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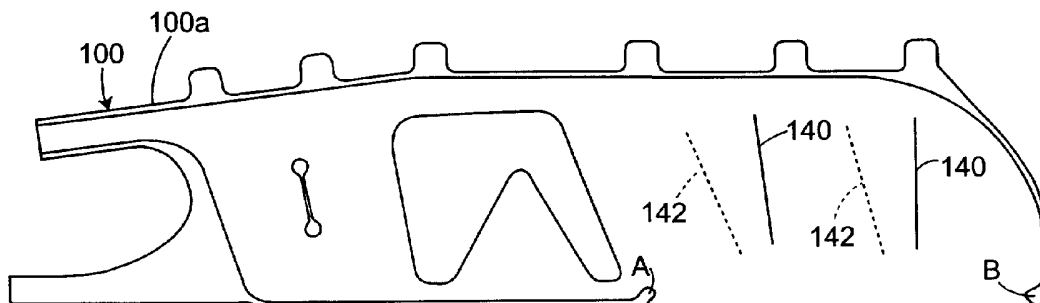
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(54) Title: AIRBAG ASSEMBLY WITH TETHERS IN A WOVEN CUSHION



(57) Abstract: An airbag (100) has opposing panels of material joined at a periphery of the airbag along a peripheral seam (56) that substantially extends about the periphery of the airbag, the peripheral seam being open along a determinable length to provide access to the interior of the airbag. A tether (80) having a determinable width is located within the interior of the airbag through the access opening (102) and having generally opposing first and second sides (80a, 80b). A first side of the tether (80a) is secured to a first airbag panel (52) and a second side of the tether (80b) is secured to a second airbag panel (54). A peripheral seam segment (56a) closes the open portion of the peripheral seam.

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AIRBAG ASSEMBLY WITH TETHERS IN A WOVEN CUSHION

The present invention relates to airbags and more particularly to a new construction of the airbags.

Historically airbags have been made by sewing layers of woven fabric together. In order to control of the extension and shape of the airbag many airbags include tethers. When the airbag is inflated the inner and outer panels are separated by the length of the tethers. This type of construction is easily achieved when the various parts of the airbag are sewn together.

The prior art also illustrates airbags can be made by rf (radio frequency) welding various panels of material together or by weaving yarn utilizing a special loom and head, such as a Jacquard head. Dobby looms can also be used to make a functionally similar airbag.

One of the issues with the rf (radio frequency) and woven types of airbag construction is that the interior or inner panel and the outer or exterior panel of the airbag are joined together along a woven or bonded seam. The present invention provides an airbag that can be constructed utilizing rf (radio frequency) or woven technologies and include internal tethers.

The invention also relates to a one-piece, integral woven tube or cover into which an elongated, folded curtain airbag can be inserted and stored.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 a plan view of a prior art curtain airbag.

FIGURE 2 is a cross-sectional view through section 2-2.

FIGURE 3 an isolated view of a tether.

FIGURE 4 shows a partially completed curtain airbag using the present invention.

FIGURE 5 is a plan view of a completed airbag with sewn-in tethers.

FIGURES 5a and 5b show further details of the airbag of FIGURE 5.

FIGURE 6 is a partial cross-sectional view showing an inflated airbag with sewn-in tethers.

FIGURE 7 is a partial cross-sectional view showing a sewn-together seam segment.

FIGURE 7a is a partial cross-sectional view showing a double-sided pressure tape used to close a portion of the airbag.

FIGURE 7b shows the use of a heat-activated tape.

FIGURE 8 shows a tearable, woven tubular airbag cover.

FIGURE 8a is a cross-sectional view taken through section line 8a-8a showing a woven-in tear seam.

DETAILED DESCRIPTION OF THE INVENTION

FIGURE 1 illustrates a prior art airbag curtain 50. The airbag includes inner and outer panel 52, 54 respectively. The panels are generally joined together along a peripheral seam 56. This seam can be a sewn seam, a bonded seam or a woven seam. As used herein and in the claims a woven bag is also referred to as a one-piece-woven bag. The airbag 50 additionally includes an inlet 58, which is connectable to an inflator. The extent to which the inner and outer panels are permitted to extend away from each other is limited by a number of interior structures.

For example, the inner and outer panels 52, 54 can be joined together along seams, or lines, 60, 60a-d or along an area 72 (this area 72 is a non-inflatable zone of the airbag). The inner and outer panels are joined directly together, as shown in FIGURE 2, along seams 60, 60a-d and along the seam that follows the periphery of area 72.

