an impact absorbing liner (10) inside the outer shell to receive loads from the outer shell and an inner liner (12) disposed inside the impact absorbing liner (10), with the inner liner (12) configured to slide relative to the impact absorbing liner (10). The inner liner (12) defines a number of apertures (16) and a deflector (14) inside each aperture. Each deflector (14) comprises: a body (20) that is connectable to the impact absorbing liner (12); a peripheral border (18) that is connectable to the aperture (16) in which it is received; and a number of deformable spokes (22) extending between the body (20) and the border (18).



WO 2015/177747 A1

HELMET

FIELD OF THE INVENTION

- 5 This invention relates to protective helmets intended to protect the head against linear and rotational impacts.

BACKGROUND TO THE INVENTION

- Most protective helmets comprise a durable, hard outer shell that can receive
10 impacts and an energy absorbing liner that is intended to dissipate energy from an impact received on the outer shell, before transferring it to the wearer's head. These conventional helmets provide reasonably good protection against impacts that could result in linear cranial acceleration, but impacts that are poorly aligned with the
15 centre of gravity of the wearer's head (that often impact the helmet at an oblique angle) can still result in substantial rotational cranial acceleration and consequential brain injury and concussion. Further, the impacts may be severe or they may be moderate and repetitive and the injuries resulting from repetitive brain injury often go unnoticed initially, until their cumulative effect is severe. Also, while conventional helmets provide reasonably good protection against severe linear impacts, they are
20 typically not designed to protect the head against moderate (e.g. low speed) impacts, which could cause brain injury from a single instance or through repetition.

- Helmets that are intended to protect a wearer against linear and rotational cranial acceleration have been proposed in US 2012/0198604, including a relatively hard
25 outer shell, an outer liner inside the outer shell and an inner liner, spaced inside the outer liner, with various resilient elastomeric isolation dampers extending between the inner and outer liners, to absorb omnidirectional loads between the two liners.

- The present invention seeks to provide an improved helmet which protects a
30 wearer's head against linear and rotational impacts, including improved protection against linear, low speed impacts.

SUMMARY OF THE INVENTION

According to the present invention there is provided a helmet comprising:

an outer shell;

an impact absorbing liner disposed inside the outer shell and connected in a load

5 transferring manner to the outer shell to receive loads from the outer shell;

an inner liner disposed inside the impact absorbing liner, said inner liner being

configured to slide relative to the impact absorbing liner and said inner liner

defining at least one receiving formation, but preferably plurality of apertures;

and

10 at least one deflector comprising: a body that is connectable to the impact
absorbing liner; a border along at least part of the deflector's periphery, said
border being connectable to one of the receiving formations of the inner liner;
and at least one deformable element extending between the body and the
border.

15

The term "connected" is intended to include any arrangement in which the impact
absorbing liner can receive loads from the outer shell and it is not limited to contact,
attachment, linkage, or any other limitation.

20 The term "aperture" is intended to include any form of recess in the inner liner, in
which a deflector is receivable, at least in part.

One or more (preferably all) of the receiving formations may be apertures defined in
the inner liner and one or more (preferably all) of the deflectors may be connectable

25 to the apertures by fitting inside the apertures

The deformable elements may include a plurality of deformable spokes extending
between the body and the border and at least some of the spokes may be curved
and/or may extend in a spiral configuration between the body and the border.

30

At least some of the deflectors may be of a non-Newtonian material preferably a
shear thickening or dilatant material.

At least some of the deflectors may define a shell extending between the impact absorbing liner and the inner liner and the shell may be at least partly collapsible and may extend at least partly around a cavity defined in the deflector.

5

The bodies of at least some of the deflectors may be releasably connectable to the impact absorbing liner and/or may be connectable to the impact absorbing liner by way of anchor formations that extend, at least in part, into the impact absorbing liner.

10 BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show how it may be carried into effect, the invention will now be described by way of non-limiting example, with reference to the accompanying drawings in which:

- 15 Figure 1 is an inside view of a deflector according to the present invention;
Figure 2 is a sectional side view of the deflector of Figure 1, taken at II-II;
Figure 3 is an outside view of the deflector of Figure 1;
Figure 4 is a detail sectional view through part of an impact absorbing liner, part of an inner liner, and the deflector of Figure 1;
- 20 Figure 5 shows diagrammatic sectional and outside views of part of an impact absorbing liner and a deflector according to the present invention, before impact and while receiving tangential impact loads from opposing directions;
Figure 6 shows a bottom view of an impact absorbing liner and deflectors according to the present invention, including deflectors hidden by part of the impact
- 25 absorbing liner;
Figure 7 shows a front view of the impact absorbing liner and deflectors of Figure 6, including deflectors hidden by part of the impact absorbing liner;
Figure 8 shows a side view of the impact absorbing liner of Figure 6, with deflectors of the lower ring;
- 30 Figure 9 shows an exploded sectional side view of a kit for installing a deflector on an impact absorbing liner according to the present invention;
Figure 10 shows a sectional view of the deflector of Figure 9 installed on the impact

absorbing liner; and

Figure 11 shows a profile view of a mounting washer of the kit of Figure 9.

