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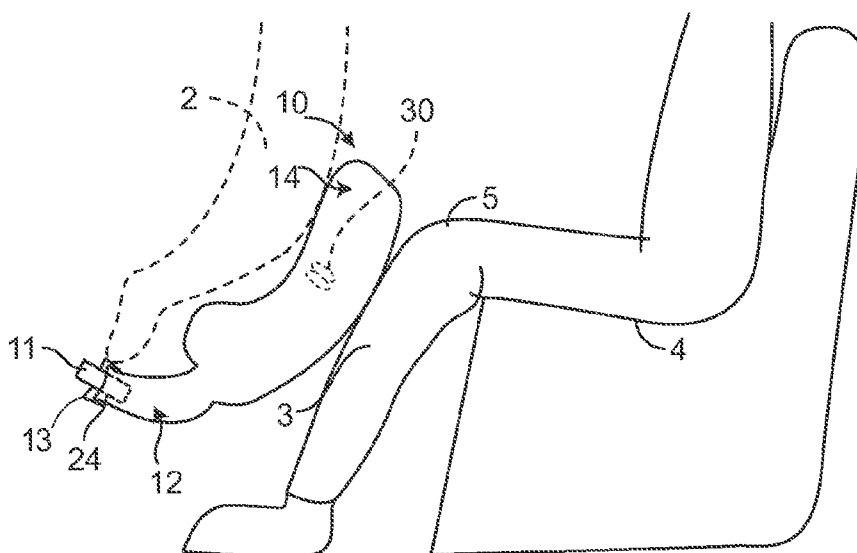


FIG. 2

(57) Abstract: A knee air bag (10) has an upper section (14) for protecting an occupant and a lower section (12) for delivering gas from an inflator (11) to the upper section (14). The upper section (14) and the lower section (12) have a forward facing panel (21) and a rearward facing panel (22) joined together by one or more joints (30) adhering the two opposing panels (21, 22). This separates the upper section (14) and the lower section (12) into inflatable chambers (12A, 14A). One chamber is the single chamber of the upper section (14A). The other chamber is a manifold chamber (12A) of the lower section (12) for providing inflation gases from an inflator (11) into the manifold chamber (12A) and thereafter into the single chamber (14A).

KNEE AIR BAG

Field of the Invention

[001] This invention relates to the field of inflatable air bags generally, more particularly to an improved knee air bag.

Background of the Invention

[002] Inflatable air bags are commonly used to protect vehicle occupants. As the technology of air bags has evolved the use of specialized protection devices has expanded from front driver side air bags and front passenger air bags to side seat-mounted air bags, side curtain air bags and others.

[003] Early on there was recognized a need to protect the front seated driver and passenger from lower leg and knee injuries. In US 4,290,627 an early driver's side air bag deployed from under the vehicle's dash toward the driver's knees and further inflated in an L-shape vertically between the driver and the steering wheel.

[004] As designs of air bags evolved, the use of steering wheel mounted air bags has been widely accepted. These designs do not lend themselves to protecting the lower legs and knees.

[005] Knee bag bolsters and air bags mounted under the dash and deploying between the occupant's knees and the dash have been designed as shown in prior art US 2002/0149187. These knee bolster air bags provide a soft cushion for protecting the knees and the lower legs.

[006] Ideally the use of knee and lower leg protecting air bags can be designed simply and efficiently. However, in order to satisfy the requirements these designs have often resorted to complex constructions employing internal tethers and separate interior chambers made of complex partitioning walls to achieve the needed protection and impact absorption.

[007] The present invention described herein greatly simplifies the knee air bag allowing it to be fabricated without internal tethers while providing a uniquely efficient impact absorbing capability.

Summary of the Invention

[008] A knee air bag has an upper section for protecting an occupant and a lower section for delivering gas from an inflator to the upper section. The air bag is inflatable from a stored condition to an inflated condition. The upper section is also referred to herein as a single

chamber or upper single chamber, which when inflated is positioned opposite the occupant's knees and tibias. The lower section which is also referred to as a manifold chamber, communicate inflation gas from the inflator to the upper section is a hollow, generally cylindrically or conical shaped region when inflated, and extends from a lower region of the upper section and is in fluid communication with the upper section. The lower section has an inflator inlet with an opening configured to receive a portion of the inflator. In the preferred embodiments, the upper section and the lower section have a forward facing panel and a rearward facing panel joined together by one or more joints adhering the forward and rear facing panels.

[009] In a preferred embodiment, portions of the upper and lower section including the front and rear panel are constructed using the same piece of fabric. The knee air bag can have an outer perimeter seam sewn or can be otherwise joined using other techniques. The outer perimeter seam joins the rearward panel to the forward panel to create a sealed knee air bag. Alternatively, the knee air bag can have two opposing side panels joined or otherwise affixed to the forward facing panel and the rearward facing panel to create a knee air bag with greater depth.

[0010] The one or more joints which adhere the two opposing panels extend partially across the rearward and forward facing panels leaving portions of the oppositely facing panels separated to form one or more gas passages for gas exiting the manifold chamber into the upper chamber. In one embodiment two joints are spaced apart in a center portion of the knee air bag to form at least one central gas passage. These two joints preferably do not extend to side edges of the knee air bag. In this embodiment, the knee air bag has three or more gas passages open between the upper chamber and the lower (manifold) chamber. The joints can be formed by sewn stitching locally connecting the forward and rearward facing panels, by interweaving or heat welding the panels together. The joints are sealed or sewn in a shape having a length and a width and positioned to form at least one passage formed in a tubular channel shape. Preferably, the at least one joint are sealed or sewn together occupying a co-joined area of the two opposing panels and the spaces between the at least one joint or the joint and a side of the air bag are open to form the gas passages in a channel between the panels.

[0011] Alternatively, the knee air bag can be fabricated wherein the upper and lower section are constructed separately and joined together.

[0012] The inflator inlet can be formed of fabric from the air bag, or as a flange affixed to the air bag or as a housing structure for holding the inflator which is affixed to the air bag. The

knee air bag can further have one or more external tethers having an end affixed to the upper section and an end affixed to the lower section or a housing adjacent the airbag. The external tethers can be formed from a portion of the rearward facing panel or both the rearward and forward facing panels and located in a non-inflated region of the knee air bag wherein the panels are joined. The external tether redirects the upper section of the knee air bag assisting in vertically positioning the upper section between a vehicle dash and the knees and/or tibia of an occupant.

Brief Description of the Drawings

[0013] The invention will be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a perspective view of the inflated knee air bag made in accordance with the present invention.

