



(51) International Patent Classification:
B60R 21/36 (2011.01)

(21) International Application Number:
PCT/EP2018/061572

(22) International Filing Date:
04 May 2018 (04.05.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1707646.4 12 May 2017 (12.05.2017) GB
1707650.6 12 May 2017 (12.05.2017) GB

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,

(54) Title: AN APPARATUS FOR HOUSING AN AIRBAG ON A VEHICLE

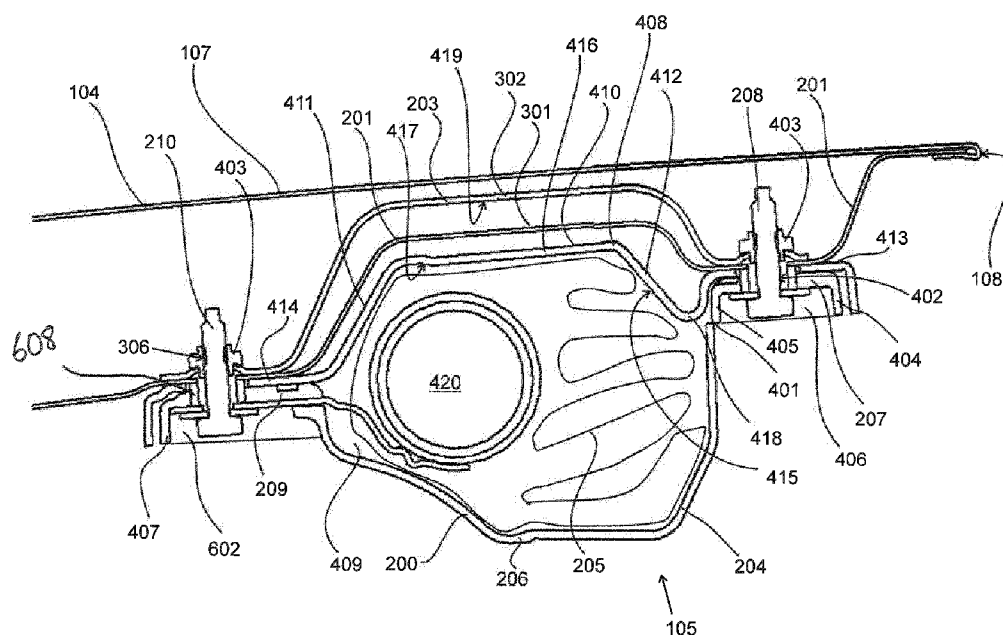


Fig. 4

(57) Abstract: An apparatus (200) for housing a pedestrian airbag (205) on a vehicle (101) is disclosed, along with an airbag unit (105) and a vehicle (101) comprising the apparatus (200). The apparatus (200) comprises a first cover part comprising a first rear connection portion (207), a first containing portion (206), and a tear line (401) positioned between the first rear connection portion and the first containing portion. The tear line (401) through which an airbag (205) can deploy. The apparatus (200) also comprises a second cover part, which, in combination with the first cover part, defines a chamber (409) for an airbag (205). The second cover part comprises a ramp surface (415) to direct, in use, a deploying airbag (205) away from the first rear connection portion (207) during inflation of the airbag (205).



MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

AN APPARATUS FOR HOUSING AN AIRBAG ON A VEHICLE

TECHNICAL FIELD

- 5 The present disclosure relates to an apparatus for housing an airbag on a vehicle. In particular, but not exclusively it relates to an apparatus for housing a pedestrian airbag on a road vehicle such as a car.

Aspects of the invention relate to an apparatus, an airbag unit and a vehicle.

10

BACKGROUND

- Pedestrian airbags have been produced which are fitted to an inner surface of a hood of an engine compartment of vehicle. The airbag is located in a housing attached to a reinforcement part of the hood. A problem with this arrangement is that the airbag takes up
15 space in the engine compartment. In addition, during deployment, the airbag must inflate through a relatively narrow gap between the hood and the leaf screen at the bottom of the windshield.

- 20 It is an aim of the present invention to address disadvantages of the prior art.

SUMMARY OF THE INVENTION

- Aspects and embodiments of the invention provide an apparatus, an airbag unit and a
25 vehicle as claimed in the appended claims.

- According to an aspect of the invention there is provided an apparatus for housing a pedestrian airbag on a vehicle, the apparatus comprising: a first cover part comprising a first rear connection portion, a first containing portion, and a tear line positioned between the first
30 rear connection portion and the first containing portion, the tear line, in use, being arranged to tearing during use to provide an aperture through which an airbag can deploy; and a second cover part; wherein the first cover part and the second cover part define a chamber for an airbag, the second cover part comprising a ramp surface to direct, in use, a deploying airbag away from the first rear connection portion during inflation of the airbag.

This provides the advantage that the airbag may be located within a channel formed in a reinforcement structure of a hood of a vehicle, and the ramp surface prevents the airbag from snagging during deployment on the first rear connection portion or snagging on a connection means that is used to attach the first rear connection means to the hood. The connection means may comprise a bolt or alternative fastener that is capable of securely attaching the first rear connection portion to the hood.

In some embodiments the second cover part comprises a second containing portion and a second rear connection portion positioned alongside the first rear connection portion; the ramp surface extends from the second containing portion to the second rear connecting portion; the second containing portion has a first surface facing into the chamber; and the ramp surface faces into the chamber at an obtuse angle to the first surface of the second containing portion.

In embodiments where the second cover part is part that is separable from a hood to which it is attached, by providing the second rear connection portion positioned alongside the first rear connection portion enables the first rear connection portion to assist with maintaining the position of the second rear connection portion.

In some embodiments the second cover part comprises a ridge positioned between the second rear connecting portion and the second rear connecting portion; and the ramp surface forms one side of the ridge.

This provides the advantage that the first rear connection portion, and/or a connection means connecting the first rear connection portion to a hood, may be positioned further back, than it otherwise would be, from the path of the airbag during its deployment.

In some embodiments, the first cover part and/or the second cover part comprise holes to enable attachment of the apparatus to an inside surface of a hood of a compartment positioned towards a front of a vehicle.

In some embodiments the second cover part comprises a reinforcement structure of a hood for a compartment of a vehicle, the compartment being an engine compartment or a trunk.

In some embodiments the first cover part comprises at least one depending feature on the first rear connection portion, the at least one depending feature being arranged such that it reduces the likelihood, in use, of a deploying airbag contacting a first connection means located within an aperture in the first rear connection portion.

This provides the advantage that a deploying airbag is provided with additional protection from the possibility of snagging on the first connection means.

