

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 February 2008 (07.02.2008)

PCT

(10) International Publication Number
WO 2008/015388 A1

(51) International Patent Classification:
D04H 3/14 (2006.01) **B60R 22/405** (2006.01)

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(21) International Application Number:
PCT/GB2007/002824

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(22) International Filing Date: 24 July 2007 (24.07.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0615193.0 31 July 2006 (31.07.2006) GB

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(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, DO, 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, ME, 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.

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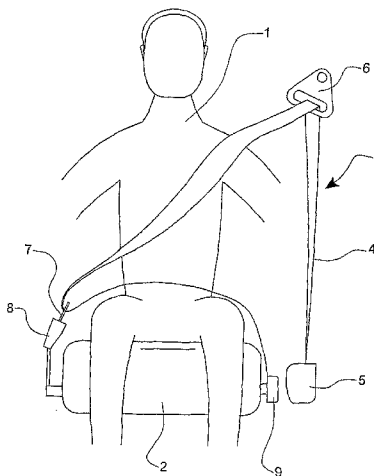
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, 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).

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Published:
— with international search report

(54) Title: A NON-WOVEN SAFETY-BELT



(57) Abstract: A non-woven safety-belt is disclosed which has one or more webs, each comprising a plurality of elongate and substantially parallel fibres (such as spun yarns) which are held together in a matrix material.

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5 **A Non-Woven Safety-Belt**

Description of Invention

10 The present invention relates to a safety-belt and, more particularly, to a non-woven safety-belt.

It is known to provide motor vehicles with safety-belts for each occupant of a motor vehicle, for example in the form of a conventional three-point “lap-and-shoulder” seat-belt arrangement. Such safety-belts are commonly formed from lengths of webbing, the webbing being woven from warp yarns and weft yarns. A known method of manufacturing a webbing belt of this general type is disclosed in EP 1514962, this document concerning itself primarily with a method for producing a webbing belt having sufficient transverse stiffness, but which has a relatively soft edge region in order to be more comfortable for a seat occupant wearing the safety-belt.

Although webbing seat-belts of the woven type are very widely known, their woven structure has been found to make it rather difficult to vary the performance characteristics of the safety-belt.

It is therefore an object of the present invention to provide an improved safety-belt, and more particularly to provide a non-woven safety-belt.

Accordingly, the present invention provides non-woven safety-belt, the safety-belt having a web comprising a plurality of elongate and substantially parallel fibres held together in a matrix.

- 5 Preferably, said plurality of fibres are longitudinal in the sense that they lie substantially parallel to the longitudinal axis of the safety-belt.

Conveniently, the web further comprises a second plurality of elongate and substantially parallel fibres, the fibres of said second set making an acute
10 angle to the longitudinal fibres.

Advantageously, said fibres take the form of yarns.

Preferably, at least some of said fibres take the form of mono-filament yarns.
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Advantageously, the safety-belt also comprises at least some multi-filament yarns.

Preferably, the longitudinal fibres in the edge-region of the belt are
20 multifilament yarns and the longitudinal fibres in the central region of the belt are monofilament yarns.

Alternatively, the longitudinal fibres in the edge-region of the belt are monofilament yarns and the longitudinal fibres in the central region of the belt
25 are multifilament yarns.

Preferably, said yarns have a maximum Decitex value of 5000.

Advantageously, said matrix is a hot-melt adhesive.
30

Conveniently, the safety-belt is fabricated from fibres pre-coated or pre-impregnated with said hot-melt adhesive.

Preferably, the safety-belt comprises a plurality of said webs secured to one
5 another in a mult-laminar construction.

Advantageously, the safety-belt has sections of different thicknesses, with a relatively thick section comprising more webs than a relatively thin section.

10 Conveniently, said webs are secured to one another by said matrix.

Preferably, said webs are secured to one another by an additional binder or adhesive.

15 Advantageously, said web is folded along its length so that its two longitudinal edges are secured to one another.

Conveniently, the safety-belt has a width which varies along its length.