Figure 1A is a cross-sectional view through section 1A-1A which extends through a portion of the airbag of figure 1 where the section line is off-center.

Figure 2 is a side view taken from figure 1.

Figure 3 is a top plan view of the uninflated knee air bag showing the joints.

Figures 4a – 4c are plan views of the fabric panels used to form the knee air bag of the present invention. Figure 4a shows the rearward and forward panels made from a single fabric panel. Figure 4b shows a partially completed airbag with a pre-stitched pattern. Figure 4c shows the stitch pattern. Figure 4d shows a complete airbag.

Figures 5a – 5d is an alternative embodiment shown in plan view, the air bag depicted with separate side panels. Figure 5a shows the rearward facing and forward facing panels. Figure 5b shows two side panels. Figure 5c shows the assembled air bag. Figure 5d is a cross-sectional view of the air bag of figure 5c taken along lines 5d-5d.

Figures 6a – 6c show another alternative embodiment of a knee air bag where the rearward facing and forward facing panels are made from two separate pieces of fabric with integral sides.

Figures 7a – 7c show another embodiment with external tethers. Figure 7a shows the stitched seams and joints. Figure 7b shows the waste removed showing the tethers. Figure 7c is a side view of the air bag when inflated.

Figure 8 shows the air bag with a flanged inlet.

Figure 9 shows the air bag with an inflator housing.

Figure 10 is another alternative embodiment wherein the upper section and lower sections are separate structures joined by a flanged connection.

Figure 11 is another alternative embodiment wherein the separate sections are separate structures with the lower section inserted into the upper section.

Figure 12 shows another alternate embodiment of the invention.

Detailed Description of the Invention

[0014] With reference to figures 1, 2 and 3, a knee air bag 10 is shown in an inflated condition projecting from underneath the dashboard or dash 2 of the vehicle (see figure 2) with the upper section positioned between the dashboard 2 and the occupant's knee and/or tibia. As shown, the knee air bag 10 has a lower section 12 which is generally cylindrically shaped, for delivering gas from an inflator 11 to an upper section 14. The upper section 14 defines an upper chamber 14A and the lower section 12 defines a lower chamber 12A. The air bag 10 in its stowed condition is inflatable from under the dash 2 and upon inflation extends upwardly to protect the occupant's knees and legs. In figures 1, 2 and 3, the lower section 12 as shown has an inflator inlet 24 with an opening configured to receive a portion of the inflator 11. The upper section 14 and lower section 12 are preferably made using opposing panels 20 including a forward facing panel 21 and a rearward facing panel 22 joined together by one or more joints 30 adhering the two opposing panels 21, 22 as well as being joined at the respective peripheries of the panels. The upper and lower sections 12, 14 can be constructed using one or more fabric panels 20. These fabric panels 20 can be coated or uncoated depending on the desire of the manufacturer. Coatings provide an air impermeable barrier and help retain the inflation gases inside the air bag 10. In regard to an uncoated bag, the denier thread and density of the weave control the rate of pressure loss in the bag. Prior to inflation the airbag can be folded with a housing such as 13 which is shown in greater detail in figure 12. The housing is secured to a structure member below the instrument panel 2. The inflator 11 is also supported within the housing 13.

[0015] A partial cross-sectional view is shown in figure 1a. A side view of the knee air bag 10 is shown in figure 2 so that one can better appreciate the positioning of the knee air bag 10 with respect to the dash 2 and the vehicle occupant seat 4.

[0016] As shown in figures 4A – 4C, the forward panel 21 and the rearward panel 22 are made of a single panel 20 that is folded about a line 29. Figure 4a shows panel laid flat while figure 4b shows panel 20 folded about the foldline 29. Figure 4b shows two joints 30 placed with a portion of the folded over panels that will form the upper panel. The panel 20 when folded can then be stitched in a series of stitches or stitch pattern 28 as illustrated in figure 4c. Some of stitches in pattern 28 form the seamed sides or edges 28a of the upper section, the lower portion 28b of the upper section 14 and also define the inlet 24 of the lower section 12 and chamber 12A through which gas inflation is delivered to the lower chamber or manifold 12A. As previously mentioned, the two joints 30 as illustrated are in the shape of figure 8's. These figure 8's can be sewn seams or heat welded joints 30 that bring the two opposing panels 21 and 22 together at one or more defined locations. The open space between the joints 30 forms air passageways so that the inflation gases can be fed from the lower manifold chamber 12A up to the upper single chamber 14. The locations marked "R" in figure 4c are waste or selvage that can be removed, as shown in figure 4d, from the air bag 10 upon stitching the panels together. As can be easily appreciated, this construction provides for a rather simple manufacturing technique to make the knee air bag 10. When assembled as shown in figure 4b, the air bag 10 is effectively divided into an upper portion and a lower portion communicated by the air passage channels 40.

[0017] With reference to figures 5a – 5d, a second alternative embodiment is shown where the forward and rearward panels 21, 22 also are produced from one piece of material 20, however, side panels 23, 25 are also provided to provide additional depth to the edges of the upper panel 14. These side panels 23, 25 can either be separate components as illustrated in figure 5b or can be integrally formed as part of the forward and rearward panels 21, 22 as illustrated in figures 6a – 6c. During assembly either prior to or after the side panels are joined to the piece of material 20, one or more joints 30 are provided as previously discussed. The side panels 23 and 25 are sewn to or otherwise joined to the front and rear facing panels forming the air bag with separate upper and lower chambers (14A, 12A); however, in this case the air bag 10 is significantly thicker or wider in the inflated condition due to the addition of side panels 23, 25 compared with the airbag in figures 1- 3. As shown in figure 5d, a cross sectional view is illustrated wherein the cross sectional view is taken through a joint 30 thereby showing how the first panel 21 and second panel 22 are adhered to each other in the construction. The inflator 11 is shown spaced apart from the airbag in figure 5c but placed within the airbag in figure 5d. This cross sectional view of figure 5d shows how the inflator 11 will send gas to the lower manifold chamber 12A filling the lower section 12

which then will flow into the upper chamber 14A and be directed on either side of the stitch joint 30.

[0018] With reference to figures 6a - 6c, a third alternative embodiment is shown wherein the forward panel 21 and rearward panel 22 are two separate pieces that are simply sewn together as is known in the art. Additionally, side panel 23 is constructed as an extension of panel 21 while side panel 25 is constructed as an extension of panel 22. The phantom lines in figures 6a and 6b show that the side panels can be formed as part of the respective forward or rearward facing panel or added thereto. In the latter case the phantom lines are illustrative of a sewn seam.

