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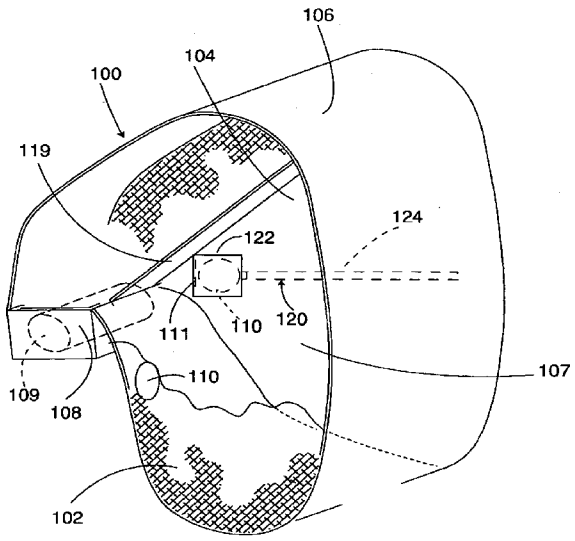
(54) Title: AIRBAG WITH ACTIVE EXHAUST VENT



(57) Abstract: A vehicle occupant protection system has an airbag (100) with an inflatable chamber (107). An inflation gas inlet (108) allows inflation gas to enter the inflatable chamber (107). The airbag (100) includes at least one exhaust vent (110) which when in an open state permits inflation gas to exit the inflatable chamber (107). An exhaust vent closure mechanism (120) is secured to the airbag (100) and is movable to close the exhaust vent (110) by tension created in a tether (124) that is part of the exhaust vent closure mechanism (120) and is guided along a surface of the airbag (100) by a guide structure (126; 112). As the airbag inflates, the tether (124) has one end secured to the airbag (100) and a second end secured to the exhaust vent closure mechanism (120), the tether (124) including a portion that is guided along a surface of the airbag (100).

WO 2008/010885 A1

AIRBAG WITH ACTIVE EXHAUST VENT

This invention relates to vehicle occupant protection system with an airbag having a closable exhaust vent.

Figures 1 and 2 show a conventional passenger-side airbag system 20 that includes an airbag 22 and an inflator 24. The airbag has an inflation gas inlet 26 to receive inflation gas from the inflator 24. The airbag has one or more inflatable chambers 28. The inflator 24 is secured to a vehicle component such as a structural member below the instrument panel. If the airbag 24 is a driver-side airbag, a curtain airbag, knee airbag or a seat-mounted airbag, then the structural member is selected from the steering wheel, roof rail, instrument panel support and seat.

A conventional passenger-side airbag 22 may have identical side panels 40, 42 sewn to an elongated main panel 44. The inflation gas inlet 26 is formed at the common region of the panels 40, 42, 44. Often airbags include exhaust vents 46 in each of the side panels 40, 42.

Sometimes the vehicle occupant to be protected is not sitting properly in his or her seat; and is said to be "out-of-position" with respect to a normal seating orientation. One such out-of-position orientation is with the vehicle occupant bent forwardly toward the location of the non-inflated airbag. In this situation, the vehicle occupant's body will impact the inflating airbag prior to the airbag becoming fully inflated. It is desirable to slow the inflation of the airbag, in the condition recited above, by permitting the exhaust vents to stay open, allowing inflation gas to leave the airbag, which among other things lessens the impact velocity of the bag with the vehicle occupant. The present invention addresses this problem by providing an airbag having an exhaust vent closure mechanism that closes an airbag exhaust vent as the airbag becomes fully inflated.

The invention provides a vehicle occupant protection system comprising an airbag having an inflatable chamber, an inflation gas inlet through which inflation gas enters the inflatable chamber, the airbag

including at least one exhaust vent which, when in an open state, permits inflation gas to exit the inflatable chamber, an exhaust vent closure mechanism is secured to the airbag and movable to close the exhaust vent by tension created in a tether, which is part of the exhaust vent closure mechanism; as the airbag inflates, the tether has one end secured to the airbag, a second end secured to the exhaust vent closure mechanism, the tether guided along a surface of the airbag by a guide structure.

Figures 1 and 2 illustrate a prior art passenger-side airbag.

Figure 3 shows the components of the new airbag.

Figure 4a shows two airbag side panels of the new airbag with an exhaust vent closure mechanisms in an opened position.

Figure 4b shows the new airbag with a portion of one of the side panels removed.

Figure 4c shows two airbag side panels of the new airbag with an exhaust vent closure mechanism in a closed position.

Figure 4d shows an inflated airbag protecting a vehicle occupant with exhaust vent closure mechanisms closing exhaust vents.

Figure 5 shows two airbag side panels for an alternate embodiment of the new airbag.

Figure 5a shows two airbag side panels for another alternate embodiment of the new airbag.