20 Optionally, the safety-belt has openings formed through it.

So that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now be described, by way of example, with reference to the accompanying
25 drawings, in which:

Figure 1 is a schematic view from the front, illustrating a three-point safety-belt in an in-use position to restrain a seat occupant in a motor vehicle;

30 Figure 2 is a schematic perspective view of a length of safety-belt in accordance with an embodiment of the present invention;

Figure 3 is a view corresponding generally to that of Figure 2 but illustrating an alternative form of the safety-belt structure;

Figure 4 is a schematic sectional view through a multi-layer safety-belt in
5 accordance with the present invention;

Figure 5 is a sectional view through an alternative structure of safety-belt in accordance with the present invention;

10 Figure 6 is a view through another form of structure of the safety-belt in accordance with the present invention;

Figure 7 is a schematic sectional view through an alternative structure of the safety-belt of the present invention;

15

Figure 8 is another schematic sectional view through a safety-belt in accordance with the present invention; and

Figure 9 is a further schematic cross-sectional view through a length of multi-
20 layer safety-belt in accordance with the present invention.

Referring initially to Figure 1, there is illustrated a motor vehicle occupant 1 sitting on a vehicle seat, only the squab 2 of which is illustrated for the sake of clarity. The seat occupant 1 is illustrated wearing a generally conventional
25 three-point seat-belt 3 of the type commonly known as a "lap-and-shoulder" belt. The safety-belt comprises a length of webbing 4 which is wound on a retractor reel 5, the retractor reel 5 being mounted to the structure of the motor vehicle adjacent one side of the seat squab 2. From the retractor reel 5, the belt 4 extends upwardly and passes through a turning loop 6 which is
30 conventionally mounted to the motor vehicle structure in the region of the seat occupant's shoulder. From the turning loop 6, the belt extends across the

occupant's torso and passes through a further loop 7 which is mounted to a releasable buckle arrangement 8 located on the opposite side of the seat squab 2 to the retractor reel 5. From here, the belt passes back across the lap of the seat occupant to a point 9 at which the end of the safety-belt is secured adjacent the seat squab 2. This configuration of safety-belt is known.

Figure 2 illustrates, in schematic form, a length of safety-belt in accordance with an embodiment of the present invention. In this arrangement, the safety-belt comprises a plurality of substantially parallel elongate fibres 10 which are held together in a matrix 11 of suitable binding material. In this context, the term "fibre" is intended to identify an elongate element and includes, *inter-alia*, monofilament yarns, multifilament yarns, threads and also non-spun fibres.

The term "matrix" is intended to refer to a material which can either fully or partially enclose the longitudinal fibres of the safety-belt and which holds the fibres in position in the resulting composite structure. Suitable matrix materials include polymer materials which can be either a thermosetting or thermoplastic polymer, or even mixtures of the two as will be appreciated to those of skill in the art. The matrix is defined as a basic compound, comprising, for example, a plastics material. The matrix material is chosen to fulfil requirements regarding friction, heat resistance, stiffness and durability.

The safety-belt structure illustrated in Figure 2 can therefore be considered to represent a composite layer made up of a plurality of fibres which, rather than being woven together as in the case of previously-proposed safety-belt arrangements, are held together by the surrounding matrix material 11. The fibres 10 give the composite structure its necessary strength in the longitudinal direction of the safety-belt, whilst the matrix material 11 gives the safety-belt its inherent shape and serves to hold the threads together so that the threads can serve their strengthening function. By eliminating the woven structure of threads, the composite structure of the present invention allows the fibres 10

to be chosen specifically for their strength characteristics, whilst the matrix material 11 can be selected for appropriate properties such as friction, visual appearance, temperature resistance and the like.