[0019] The alternative embodiment shown in figures 7a – 7d is similar to the embodiment shown in figure 4c with one exception that parts of the two scrap portions R are not removed, but used to form extensions which form external tethers 50. As before the forward and rearward panels 21, 22 are folded about foldline 29. When scrap portions R1 and R2 and L1 and L2 are respectively removed from the lower left-hand and lower-right hand portions of the partially formed bag, right and left side integral tethers 50 are formed. The scrap portions are separated by cutting along cut lines C and C. Figure 7b shows the airbag with the scrap portions R1, R2, L1 and L2 removed. In figure 7b, the indication “A” shows the ends of each tether 50 while the indication “B” shows stitching locations for the external tethers 50. Each tether 50 is folded over and a respective endA is sewn or otherwise secured to location B as shown in figure 7c. These external tethers 50 when the air bag 10 is inflated help direct the upper section 14 of the air bag 10 into a more vertical position causing a bend C in the air bag that helps position it between the dash 2 and the vehicle occupant. These and other alternatives can be provided; as shown in this embodiment the forward and rearward panels 21, 22 were formed from the same piece of material. The side edges or seams 28 of the air bag 10 are simply sewn together. However, in the embodiment the side panels 23, 25 could have been used to provide increased depth to the side edge portions of the airbag. As a variation a single figure 8 joint is formed in the center of the upper chamber and is shown in figure 7a; multiple joints 30 are shown for the purpose of illustration in figure 7c. These figure 8’s can be formed by stitches or heat sealing panels 21, 22 together.

[0020] Figure 8 shows alternative joint constructions using two opposing L-shaped joints 30 creating channels 40. When producing the joints 30 in this configuration, the passageways become more of a tubular channel that can be directed towards the single chambered upper section from the gas inlet.

[0021] As further shown in figures 8 and 9, the gas inlet 24 can have a flange 27 situated about the gas inlet 24. This flange 27 can assist in the mounting of the air bag 10 if so desired. Additionally, the air bag 10 can be provided with a housing 26 to hold and to affix the air inflator 11 at which point the air bag inlet 24 is then affixed to the housing 26. In figure 8 the inlet of the airbag 24 is shown in plan view and the housing is shown in side view for the purpose of illustration. Arrow 26a diagrammatically shows how the flange 27 can be moved and placed upon the flange 27a of the housing which may extend peripherally about the housing 26. This relationship is also shown in figure 9. One airbag flange 27 is also shown in figure 10. These and other alternative configurations are considered within the scope of the present invention and are provided for illustrative purposes showing alternative constructions of the knee air bag 10.

[0022] As was shown in figures 7a – 7c, the tether 50 was formed as an integral construction of the forward and rearward panels 21, 22. Alternatively, the tethers 50 can simply be separate components that are externally stitched at both locations A and B as shown in figure 7c. When constructed in this manner, the fabric tethers 50 provide the same function of redirecting the air bag 10 as it inflates to ensure it is properly positioned between the knees and dashboard 2.

[0023] With reference to figures 10 and 11, the knee air bag 10 can be made from two separate structures joined together. The upper chamber 14A in the upper section 14 is the protection zone for the knee 5 and tibia 3 and upon inflation will be positioned between the knees and/or tibia and the lower portions of the instrument panel or dash. In the air bag 10 embodiment of figure 10, two flanges 27 one on the upper section and another on the lower section are joined together to form the assembled air bag 10. The inflation or lower chamber 12A has the inflator 11 positioned with one of either the horizontal or vertical position options shown to provide the inflation gas to fill the air bag 10. The lower section 12 has a curvature or “J” shape that properly directs the knee bag 10 on deployment to deploy in a direction toward the knees and then upwardly as the knee air bag 10 continues to inflate. The embodiments of figures 10 and 11 have the lower chamber 12A substantially narrower than the upper protection chamber 14A. This insures the inflation gases required to fill the upper chamber 14A protection zone are optimized thus maximizing the gases directed to protecting the occupant.

[0024] As shown in figure 11, the throat or opening of the lower section 12 joining the upper section 14 can be stitched using stitching 30 or a flap (not shown) to reduce the opening size

on inflation. Similarly the “J” shaped lower section 12 may employ tethers 50 to help form the bend or curvature shape as previously discussed.

[0025] Reference is briefly made to figure 12 which shows the lower section 12 of the airbag supported within housing 13 with the inflator 11 also supported in the housing 13.

[0026] Variations in the present invention are possible in light of the description of it provided herein. While certain representative embodiments and details have been shown for the purpose of illustrating the subject invention, it will be apparent to those skilled in this art that various changes and modifications can be made therein without departing from the scope of the subject invention. It is, therefore, to be understood that changes can be made in the particular embodiments described which will be within the full intended scope of the invention as defined by the following appended claims.

CLAIMS

What is claimed is:

1. A knee air bag (10) comprising an upper section (14) for protecting an occupant and a lower section (12) for delivering gas from an inflator (11) to the upper section (14); the air bag (10) inflatable from a stored condition to an inflated condition;

the upper section (14) comprising a single chamber (14A) which when inflated is positioned opposite the occupant's knee (5) and tibia (3);

the lower section (12), for communicating inflation gas from the inflator (11) to the upper section (14), the lower section (12) comprising a hollow, generally cylindrically shaped region when inflated and extending from a lower region of the upper section (14) and in fluid communication with the upper section (14), the lower section (12) having an inflator inlet (24) with an opening configured to receive a portion of the inflator (11); and

wherein said upper section (14) and said lower section (12) have a forward facing panel (21) and a rearward facing panel (22) joined together by one or more joints (30) adhering the two opposing panels (21, 22) separating the upper section (14) and the lower section (12) into inflatable chambers (12A, 14A), one chamber being the single chamber (14A) of the upper section (14), the other chamber being a manifold chamber (12A) of the lower section (12) for providing inflation gases from the inflator (11) into the manifold chamber (12A) and thereafter into the single chamber (14A).

2. The knee air bag (10) according to claim 1 wherein panels (21, 22) of the upper and lower section (14, 12) are constructed using the same piece of fabric (20).

3. The knee air bag (10) according to claim 2 wherein the forward panel (21) and the rearward panel (22) are constructed using the same piece of fabric (20).

4. The knee air bag (10) according to claim 1 wherein the knee air bag (10) has an outer perimeter seam (28) sewn or otherwise joined, the outer perimeter seam (28) joins the rearward panel (22) to the forward panel (21) to seal sides of the knee air bag.