When the airbag 50 is deployed, the airbag unfolds from its stored orientation and the outer panel 54 will lie against an adjacent vehicle side 62. Because of the zero distance connection between the inner and the outer panels along seams 60, 60a-60d, as well as about region 72, and depending upon inflation pressure, it is possible to collapse the airbag in the vicinity of these joined-together areas and impact the vehicle side.

One of the main purposes of joining the panels 52, 54 together is to limit the volume 70 of the airbag 50 that needs to be inflated. This permits a smaller sized inflator to be used to inflate the airbag.

The inlet 58, mentioned above, can be located within a vehicle passenger compartment generally near the A-pillar of the vehicle, while the non-inflated region 72 is located proximate to and slightly behind the B-pillar. End 66 of the airbag is located near the C-pillar of the vehicle. The bag and its components can be reversed, in which case the end 66 would be located near the A-pillar with the inlet 58 near the C-pillar, or even at the B-pillar. When inflated, the lower portions 68 of the airbag 50 may be loosely positioned relative to the adjacent side of the vehicle or alternatively the

airbag may include non-inflatable regions that are used as tethers; one such non-inflatable region is shown by numeral 76. As is known in the art, some curtain airbags include inflatable end tethers or like structures, which can be achieved by constructing a sack at the location of the tether 76 and communicating the sack to the interior of the airbag. An opposing end 76a of the tether 76 can be secured to an adjacent side of the vehicle.

In many situations it is desirable to permit the side panels of the airbag to become spaced from each other when the airbag is inflated. If the airbag 50 is made of a sewn-together construction, it is relatively easy to sew or otherwise insert a tether such as 80, as shown in FIGURE 3, between the inner and outer panels 50, 54. This type of tether is sometimes referred to as a 3-D tether. With the use of a 3-D tether, the inner and outer panels are allowed to move apart, by a distance equal to the width of the tether, when the airbag is inflated, thereby insuring the vehicle occupant stays further away from a hard surface such as the adjacent vehicle side structure.

FIGURE 4 illustrates the airbag 100 constructed using the present invention. The general shape of airbag 100 is very similar if not identical to that of airbag 50. The present invention assembly process first partially constructs the airbag 100, then one or more tethers 80 are added to the partially constructed bag, and the airbag is then completed. The partially constructed airbag is designated by numeral 100a.

The partially constructed airbag 100a, in general, can be achieved by weaving the bag 100a, which has some advantages. For example, in a one-piece-woven operation the bag would be removed from the loom in an almost complete state. The capital investment to make a woven bag is greater than that of a sewn bag but the labor cost is less. Ultimately, the bag as taken from loom will be coated with urethane or silicon to control the permeability of the bag and then completed in accordance with the present invention. The inner and outer panels 52, 54 can be joined together by other appropriate means such by rf welding, or sewing, the panels together. Regardless of the process used to make the partially constructed bag, the panels are secured together. In the preferred embodiment of the invention the bag is integrally

woven, however the peripheral seam 56 does not extend completely about the periphery of the airbag.

In FIGURE 4 the peripheral seam 56 is absent between points A and B. This partial construction defines an access opening 102 to the interior of the partially constructed airbag 100a. The 3-D tether 80 will be inserted within the partially completed airbag through this access opening.

FIGURE 3 illustrates one of the 3-D tethers 80. As illustrated, the tether 80 is trapezoidal in shape having sides 80a, 80b and ends 82a, 82b. Each of the ends 82a, 82b includes an optional notch 84, which reduces stress concentration at the ends of the tether.

In FIGURE 4 as an assembly aid, the bag 100a includes marking lines on both of its side panels 52, 54 respectively. For example, one such marking line 140 is located on panel 52 at the desired location of each seam used to secure a tether to panel 52. Additionally, another marking line, such as 142, is placed on panel 54 at the desired location of each seam used to secure a tether 80 to panel 54. FIGURE 4 shows two such marking lines 140, 142, which will secure two tethers 80 to the airbag 100a. Of course more tethers can be used. If the partially constructed airbag 100a is made using one-piece woven technology, the marking lines are formed using colored, preferably a contrasting color, yarn, which is integrally woven into each panel 52, 54. If woven into the bag, the marking lines 140, 142 will be visible from either side of each panel 52, 54. The marking lines 140, 142 can also be printed or painted.