- 5 Figure 3 illustrates an alternative form of the non-woven safety-belt of the present invention. The embodiment of Figure 3 is generally similar to that of Figure 2 and again comprises a plurality of substantially parallel longitudinal fibres which lie substantially parallel to the longitudinal axis A of the safety-belt. However, in the embodiment of Figure 3, the composite web of the
- 10 safety-belt additionally comprises a second plurality of elongate and substantially parallel fibres 12 which lie so as to make an acute angle to the longitudinal fibres and the longitudinal axis A of the web. The second set of fibres 12 thus extend generally across the web of the safety-belt as illustrated. Nevertheless, both the longitudinal fibres 10 and the oblique, transverse fibres
- 15 12 are held together in the same matrix 11 in a manner generally similar to that of Figure 2.

The combination of a longitudinal and cross-ply structure such as that illustrated in Figure 3 provides additional strength to the safety-belt in the

20 transverse direction, although the second set of fibres 12 provide a component of strength both in the transverse direction and the longitudinal direction of the safety-belt.

Figures 2 and 3 both illustrate safety-belt structures comprising a single web of fibres held together in an appropriate matrix. However, it should be

25 appreciated that variants of this present invention can comprise a plurality of such webs secured to one another so as to form a multi-lamina construction. For example, Figure 4 illustrates in schematic cross-sectional view a safety-belt structure comprising two overlaid webs, namely a lower web 13 and an

30 upper web 14. The lower web 13 and the upper web 14 each comprise a plurality of longitudinal fibres 10 although it should be appreciated that the

upper and lower webs 13, 14 could also comprise a second set of oblique transverse fibres 12 of the type illustrated in Figure 3. The fibres 10 making up the lower web 13 and the upper web 14 are held together in a surrounding matrix 11 which encompasses the fibres of both webs together.

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Alternatively, Figure 5 illustrates, again schematically, an alternative arrangement comprising upper and lower webs 14, in which the fibres of the lower web 13 are bonded to those of the upper web 14 by a layer of adhesive 15 lying between the two webs 13, 15. The adhesive layer 15, whilst not completely encasing the fibres 10 as in the case of the arrangement of Figure 4, will at least partially enclose the fibres of each web 13, 14 and so can nevertheless be considered to represent a matrix holding together the fibres 10.

15 Figure 6 illustrates an alternative multi-lamina structure in which the fibres of the upper and lower webs 13, 14 are held together not only by an intermediate layer of adhesive 15, but also by an additional matrix material 11 which completely encases all of the fibres 10 and also the intermediate layer of adhesive 15.

20

In a preferred embodiment, the matrix 11 comprises a hot-melt adhesive which has a liquid form during a manufacturing process in which the matrix material is heated, but which sets to a more rigid matrix structure upon cooling. Although the matrix material can be flowed around the fibres (either in the singular construction of Figures 2 and 3, or in the multi-lamina constructions of Figures 4-6), it is preferred that the fibres are initially pre-coated or pre-impregnated with matrix material such that, upon heating the plurality of fibres when arranged in their desired ultimate configuration, the matrix material melts and flows together such that, upon subsequent cooling, the resulting matrix encases all of the fibres 10.

30

In preferred arrangements, it is envisaged that some sections of the overall safety-belt length may be formed so as to be thicker than other sections of the safety-belt. In such an arrangement, it is envisaged that the thicker layers could be made to comprise more webs, in a multi-lamina construction, than the other relatively thin sections of the safety-belt arrangement.

In preferred embodiments of the present invention, the fibres 10 take the form of yarns which may comprise either solely mono-filament yarns, solely multi-filament yarns or combinations of the two. Preferably, the yarns used in the present invention are between 100 and 5000 dtx, 5000 being the preferred maximum Decitex value.

Figure 7 illustrates, in schematic cross-section, a structure of non-woven safety-belt in accordance with the present invention in which the single web of the safety-belt comprises longitudinal fibres of different form. In particular, the arrangement illustrated in Figure 7 is configured such that the longitudinal fibres 10a in the central region of the web are relatively thin (multi-filament) yarns, whilst the longitudinal filaments 10b in the two opposed edge regions of the web are slightly thicker (mono-filament) yarns. This structure has been found to provide a beneficial level of stiffness to the resulting safety-belt by virtue of the mono-filament yarns provided in the edge regions of the web. However, such an arrangement can suffer from the disadvantage of presenting rather hard belt edges which can rub against the neck of a seat occupant. The arrangement of Figure 7 can therefore be modified, as illustrated schematically in Figure 8, by folding the edge regions of the safety-belt web inwardly such that the mono-filament yarns in the edge regions of the web lie generally adjacent one another. In this arrangement, the mono-filament yarns can be secured with respect to one another by an encasing matrix and the resulting arrangement effectively presents a double thickness safety-belt web, the resulting edge regions of which comprise multi-filament yarns which present relatively softer edges to a seat occupant.

