

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
29 November 2007 (29.11.2007)

PCT

(10) International Publication Number
WO 2007/135372 A1

(51) International Patent Classification:
F16F 9/04 (2006.01)

(21) International Application Number:
PCT/GB2007/001787

(22) International Filing Date: 15 May 2007 (15.05.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0609870.1 18 May 2006 (18.05.2006) GB

(71) Applicants and

(72) Inventors: **PARKER, Carl John** [GB/GB]; 39 Foundary Lane, Highfield, Wigan WN3 6BW (GB). **TURNBULL, Michael Alastair** [GB/GB]; 7 Hopefold Drive, Worsley, Manchester M28 3PN (GB).

(74) Agents: **GILMOUR, David** et al.; Potts, Kerr & Co, 15 Hamilton Square, Birkenhead, Merseyside CH41 6BR (GB).

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

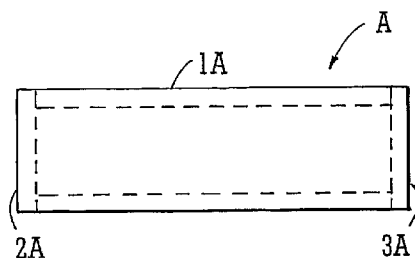
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CUSHIONING DEVICE



(57) Abstract: A cushioning device comprising a body (1A) of resilient, closed cell, foam material or memory foam defining a closed inner air space or chamber and closed except for an air expulsion restriction means in the form of one or more apertures of smaller diameter of cross section than that of the space or chamber and communicating or for communicating said space with ambient atmosphere, and such as to restrict or control the expulsion of air from the inner air space or chamber in the event of an impact on said body to provide a desired cushioning effect.

WO 2007/135372 A1

CUSHIONING DEVICE

The present invention relates to a cushioning device and particularly to one which, when used alone or with others will, when impacted upon, absorb the kinetic energy of a falling person or object to reduce the risk of injury or damage.

Known systems are available but rely solely on either impact absorbent materials such as polyurethane foams and expanded polystyrene, or comprise inflatable air bags, which rely on generators for providing a constant air flow. The present invention does not relate to an inflatable device.

It is an object of the present invention to provide a self-sustainable source of kinetic energy absorbing means. It is also intended that the means may be produced having an outer cover or casing to render it suitable for various industries and activities such as in the building industry or for sporting activities.

According to the present invention there is provided a cushioning device as defined in claim 1.

The cushioning device preferably has features either alone or in combination as defined in any of claims 2 to 30.

Preferably there is provided an end panel of flexible material secured at each end of said body to define with the body an airtight inner air space, and one or more apertures or passages in the end panel or panels and/or in the body communicating the exterior atmosphere with said inner air space and forming said air expulsion control means.

Thus, preferably, apart from the air expulsion restriction or control means when defined, for example, by a grommet or other valve means, an airtight device is created from a resilient, closed cell, shape-recovering, lightweight foam material or memory foam, extruded or cut into predetermined shapes and sealed together by welding and/or adhesive to create a cylinder or cuboid. The device or module is preferably provided with grommets or other aperture means to allow governed airflow in both directions.

After the device has absorbed kinetic energy from an impact and the person or object is removed, the foam is such as that the device(s) will recover unaided to it's (their) original state.

Preferably the material of the device comprises a resilient, closed cell, lightweight foam such as a closed cell polyethylene foam or other memory recoverable polyolefin foam such as polyethylene foam and is one which is compressible and resilient and of closed cell and does not permit air flow therethrough and one which recovers its shape.

Thus the resilient/flexible foam material is self-supporting of its shape and is such as to maintain its impact receiving/absorbing shape with the interior space being at normal ambient atmospheric pressure and with the interior being open to or adjustable/adaptable to the exterior ambient pressure.

Accordingly this invention provides a kinetic energy absorbing device that due to its unique design, may perform consistently and may be used repeatedly offering protection to person or objects in the event of impact with the said device.

Normally a plurality of impact absorbing units or cushioning devices for absorbing the impact of a falling person are arranged together as a plurality of

assembled and detachably connected cushioning devices to provide in effect a substantially continuous upper surface.

Each device will normally define a single space. Normally the space within the device contains nothing other than air.