Prior to attaching the tethers 80, the flexible airbag panels 52, 54 are separated at opening 102 to permit the operator to gain access to the interior of the airbag 100a. Thereafter the operator aligns side 80a of tether 80 to the marking line 142 in panel 54 and then secures side 80a to panel 54 along seam 120 which runs along the marking line 142. As used herein the seam 120 can be achieved by rf welding side 80a to panel 54 or alternatively sewing side 80a to panel 54. In the preferred embodiment of this invention the tethers are sewn onto a partially woven bag. The process is repeated for as many tethers as are being used, that is, each tether is sewn to a

corresponding marking line 142 in panel 54. Thereafter the airbag 100a is turned upside down such that panel 52 is placed upon the work surface. Side 80b of the tether 80 is aligned to a marking line 140 in panel 52 and appropriately secured along seam 122 which extends along marking line 140. The seam 122, as with seam 120, can be of an rf or of a sewn construction. If permeability of a sewn seam is of concern, that is, if the use of a sewn seam may increase the permeability of the airbag to an unacceptable level, each seam 120, 122 can be reinforced or sealed to limit the airbag thereacross. FIGURE 5 shows the airbag of FIGURE 4 with two sewn-in tethers 80.

The air flow across a sewn seam that is the air flow through the needle and thread holes can be reduced, assuming it is an issue, by first placing an pressure sensitive or heat sensitive adhesive tape segment 146 to the outside of each panel 52, 54 at the location of seam 120, 122 at the location of the marking lines 140, 142 as shown in FIGUREs 5a and 5b. In the present invention the use of the tape segments 146 is optional. The sewing threads forming seams 120, 122 will extend through the respective tether side, which is attached to the inside of each panel 52, 54, as well as through and about respective tape segments. As an alternative to placing an adhesive tape on the outside of the panels, a double-sided pressure or heat sensitive tape can be placed on the inside of one of the panels, such as 52, and then one side of the tether can be placed on the tape and the tethers sewn to the panel. This process is repeated for the other side of the tether. Thereafter the panels and the sides of the tether 80 are ironed together with the application of heat and pressure, at the locations defined by the marking lines 140, 142. FIGURE 6 is a partial cross-sectional view showing one tether 80, which has been sewn to the panels 52, 54. The airbag is shown in an inflated condition.

After the tethers 80 are added to the partially constructed airbag 100a, the missing portion of the peripheral seam, for example portion 56a, is then added to the airbag. This missing segment 56a of seam can be an rf seam 56 or for example the airbag 100a can be closed by sewing the airbag such as by joining the panels 52, 54 together with a sewn seam 130 in FIGURE 7. If permeability is a concern, an adhesive tape segment 146 can be placed on or

between both panels along the location of seam 130 and the bag sewn closed in a manner similar to that used in FIGURE 5b. In the present invention a segment of double-sided adhesive tape 148 can be inserted between the panels 52 or 54 and the panels optionally sewn together at seam 130 as shown in FIGURE 7a. In the preferred embodiment of the invention, an adhesive, heat sensitive tape segment 148 is inserted between points A and B, as shown in FIGURE 7b. Thereafter the panels are ironed together, that is with the application of heat and pressure, thereby closing the opening 102.

Curtain airbags, which are usually oblong in shape, can easily be folded into a configuration that is somewhat cylindrical. The prior art shows that folded curtain airbags can be inserted within an elongated, thin, hollow cylindrical tube of airbag material, which is formed by folding over a length of material and sewing it closed at a seam, which runs opposite to and parallel to the fold. In the present invention it is proposed that this sewn cylindrical tube can be replaced by a woven tube, which will be more uniform (that is when comparing one tube to another) and which will eliminate the sewing process. This type of one-piece-woven tube can be manufactured using a Dobby or Jacquard type loom.

FIGURE 8 illustrates a woven curtain cover 300 comprising an integrally formed hollow woven tube 302. The tube includes a double thickness seam or border 304 running its length on one side. Two opposing panels 306a, 306b integrally extend from the seam or border 304. The construction of the tube 300 along its side opposite the double thickness border is as follows. The panels 306a, 306b end at opposing single thickness panel sides 308a, 308b. Preferably a single weft or fill thread 310, or a relatively few weft threads, interconnects each of the sides 308a, 308b, the threads form a tear seam as also shown in FIGURE 8a.