Figure 9 illustrates an alternative, multi-lamina construction of the safety-belt, in which the central region of each super imposed web comprises a plurality of relatively thick mono-filament yarns, but where the opposed edge regions of the safety-belt comprise a plurality of multi-filament yarns 10a so as to present softer edges. In the preferred arrangement illustrated in Figure 9, the edge regions of the multi-lamina construction are tapered.

Whilst the present invention has been described with particular reference to specific arrangements, it is to be appreciated that certain modifications can be made without departing from the scope of the present invention as defined by the appended claims. For example, it is envisaged that a safety-belt in accordance with the present invention could be configured so as to have a width which varies along its length, the structure of the present invention comprising a plurality of fibres held in a matrix allowing the width of the safety-belt to be varied along its length with much more ease than with a more conventional woven structure.

Furthermore, it is envisaged that variants of the present invention may be configured so as to have one or more openings formed through the safety-belt along its length which could, for example, enable better ventilation in the region where the safety-belt rests against the seat occupant's lap and/or torso so as to prevent the build-up of uncomfortable perspiration. It is even envisaged that variants of the present invention could be configured so as to have a profiled surface on the safety-belt provided by additional threads in the surface region of the safety-belt.

When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for
5 attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

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CLAIMS

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1. A non-woven safety-belt (3), the safety-belt having a web comprising a plurality of elongate and substantially parallel fibres (10) held together in a matrix (11).

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2. A safety-belt according to claim 1, wherein said plurality of fibres (10) are longitudinal in the sense that they lie substantially parallel to the longitudinal axis (A) of the safety-belt.

15

3. A safety-belt according to claim 2, wherein the web further comprises a second plurality of elongate and substantially parallel fibres (12), the fibres of said second set (12) making an acute angle to the longitudinal fibres (10).

20

4. A safety-belt according to any preceding claim in which said fibres (10,12) take the form of yarns.

5. A safety-belt according to claim 4, wherein at least some of said fibres (10,12) take the form of mono-filament yarns (10b).

25

6. A safety belt according to claim 5 also comprising at least some multi-filament yarns (10a).

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7. A safety belt according to claim 6 as dependent upon claim 2, wherein the longitudinal fibres in the edge-region of the belt (10a)

are multifilament yarns and the longitudinal fibres in the central region of the belt (10b) are monofilament yarns.

- 5 8. A safety-belt according to claim 6 as dependant upon claim 2, wherein the longitudinal fibres in the edge-region of the belt (10a) are monofilament yarns and the longitudinal fibres in the central region of the belt are multifilament yarns (10b).
- 10 9. A safety belt according to any one of claims 4 to 8, wherein said yarns have a maximum Decitex value of 5000.
10. A safety-belt according to any preceding claim, wherein said matrix (11) is a hot-melt adhesive.
- 15 11. A safety-belt according to any preceding claim 10, fabricated from fibres pre-coated or pre-impregnated with said hot-melt adhesive.
- 20 12. A safety belt according to any preceding claim comprising a plurality of said webs (13,14) secured to one another in a multi-laminar construction.
- 25 13. A safety-belt according to claim 12 having sections of different thicknesses, with a relatively thick section comprising more webs than a relatively thin section.
14. A safety-belt according to claim 12 or 13, wherein said webs (13,14) are secured to one another by said matrix (11).
- 30 15. A safety-belt according to claim 12 or 13, wherein said webs (13,14) are secured to one another by an additional binder or adhesive (15).