Preferably the apertures defining the air expulsion control means will be closeable, such as by means of a stopper, and this is particularly useful in facilitating transport/storage of the devices after such have been collapsed e.g. by evacuating the air by means of a suction pump.

The invention will be described further, by way of example, with reference to the two embodiments illustrated schematically in the accompanying drawings, in which:-

Fig. 1 is a plan view of the cylindrical cushioning device A;

Fig. 2 is a plan view of the cuboid cushioning device B;

Fig. 3 is a side view of the cylindrical cushioning device A of Fig. 1;

Fig. 4 is a side view of the cuboid cushioning device B of Fig. 2;

Fig. 5 is an end view of the cylindrical cushioning device A of Fig. 1 and is fitted with two airflow apertures or grommets to govern expelled air and to allow recovery;

Fig. 6 is an end view of the cuboid cushioning device B of Fig. 2 and is fitted with two airflow apertures or grommets to govern expelled air and to allow recovery;

Fig. 7 is a plan view of a plurality of assembled and connected cushioning devices A of Fig. 1;

Fig. 8 is a plan view of a plurality of assembled and connected cushioning devices B of Fig. 2;

Fig. 9 is an end view of cushioning devices of Fig. 7;

Fig. 10 is an end view of cushioning devices of Fig. 8;

Fig. 11 is a schematically illustrated construction of cushioning device A and comprises of a seamless extruded tube D and two circular end panels F;

Fig. 12 is a schematically illustrated construction of cushioning device A and comprises of a tube E created from a rolling then joining one flat panel and two circular end panels F;

Fig. 13 is a schematically illustrated construction of cushioning device B and comprises of one rectangular tube created using four side panels G and two square end panels I;

Fig. 14 is a schematically illustrated construction of cushioning device B and comprises of one rectangular tube created from folding then joining one flat panel H and two square end panels I;

Figs. 1-14 of the accompanying drawings schematically illustrate the construction of two cushioning devices A and B with A having a tubular body 1A, of resilient foamed plastics material and circular cross section and the other B also of such material, having a tubular body 1B of rectangular cross section and appropriately shaped end panels 2A, 3A and 2B, 3B of welded/bonded or otherwise adhesive to secure thereto and having apertures or passages with grommets 5A, 6A and 5B, 6B located in at least one and being of such a size and/or number such as to suitably regulate the outflow of air upon impact and preferably also to suitably regulate the flow of air back into the container for recovery. Thus the air within the inner spaces is normally open to the atmosphere and at ambient atmospheric pressure. However, bungs may be provided to close the aperture when it might be desired to have a lower layer of devices firmer or to maintain devices in a deflated and compact condition for storage/transport.

In Figs. 7 and 8 a plurality of each of the devices A and B are illustrated combined together and connected by interconnection means (not shown).

Normally each of the cushioning devices will be contained within a suitable casing of correspondingly shaped bag-like form of flexible sheet material such as of polypropylene and preferably woven and preferably air permeable because of being woven or provided with vent means. The cover is preferably provided with interconnection means or clip connection means provided for connection to identical/similar devices. In Fig. 4, three devices are illustrated connected together side by side and a fourth device located across the ends thereof.

Fig. 9 is an end elevation of the three devices from the remote side of Fig. 7 and Fig. 10 similarly of the remote side of Fig. 8

The broken lines in Figs. 1-14 illustrate the inner walls of the tubular members or bodies and its end panels 2A, 3A.

Fig. 11 illustrates a tubular body D of circular cross section having been formed by extrusion and having end panels F fixed at opposite ends – (air passages or grommets not being shown). Fig. 12 shows the formation of a tubular body E also of circular section but rather having been formed from a rectangular sheet (not shown but clearly appreciated) which is rolled and secured along the adjacent edges as illustrated by the longitudinal dotted line and also having circular end panels F fixed at opposite ends.

Somewhat similarly, Fig. 13 illustrates alternative possible constructions of a tubular body G which is of a square transverse cross section forming a cuboid device either being made up from four individual panels G welded, bonded or otherwise adhesively secured together to form the box-like body H and having square end panels I welded or otherwise fixed at the ends thereof. Alternatively as illustrated in Fig. 14, a single sheet may be provided and has three fold lines along which the sheet may be folded to form a body H bonded at the abutting edges and again end panels I welded or

otherwise secured at the ends thereof. In this embodiment the air flow passages are not shown although will be readily apparent as to their manner and/or construction, etc. Similarly outer casings are not illustrated.