As known the prior art teaches tubular covers sewn together along sides analogous to sides 308a, 308b, however the present invention has distinct advantages to sewing these sides together. The thread or yarn, which forms the tear seam, is integrally constructed as part of one of the panels such as 306a, 306b, and during the weaving process this tear seam thread

310 is caused to periodically jump from one panel to another with a pitch that is or can be uneven, at least in contrast with the even and uniform pitch stitch pattern generated by sewing. This construction has advantages over making the cover with a sewn tear seam. If, however, the tear seam is woven into the cover, the tear seam can be made to jump between panel 306a, 306b at arbitrary or uneven intervals as distinguished from a sewn-in tear seam. Additionally the tear seam can be reinforced along various sections of the cover 300. For example, the tear seam can be more densely woven (see the second integrally woven thread 310a, which joins sides 308a, 308b over a short center length) or stronger in the center of the cover 300 than at the ends of the tube, thereby encouraging the tube to open at one or both of the ends.

Claims

1. An airbag (100) comprising:
opposing panels (52, 54) of material are joined at a periphery of the airbag along a peripheral seam (56) that substantially extends about the periphery of the airbag, the peripheral seam being open along a determinable length to provide access to the interior of the airbag;
a tether (80) having a determinable width is located within the interior of the airbag through the access opening (102) and has generally opposing first and second sides (80a, 80b), the first tether side (80a) is secured to a first of the airbag panels (52) and a second tether side (80b) is secured to a second of the airbag panels (54); and
a peripheral seam segment (56a) closes the open portion of the peripheral seam (56).
2. The airbag (100) defined in Claim 1 wherein the sides (80a, 80b) of the tether (80) are not parallel to each other.
3. The airbag (100) defined in Claim 1 or 2 wherein each tether side (80a, 80b) is rf bonded to an adjacent panel (52, 54) of the airbag.
4. The airbag (100) defined in Claim 1 or 2 wherein each tether side (80a, 80b) is sewn to an adjacent panel (52, 54) of the airbag.
5. The airbag (100) defined in Claim 4 wherein the airbag includes an adhesive tape located on each of the airbag panels (52, 54) at the location of the seam used to sew each tether side (80a, 80b) to a panel of the airbag.
6. The airbag (100) defined in any of Claims 1 – 5 wherein the peripheral seam segment (56a) is a sewn seam.

7. The airbag (100) defined in Claim 6 wherein the airbag includes at least one segment (146) of reinforcing tape located at the peripheral seam segment (56a).

8. The airbag (100) defined in any of the receding claims wherein the airbag is formed by:

partially constructing the airbag and leaving an opening (102) at a determinable location at or near the periphery of the partially constructed airbag to provide access to the interior thereof;

inserting a tether (80) into the interior of the bag through the opening (102);

securing one side (80a) of the tether to the first panel (52) of the airbag and securing a second side (80b) of the tether to the second panel (54) of the airbag; and

closing the opening (102).

9. The airbag (100) defined in Claim 8 wherein the step of partially constructing the airbag includes weaving the airbag to form the panels (52, 54) and integrally formed seam (56), which generally extends about a determinable portion the airbag periphery but does not extend across that part of the airbag that defines the opening (102), which provides access to the interior thereof.

10. The airbag (100) defined in Claim 8 or 9 wherein the step of partially constructing the airbag includes forming the bag by weaving.