5. The knee air bag (10) according to claim 1 wherein the knee air bag (10) has two opposing side panels (23, 25) joined or otherwise affixed to the forward facing panel and the rearward facing panel (21, 22) to seal sides of the knee air bag (10).

6. The knee air bag (10) according to claim 1 wherein the one or more joints (30) adhering the two opposing panels (21, 22) extend partially across the rearward and forward facing panels (21, 22) leaving portions of the oppositely facing panels (21, 22) separated to form one or more gas passages from the manifold chamber (12A) into the single chamber (14A).
7. The knee air bag (10) according to claim 6 wherein the one or more joints (30) are two joints spaced in a center portion of the knee air bag (10) to form at least one central gas passage (40).
8. The knee air bag (10) according to claim 7 wherein the two joints (30) do not extend to side edges of the knee air bag (10) to form two side gas passages (40).
9. The knee air bag (10) according to claim 7 wherein the knee air bag (10) has three or more gas passages (40) open between the single chamber (14A) and the manifold (12A).
10. The knee air bag (10) according to claim 1 wherein the joints (30) are formed by sewn stitching locally connecting the forward and rearward facing panels (21, 22).
11. The knee air bag (10) according to claim 1 wherein the joints (30) are sealed or sewn in a shape having a length and a width to form at least one passage (40) formed in a tubular channel (40) shape.
12. The knee air bag (10) according to claim 1 wherein the at least one joint (30) are sealed or sewn together occupying a co-joined area of the two opposing panels (21, 22) and the spaces between the at least one joint (30) or the joint and a side of the air bag are open to form the gas passages (40) in a channel (40) between the panels (21, 22).
13. The knee air bag (10) according to claim 1 wherein the upper and lower section (14, 12) are constructed separately and joined together.
14. The knee air bag (10) according to claim 1 wherein the upper section (14) comprises:

a first panel (21) which in an inflated condition faces a knee (5) or tibia (3) of an occupant to be protected, a second panel (22) which in an inflated condition faces away from the occupant to be protected, the first panel (21) having a top, bottom, first end and an opposite second end, the second panel (22) having a top, bottom, first end and an opposite second end;

the first and second panels (21, 22) are formed of one piece of material (20) or are formed of at least two pieces of material and are joined together along respective tops, the bottom of the first and second panels (21, 22) are partially joined along their respective bottoms, any unjoined section forming an inlet (24) to receive inflation gas to enter into the single chamber (14A) formed at least partially by the first and second panels; and

a first side panel (23) and a second side panel (25) secured to the top and oppositely positioned ends of respective first and second panels (21, 22) to form the knee air bag (10).

15. The knee air bag (10) according to claim 1 wherein the inflator inlet (24) is formed of fabric (20) from the air bag.

16. The knee air bag (10) according to claim 1 wherein the inflator inlet (24) is formed as a flange (27) affixed to the air bag.

17. The knee air bag (10) according to claim 1 wherein the inflator inlet (24) is formed of a housing structure (26) for holding the inflator (11) which is affixed to the air bag.

18. The knee air bag (10) according to claim 1 further comprising one or more external tethers (50) having an end (A) affixed to the upper section (14) and an end (A) affixed to the lower section (12).

19. The knee air bag (10) according to claim 1 wherein the external tethers (50) are formed from a portion of the rearward panel or both the rearward (22) and forward (21) facing panels in a non-inflated region of the knee air bag (10) wherein the panels are joined.

20. The knee air bag (10) according to claim 1 wherein the external tether (50) redirects the upper section (14) of the knee air bag generally vertically positioning the upper section (14) between a vehicle dash (2) and the knees (5) of an occupant.

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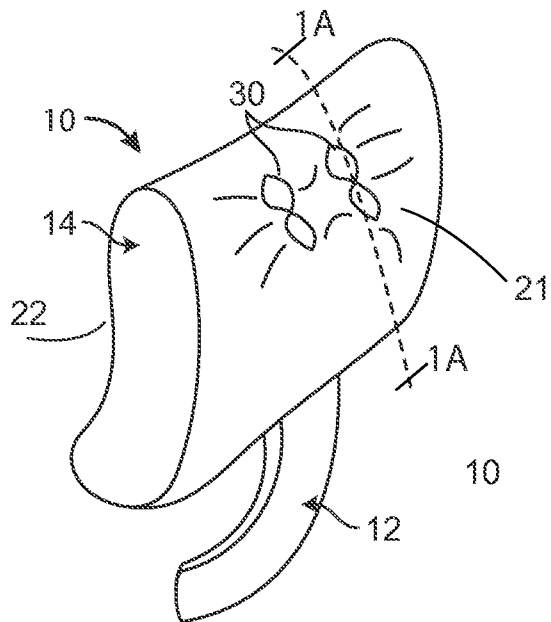