The resilient/flexible foam material is self-supporting of its shape and is such as to maintain its impact receiving/absorbing shape with the interior space being at normal ambient atmospheric pressure and with the interior being open to or adjustable/adaptable to the exterior ambient pressure. The foam material is preferably such as will not absorb water to any significant extent. The interior space is normally empty apart from air.

In all of the embodiments illustrated the material of the device comprises a resilient, closed, cell, lightweight foam such as a closed cell polyethylene foam or other memory recoverable polyolefin foam such as polyethylene foam and is one which is compressible and resilient and of closed cell and does not permit air flow therethrough and one which recovers its shape. Such a suitable foam is one which is manufactured in 20mm thickness and for this use is laminated in multiples to increase thickness-g. to 40mm. The wall thickness and hollow space and air expulsion control means achieve the desired deacceleration forces suitable to receive a falling person without injury. When constructed the device is hollow and provides said inner air space and the apertures or passages provided in the walls and/or end panels are such as control the expulsion of air upon impact to the desired degree and similarly the intake of air in recovery.

It is conceivable the wall thickness might vary up or down - even as low as 5mm. Anything over 100mm would be too rigid.

A not too hard impact is achieved at reasonable cost and with a device which is not too heavy.

Also, whilst not shown, the cushioning devices of Figs. 1 to 7 will preferably have an outer covering or casing of flexible sheet material such as of sheets of polypropylene or vinyl such as PVC which may be woven textile and the cover will be air permeable or vented. As mentioned, the interconnection of cushioning devices will be by way of fastening means (not shown) connected to covers or casings covering the devices and to enable suitable interlinking of the devices.

Panels or sheets of the body will preferably be secured together by welding and/or fixing using adhesives and preferably heat welded together.

The end panels, when provided, may be made of the same foam material and preferably the same thickness as the main body or may be made of an alternative material such as sheet polyethylene or polypropylene. The end panels will normally have the same external diameter as the main body. Also, the thickness of the end panels may differ from the main body.

It is envisaged the end panels may be omitted and the control of the expulsion of air achieved by means of the air permeability of the cover or venting/valve means thereof.

The density of the preferred foam used is 16kg/m³ however it is conceivable such might vary up and down – even as low as 10kg/m³. Anything over 35kg/m³ would likely be too dense.

CLAIMS

1. A cushioning device comprising an body of resilient, closed cell, foam material or memory foam defining a closed inner air space or chamber and closed except for an air expulsion restriction means in the form of one or more apertures of smaller diameter of cross section than that of the space or chamber and communicating or for communicating said space with ambient atmosphere, and such as to restrict or control the expulsion of air from the inner air space or chamber in the event of an impact on said body to provide a desired cushioning effect.
2. A device as claimed in claim 1, including an end panel of flexible material secured at each end of said body to define with the body an airtight inner air space, and one or more of said apertures or passages in the end panel or panels and/or in the body communicating the exterior atmosphere with said inner air space and forming said air expulsion restriction or control means.
3. A cushioning device as claimed in claim 2, in which the or each end panel or panels are of the same material as the body.
4. A cushioning device as claimed in claim 2 or 3, in which the end panel or panels is/are secured by welding, bonding or other adhesive means.
5. A cushioning device as claimed in any of claims 1 to 4, in which said apertures or passages are provided with two-way valves which only open to permit escape of air from the inner air space at a certain pressure.
6. A cushioning device as claimed in any of claims 1 to 5, in which grommets or the like lining ring or collar are fitted in the apertures or passages and such as to govern the expulsion of air when the body is subject to impact.