In some embodiments the at least one depending feature comprises at least one lip extending from the first rear connection portion.

This provides the advantages that a deploying airbag is provided with additional protection from the possibility of snagging on the first connection means and that the first rear connection portion is provided with additional strength and rigidity

In some embodiments the at least one lip comprises a continuous lip extending along the first rear connection portion.

In some embodiments the at least one lip extends along an outer edge of the first rear connection portion.

In some embodiments the at least one lip extends from the first rear connection portion to the tear line.

This provides the advantages that the first rear connection portion is provided with additional strength and stiffness adjacent to the tear line, to facilitate rapid tearing along the tear line.

In some embodiments: the at least one depending feature comprises a first lip and a second lip; and the first lip and the second lip in combination with the first rear connection portion form a U-shaped channel.

This provides the advantages that the first rear connection portion is provided with a strong and rigid structure, and also the U-shaped channel provides a recess in which a connections means, such as a bolt may reside without being in the path of a deploying airbag.

- 5 In some embodiments the at least one depending feature comprises rigidizing ribs.

This provides the advantages that the first rear connection portion is provided with a strong and rigid structure.

- 10 In some embodiments the rigidizing ribs are attached to the at least one lip.

In some embodiments the rigidizing ribs extend across the U-shaped channel.

- 15 In some embodiments an outer surface of the U-shaped channel faces the second rear connection portion.

In some embodiments the first cover part comprises a first front connection portion and a channel of the first cover part is positioned between the first rear connection portion and the first front connection portion.

20

In some embodiments the first cover part comprises a first peripheral connecting portion that includes the first front connection portion and the first rear connection portion and which extends around the entire periphery of the first cover part.

- 25 This provides the advantage that the first cover part, as a whole is provided with a strong structure.

- 30 In some embodiments the second cover part comprises a second peripheral connecting portion that includes the second front connection portion and the second rear connection portion and which extends alongside the first peripheral connecting portion around the entire periphery of the second cover part.

This provides the advantage that a continuous seal may be provided between the first and second peripheral connecting portions so that an airbag within the housing is isolated from the environment outside of its housing.

- 5 In some embodiments the first cover part comprises a downturned lip extending along a front edge of the first front connection portion.

In some embodiments the first front connection portion comprises front rigidizing ribs.

- 10 In some embodiments the front rigidizing ribs are attached to the downturned lip extending along the front edge and the first front connection portion.

- 15 In some embodiments the second cover part comprises a front wall portion; and the second containing portion extends between the ramp portion and the front wall portion to form a channel.

This provides the advantage that at least a portion of an airbag located within the housing may be located within the channel formed in the second cover portion, rather than the whole of the airbag being located in the first cover part.

20

According to another aspect of the invention there is provided an airbag unit comprising the apparatus according to any one of the previous paragraphs and an airbag positioned between the first cover part and the second cover part.

- 25 According to a further aspect of the invention there is provided a vehicle comprising: a hood covering a front compartment of the vehicle; an apparatus according to any one of the previous paragraphs attached to an inner surface of the hood and an airbag positioned between the first cover part and the second cover part of the apparatus.

- 30 In some embodiments the first cover part is attached to the hood by a fixing means extending through a hole in the first rear connection portion; and a head of the fixing means is positioned between two rigidizing ribs forming a part of the first rear connection portion.

This provides the advantage that the head of the fixing means is shielded from contact with the airbag by the two rigidizing ribs.

5 In some embodiments the second cover part is attached to the hood by the same fixing means, which extends through a hole in the second rear connection portion.

10 In some embodiments the hood comprises an outer panel and a reinforcement structure attached to the outer panel; and the reinforcement structure comprises a channel in which the airbag is positioned.

This provides the advantage that at least a portion of the airbag may be located within the channel formed in the reinforcement structure rather than taking up space in the compartment.

15 In some embodiments the hood comprises an outer panel and a reinforcement structure attached to the outer panel; and the reinforcement structure provides the second cover part.

This provides the advantage that a separate second cover part does not have to be provided.

20 In some embodiments: the reinforcement structure comprises a portion at the rear of the channel to which the first rear connection portion is attached, and a portion at the front of the channel to which the first front connection portion is attached; the portion at the front of the channel is a first distance from the outer panel; the portion at the rear of the channel is a
25 second distance from the outer panel; and the second distance is shorter than the first distance.

30 According to yet another aspect of the invention there is provided a pedestrian airbag unit for use on a vehicle, the apparatus comprising: a first cover part comprising a first rear connection portion, a first containing portion, and a tear line positioned between the first rear connection portion and the first containing portion; a second cover part comprising a second rear connection portion positioned alongside the first rear connection portion, a second containing portion, and a ramp portion extending from the second containing portion to the second rear connecting portion; and an airbag contained between the first cover part and the

second cover part; wherein the ramp portion has a ramp surface facing the airbag and arranged to direct the airbag away from the first rear connection portion during inflation of the airbag.

- 5 Aspects and embodiments of the invention provide an apparatus, an airbag unit and a vehicle as claimed in the appended claims.

According to an aspect of the invention there is provided an apparatus for housing a pedestrian airbag on a vehicle, the apparatus comprising: a first cover part comprising a first
10 containing portion a first rear connection portion comprising an aperture for receiving a first connection means for connecting the first cover part to a second cover part and/or a hood of a compartment of a vehicle; and a tear line positioned between the first rear connection portion and the first containing portion; and wherein the first cover part comprises at least one depending feature on the first rear connection portion, the at least one depending
15 feature being at least one lip that extends from the first connection portion and wherein the at least one lip extends along the outer edge arranged such that it reduces the likelihood in use, of a deploying airbag contacting a first connection means located within the aperture.

This provides the advantage that a deploying airbag is provided with protection from the
20 possibility of snagging on the first connection means.

In some embodiments the at least one lip comprises a continuous lip extending along the first rear connection portion. This provides the advantage that the first rear connection portion is provided with additional rigidity and strength.

25

In some embodiments the at least one lip extends from the first rear connection portion to the tear line. This provides the advantage that the rigidity of the first rear connection portion is increased alongside the tear line.

30 In some embodiments the at least one depending feature comprises a first lip and a second lip; and the first lip and the second lip in combination with the first rear connection portion form a U-shaped channel.

This provides the advantage of increased strength and rigidity. Also it allows the connection means to be positioned within the U-shaped channel and therefore it is less likely to contact the airbag during deployment.

5 In some embodiments the at least one depending feature comprises rigidizing ribs.

In some embodiments the rigidizing ribs are attached to the first lip.