DETAILED DESCRIPTION OF THE DRAWINGS

5 Referring to the drawings, a helmet according to the present invention includes: an outer shell of tough, durable material (not shown); an impact absorbing liner generally designated by reference number 10; an inner liner, which in the illustrated example it is a comfort liner, generally designated by reference number 12; and a plurality of deflectors, generally designated by reference number 14, with suffixes to
10 distinguish between different deflectors, where relevant. It is possible for the helmet to have any number of deflectors 14 – even only one, but preferably, the helmet includes a plurality of spaced deflectors.

The impact absorbing liner 10 can be of any suitable material that can absorb impact
15 energy, such as expanded polystyrene (EPS) and it extends directly inside the outer shell. The impact absorbing liner 10 can be attached to the outer shell (e.g. with releasable attachment), it can be held in place by complementary geometries of these components, or it can be held in place inside the outer shell in any other way, but it is preferably attached to the inside of the outer shell by being moulded inside
20 the outer shell. The outer shell and impact absorbing liner 10 are configured so that the energy from impacts received on the outer shell are dissipated in part, in the impact absorbing liner, before the impact is transferred to the head of a wearer of the helmet – much as in conventional helmets.

25 The comfort liner 12 extends along the inside of the impact absorbing liner 10, preferably in direct contact, but is not attached to the impact absorbing layer and can slide relative to it. Instead of the comfort liner 12, in other embodiments of the invention, the inner liner can be of any material, but the comfort liner 12 is of soft compressible material, such as soft foam that is soft enough to fit comfortably on the
30 wearer's head. In a preferred embodiment, relative sliding motion between the impact absorbing liner 10 and comfort liner 12 is improved by choice of materials, slip washers provided between these components, or the like.

The comfort liner 12 includes one or more receiving formations for connecting to the deflectors and in the illustrated embodiment, the receiving formations are in the form of apertures 16 that are defined in the comfort liner 12 and in the preferred
5 embodiment, each of the apertures has a circular profile and extends through the comfort liner, with a diameter similar to the outer diameter of a deflector 14. In other embodiments, the apertures defined in the inner liners can be in the form of recesses that do not extend through the comfort liner, or the comfort liner could include other forms of receiving formations such as protuberances, grip formations,
10 adhesive or gripping material, or the like.

Referring in particular to Figures 1-3, in a first preferred embodiment, each deflector 14 is generally disc shaped and is a unitary injection moulding of a non-Newtonian, shear thickening (dilatant) material.

15

Each deflector 14 has a central body in the form of a hub 20 and a border 18 extending around its circumference, with a number of deformable elements in the form of curved spokes 22 extending between the hub and border in a spiral configuration. In the illustrated embodiment, each of the spokes 22 has an
20 elongated cross-sectional profile and can flex with relative ease if the hub 20 moves relative to the border 18. In other embodiments of the invention can include differently configured deformable elements instead or, or in addition to the spokes 22, which also extend flexibly between the body and the border.

25 A central passage 24 is defined in the hub 20, through which an anchor formation in the form of a pin 26 can pass.

In the illustrated embodiment, the hub 20 and border 18 are each of a hollow design, comprising partly collapsible shells 19,21 around open internal cavities 28, which
30 allow the hub and border to be compressed, when the shells collapse to any degree. When the hub 20 and border 18 are compressed, the spokes 22 also flex or twist, so that the whole deflector 14 is compressible. The shear-thickening properties of the

material from which the deflector 14 is made, allows it to be compressed with relative ease when not exposed to impacts (e.g. during normal use of the helmet), but if it receives a compression impact, e.g. from a linear impact exerted on the outer shell of the helmet, the deflector offers more resistance to compression. The hollow (U-shaped) profile of the shells 19,21 of the hub 20 and border 18 allows these features to collapse under pressure and expand sideways, which allows the spokes 22 more freedom to stretch and allow movement between the hub and border.