16. A safety belt according to any preceding claim, wherein said web is folded along its length so that its two longitudinal edges are secured to one another.

5 17. A safety-belt according to any preceding claim, having a width which varies along its length.

18. A safety-belt according to any preceding claim having openings formed through it.

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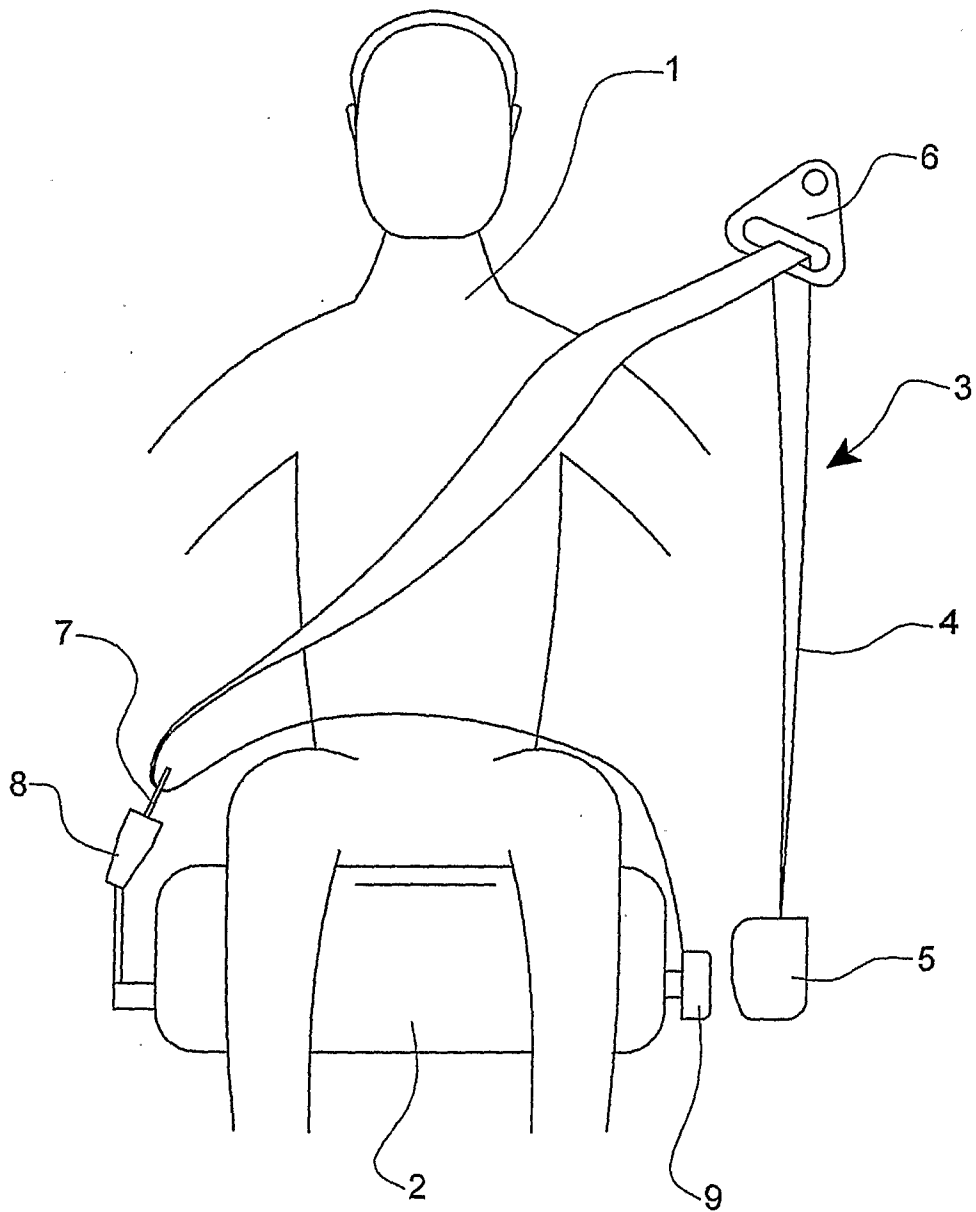
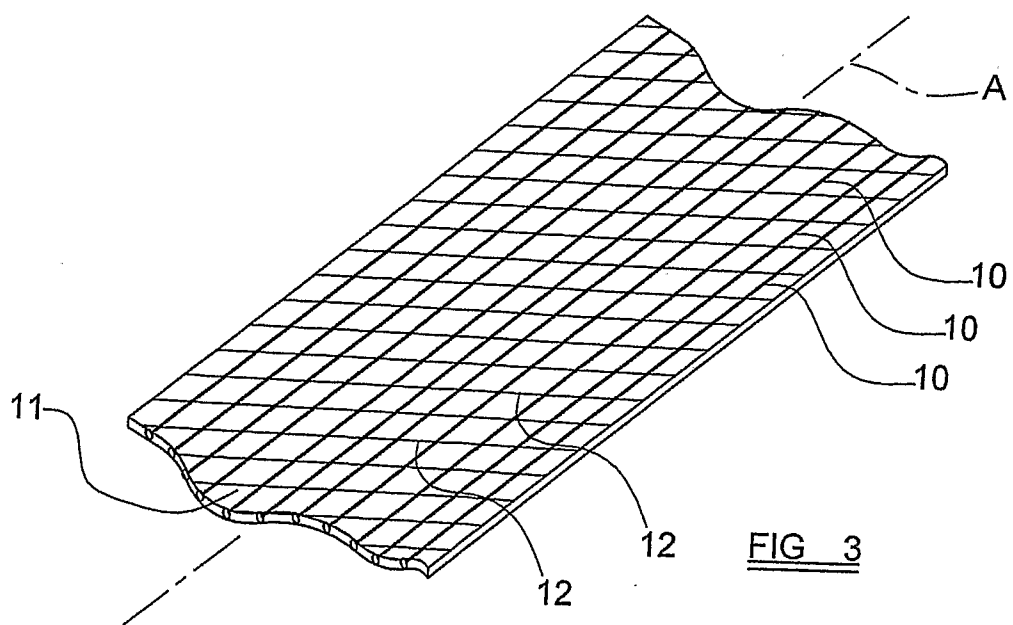
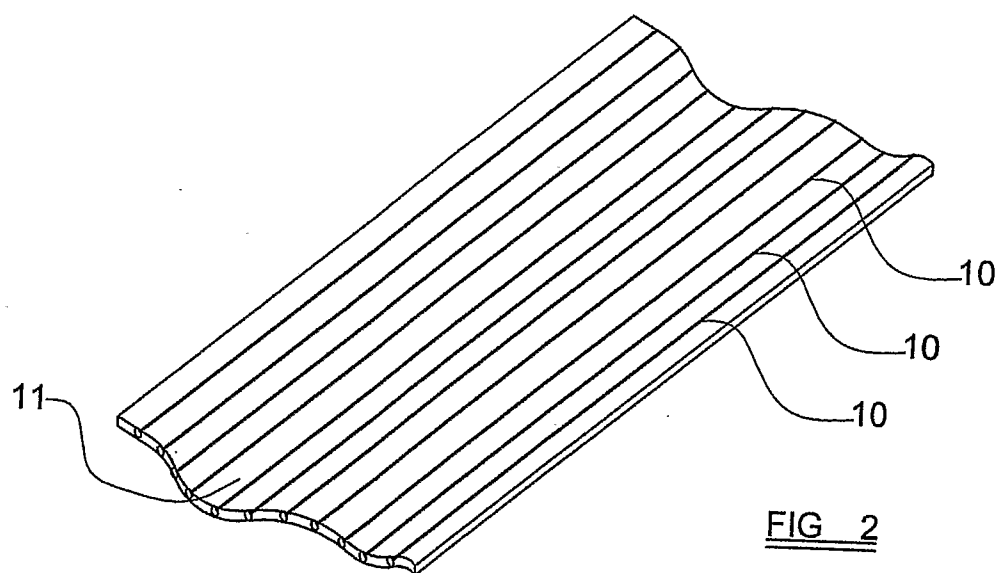