FIG. 1

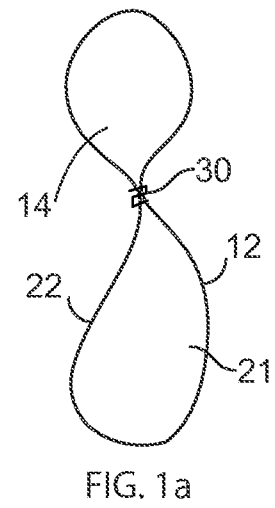


FIG. 1a

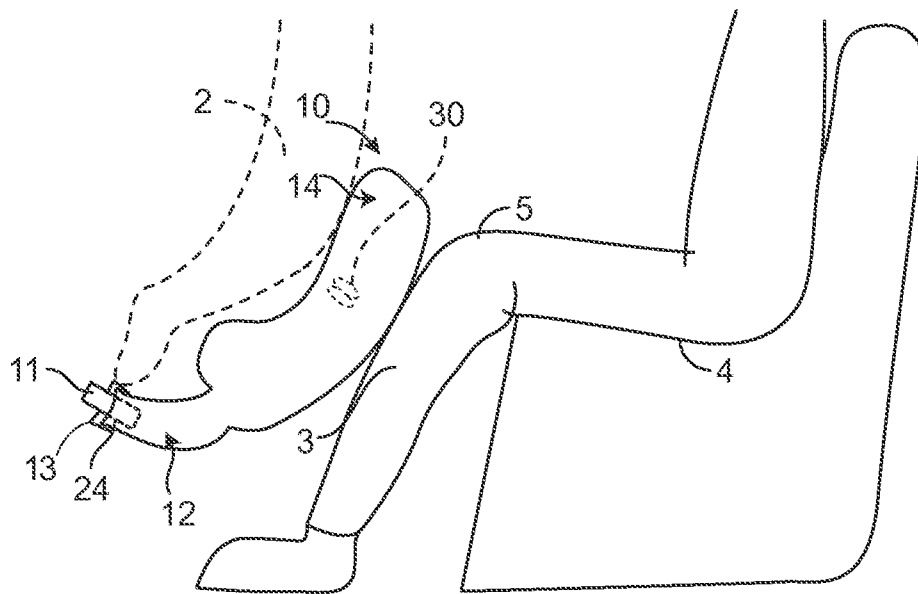


FIG. 2

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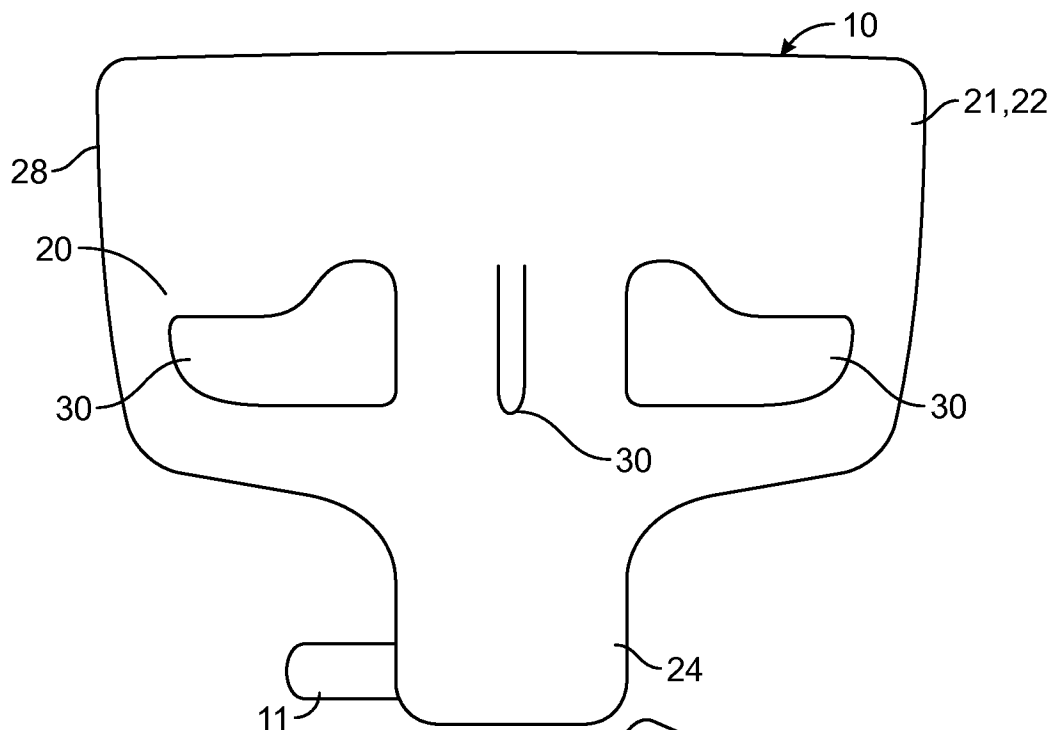
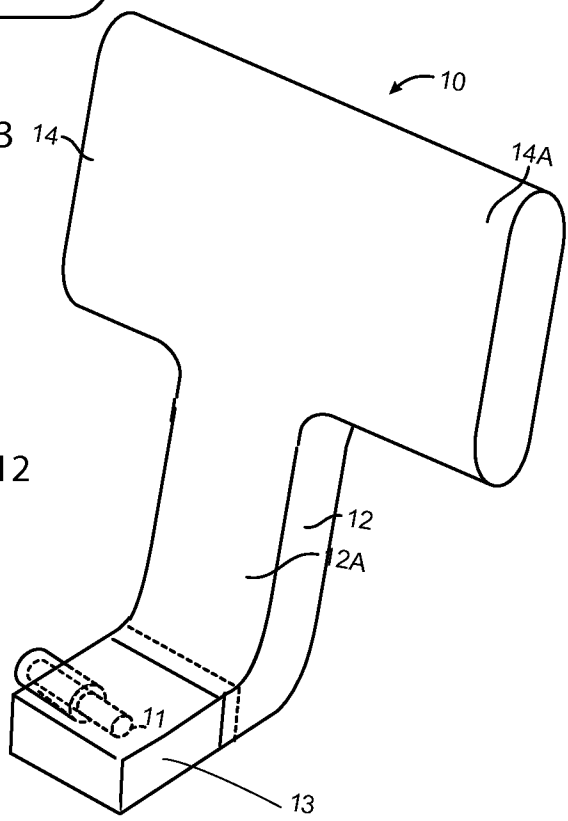


FIG. 3

FIG. 12



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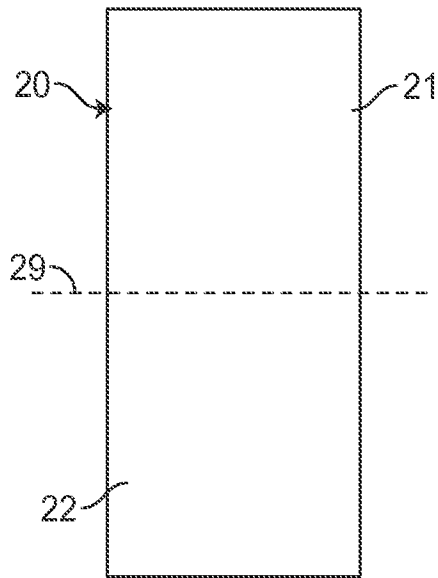