- 10 Referring to Figure 4, each deflector 14 is attached to the impact absorbing liner 10 by the pin 26 that is received in a recess inside the impact absorbing liner. Preferably, the recess in the impact absorbing liner 10 is lined with a basket 30 in which the end of the pin 26 is receivable in a clipping manner – holding the deflector firmly 14 in place, but allowing it to be removed and/or replaced, if necessary. In other embodiments, an attachment formation similar to the pin 26 may be integrally formed with the deflector 14 or the deflector may be attached to the impact absorbing liner 10 by other means, such as partially embedding it in the impact absorbing liner during moulding (of the impact absorbing liner).
- 20 The border 18 of the deflector 14 fits snugly inside the circumference of the aperture 16 and in the illustrated embodiment has a thickness that is substantially less than the thickness of the comfort liner 12. In one embodiment, the deflector 14 has a thickness of about 5mm and a diameter of about 26mm.
- 25 Various configurations of the comfort liner 12 and deflectors 14 are possible in other embodiments of the invention. For example, the comfort liner 12 could define open apertures in which the deflectors 14 are received (as in the illustrated embodiment), with the deflectors exposed, the deflectors could be flush or protrude on the inside of the comfort liner (if this does not create discomfort), or the comfort liner could receive the deflectors in blind recesses and cover the deflectors on the inside of the helmet. In other embodiments of the invention, the deflectors 14 could connect the comfort liner 12 with the impact absorbing liner 10; the deflectors could replace the
- 30

comfort liner; the deflectors could be integrated (e.g. injected) into the comfort liner; or the deflectors could be in-layered (during the in-moulding process) in the impact absorbing liner.

- 5 Referring to Figure 5: sectional and outside views of two deflectors are shown, numbered as 14.1, 14.2 and 14.3, each anchored in the impact absorbing liner 10 and received in the comfort liner 12. The deflector 14.1 on the left in each view has not been subjected to any force and is in its original shape, but the deflectors 14.2 and 14.3 in the centre and on the right in each view, have been subjected to forces 10 32 in tangential directions. The tangential forces 32 caused the borders 18.2 and 18.3 of the deflectors 14.2 and 14.3 to be displaced relative to their hubs 20.2 and 20.3 and caused their spokes 22.2 and 22.3 to be deflected by the relative displacement of the borders.
- 15 The deflection of the spokes 22 and the relative displacement of the border 18 relative to the hub 20 results partly from the geometry of the deflector 14 (particularly the spokes) and partly from the resilient deformability of the non-Newtonian material of the deflector 14.2.
- 20 Referring to Figures 6 to 8, the positions of the deflectors 14 relative to the impact absorbing layer 10 are shown and include three deflectors in an upper ring and six deflectors in a lower ring, disposed on an imaginary profile resembling the profile of a human head. The deflectors 14 in the upper ring include two front deflectors 14a and a rear deflector 14b. The deflectors in the lower ring includes a rear deflector 25 14c, of a lower ring of deflectors, with the deflector 14c disposed about midway between the deflector 14b and the base 34 of the impact absorbing liner 10. The other deflectors in the lower ring include a front deflector 14d and two lateral deflectors 14e on each side of the helmet. The positioning of the deflectors 14 is intended to provide an even distribution of rotational/tangential forces transferred 30 between the impact absorbing liner 10 and comfort liner 12 by the deflectors 14, as will be described below. However, this distribution of the deflectors 14 is only one example and in other embodiments of the invention, more or fewer deflectors can be

used and they can be distributed in various other configurations.

Referring to Figures 9 to 11, instead of the helmet being manufactured originally according to the embodiments of the invention described above, the invention
5 extends to a kit that can be used to modify a helmet by fitting deflectors 14 to the impact absorbing liner 10 of the helmet. (Rigorous safety standards are applied to the design and manufacture of helmets in most countries and modification of helmets is not necessarily advisable or permitted, so care needs to be taken when considering modification of a helmet.)

10 The kit includes one or more deflectors 14 as described above, a rough washer 36, an adhesive layer 38 for attaching the washer to the inside of the impact absorbing liner 10 and a pin 26 for securing the deflector. The adhesive layer 38 is typically applied to the washer 36 (even though they are shown separately in Figure 9) and
15 the washer is attached to the impact absorbing liner 10 in a preferred position. The washer 36 preferably includes radial grooves 40 that allow it to be shaped to fit on a concave surface. The deflector 14 is fitted by passing the pin 26 through the central passage 24 of the deflector and clipping an end of the pin into an aperture 42 defined in the washer 36.

20 The border 18 and hub 20 of the deflector 14 shown in Figures 9 and 10 have different profiles from those shown in preceding figures, but they still each define a collapsible shell 19,21 and cavity 28 so that they are compressible, as described above.