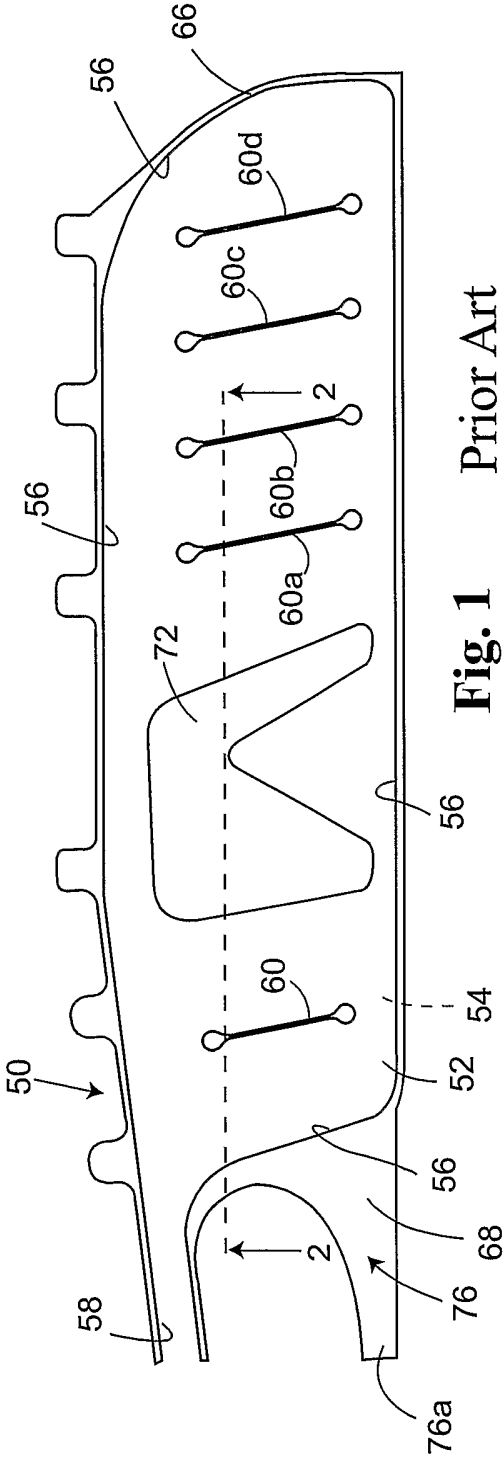


Fig. 1 Prior Art

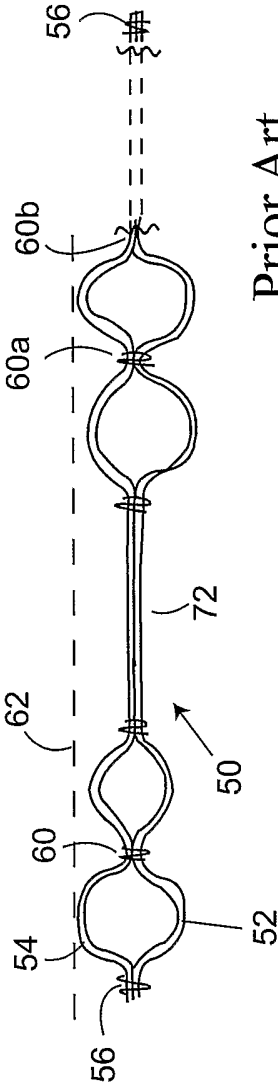
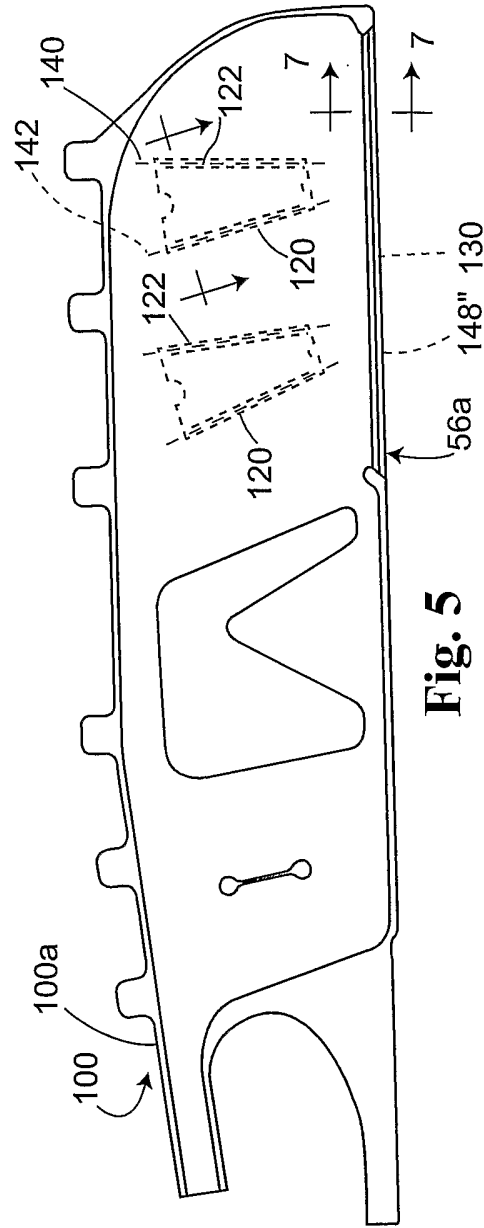
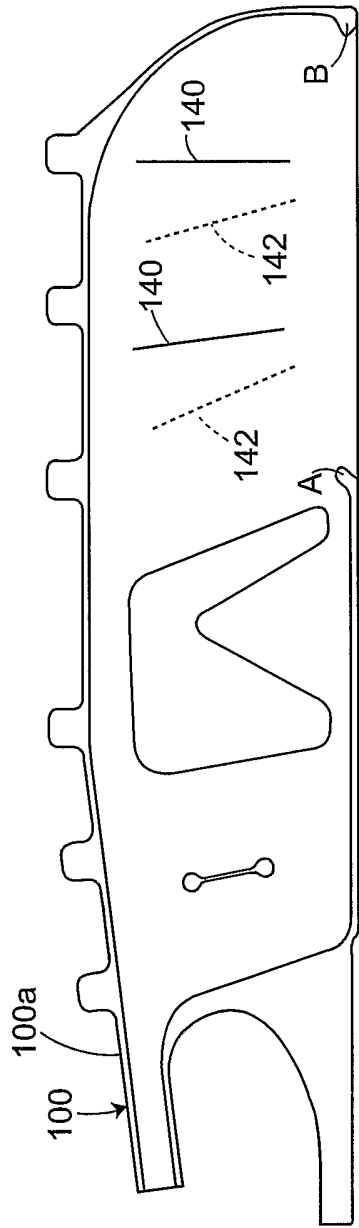
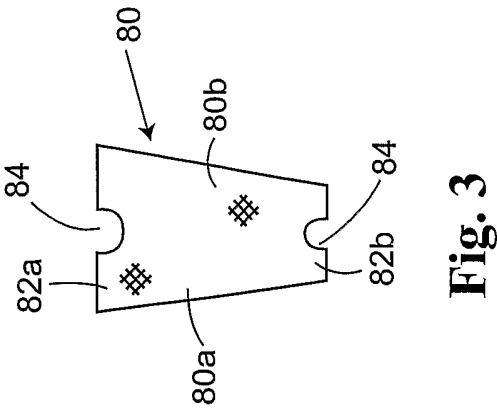
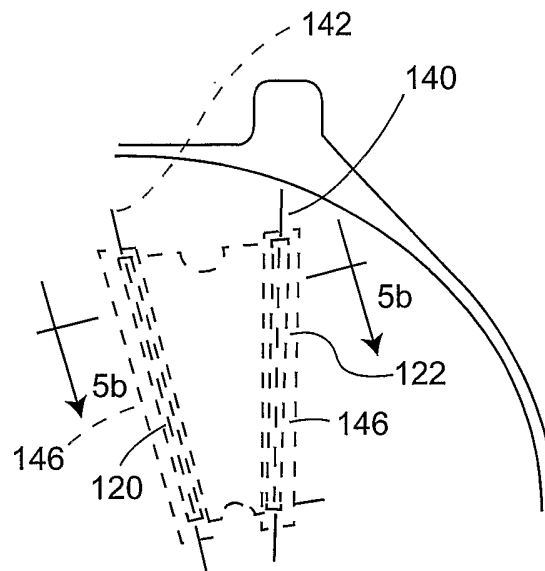
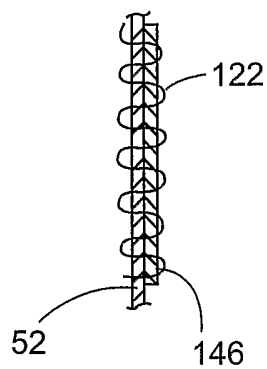


Fig. 2 Prior Art



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**Fig. 5a****Fig. 5b**

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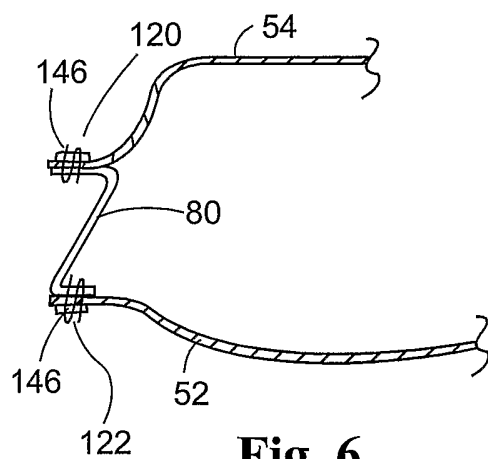