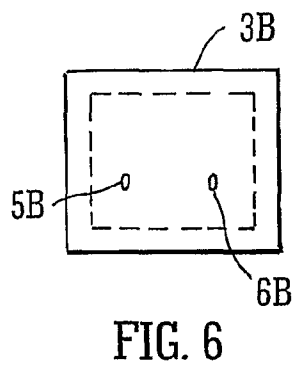
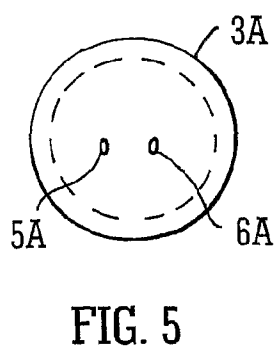
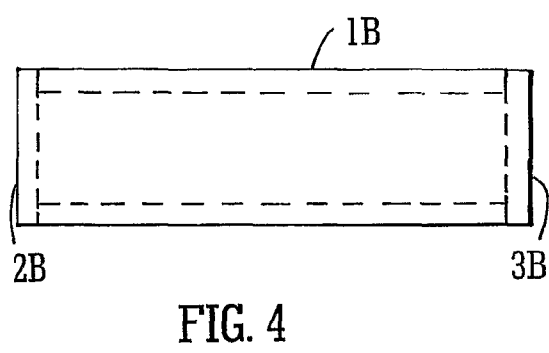
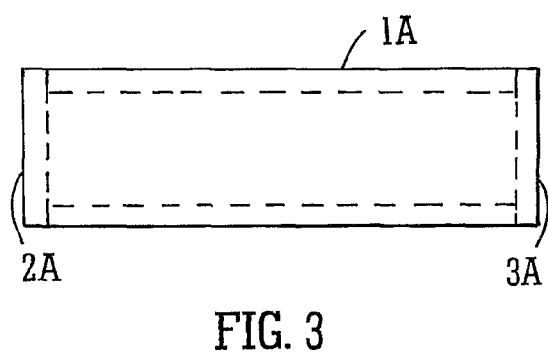
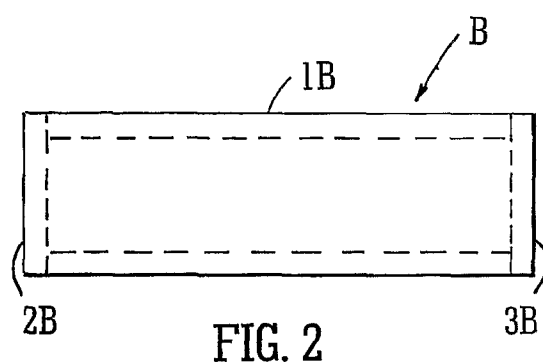
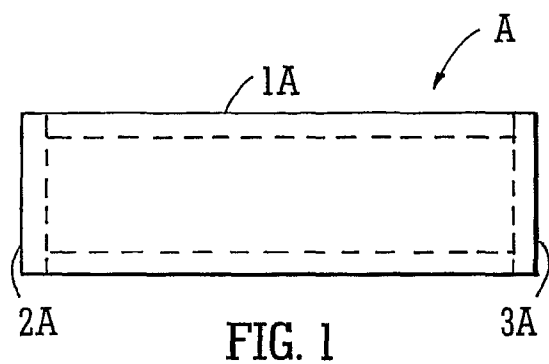
7. A cushioning device as claimed in claim 6, in which the size of the grommets or the like is also selected to govern the intake of air when the device is recovering from an impact.
8. A cushioning device as claimed in claims 1 to 7, in which the body has an outer cover or casing.
9. A cushioning device as claimed in claim 8, in which the cover or casing is formed of a suitable hardwearing material.
10. A cushioning device as claimed in claims 8 or 9, in which the material of the casing is polypropylene or vinyl such as PVC.
11. A cushioning device as claimed in claims 1 to 10, in which the foam material is a lightweight polyolefin foam material.
12. A cushioning device as claimed in claim 11, in which the foam is a polyethylene foam.
13. A cushioning device as claimed in any of claims 8, 9 or 10, in which said outer cover or casing is fitted with suitable means for interlinking with other like cushioning device or devices.
14. A cushioning device as claimed in claims 1 to 13, in which the body comprises either a hollow cylinder having substantially circular end panels fixed to the ends thereof to define a resilient cylindrical unit with an inner airtight sealed space other than for the apertures or comprises a cuboid having substantially square end panels fixed to the ends thereof to define a resilient or cubic unit with an inner airtight space sealed except for the apertures.