25 Referring to all the drawings, in use, if severe linear impacts are received on the outer shell of the helmet, i.e. impacts that are aligned with the centre of gravity of the wearer's head and helmet, and where the impact thus results primarily in linear compression, without significant rotational forces, the impacts are dissipated in the
30 impact absorbing liner 10 before being transferred to the wearer's head, by compression of the impact absorbing liner – generally as occurs in conventional helmets.

If moderate linear impacts are received, e.g. linear impacts at low speeds, the energy from the impact will be transferred through the impact absorbing liner 10 and the comfort liner 12 will readily compress without dissipating much of the impact energy, but the deflectors 14 will be compressed between the impact absorbing liner 10 and the wearer's head and a substantial part of the impact energy will be absorbed by the compression of the deflectors 14.

If the impact forces are very low (probably too low to cause injury), they may be adequately dissipated in the comfort liner 12 and if they are severe, they may be adequately dissipated in the impact absorbing liner 10, but the present invention also protects the wearer against moderate impacts, with impact absorption in the deflectors that varies with the severity of the impact, due to the non-Newtonian properties of the material from which the deflectors 14 are made.

If rotational impacts are received on the outer shell of the helmet, i.e. impacts that are not aligned with the centre of gravity of the wearer's head and helmet, and that thus result in rotational forces, the rotational forces are transferred as tangential forces 32 from the impact absorbing liner 10 to the comfort liner, via the deflectors 14.

In the event that a rotational / tangential force 32 is transferred from the impact absorbing liner 10 to the comfort liner 12, the spokes 22 deflect and the border 18 and hub 20 are displaced relative to each other, as shown in Figure 5, but the relative position of the comfort liner 12 relative to the impact absorbing liner is determined by the position of the border 18, so that the deflection of the spokes allows relative displacement between the impact absorbing liner and the comfort liner.

The resilience of the spokes 22 when they deflect, causes some of the impact of the rotational / tangential force 32 to be dissipated before it is transferred from the impact absorbing layer 10 to the comfort liner 12 and accordingly, the rotational

impact is reduced before it is transferred to the wearer's head. The deflection of the spokes 22 is also reversible in the case of moderate impacts and accordingly, the deflectors 14 can protect the wearer's head against repeated moderate rotational impacts.

5

The invention has been described with reference to the impact absorbing liner 10 and comfort liner 12, but the liner 10 need not form the only impact absorbing layer and can be a liner inside another impact absorbing liner and likewise, the liner 12 need not be the only comfort liner and can have an additional liner on its inside. The

10

liners 10 and/or 12 can thus replace the impact absorbing liner and comfort liner of conventional helmet construction, wholly or in part.

CLAIMS:

1. A helmet comprising:
 - an outer shell;
 - an impact absorbing liner (10) disposed inside the outer shell and connected in a load transferring manner to the outer shell to receive loads from the outer shell;
 - an inner liner (12) disposed inside the impact absorbing liner (10), said inner liner (12) being configured to slide relative to the impact absorbing liner (10);
 - characterised in that said inner liner (12) defines at least one receiving formation (16); and
 - said helmet includes at least one deflector (14) comprising: a body (20) that is connectable to the impact absorbing liner (12); a border (18) along at least part of the deflector's (14) periphery, said border (18) being connectable to one of the receiving formations (16) of the inner liner (12); and at least one deformable element (22) extending between the body (20) and the border (18).
2. A helmet according to claim 1, characterised in that at least some of the receiving formations are apertures (16) defined in the inner liner (12) and at least some of the deflectors (14) are connectable to the apertures (16) by fitting inside the apertures (16).
3. A helmet according to claim 1 or claim 2, characterised in that the deformable elements include a plurality of deformable spokes (22) extending between the body (20) and the border (18).
4. A helmet according to claim 3, characterised in that at least some of the spokes (22) are curved.
5. A helmet according to claim 3 or claim 4, characterised in that at least some

of the spokes (22) extend in a spiral configuration between the body (20) and the border (18).

6. A helmet according to any one of the preceding claims, characterised in that at least some of the deflectors (14) are of a non-Newtonian material.
7. A helmet according to claim 6, characterised in that said non-Newtonian material is shear thickening.
8. A helmet according to any one of the preceding claims, characterised in that at least some of the deflectors (14) each define a shell (19,21) extending between the impact absorbing liner (10) and the inner liner (12), said shell (19,21) being at least partly collapsible.
9. A helmet according to claim 8, characterised in that said shell (19,21) extends at least partly around a cavity (28) defined in the deflector (14).
10. A helmet according to any one of the preceding claims, characterised in that the bodies (20) of at least some of the deflectors (14) are releasably connectable to the impact absorbing liner (10).
11. A helmet according to any one of the preceding claims, characterised in that the bodies (20) of at least some of the deflectors (14) are connectable to the impact absorbing liner (10) by way of anchor formations (26) that extend, at least in part, into the impact absorbing liner (10).