Fig. 6

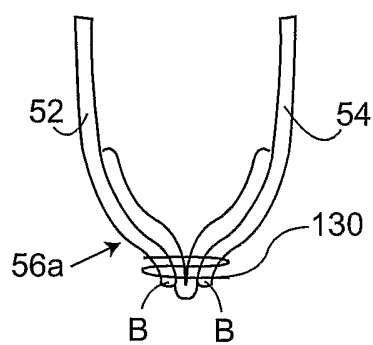


Fig. 7

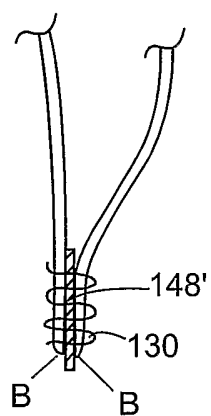


Fig. 7a

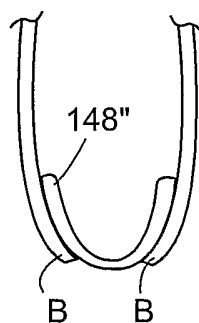
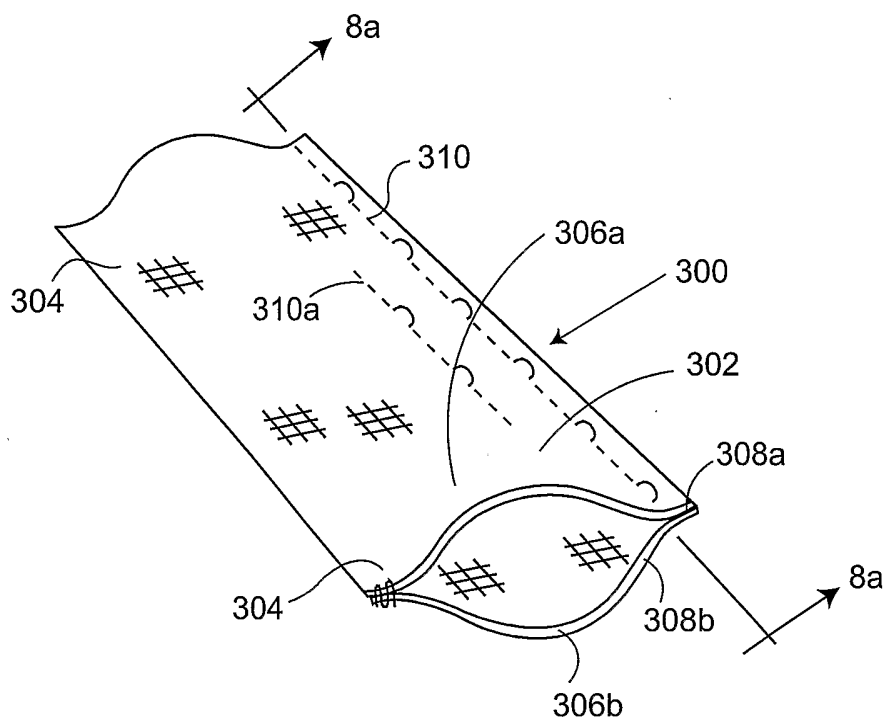
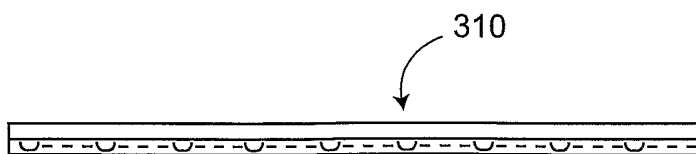


Fig. 7b

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**Fig. 8****Fig. 8a**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/16952

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B60R 21/16

US CL : 280/743.2

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)

U.S. : 280/743.2; 280/750.2; 280/749

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,299,965 B1 (KESHAVARAJ) 09 October 2001, see entire document.	1-10
X	US 6,357,788 B2 (KREILE) 19 March 2002, see entire document.	18
A, P	US 6,489,006 B1 (KESHAVARAJ) 03 December 2002.	1-10
A	US 6,375,214 B1 (NISHIKAJI) 23 April 2002.	1-10
A	US 6,257,616 B1 (NOWAK et al.) 10 July 2001.	1-10
A	US 6,237,943 B1 (BROWN et al.) 29 May 2001.	1-10
A	US 6,189,915 B1 (SODERQUIST et al.) 20 February 2001.	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"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
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