FIG. 4a

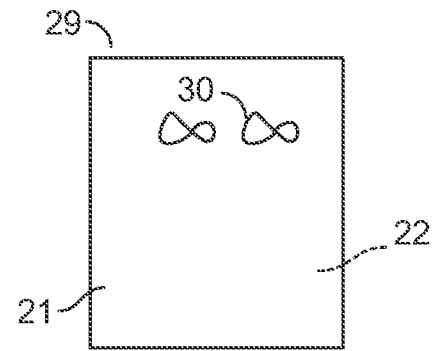


FIG. 4b

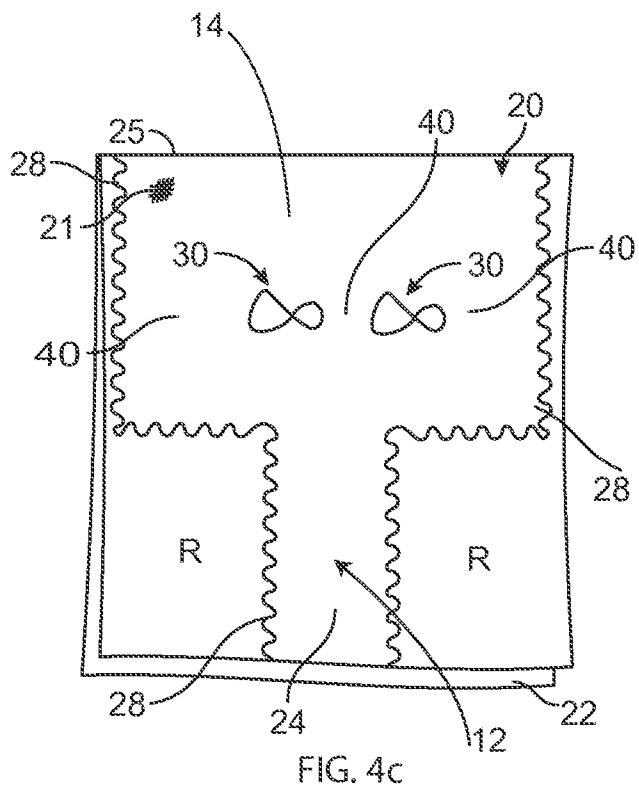


FIG. 4c

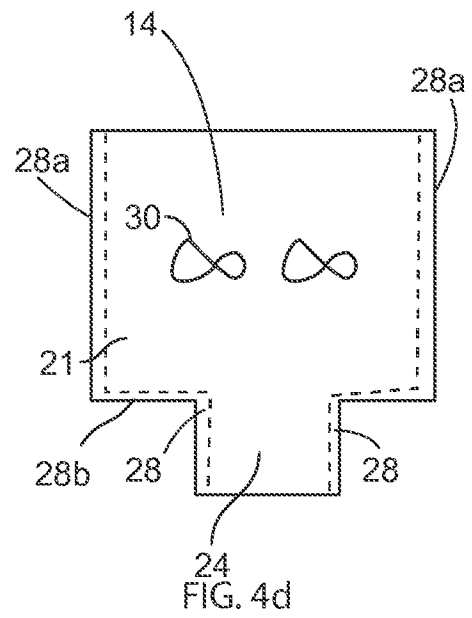


FIG. 4d

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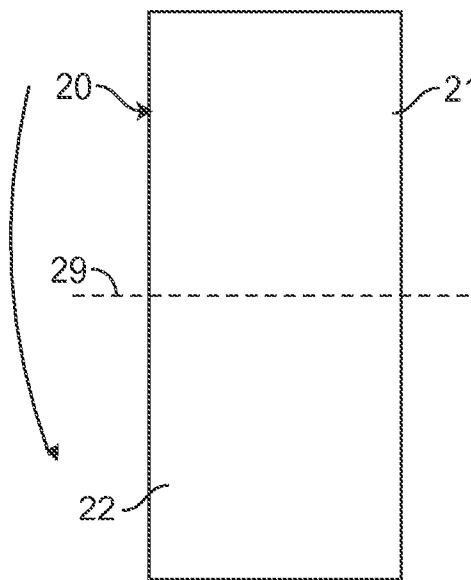