In some embodiments the rigidizing ribs extend across the U-shaped channel.

10

In some embodiments the first cover part defines a space between two of the rigidizing ribs for receiving a head of a bolt located in the aperture. This provides the advantage that it allows the bolt to be further hidden from the airbag during its deployment.

15 In some embodiments the first cover part comprises a first front connection portion and a first cover channel for at least partially containing an airbag; the first cover channel is positioned between the first rear connection portion and the first front connection portion; and the first front connection portion comprises an aperture for enabling connection to a second cover part and/or a hood of a compartment of a vehicle.

20

In some embodiments the first cover part comprises a downturned lip extending along an outer edge of the first front connection portion.

In some embodiments the first front connection portion comprises front rigidizing ribs.

25

In some embodiments the front rigidizing ribs of the first front connection portion are attached to its downturned lip.

In some embodiments the first front connection portion comprises a U-shaped channel, and
30 the rigidizing ribs of the first front connection portion extend across the U-shaped channel.

In some embodiments the first cover part comprises a first peripheral connecting portion that includes the first rear connection portion and which extends around the entire periphery of the first cover part.

In some embodiments the first cover part comprises a peripheral downturned lip which extends around an outside edge of the entire first peripheral connecting portion. This provides the advantage that the first cover part, as a whole, is provided with a strong structure.

In some embodiments the first cover part is attached to a second cover part and an airbag is located between the first cover part and the second cover part.

In some embodiments the second cover part comprises a reinforcing structure of a hood for a front compartment of a vehicle.

In some embodiments the second cover part comprises apertures for enabling connection of the second cover part to the first cover part and/or a reinforcing structure of a hood for a front compartment of a vehicle.

In some embodiments the second cover part comprises a second containing portion and a second rear connection portion; the second rear connection portion is connected to the first rear connection portion of the first cover part; and the airbag is located between the first containing portion of the first cover part and the second containing portion of the second cover part.

In some embodiments the second cover part comprises a ramp portion having a ramp surface positioned between the second containing portion and the second rear connection portion; and the ramp surface faces the airbag and is configured to direct the airbag away from the first rear connection portion during inflation of the airbag. This provides the advantage that the airbag is less likely to contact the first rear connection portion or the connection means located during deployment of the airbag.

In some embodiments the second cover part comprises a ridge positioned between the second rear connection portion and the second containing portion; and the ramp surface forms one side of the ridge.

This provides the advantage that the first rear connection portion, and/or a connection means connecting the first rear connection portion to a hood, may be positioned further back, than it otherwise would be, from the path of the airbag during its deployment.

- 5 In some embodiments the second cover part comprises a front wall portion and the second containing portion extends between the ramp portion and the front wall portion to form a channel in the second cover.

10 In some embodiments a second cover part is attached to the first cover part and an airbag located between the first cover part and the second cover part.

According to another aspect of the invention there is provided a vehicle comprising: a compartment positioned in front of a windshield of the vehicle, the compartment being an engine compartment or a trunk; a hood covering the compartment and the apparatus
15 according to any one of the previous paragraphs attached to an inner surface of the hood.

In some embodiments the hood comprises an outer panel and a reinforcement structure attached to the outer panel, and the reinforcement structure comprises a channel in which the airbag is positioned. This provides the advantage that the airbag takes up less space in
20 the compartment.

In some embodiments the first cover part is attached to the hood by a bolt extending through the aperture in the first rear connection portion and a head of the bolt is positioned between two rigidizing ribs attached to the first rear connection portion.
25

In some embodiments the second cover part is attached to the hood by the same bolt which extends through a hole in the second rear connection portion.

According to another aspect of the invention there is provided an apparatus for housing a pedestrian airbag on a vehicle, the apparatus comprising a first cover part comprising: a first
30 containing portion and a first rear connection portion configured to receive a first connection means for connecting the first cover part to a second cover part and/or a hood of a compartment of a vehicle; and a tear line positioned between the first rear connection portion and the first containing portion; and wherein the first cover part comprises at least one

depending feature on the first rear connection portion, the at least one depending feature being arranged such that it reduces the likelihood in use, of a deploying airbag contacting a first connection means connecting the first rear connection portion to a second cover part and/or a hood of a vehicle.

5

For the purposes of the present application “a compartment positioned towards a front of a vehicle”, or “a hood for a compartment of a vehicle” or “a hood for a front compartment of a vehicle” is an engine compartment or trunk positioned in front of a windshield of the vehicle.

10 The apparatus of any of the above aspects may be for use within a road vehicle.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features
15 thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally
20 claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described, by way of example only,
25 with reference to the accompanying drawings, in which:

Fig. 1 shows a plan view of a vehicle embodying the present invention;

Fig. 2 shows a view of the underside of the hood of the vehicle shown in Fig. 1;

30

Fig. 3 shows a view of the underside of the hood without an airbag unit attached;

Fig. 4 shows a cross-sectional view of an airbag unit attached to the hood;

Fig. 5 shows a bottom view of the airbag unit;

Fig. 6 shows a bottom view of just one half of the airbag unit of Fig. 5;

5 Fig. 7 shows a perspective view of the airbag unit;

Fig. 8 shows a top view of the airbag unit of Fig. 4;

Fig. 9 shows an alternative embodiment, in which the airbag is positioned between the first
10 cover part and the inner panel, directly against the inner panel;

Figs. 10 and 11 respectively show the airbag unit of Fig. 4 before and after deployment of
the airbag; and

15 Fig. 12 shows a further alternative airbag unit embodying the present invention.

DETAILED DESCRIPTION

A vehicle 101 embodying the present invention is shown in a plan view in Fig. 1. The vehicle
20 101 comprises a windshield 102 and a compartment 103 positioned in front of a windshield
102. In the embodiment of Fig. 1, the compartment 103 is an engine compartment. However,
in alternative embodiments where the vehicle 101 is a rear engine vehicle 101 or a battery
powered electric vehicle, the compartment 103 may be a luggage compartment, which may
be referred to as a trunk or boot.

25

The vehicle 101 comprises a hood 104 (or bonnet), in the form of a hinged lid for the
compartment 103. The hood 104 comprises an outer panel 107, an outer surface of which
provides an A-surface of the vehicle 101 which forms a part of the exterior shape of the
vehicle 101. The vehicle 101 also comprises a pedestrian airbag unit 105, which is attached
30 to an inner surface (as shown in Fig. 2) of the hood 104. In the event that the vehicle 101
has a collision with a pedestrian, sensors (not shown) located at the front 106 of the vehicle
101, provide a signal to an electronic controller (not shown) which causes the deployment
and lifting of the rear end of the hood 104 and the inflation of an airbag 205 (as shown in Fig.
11) stored in the airbag unit 105. The airbag 205, when inflated, expands out past a rear

edge 108 of the hood 103 to at least partially cover the windshield 102, windshield wipers (not shown) and A-pillars of the vehicle 101 to protect the pedestrian against direct collision with the windshield 102, windshield wipers and A-pillars.