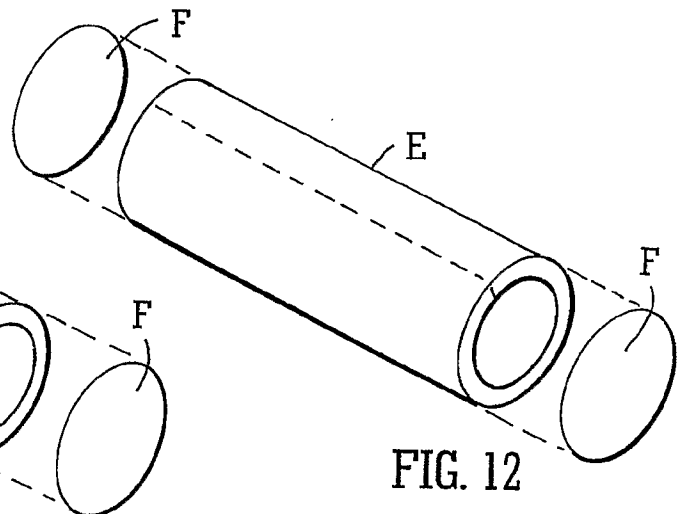
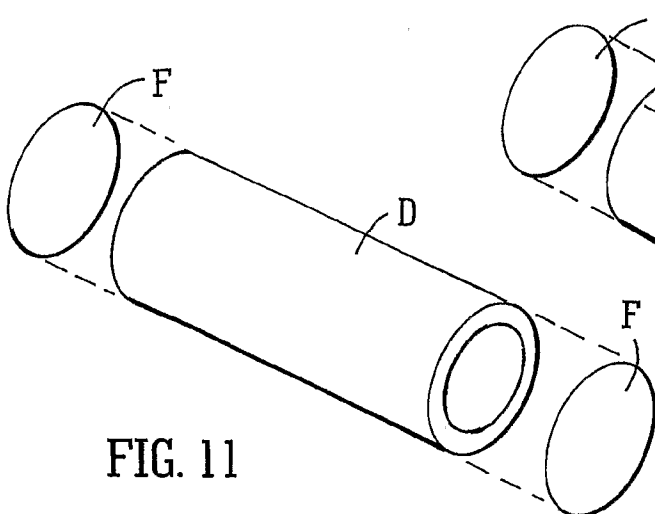
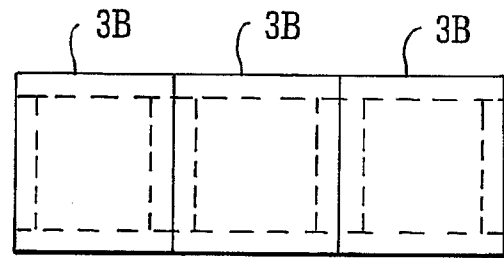
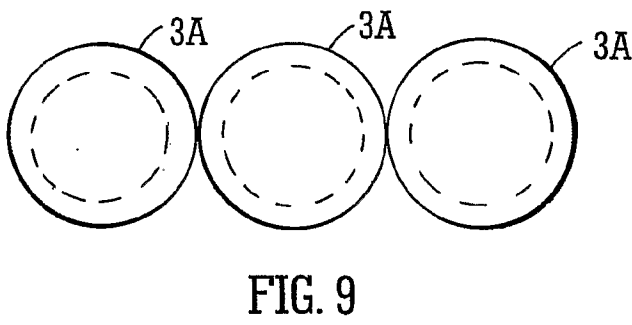
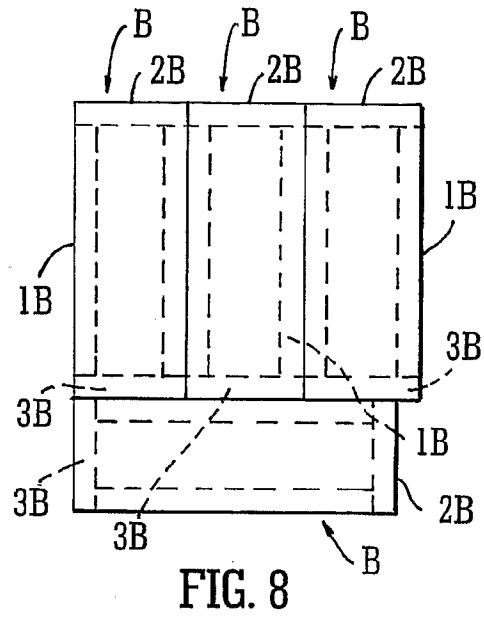
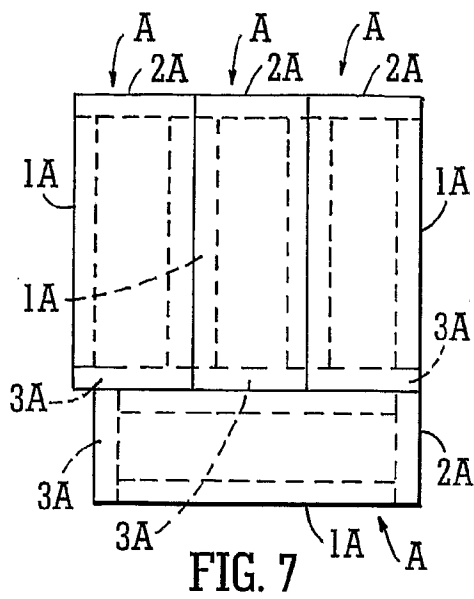
15. A cushioning device as claimed in any of claims 1 to 14, in which the body is tubular and formed by being extruded as a tube or made from a flat panel (E) welded and/or fixed using adhesive at edges into a tube (F), with two circular end panels (G) being welded and/or fixed using adhesive, at opposite ends to close the inner space.
16. A cushioning device as claimed in any of claims 1 to 15, in which the body is cuboid and made from four flat panels (H) welded and/or fixed at their edges using adhesive or one flat panel folded (I) and welded and/or fixed using adhesive thereby creating the cuboid (J), with two square end panels (K), being welded and/or fixed using adhesive.
17. A cushioning device comprising a body of resilient foam material and defining a closed or sealed space therein containing air, and venting means for enabling escape of air upon impact at a rate such as to achieve a desired cushioning effect.
18. A cushioning device as claimed in any of claims 1 to 17, wherein a cover for the body is provided and is such as to enable expulsion of air on impact.
19. A cushioning device as claimed in claim 18, in which the cover includes said air expulsion control means by being suitably woven or having venting means or the like.
20. A cushioning device as claimed in any of claims 1 to 19, in which the resilient/flexible foam material or memory foam is self-supporting of its shape and is such as to maintain its impact receiving/absorbing shape with the interior space being at normal ambient atmospheric pressure and with the interior being open or adjustable/adaptable to the exterior ambient pressure.