FIG. 5a

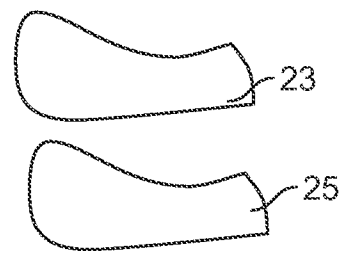


FIG. 5b

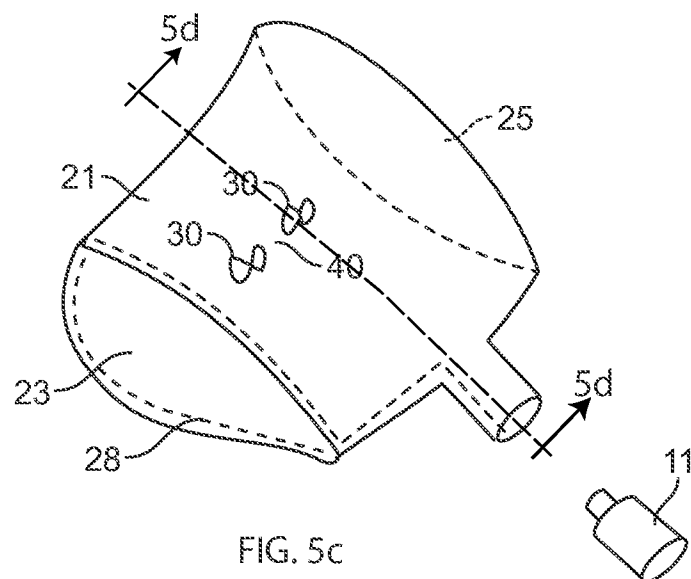


FIG. 5c

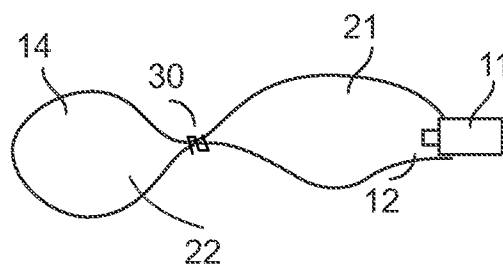


FIG. 5d

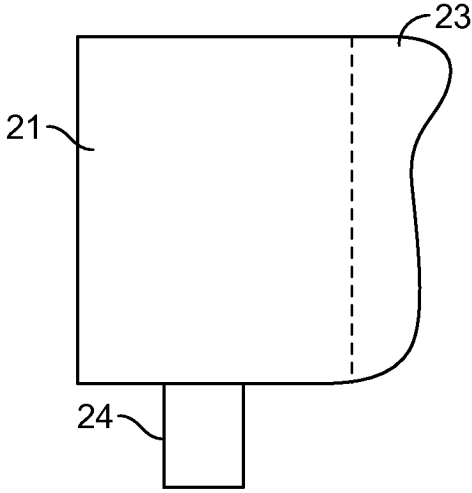


FIG. 6a

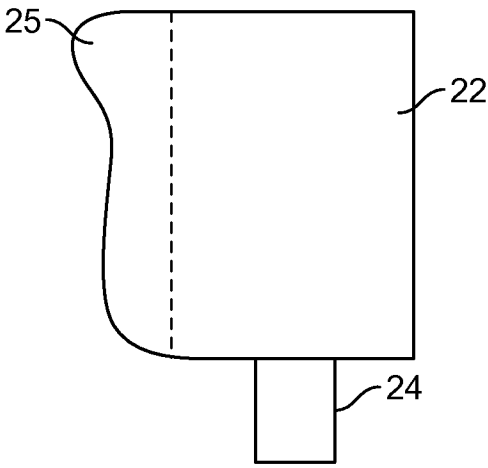


FIG. 6b

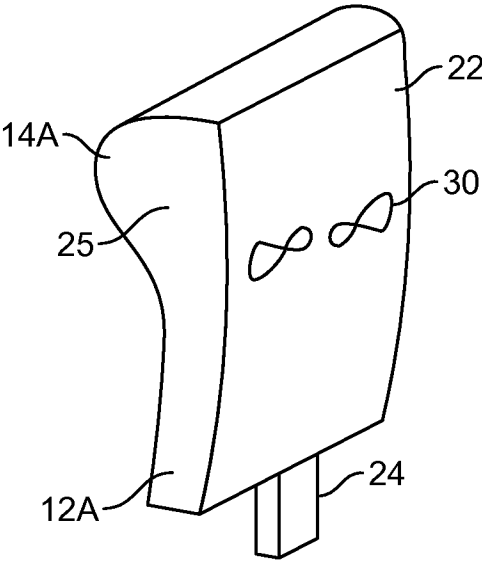


FIG. 6c

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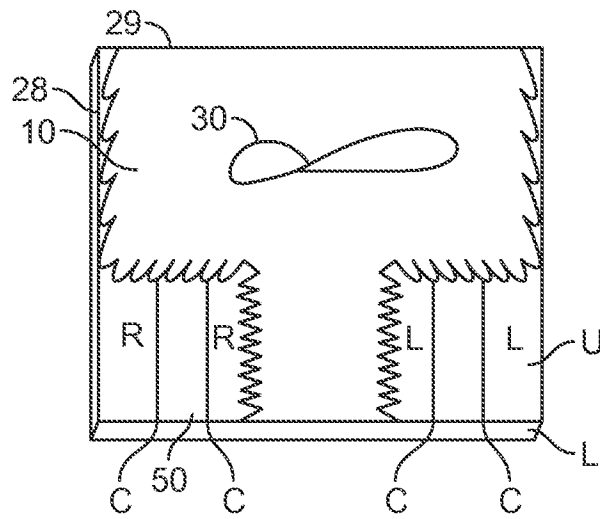


FIG. 7a

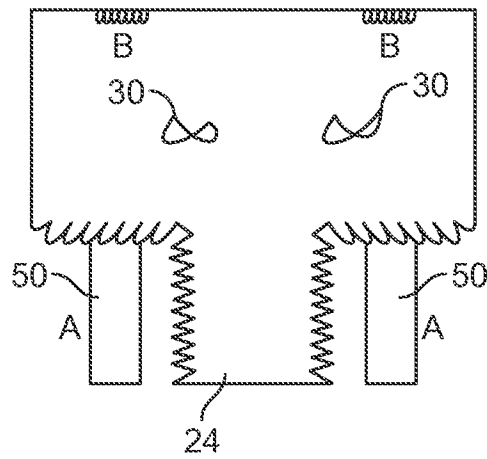


FIG. 7b

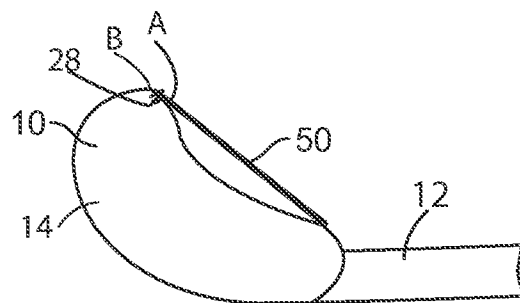
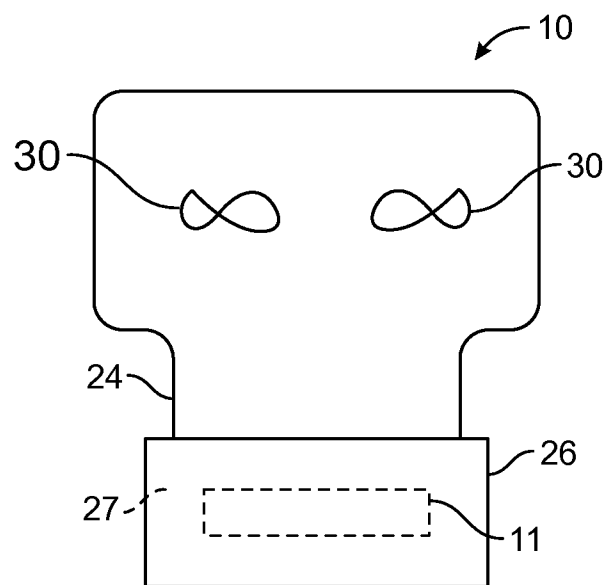
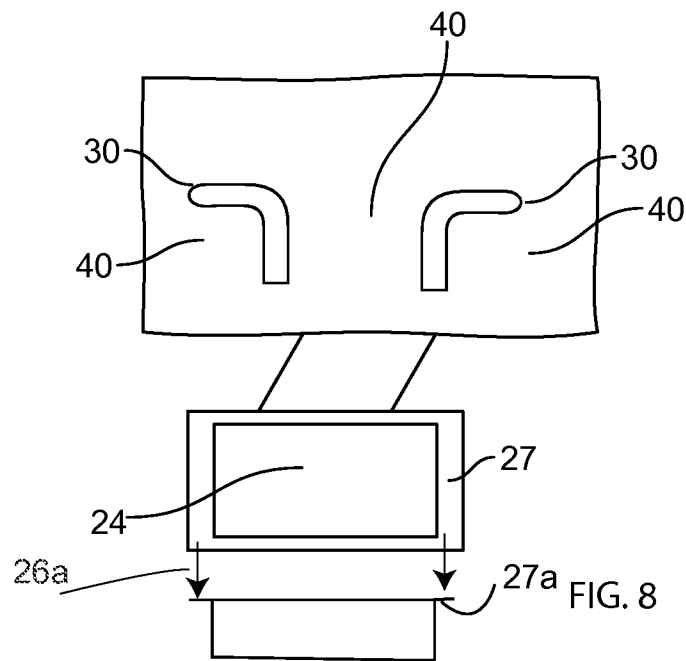