5 A view of the underside of the hood 104 is shown in Fig. 2. In the present embodiment, the underside of the hood 104 comprises an inner panel 201 that in general is spatially separated from the outer panel 107, but which meets the outer panel 107 along a seam 202 around the periphery of the hood 104. A reinforcement structure 203 is permanently attached to the outer panel 107 and positioned between the inner panel 201 and the outer
10 panel 107. As is known, the reinforcement structure 203 may have a complex 3-dimensional shape to provide the hood 104 with increased strength and rigidity. However, in the present embodiment, the reinforcement structure 203 also provides a rigid structure to support attachment means for enabling attachment of the airbag unit 105 to the hood 104.

15 The airbag unit 105 comprises a first cover part 204, which forms a part of an apparatus 200 for housing an airbag 205. The first cover part 204 comprises a first containing portion 206, which contains at least a portion of the airbag 205. The first cover part 204 also comprises a first rear connection portion 207, which comprises apertures (402 shown in Figs. 4, 5 and 6) to enable attachment of the first cover part 204 to the reinforcement structure 203 by
20 connection means 208, which may comprise several bolts 208.

In the present embodiment, the first cover part 204 also comprises a first front connection portion 209, which also comprises apertures (608 shown in Figs. 4, 5 and 6) to enable attachment of the first cover part 204 to the reinforcement structure 203, for example by
25 several bolts 210. The first containing portion 206 is located between the first rear connection portion 207 and the first front connection portion 209.

The hood 104 with the airbag unit 105 removed is shown in Fig. 3. The reinforcement structure 203 defines a channel 302 (shown in dashed outline) in which the airbag unit 105
30 at least partially resides. In the present embodiment, in which the inner panel 201 overlays the reinforcement structure 203, the inner panel 201 also defines a channel 301, positioned within the channel 302 in the reinforcement structure 203, and in which the airbag 205 at least partially resides.

As illustrated in Fig. 3, the channel 302 in the reinforcement structure 203, like the channel 301 in the inner panel, extends substantially parallel to the curved rear edge 108 of the hood 104. The reinforcement means 203 comprises attachment means 304 for enabling attachment of the airbag unit 105. The attachment means 304 comprises several threaded
5 holes 305 positioned on a line alongside the channel 302, between the channel 302 and the rear edge 108 of the hood 104. In the present embodiment, the attachment means 304 also comprises several threaded holes 306 positioned on a line alongside the channel 302, between the channel 302 and a front edge 307 of the hood 104. In the present embodiment, the reinforcement structure 203 is formed of a pressed steel sheet, and the threaded holes
10 305 and 306 are formed by positioning clinch nuts (403 in Fig. 4) in holes formed in the steel sheet.

The channel 302 is positioned in close proximity to the rear edge 108 of the hood 104 to facilitate expansion of the airbag 205, out from under the hood 104, during inflation of the
15 airbag. Thus, the channel 302 is spaced from the rear edge 108 of the hood 104 by a relatively short first distance 308 and spaced from the front edge 307 of the hood 104 by a relatively long second distance 309.

A cross-sectional view of the airbag unit 105 attached to the hood 104 is shown in Fig. 4. As
20 mentioned above, the airbag unit 105 comprises a first cover part 204, which comprises a first containing portion 206 in which the un-deployed airbag 205 partially resides. The airbag 205 comprises an inflatable bag containing an electronically actuatable inflation unit 420 configured to generate gas to inflate the airbag 205 on receipt of a signal.

The first containing portion 206 comprises a channel which has the first rear connection
25 portion 207 on one side and the first front connection portion 209 on the opposite side. The first cover part 204 also comprises a tear line 401 positioned between the first rear connection portion 207 and the first containing portion 206, the tear line 401 being arranged to tear during use to provide an aperture (1101 shown in Fig. 11) through which the airbag
30 205 can deploy. The tear line 401 extends into and out of the page as viewed in Fig. 4, along the whole length of the first containing portion 206. The first cover part 204 may be formed of a molded plastics material, and the tear line 401 may be formed as a line of reduced material thickness.

In the present embodiment, one or more depending features are provided on the first rear connection portion 207. The depending features are arranged to reduce the likelihood, in use, of the airbag 205 contacting a connection means used to attach the first rear connection portion 207 to the reinforcement structure 203. In the present example, the connection means are the bolts 208 which are located within apertures 402 formed in the first rear connection portion 207 and screwed into clinch nuts 403 fixed to the metal sheet forming the reinforcement structure 203.

The depending features also provide the rear connection portion 207 with increased strength and rigidity, so that the first connecting portion 207 is held firmly in place along its whole length while the first cover portion 204 is torn along the tear line 401 during deployment of the airbag 205.

The first cover part 204 comprises a first depending feature in the form of a first lip 404 that depends from the first rear connection portion 207. The first lip 404 may extend continuously along the entire length of the first rear connection portion 207 or may be one of a series of lips positioned in the vicinity of the bolts 208 to shield the bolt from the airbag 205 during its deployment.

In the present embodiment, the first lip 404 extends from an outer edge of the first rear connection portion 207. A second lip 405 extends from the first rear connection portion 207 to the tear line 401. I.e. the tear line 401 runs along an edge of the second lip 405. The first lip 404 and the second lip 405 may both extend to one side of the first rear connection portion 207, so that the combination of the first lip 404, the second lip 405 and the first rear connection portion 207 form a U-shaped channel. The heads of the bolts 208 reside within the U-shaped channel and therefore they are shielded from the airbag 205 during its deployment.

Alternatively, or in addition to the lips 404 and 405, the depending features may comprise rigidizing ribs 406. The rigidizing ribs 406 may extend across the U-shaped channel formed by the combination of the first lip 404, the second lip 405 and the first rear connection portion 207 and may be attached to both the first lip 404 and the second lip 405, as is the case in the embodiment of Fig. 4.

As illustrated in Fig. 2, the bolts 208 may be positioned between two of the rigidizing ribs 406, and therefore the ribs 406 further shield the airbag 205 from the head of the bolts 208.