21. A device as claimed in any of claims 1 to 20, in which the foam material is such as will not absorb water to any significant extent.
22. A cushion device as claimed in any of claims 1 to 21, in which the interior space is normally empty apart from air.
23. A plurality of cushioning devices as claimed in any of claims 1 to 22, assembled and held together to provide an upper surface area sufficient to safely receive a falling body or object and cushion the fall to avoid injury and damage.
24. A cylindrical cushioning device substantially as herein described with reference to the accompanying drawings.
25. A cubic cushioning device substantially as herein described with reference to the accompanying drawings.
26. A cushioning device as claimed in any of claims 1 to 23, in which the body is elongate.
27. A cushioning device as claimed in any of claims 1 to 23, in which the body is elongate as is the space/chamber defined thereby and which is closed/sealed, and in which the air expulsion restriction means is only provided in at least one end wall of the body.
28. A cushioning device as claimed in any of claims 1 to 27, in which a large single air space or chamber is formed by the body.
29. A cushioning device as claimed in any of claims 1 to 28, in which the foam is mainly used for its memory to recover the void after impacting more

that its ability to cushion a falling object which latter is provided mainly by the air and controlled air release via the aperture or apertures.

30. A cushioning device as claimed in any of claims 1 to 29, in which said apertures or passages forming the air expulsion restriction means each include a closeable valve means or are provided with removable bungs.