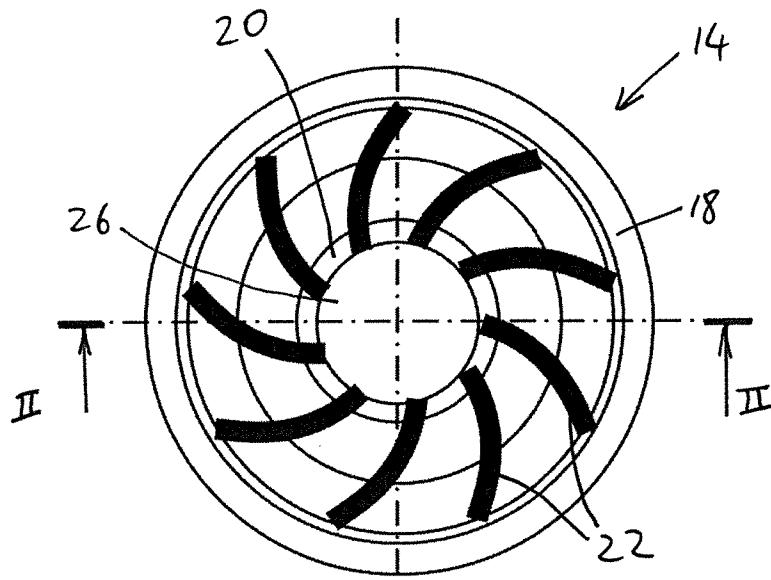


FIGURE 1

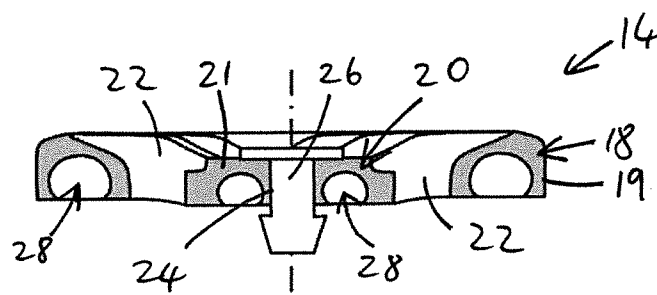


FIGURE 2

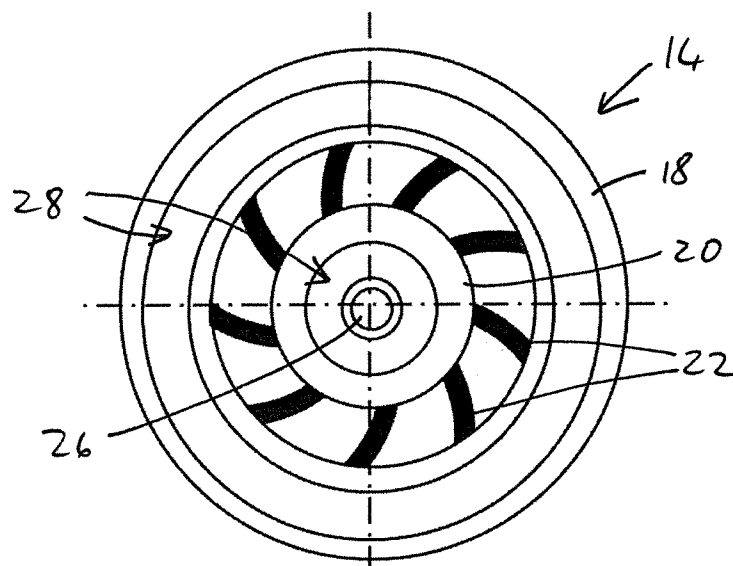


FIGURE 3

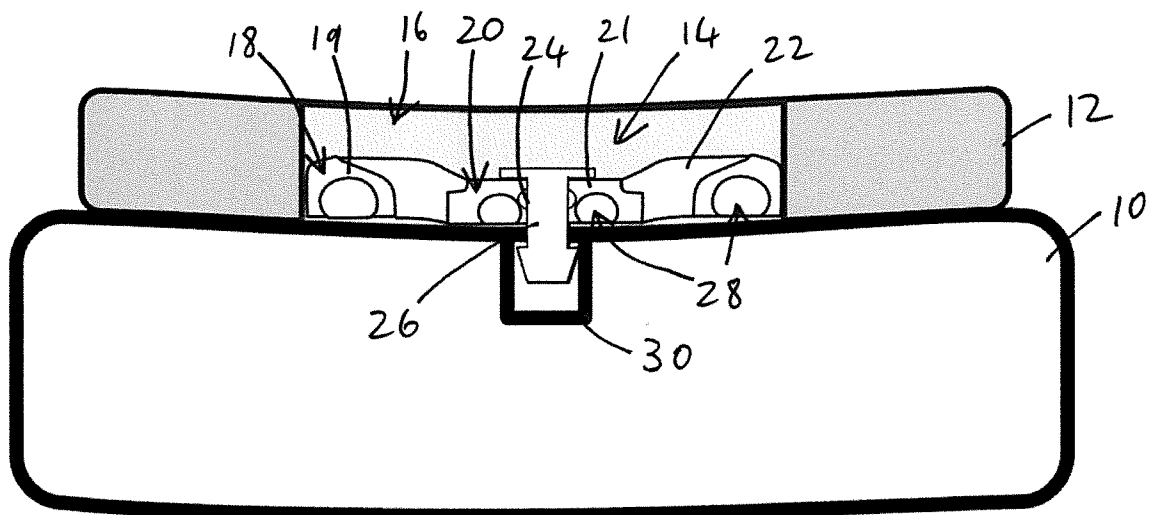


FIGURE 4

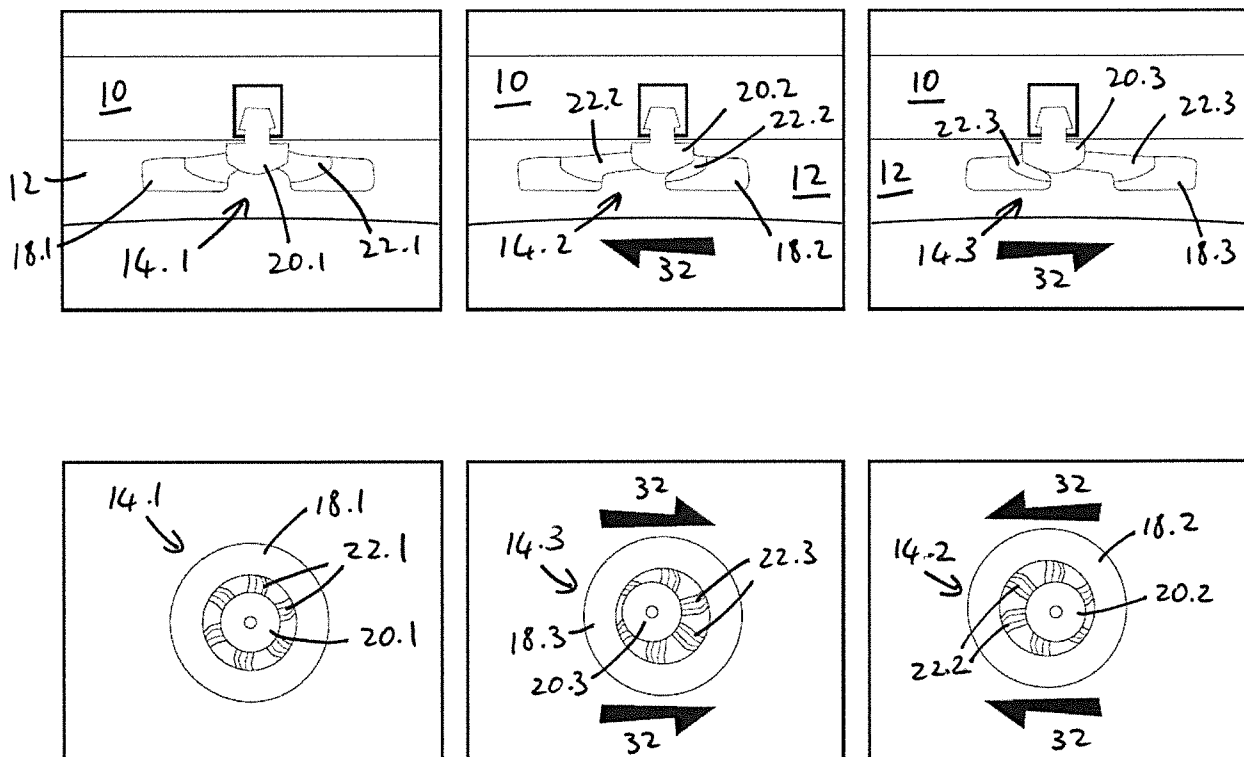


FIGURE 5

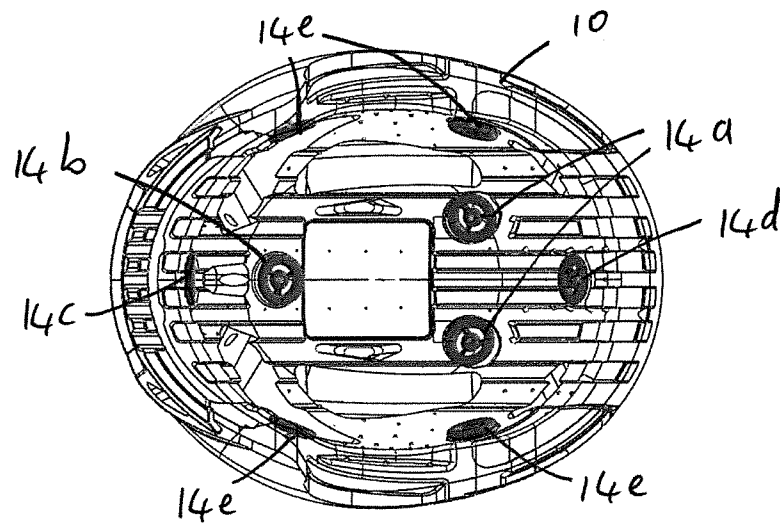


FIGURE 6

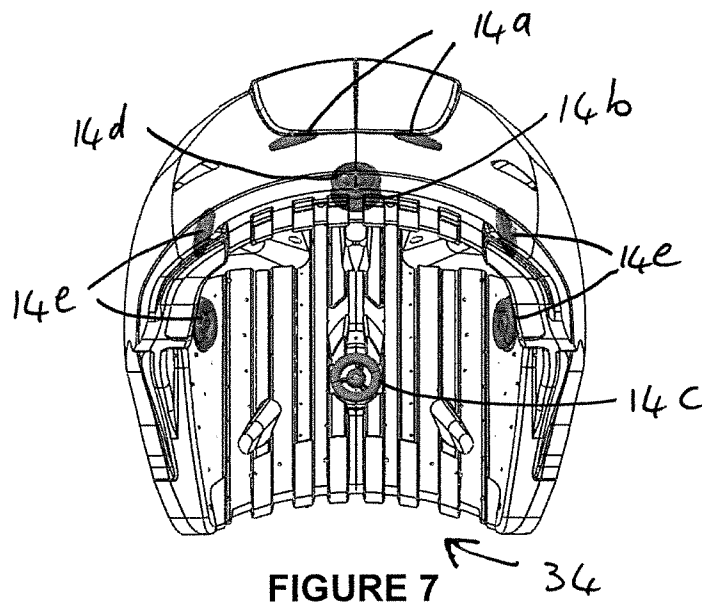


FIGURE 7

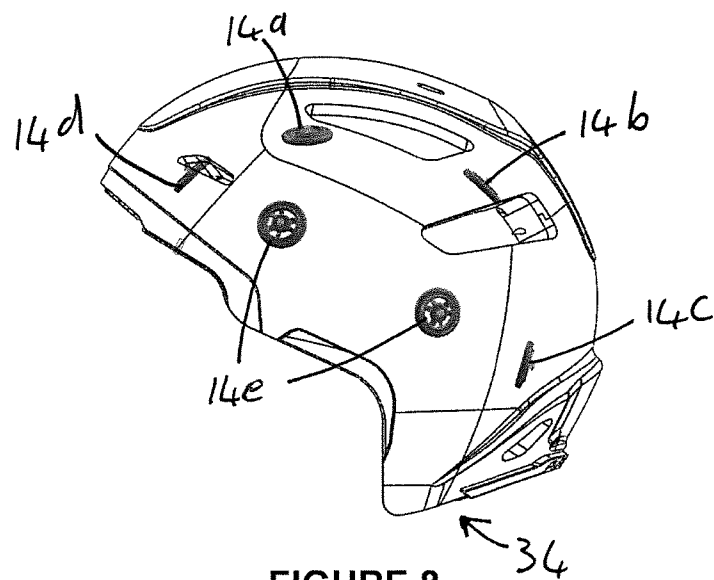


FIGURE 8

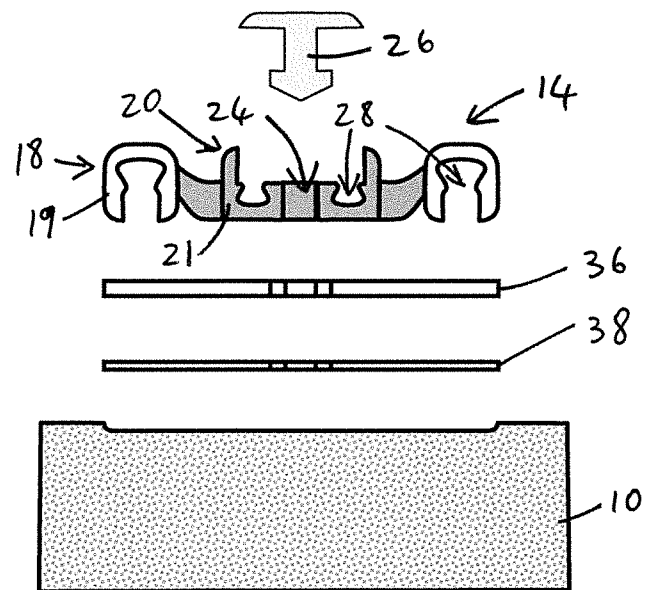


FIGURE 9

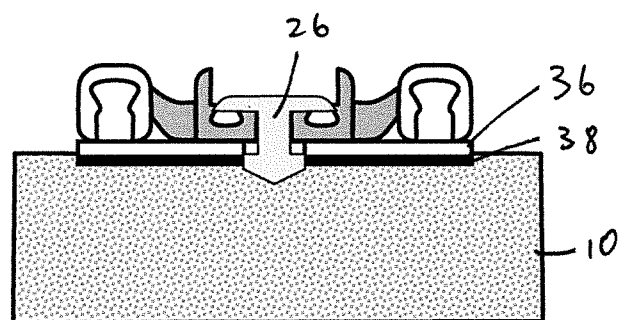


FIGURE 10

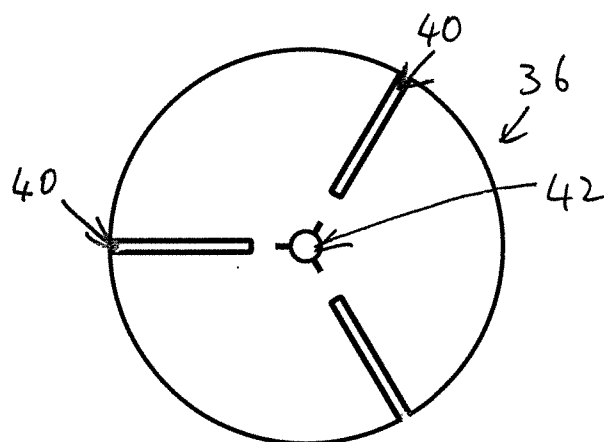