A bottom view of the airbag unit 105 is shown in Fig. 5. An enlarged bottom view of a portion of the airbag unit 105 is shown in Fig. 6, where features of the airbag unit 105 are more clearly visible and labelled. As can best be seen in Fig. 6, additional ribs 601 may be provided on the first rear attachment portion 207 that extend approximately parallel to the lips 404 and 405, and which extend between selected ones of the first rigidizing ribs 406, to further enhance the rigidity of the first rear connection portion 207. Figs. 5 and 6 also show the positions of the apertures 402 formed in the first rear connection portion 207 through which the bolts 208 are located.

The first cover part 204 also comprises a downturned lip 407 extending along a front edge of the first front connection portion 209. In the present embodiment, the first front connection portion 209 and the first rear connection portion 207 are sections of a first peripheral connecting portion 602 that extends around the entire periphery of the first cover part 204. Similarly, the first lip 404 on the first rear connection portion 207 and the downturned lip 407 on the first front connection portion 209 are sections of a peripheral downturned lip 603 that extends around the entire outer edge of the first peripheral connecting portion 602.

The first front connection portion 209 may also be provided with first ribs 604, which extend substantially perpendicularly to the downturned lip 407, and second ribs 605, which extend between the first ribs 604. Other sections of the first peripheral connecting portion 602 may be provided with rigidizing ribs 606 in a similar manner to the first rear connecting portion 207.

As shown in the perspective view of the airbag unit 105 in Fig. 7, the ribs 604 may include larger ribs 701 that extend further around the first containing portion 206 to provide it with additional support.

As shown in the bottom views of Figs. 5 and 6, the first front connecting portion 209 is also provided with apertures 608 to enable attachment of the first cover part 204 to the hood 104. This may be achieved by locating a bolt 210 through each of the apertures 608 and screwing into a threaded hole 306 in the reinforcement structure 203, as shown in Fig. 4. The

threaded holes 306 may be provided by clinch nuts 403 fixed to the metal sheet forming the reinforcement structure 203.

As shown in Fig. 4, the apparatus 200 housing the airbag 205 also comprises a second cover part 408. In combination, the first cover part 204 and the second cover part 408 define a chamber 409 for containing the airbag 205.

The second cover part 408 comprises a second containing portion 410. In the present embodiment, the second containing portion 410 is positioned between a front wall portion 411 and a ramp portion 412 of the second cover part 408 to form a channel 416 in which the un-deployed airbag 205 is partially located. The second cover part 408 also comprises a second rear connection portion 413, and a second front connection portion 414, which are positioned so that they extend respectively alongside the first rear connection portion 207 and first front connection portion 209 of the first cover part 204.

A top view of the airbag unit 105, which shows the top of the second cover part 408, is shown in Fig. 8. The second rear connection portion 413 extends along one side of the channel 416 of the second cover part 408 and the second front connection portion 414 extends along the opposite side of the channel 416. The second rear connection portion 413 and the second front connection portion 414 form a part of a second peripheral connection portion 801 which extends around the entire periphery of the second cover part 408. The first cover part 204 and the second cover part 408 are connected together so that the second peripheral connecting portion 801 extends alongside the first peripheral connecting portion 602 (shown in Figs. 5 and 6).

The second rear connection portion 413 and the second front connection portion 414 comprise apertures 802 to enable a fixing means such as a bolt 208 or 210 to pass through and attach the second cover part 408 to the first cover part 204 and the hood 104, as shown in Fig. 4.

As shown in Fig. 4, the ramp portion 412 comprises a ramp surface 415 to direct, in use, the airbag 205 away from the first rear connection portion 207 during inflation of the airbag 205. Thus, there is a reduced likelihood of the airbag 205 coming into contact with the connection

means, such as bolts 208, used to connect the first rear connection portion 207 to the hood 104.

5 The second containing portion 410 is arranged substantially parallel to the outer panel 107 of the hood 104. The second containing portion 410 has a first surface 417 that faces inwards into the chamber 409 containing the airbag 205 and an outer surface that faces the channel 302 formed in the reinforcement structure 203. The ramp surface 415 also faces into the chamber 409 and the ramp surface 415 is oriented at an obtuse angle to the first surface 417 of the second containing portion 410 in order to direct the airbag 205 away from the first
10 connection portion 207 during deployment of the airbag 205.

The second cover part 408 also comprises a ridge 418, and the ramp surface 415 forms one side of the ridge 418. The ridge 418 is positioned between the second containing portion 410 of the second cover part 408 and the second rear connection portion 209. The ridge 418
15 enables the head of the bolts 208 to be positioned further back from the projected path of the deployed airbag 205 than they otherwise would be.

Fig. 4 also illustrates the cross-sectional shape of the reinforcement structure 203. The reinforcement structure 203 defines the channel 302, which extends laterally across the hood 104, i.e. into and out of the page in Fig. 4. The channel 302 has an inner surface 419
20 that faces away from the outer panel 107 to enable the channel 302 to receive at least a part of the airbag unit 105. I.e. A part of the airbag unit 105 is able to reside within the channel 302 of the reinforcement structure 203.

25 In the embodiment of Fig. 4, the hood comprises the inner panel 201, which has a channel 301 positioned within the channel 302 formed in the reinforcement structure 203, and the airbag unit 105 is positioned within the channel 301 of the inner panel 201. However, in an alternative embodiment, the hood 104 does not include an inner panel 201 between the outer airbag unit 205 and the reinforcement structure 203, and the airbag unit 205 is
30 positioned directly within the channel 302 formed in the reinforcement structure 203.

In the embodiment of Fig. 4, the airbag 205, the first cover part 204 and the second cover part 408 form an airbag unit 105 which may be handled and installed as a complete module. However, in alternative embodiments, the airbag unit 105 may not include a second cover

part 408 that is separable from the hood 104. An example of such an alternative embodiment is shown in Fig. 9, in which the airbag 205 is positioned between the first cover part 204 and the inner panel 201, directly against the inner panel 201. i.e. the inner panel 201 provides a second cover part, which in combination with the first cover part 204 forms the chamber 409 in which the airbag 205 is stored.

The airbag 205 is held within a first cover part 204, which is attached to the hood 104 by connection means in the form of bolts 208 passing through its first rear connection portion 207 and bolts 210 passing through its first front connection portion 209. The first cover part 204 may be configured substantially as described above with regard to the embodiment of Fig. 4.