Figure 3 shows the components of a passenger-side airbag 100 according to the present invention. The airbag 100 includes side panels 102, 104 that are substantially the same as those used in conventional airbags. The airbag 100 includes a main panel 106 that is secured to the side panels 102, 104 to form an inflation gas inlet 108 and an inflatable chamber 107 as shown in Figure 4b. An exemplary inflator 109 is positioned within the inflation gas inlet 108. Each side panel 102, 104 includes an exhaust vent 110, with the understanding that more than one exhaust vent can be used. Typical of airbag construction is that each of the panels 102, 104,106 is made of woven nylon or polyester. The panels may

be coated or uncoated and, as known in the art, the permeability of uncoated panels can be controlled by utilizing various weaving or knitting techniques. The exhaust vents 110 can be openings in a panel or high permeability areas in a panel. An exhaust vent provides a path such that inflation gas can exit the airbag. It is desirable to keep the exhaust vent open while the fully inflated shape of the airbag has not been achieved and to close the exhaust vent when the airbag is fully inflated. The airbag 100 additionally includes an exhaust vent closure mechanism 120 associated with each exhaust vent 110. The exhaust vent closure mechanism 120 comprises a movable flap 122 and a flexible tether 124 that assists in moving the flap to a position in which an associated exhaust vent 110 is closed. The exhaust vent closure mechanism 120 includes guide structure such as a flexible elongated panel 126 that is typically rectangular. A flexible elongated panel 126 is secured to each side panel 102, 104 to provide a flexible tubular channel for the tether 124 and to guide the tether across a region or path along a surface of the side panel. The guide structure for the tether further comprises a narrow opening or slit 112 in the airbag located proximate each exhaust vent 110. In general, the number of exhaust vent closure mechanisms 120 used equals of the number of exhaust vents that need to be closed during deployment of the airbag 100.

Each of the side panels 102, 104 of Figure 3 exhibits a dotted line 111 and a location 113 indicated by an "X". The dotted line 111 represents a seam that secures one side 123 of flap 122 to either panel 102, 104. Similarly the "X" identifies the location 113 where an end 130 of the tether 124 is secured to the side panel 102, 104. An end 132 of the tether 124 is secured to the flap 122 at a location 134, generally opposite the side of the flap secured to the side panel.

Figure 4b shows a fully inflated airbag 100. A portion of one side panel 102 has been removed so the interior of the inflatable chamber 107 is more easily seen. One of the exhaust vent closure mechanisms 120 is shown closing an exhaust vent 110. In this condition the tether 124 is

drawn taut, as the airbag approaches a fully inflated state, and has pulled, moved or rotated the flap 122 from the flap's initial position away from the exhaust vent to cover the previously open exhaust vent 110. Arrows 131 in Figure 4d indicate the movement of the flap 122. Figure 4b shows an additional internal tether 119 that connects the top of main panel 106 to the fabric adjacent the inflation gas inlet 108 to influence the inflated shape of the upper portion of the airbag.

Figure 4c shows the construction of a typical exhaust vent closure mechanism 120. Each flap 122 is sewn along the seam 111 to an interior surface of a side panel 102, 104 to act as a guide structure for the tether. When the airbag 100 is in a folded condition the flap is manipulated so that it is rotated away from the exhaust vent 110. A guide panel 126 is sewn to an exterior surface of a side panel as shown in Figure 4c. The numeral 140 identifies the seam or seams by which each guide panel 126 is secured to a side panel of the airbag. The seams 140 can be replaced by a plastic weld or adhesive. The center of each guide panel 126 not secured to the side panel of the airbag, which creates a flexible passage 144. A tether 124 is threaded through this passage that acts as a guide structure and is secured at position 113 to the side panel of the airbag. An end 132 of tether 124 is threaded through a narrow opening 112 that also acts as a guide structure for the tether so that the end 132 is adjacent an interior surface of the side panel 102, 104. Thereafter the end 132 of the tether is secured at location 134 of the previously secured flap 126.

Figure 4d shows a vehicle occupant 150 seated on a seat 152 with the airbag 100 in a fully inflated condition. Each flap 122 has been pulled by a tether 124 into a position closing an associated exhaust vent 110. Each flap 122 is also shown by phantom line folded or rotated away from the exhaust vent 110, which as mentioned is the orientation assumed by each flap 122 in the folded airbag. Figure 4a shows the two side panels 102, 104 in a condition illustrative of a partially inflated airbag 100. In this condition each flap 122 is still rotated away from the exhaust vent 110 it will

eventually close. Each exhaust vent 110 is shown in a partially opened condition to show this transitory state during the deployment of the airbag. The front portions 160 of each panel 102, 104 are shown indented to illustrate that the airbag has not been inflated and also to illustrate that each tether 122 has not yet become tensioned, as illustrated in Figure 4d. Figure 4d shows another embodiment of the invention. The exhaust vents can be located on any surface of the airbag including the top and/or bottom. An exhaust vent closure mechanism 120b closes an exhaust vent 110 located on the top of the airbag. The construction of the exhaust vent closure mechanism 120b is the same as the exhaust vent closure mechanism disclosed above.

Figure 5 shows an alternate embodiment. In this embodiment panel 126 has been removed from the exhaust vent closure mechanism now shown by numeral 120a. The panel 126 is a guide for tether 122 so that the medial portion 127 of the tether lies along a specified region of a surface of a side panel. The panel 126 is secured to the outer surface of the side panel, however the panel 126 could be secured to an interior surface of the side panel in which case the tether would slide adjacent this inside surface. In Figure 5 each side panel has a plurality of tether guiding openings 112 therein that act as a guide structure for the tether, and each tether 124 is woven through these tether guiding openings 112. The tether guiding openings 112, as did panel 126, locate the tether along a specified region, path or trajectory on a side panel. One end 130 of the tether 124 is secured to the side panel while the other end is secured to the flap 122.