FIG. 7c

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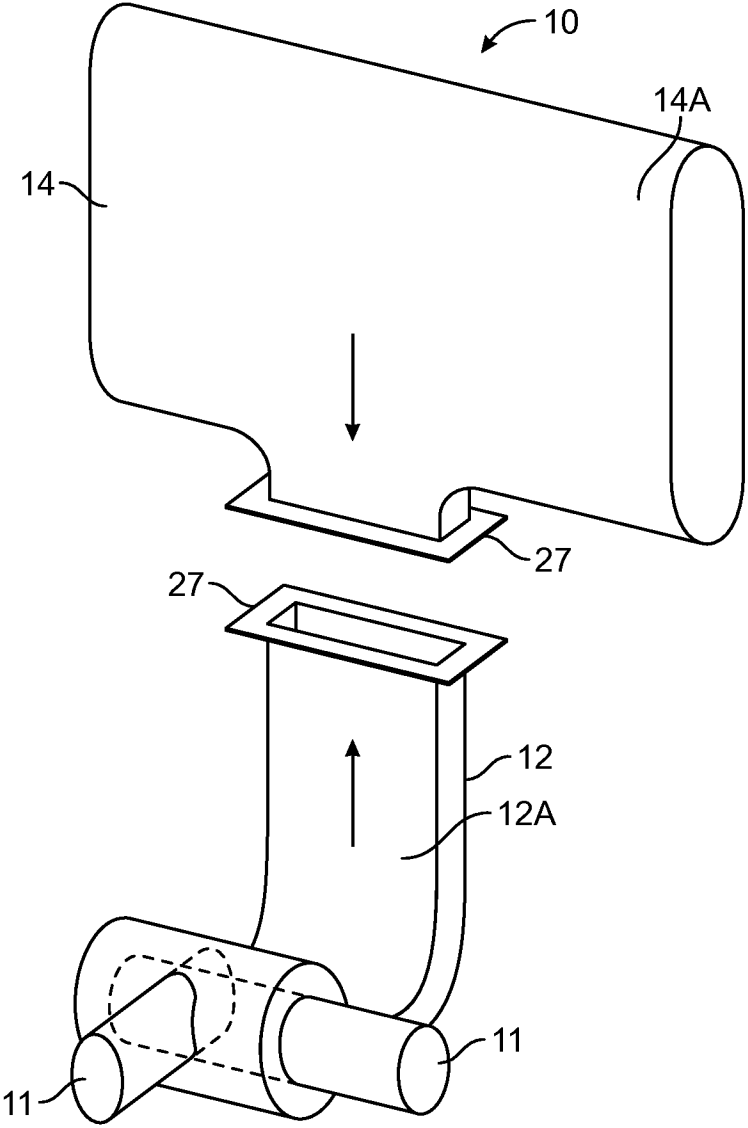


FIG. 10

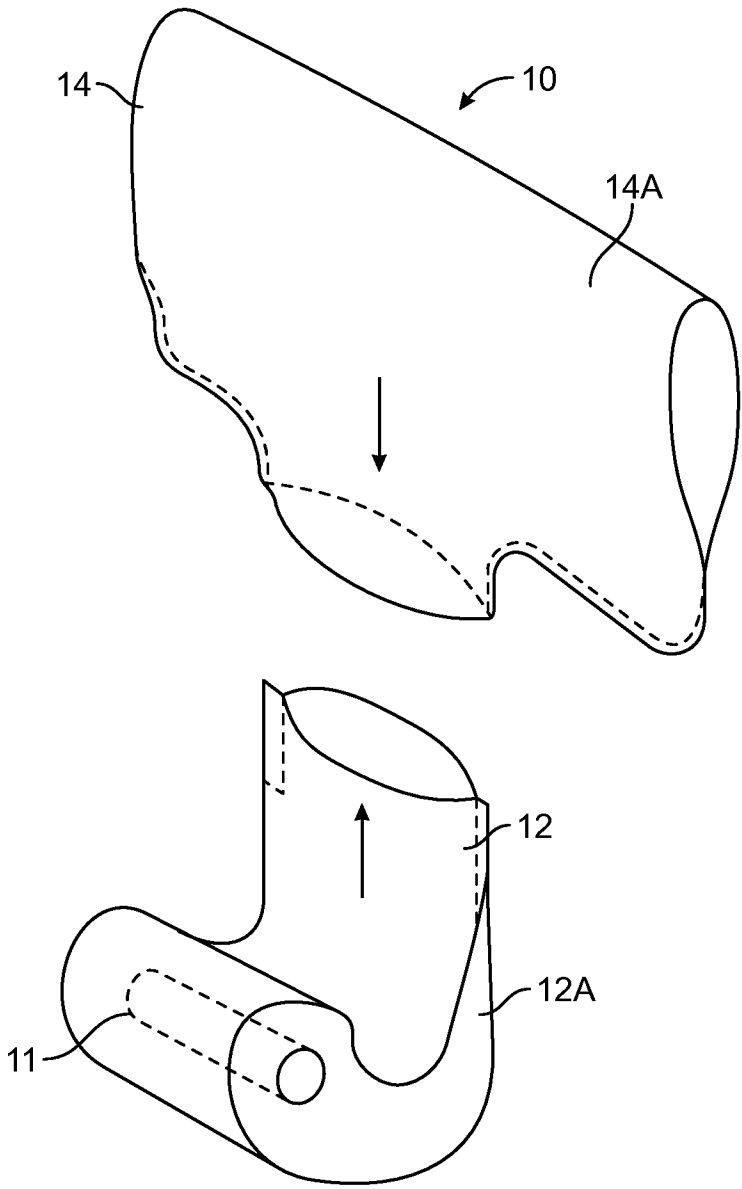


FIG. 1 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/078025

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R21/206
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)
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 practicable, search terms used)

EPO-Internal, PAJ, 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 2011/101660 A1 (SCHNEIDER DAVID W [US] ET AL) 5 May 2011 (2011-05-05)	1,4-6, 10-17
Y	paragraph [0019] - paragraph [0034]; figures 1-9	18-20
X	DE 10 2006 051218 A1 (TRW AUTOMOTIVE GMBH [DE]) 8 November 2007 (2007-11-08) paragraph [0052] - paragraph [0092]; figures 1-4	1-3,5-11
Y	US 2012/007348 A1 (WEHNER KATHARINA [DE] ET AL) 12 January 2012 (2012-01-12) paragraph [0029]; figure 7	18-20
X	US 2005/151351 A1 (ENDERS MARK L [US] ET AL) 14 July 2005 (2005-07-14) paragraph [0040] - paragraph [0053]; figure 2b	1-4, 18-20



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

4 March 2014

Date of mailing of the international search report

11/03/2014

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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