Like the embodiment of Fig. 4, the inner panel 201 of Fig. 9 includes a channel 301 that has a middle portion 901 substantially parallel to the outer panel 107 and a ramp portion 902 having a ramp surface 904 extending from the middle portion 901 towards the first rear connection portion 207 of the first cover part 204 of the airbag unit 105A. In this embodiment, the inner panel 201 has been formed into a shape that includes a ridge 903, and the ramp surface 904, of the inner panel 201 forms one side of the ridge 903. The ramp surface 904 of the inner panel 201 is configured to direct the airbag 205 away from the first rear connection portion 207 during deployment of the airbag 205. Furthermore, the ridge 903 included in the first panel 201 results in the head of a bolt 208 being positioned further back from the path of the airbag 205 during deployment than it otherwise would be.

A further alternative airbag unit 105B embodying the present invention is shown in Fig. 12. In this embodiment, the hood 104 is produced without an inner panel 201 and the airbag 205 is held between the first cover part 204 and the channel 302 formed in the reinforcement structure 203, directly against the channel 302. Thus, in this embodiment, the reinforcement structure 203 provides the function of the second cover part, which in combination with the first cover part 204 forms the chamber 409 in which the airbag 205 is stored.

The first rear connection portion 207 is fixed against the second rear connection portion 1205, which in the embodiment of Fig. 12, is a portion of the reinforcement structure 203 positioned to the rear of the channel 302.

The reinforcement structure 203 may be formed into a shape that includes a ramp portion 1202 having a ramp surface 1204 facing the airbag 205. The ramp surface 1204 is configured to direct the airbag 205 away from the first rear connection portion 207 and the connection means 208 during deployment of the airbag 205.

5

The reinforcement structure 203 is also provided with a ridge 1203 positioned alongside the channel 302 and between the channel 302 and the second connection portion 1205. The ramp surface 1204 forms one side of the ridge 1203.

10 The airbag unit 105 of Fig. 4 is shown in Figs. 10 and 11 before and after deployment of the airbag 205 respectively. Before deployment of the airbag 205, the hood 104 is in its normal closed position. The vehicle 101 may be provided with a leaf screen 1001 which separates the airbag unit 105 from the compartment 103. A seal 1007 may be provided on the inner panel 201 of the hood 104, or on the leaf screen 1001, to isolate the airbag unit 105 from the
15 environment within the compartment 103.

In the event of a collision, the hood 104 is deployed and lifted and the inflator unit 420 of the airbag 205 is activated causing the airbag 205 to inflate. The expanding airbag 205 causes the first cover part 204 to tear along the tear line 401 to create an aperture 1101 through
20 which the airbag 205 is able to expand and cover the windshield 102, as shown in Fig. 11.

As shown in Fig. 10, the reinforcement structure 203 is shaped so that it extends away from the outer panel 107 by a first distance 1002. The separation of the reinforcement structure 203 from the outer panel 107 by the first distance 1002 provides the hood 104 with the
25 strength and rigidity that is required. The first front connection portion 209 of the airbag unit 105 may be attached to a portion 1003 of the reinforcement structure 203 at the front of the channel 302 that is separated from the outer panel 107 by the first distance 1002, as shown in Fig. 10.

30 The first rear connection portion 207 of the airbag unit 105 is attached to a portion 1004 of the reinforcement structure 203 at the rear of the channel 302 that is separated from the outer panel 107 by a second distance 1005 that is smaller than the first distance 1002. The separation between the portion 1004 and the outer panel 107 enables bolts 208 to be screwed through the reinforcement structure 203. However, because the second distance

1005 between the portion 1004 and the outer panel 107 of the hood 104 is smaller than the first distance 1002 between the outer panel 107 and other parts of the reinforcement structure 203, a gap 1006 between the first rear connection portion 207 and the leaf screen 1001 is larger than it otherwise would be. By arranging the gap 1006 to be larger, the expansion of the airbag 205 through the gap 1006 and over the windshield 102 is facilitated. In embodiments of the invention, if the gap 1006 is too wide thus resulting in a visible gap under the bonnet then there may be provided a flexible lip seal between the leaf screen 1001 and the bonnet panel 201 to substantially cover the gap 1006. The lip seal may be made from a flexible material such as a rubber sealant and thus would not obstruct the deployment of the pedestrian airbag.

Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed. For example, in alternative embodiments, a ridge may not be provided on the second cover part. In alternative embodiments, connection means other than bolts may be used to attach the first rear connection portion and/or the first front connection portion to the hood. For example, the hood may be configured to enable the first rear connection portion or the first front connection portion, itself, to engage with the hood. For example, the hood may be formed with means to enable the first rear connection portion or the first front connection portion to be hooked onto the hood.

Features described in the preceding description may be used in combinations other than the combinations explicitly described.

Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

Although features have been described with reference to certain embodiments, those features may also be present in other embodiments whether described or not.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features

hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

CLAIMS

1. Apparatus for housing a pedestrian airbag on a vehicle, the apparatus comprising:
a first cover part comprising a first rear connection portion, a first containing portion,
5 and a tear line positioned between the first rear connection portion and the first containing portion, the tear line being arranged to tear during use to provide an aperture through which an airbag can deploy; and
a second cover part;
wherein the first cover part and the second cover part define a chamber for an airbag, the
10 second cover part comprising a ramp surface to direct, in use, a deploying airbag away from the first rear connection portion during inflation of the airbag.
2. The apparatus according to claim 1, wherein: the second cover part comprises a
second containing portion and a second rear connection portion positioned alongside the
15 first rear connection portion; the ramp surface extends from the second containing portion to the second rear connecting portion; the second containing portion has a first surface facing into the chamber; and the ramp surface faces into the chamber at an obtuse angle to the first surface of the second containing portion.
- 20 3. The apparatus according to claim 2, wherein: the second cover part comprises a ridge positioned between the second rear connecting portion and the second containing portion; and the ramp surface forms one side of the ridge.
4. The apparatus according to any one of claims 1 to 3, wherein the first cover part
25 and/or the second cover part comprise holes to enable attachment of the apparatus to an inside surface of a hood of a compartment positioned towards a front of a vehicle.
5. The apparatus according to any one of claims 1 to 4, wherein the second cover part
30 comprises a reinforcement structure of a hood for a compartment of a vehicle, the compartment being an engine compartment or a trunk.
6. The apparatus according to any one of claims 1 to 5, wherein the first cover part comprises at least one depending feature on the first rear connection portion, the at least one depending feature being arranged such that it reduces the likelihood, in use, of a

deploying airbag contacting a first connection means located within an aperture in the first rear connection portion.

7. The apparatus according to claim 6, wherein the at least one depending feature
5 comprises at least one lip extending from the first rear connection portion.

8. The apparatus according to claim 7, wherein the at least one lip comprises a continuous lip extending along the first rear connection portion.