The tether 124 need not move horizontally across a side panel when the airbag is deployed. This is illustrated in Figure 5a in which exemplary obliquely positioned tethers are shown. In one instance one tether 124a extends toward the lower extreme of the side panel. In this configuration the tether 124a, the flap, seams 111 and loops 112 are all rotated by the same angle from the positions shown in Figure 5. Figure 5a also shows a

second obliquely positioned tether 124b, as in another embodiment, rotated toward the upper portion of the side panel.

The present invention is applicable to all known types of airbags including driver-side airbags, passenger-side airbags, curtain airbags and seat-mounted side impact airbags.

Claims

1. A vehicle occupant protection system comprising an airbag (100) configured to have an inflatable chamber (107), an inflation gas inlet (108) through which inflation gas enters the inflatable chamber (108), the airbag (100) including at least one exhaust vent (110) which when in an open state permits inflation gas to exit the inflatable chamber (107), an exhaust vent closure mechanism (120) secured to the airbag (100) and movable to close the exhaust vent (110) by tension created in a tether (124); as the airbag (100) is inflated, the tether (124) has one end secured to the airbag (100), a second end is secured to the exhaust vent closure mechanism (120), the tether (124) is guided along a surface of the airbag (100) by a guide structure (126; 112).

2. A vehicle occupant protection system according to Claim 1 wherein the one end of the tether (124) is secured to either an outside surface or an inside surface of the airbag (100), a portion of the tether (124)held in close proximity to an adjacent portion of the airbag by the guide structure (126; 112) and permitted to move relative to the adjacent portion of the airbag (100).

3. A vehicle occupant protection system according to claim 1 wherein the exhaust vent closure mechanism (120) moves from a first position in which the exhaust vent (110) is open to a second position in which the exhaust vent (110) is fully or partially closed.

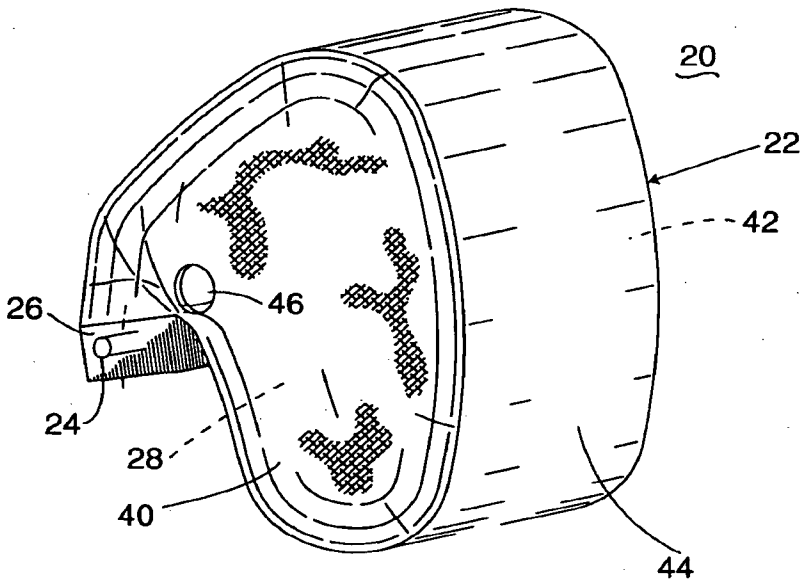
4. A vehicle occupant protection system according to any one of Claims 1 through 3 wherein the guide structure comprises a panel (126) secured to a surface of the airbag (100) to provide a flexible tubular channel for receiving and guiding the tether (124) along a surface of the airbag (100).

5. A vehicle occupant protection system according to Claim 4 wherein the guide structure further comprises a tether opening (112) proximate the exhaust vent (110).

6. A vehicle occupant protection system according to any one of Claims 1 through 3 wherein the guide structure comprises a plurality of tether guiding openings (112) through the airbag (100) through which the tether (124) is woven to extends along a surface of the airbag (100).

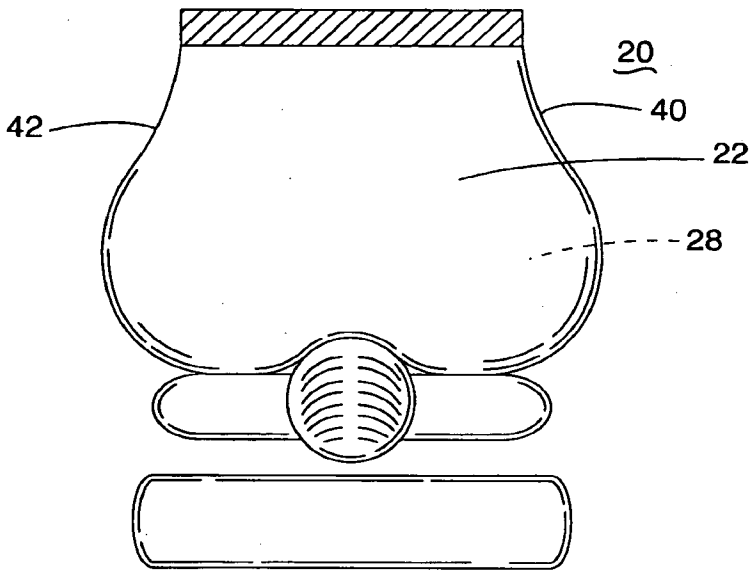
7. A vehicle occupant protection system according to any one of Claims 1 through 3wherein the exhaust vent closure mechanism (120) includes a flap (122) hinged on an inside surface of the airbag (100) and can rotate to close the exhaust vent (110).