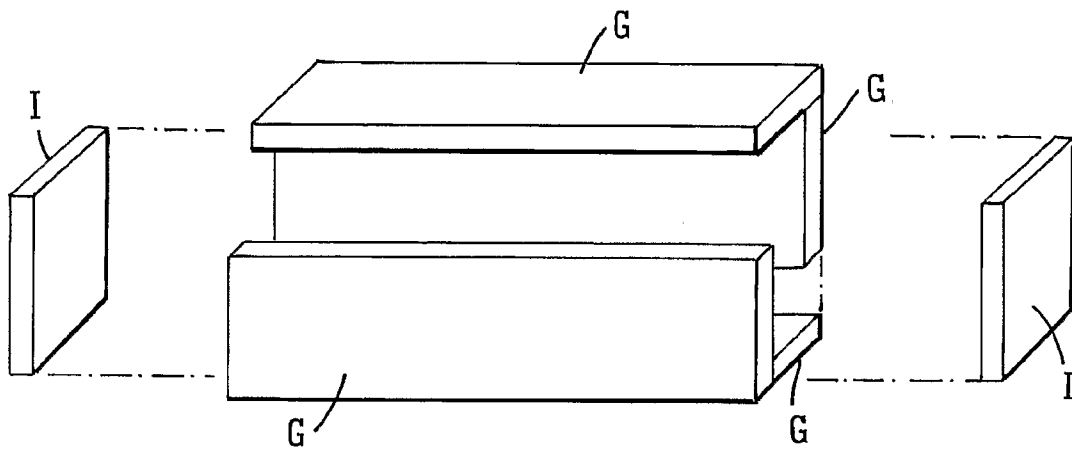


FIG. 13

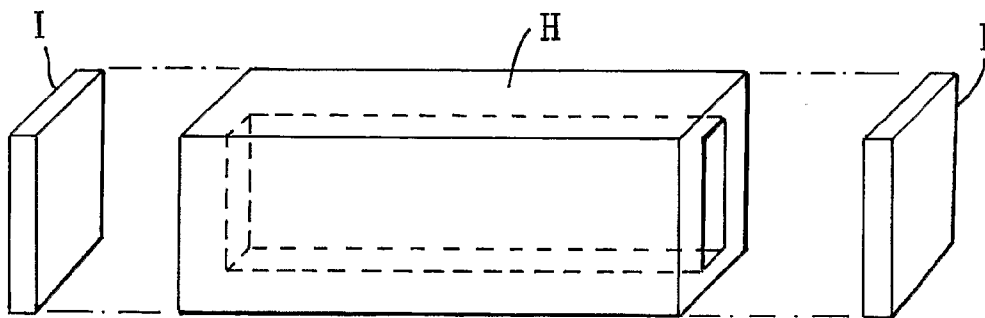


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2007/001787

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16F9/04

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)

F16F B60R B29D

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 practical, 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	US 3 231 454 A (JOSEPH WILLIAMS ROBERT) 25 January 1966 (1966-01-25) column 3, lines 6-29 figures 1-6	1-14, 17-30
A		15, 16
X	US 5 098 124 A (BREED DAVID S [US] ET AL) 24 March 1992 (1992-03-24) column 5, lines 59-61 column 6, lines 7,8 claim 3 figures 1,2	1-4, 11-14, 17-20, 22-29
	----- -/--	

☒ 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 document 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

21 August 2007

Date of mailing of the international search report

28/08/2007

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Fritzen, Claas

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2007/001787

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 445 430 A (NICHOLS LAWRENCE R [US]) 29 August 1995 (1995-08-29) column 3, lines 35-40 figures 2,3 -----	1-5,8-13
A	DE 17 72 785 U (MIELE & CIE [DE]) 21 August 1958 (1958-08-21) page 3 figures 1,2 -----	5
A	FR 362 365 A (ETABLISSEMENTS FALCONNET-PERODEAUD SA) 21 June 1906 (1906-06-21) column 2, lines 52-56 figures 1-4 -----	6,7
A	US 2004/065988 A1 (MAYERBERG WILLSON L [US] ET AL MAYERBERG II WILLSON L [US] ET AL) 8 April 2004 (2004-04-08) paragraph [0034]; figure 3 -----	14
A	BALLIS D ET AL: "IMPROVED MECHANICAL SHOCK PROTECTION FOR SHOCK SENSITIVE DEVICES" MOTOROLA TECHNICAL DEVELOPMENTS, MOTOROLA INC. SCHAUMBURG, ILLINOIS, US, vol. 18, 1 March 1993 (1993-03-01), pages 40-41, XP000349552 ISSN: 0887-5286 figures -----	26-28
A	WO 95/13489 A (LIN YNG LANG [CN]) 18 May 1995 (1995-05-18) figures 1-3 -----	30

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2007/001787

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3231454	A	25-01-1966	NONE	
US 5098124	A	24-03-1992	WO 9204210 A1	19-03-1992
US 5445430	A	29-08-1995	NONE	
DE 1772785	U	21-08-1958	NONE	
FR 362365	A		NONE	
US 2004065988	A1	08-04-2004	NONE	
WO 9513489	A	18-05-1995	AU 8103194 A	29-05-1995