9. The apparatus according to claim 7 or claim 8, wherein the at least one lip extends
10 along an outer edge of the first rear connection portion.

10. The apparatus according to any one of claims 7 to 9, wherein the at least one lip extends from the first rear connection portion to the tear line.

11. The apparatus according to any one of claims 7 to 10, wherein: the at least one
15 depending feature comprises a first and a second lip; and the first lip and the second lip in combination with the first rear connection portion form a U-shaped channel.

12. The apparatus according to any one of claims 6 to 11, wherein the at least one
20 depending feature comprises rigidizing ribs.

13. The apparatus according to claim 12 when dependent from any one of claims 7 to 11, wherein the rigidizing ribs are attached to the at least one lip.

14. The apparatus according to claim 13 when dependent on claim 11, wherein the
25 rigidizing ribs extend across the U-shaped channel.

15. The apparatus according to claim 8 when dependent on claim 2, wherein an outer
30 surface of the U-shaped channel faces the second rear connection portion.

16. The apparatus according to any one of claims 1 to 15, wherein the first cover part comprises: a first front connection portion; and a channel positioned between the first rear connection portion and the first front connection portion.

17. The apparatus according to claim 16, wherein: the first cover part comprises a first peripheral connecting portion that includes the first front connection portion and the first rear connection portion and which extends around the entire periphery of the first cover part.

5

18. The apparatus according to claim 17, wherein the second cover part comprises a second peripheral connecting portion that includes the second front connection portion and the second rear connection portion, and which extends alongside the first peripheral connecting portion around the entire periphery of the second cover part.

10

19. The apparatus according to any one of claims 16 to 18, wherein the first cover part comprises a downturned lip extending along a front edge of the first front connection portion.

20. The apparatus according to any one of claims 16 to 19, wherein the first front connection portion comprises front rigidizing ribs.

15

21. The apparatus according to claim 20 when dependent on claim 19, wherein the front rigidizing ribs are attached to the downturned lip extending along the front edge and the first front connection portion.

20

22. The apparatus according to any one of claims 2 to 21, wherein: the second cover part comprises a front wall portion; and the second containing portion extends between the ramp portion and the front wall portion to form a channel.

23. Apparatus for housing a pedestrian airbag on a vehicle, the apparatus comprising: a first cover part comprising a first containing portion; a first rear connection portion comprising an aperture for receiving a first connection means for connecting the first cover part to a second cover part and/or a hood of a compartment of a vehicle; and a tear line positioned between the first rear connection portion and the first containing portion; and

wherein the first cover part comprises at least one depending feature on the first rear connection portion, the at least one depending feature being at least one lip that extends from the first rear connection portion and wherein the at least one lip extends along the outer edge arranged such that it reduces the likelihood, in use, of a deploying airbag contacting a first connection means located within the aperture.

30

24. An airbag unit comprising the apparatus according to any one of claims 1 to 23, a second cover part attached to the first cover part and an airbag located between the first cover part and the second cover part.

5

25. A vehicle comprising: a hood covering a front compartment of the vehicle; an apparatus according to any one of claims 1 to 24 attached to an inner surface of the hood and an airbag positioned between the first cover part and the second cover part of the apparatus.

10

26. The vehicle according to claim 25, wherein: the first cover part is attached to the hood by a fixing means extending through a hole in the first rear connection portion; and a head of the bolt is positioned between two rigidizing ribs on the first rear connection portion.

15

27. The vehicle according to claim 26, wherein: the second cover part is attached to the hood by the same fixing means, which extends through a hole in the second rear connection portion.

20

28. The vehicle according to any one of claims 25 to 27, wherein: the hood comprises an outer panel and a reinforcement structure attached to the outer panel; and the reinforcement structure comprises a channel in which the airbag is positioned.

25

29. The vehicle according to claim 25 or claim 26, wherein: the hood comprises an outer panel and a reinforcement structure attached to the outer panel; and the reinforcement structure provides the second cover part.

30

30. The vehicle according to claim 28 or claim 29, wherein: the reinforcement structure comprises a portion at the rear of the channel to which the first rear connection portion is attached, and a portion at the front of the channel to which the first front connection portion is attached; the portion at the front of the channel is a first distance from the outer panel; the portion at the rear of the channel is a second distance from the outer panel; and the second distance is shorter than the first distance.

31. An apparatus, an airbag unit or a vehicle as herein described with reference to the accompanying figures.

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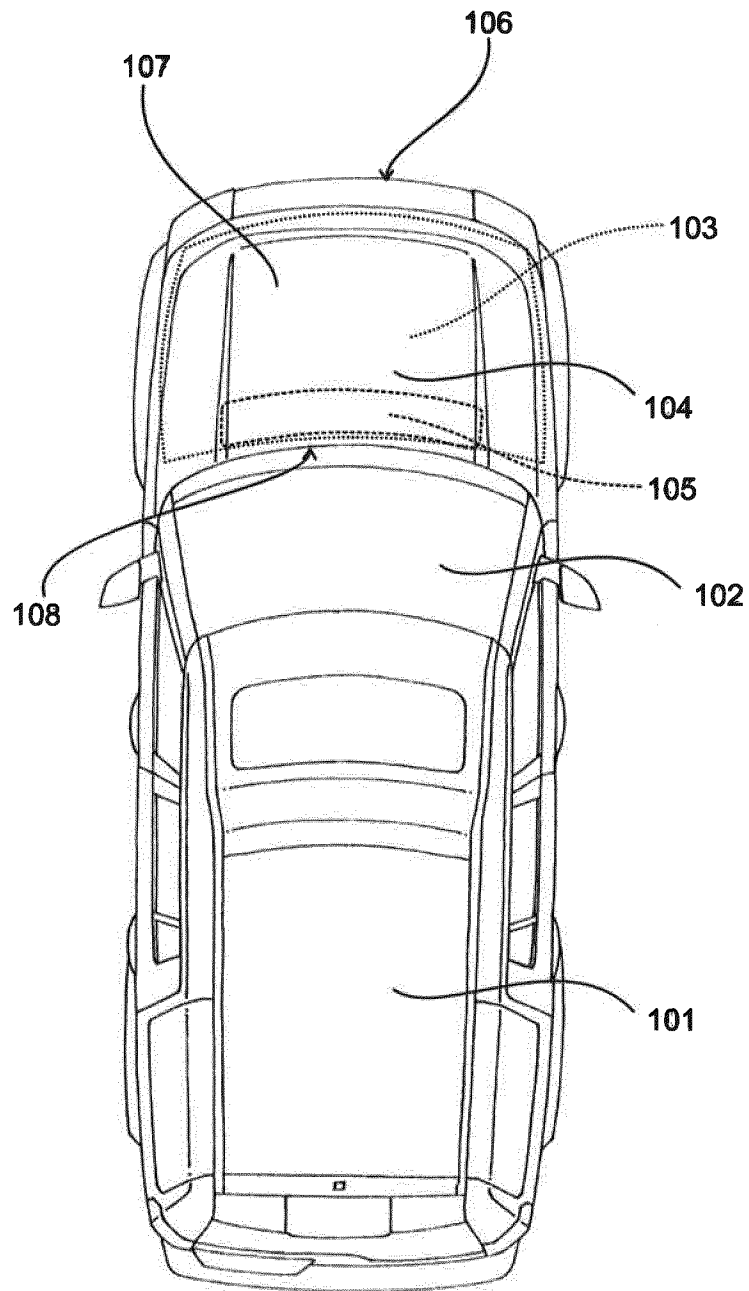