8. A vehicle occupant protection system according to any one of Claims 1 through 3 wherein the exhaust vent closure mechanism (120) includes a flap (122) attached to an inside surface of the airbag (100) and can be moved laterally to close the exhaust vent (110).



Prior Art

Fig - 1



Prior Art

Fig. -2

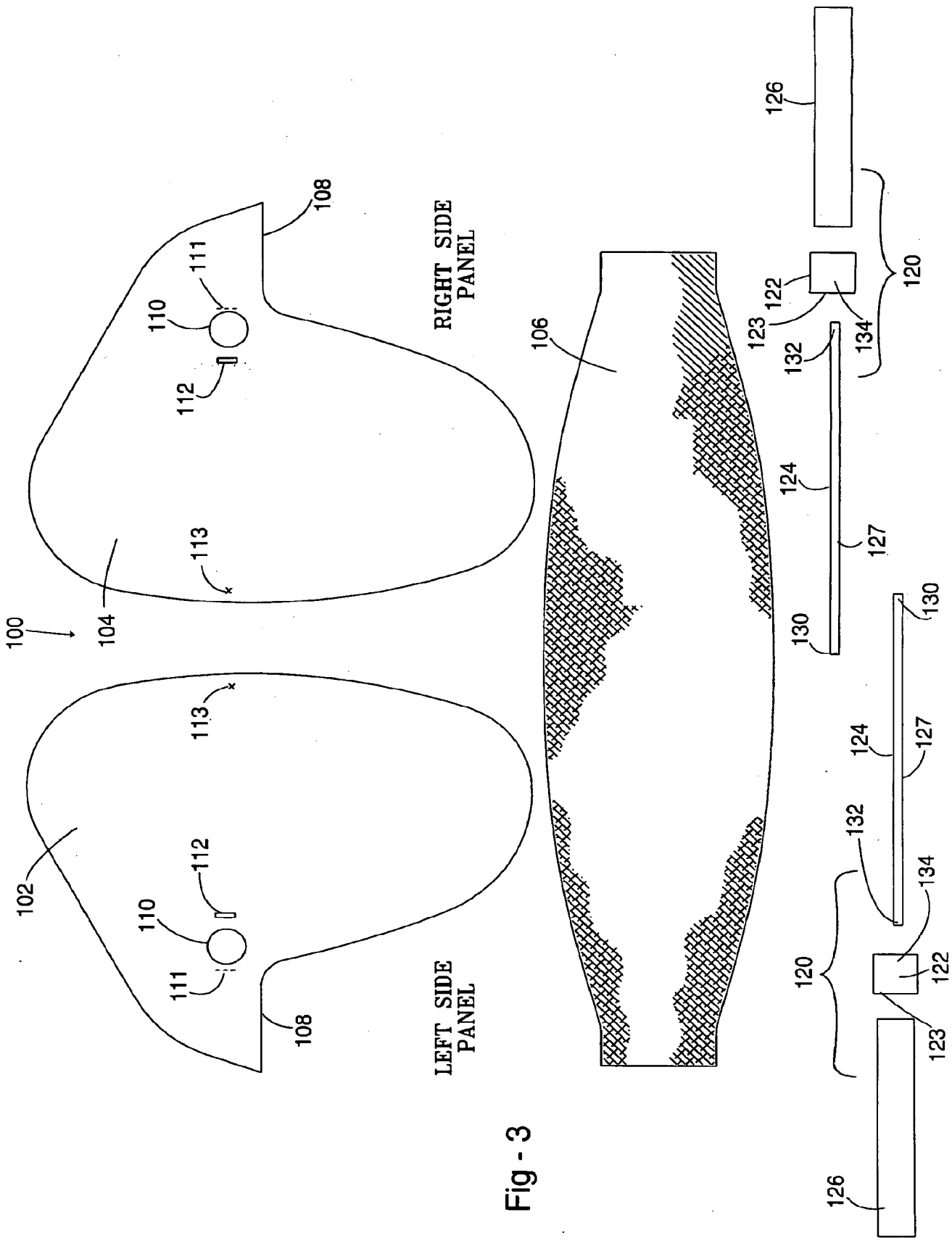

100
102
104
106
108
110
111
112
113
120
122
123
124
126
127
130
132
134
RIGHT SIDE PANEL
LEFT SIDE PANEL

Fig - 3

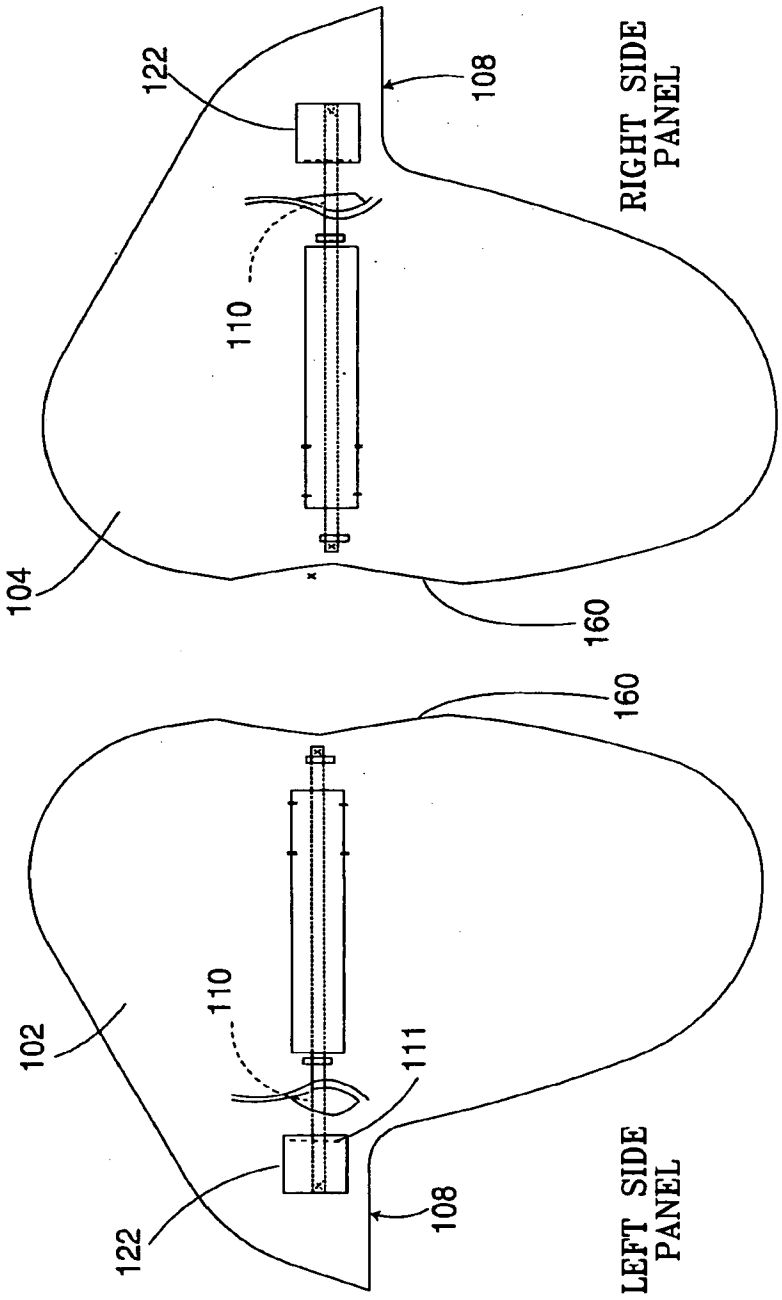

122
108
RIGHT SIDE PANEL
110
104
160
160
102
110
111
122
108
LEFT SIDE PANEL

Fig 4a