FIGURE 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/053735

A. CLASSIFICATION OF SUBJECT MATTER
INV. A42B3/06
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)
A42B

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)

EP0-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	US 2013/247284 A1 (HOSHIZAKI THOMAS BLAINE [CA] ET AL) 26 September 2013 (2013-09-26) paragraphs [0039] - [0045], [0063] - [0070]; figures 3,5 -----	1,6-9
A	US 2014/013491 A1 (HOSHIZAKI THOMAS BLAINE [CA] ET AL) 16 January 2014 (2014-01-16) paragraphs [0060], [0069], [0076] - [0078]; figures 1,8 -----	1
A	US 2013/291289 A1 (SZALKOWSKI RON [US] ET AL) 7 November 2013 (2013-11-07) paragraphs [0029] - [0034]; figures 1,4 -----	1
A	US 2010/186150 A1 (FERRARA VINCENT R [US] ET AL) 29 July 2010 (2010-07-29) paragraphs [0021], [0022], [0031]; figures 1,4 -----	1

☐

Further documents are listed in the continuation of Box C.

☒

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

7 August 2015

Date of mailing of the international search report

14/08/2015

Name and mailing address of the ISA/

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

Authorized officer

D'Souza, Jennifer

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2015/053735

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013247284 A1	26-09-2013	CA 2864522 A1 CN 104244754 A EP 2802229 A1 US 2013247284 A1 WO 2013104073 A1	18-07-2013 24-12-2014 19-11-2014 26-09-2013 18-07-2013
US 2014013491 A1	16-01-2014	CA 2850636 A1 CN 104219975 A EP 2833748 A1 US 2014013491 A1 WO 2013149335 A1	10-10-2013 17-12-2014 11-02-2015 16-01-2014 10-10-2013
US 2013291289 A1	07-11-2013	NONE	
US 2010186150 A1	29-07-2010	CA 2750596 A1 EP 2381808 A1 TW 201036564 A US 2010186150 A1 WO 2010087957 A1	05-08-2010 02-11-2011 16-10-2010 29-07-2010 05-08-2010