FIG 1

2 / 4



3 / 4

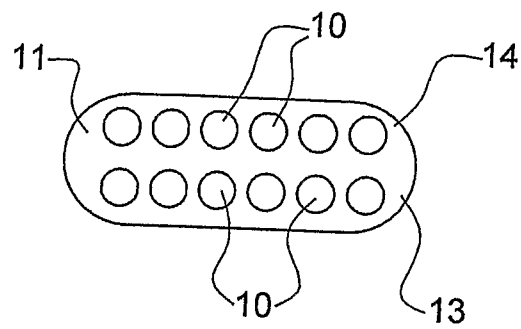


FIG 4

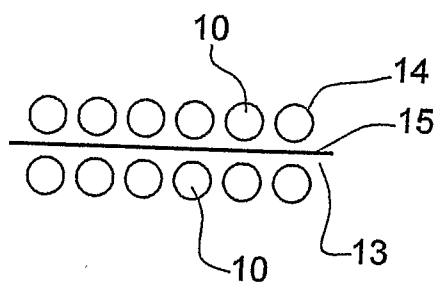


FIG 5

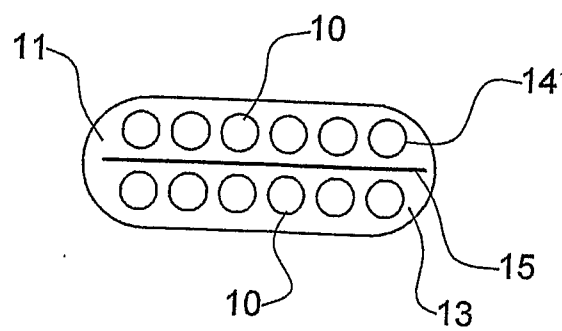


FIG 6

4 / 4

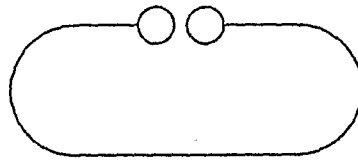


FIG 8

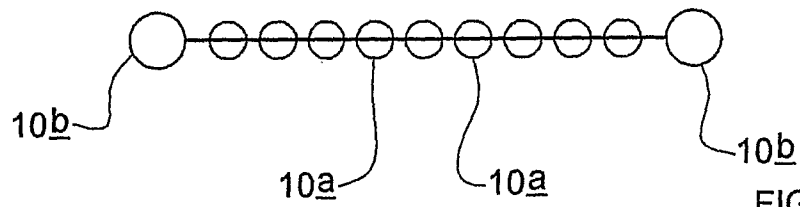


FIG 7

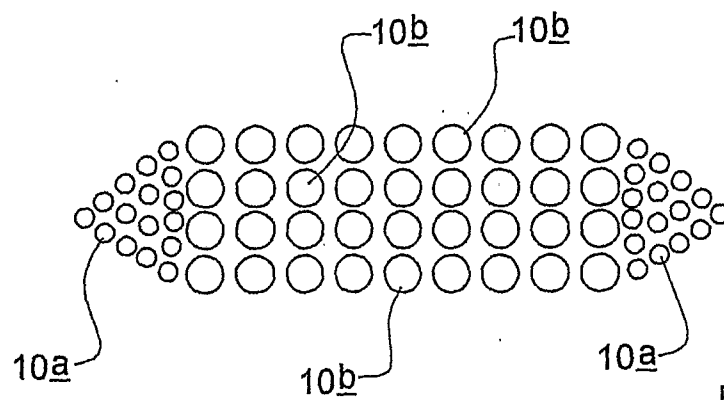


FIG 9

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2007/002824

A. CLASSIFICATION OF SUBJECT MATTER

INV. D04H3/14 B60R22/405

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)

D04H B60R

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

11 October 2007

Date of mailing of the international search report

29/10/2007

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INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2007/002824

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

International application No

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