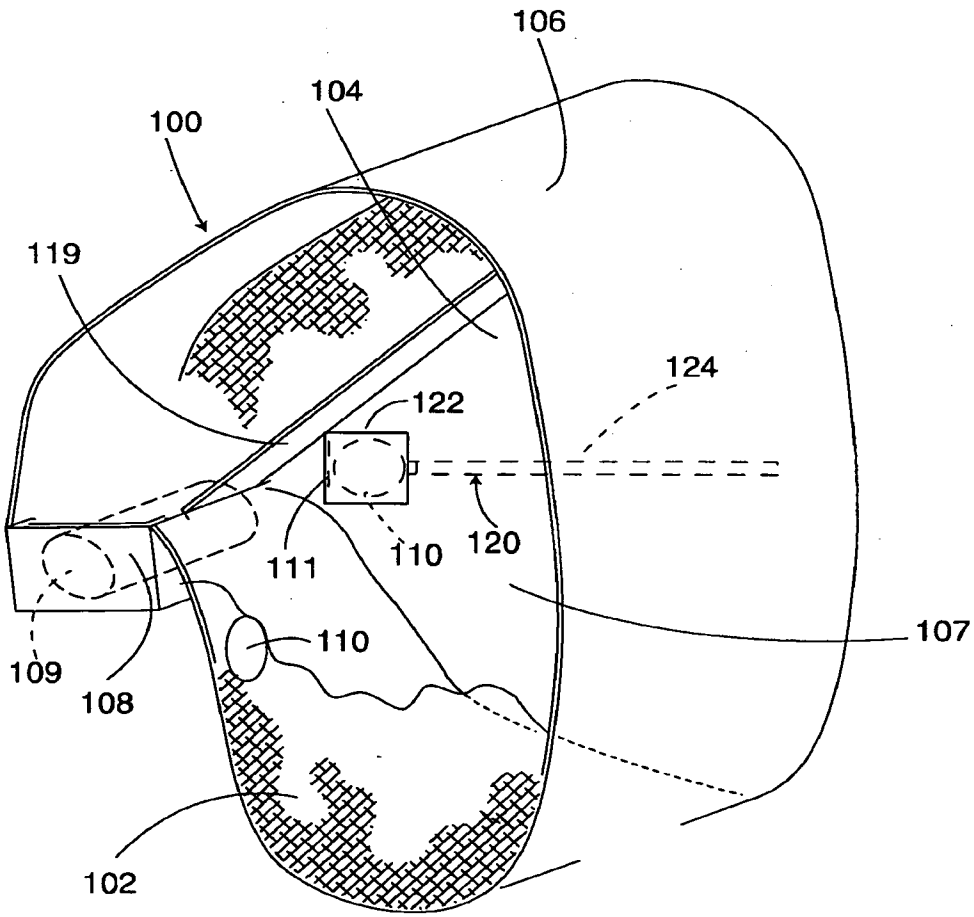


Fig - 4b

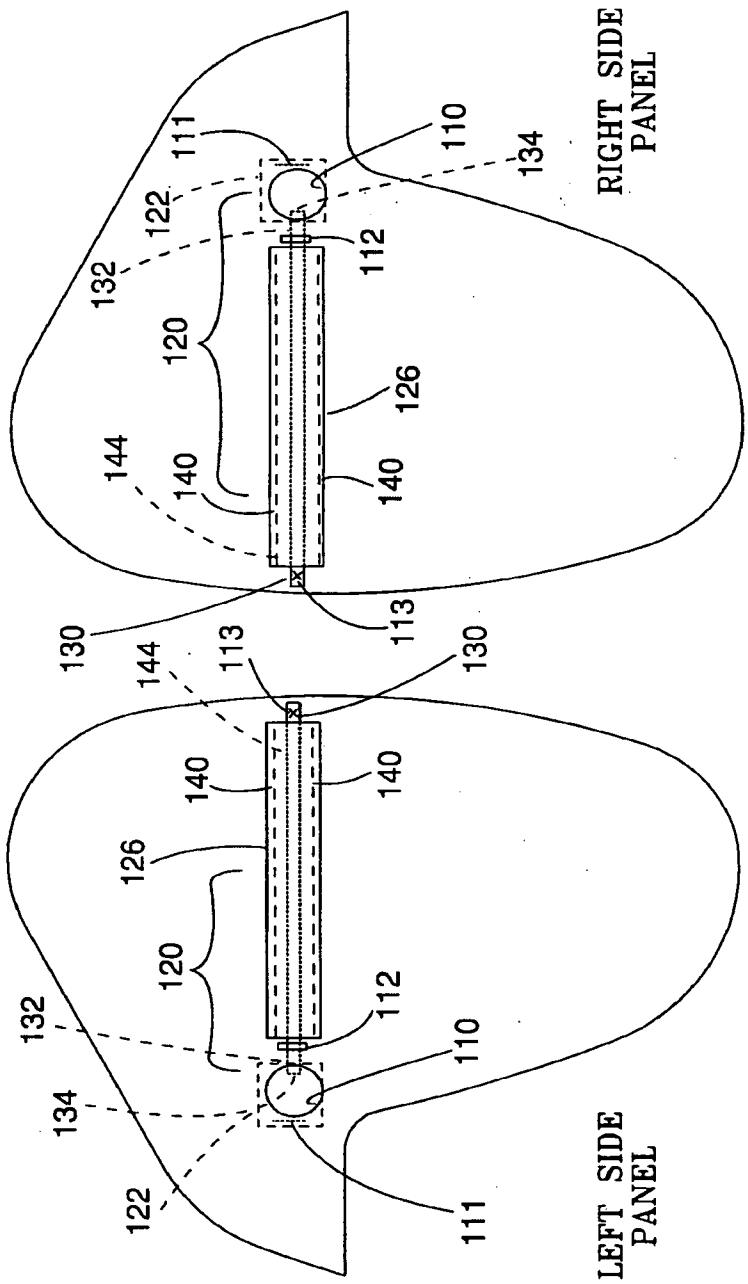

RIGHT SIDE PANEL
LEFT SIDE PANEL
111
110
134
122
132
112
120
126
144
140
130
113

Fig - 4c

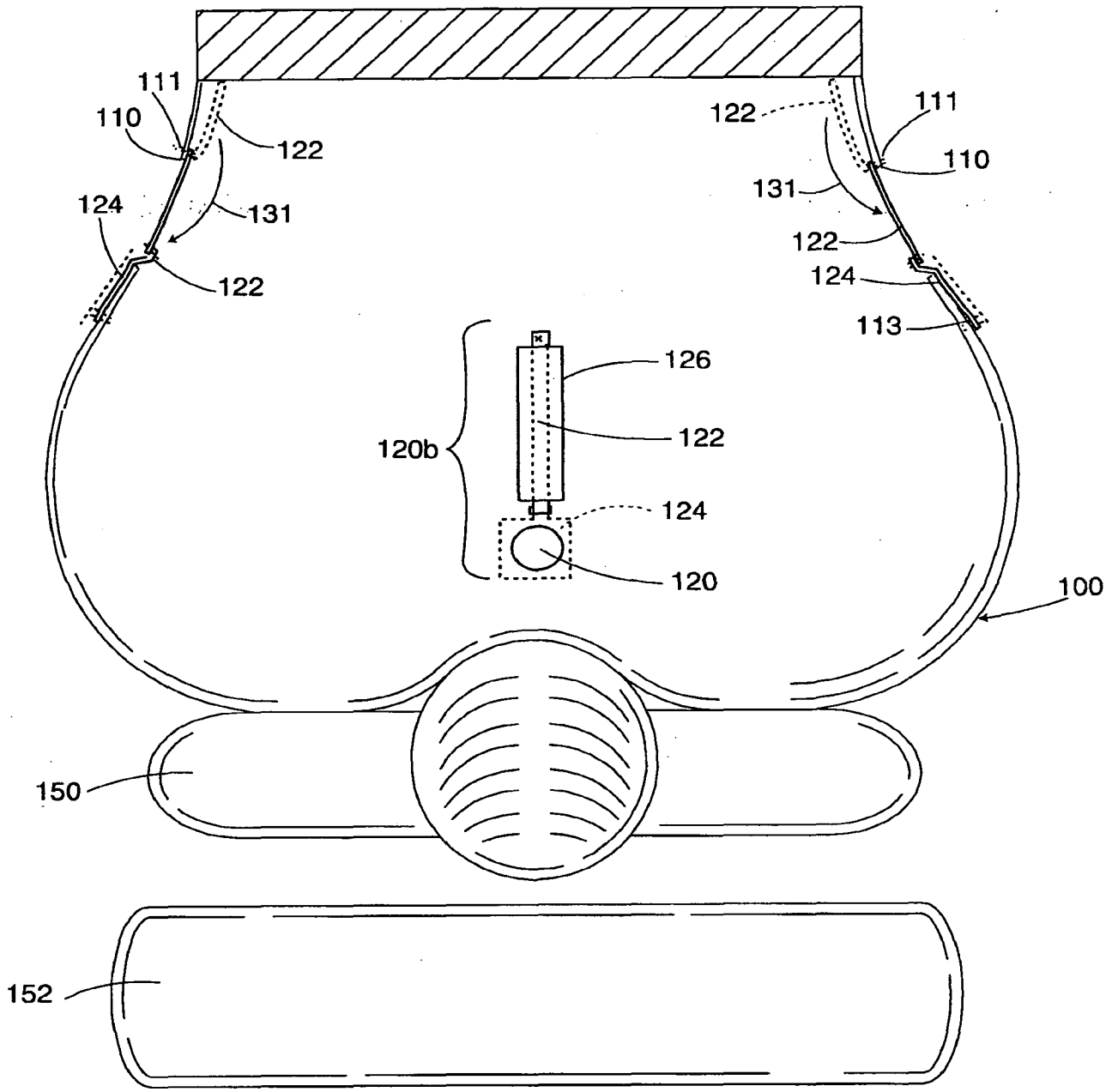

111
110
122
124
131
122
122
111
110
131
122
124
113
126
120b
122
124
120
100
150
152

Fig - 4d

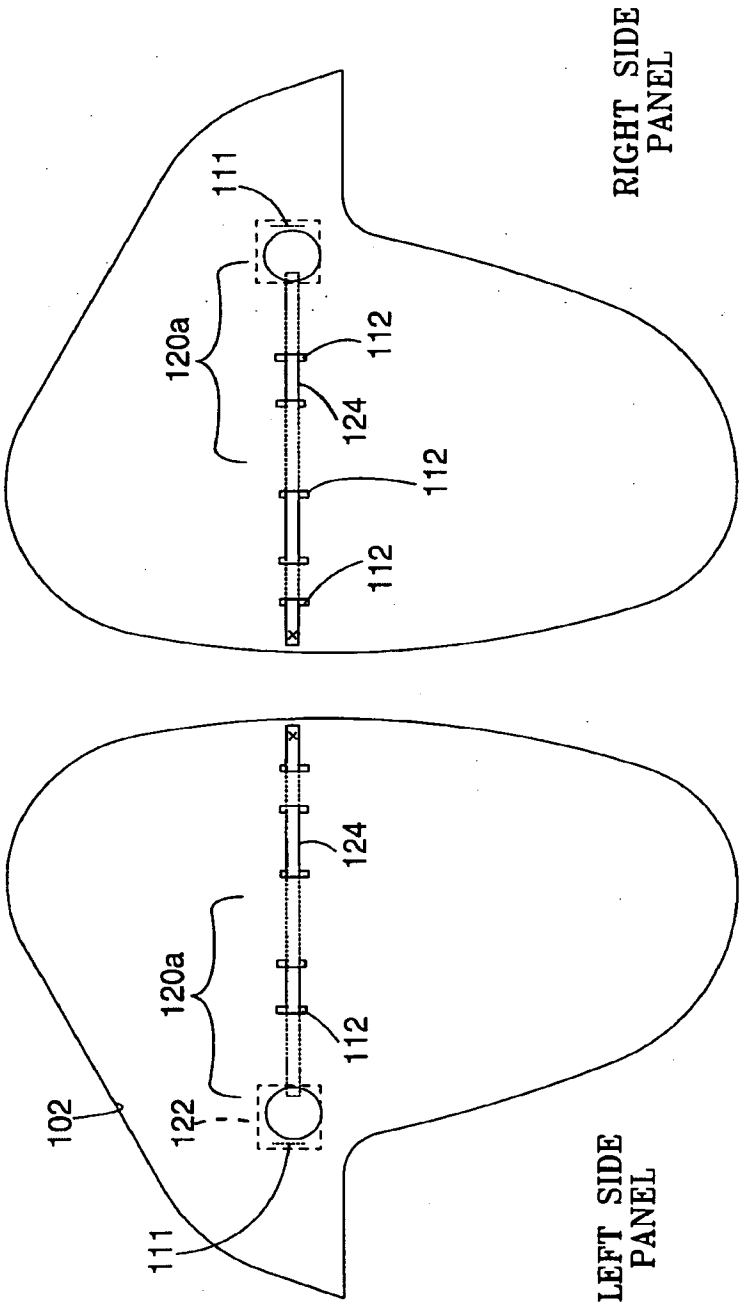

RIGHT SIDE PANEL
111
120a
112
124
112
112
LEFT SIDE PANEL
102
122
120a
124
112
111

Fig 5

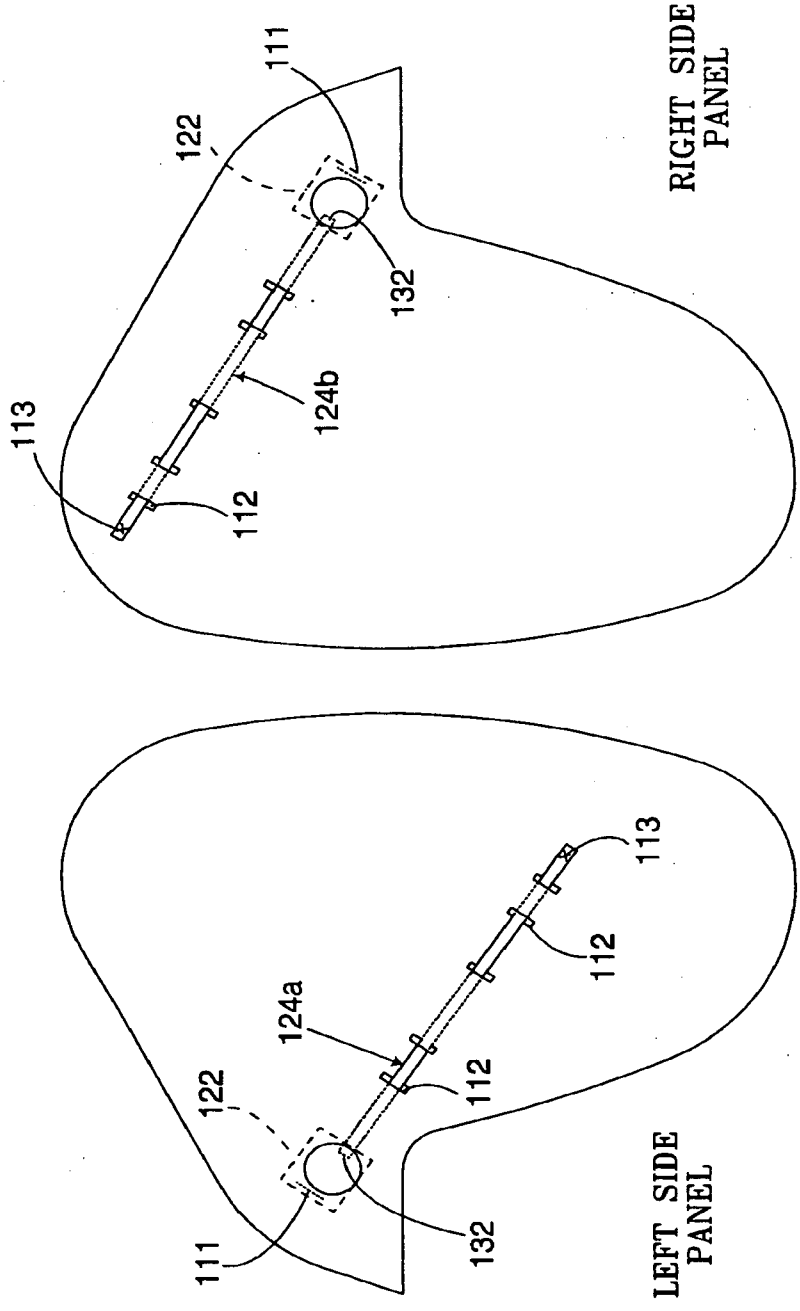

RIGHT SIDE PANEL
111
122
132
124b
113
112
LEFT SIDE PANEL
124a
112
113
122
111
132

Fig 5a

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/013866

A. CLASSIFICATION OF SUBJECT MATTER

B60R 21/239(2006.01)i, B60R 21/23(2006.01)i

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)
IPC 8: B60R 21/239, B60R21/23

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR, JP: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS (KIPO internal) & keywords: "airbag", "vent", and "tether"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2004-0041350 A (HYUNDAI MOTOR COMPANY) 17 JULY 2004 See claims, Figs. 3, 4.	1-8
A	US 5 280 953 A (WOLANIN et al.) 25 January 1994 See abstract, and figures.	1-8

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of 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	Date of mailing of the international search report
25 OCTOBER 2007 (25.10.2007)	**25 OCTOBER 2007 (25.10.2007)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea	CHO, Do Yeon
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-8557

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2007/013866

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2004-0041350 A	17-07-2004	NONE	
US 5 280 953 A	25-01-1994	EP 599377 A1	01-06-1994