Fig. 1

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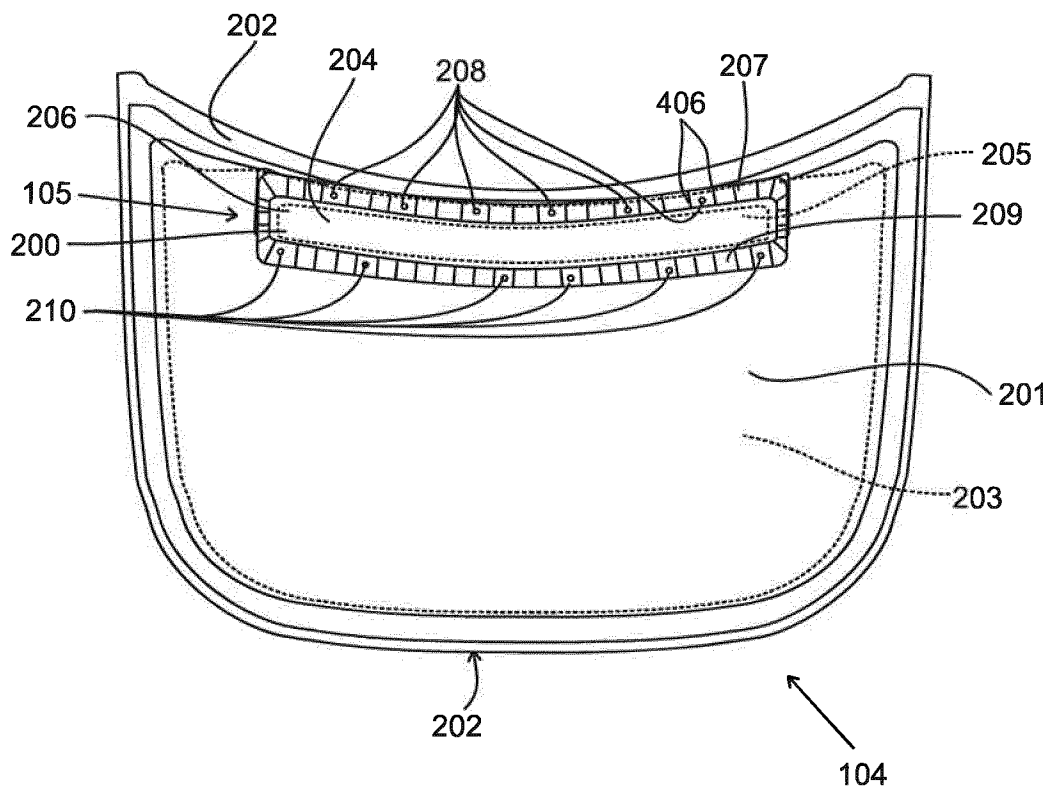


Fig. 2

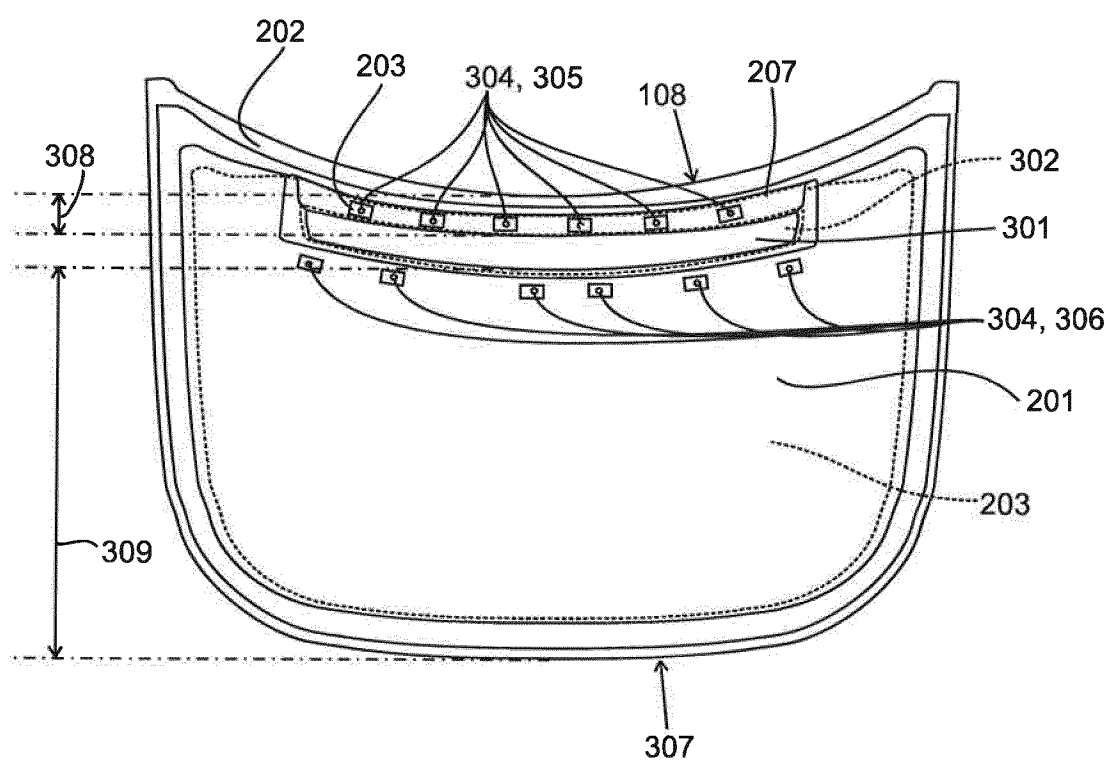


Fig. 3

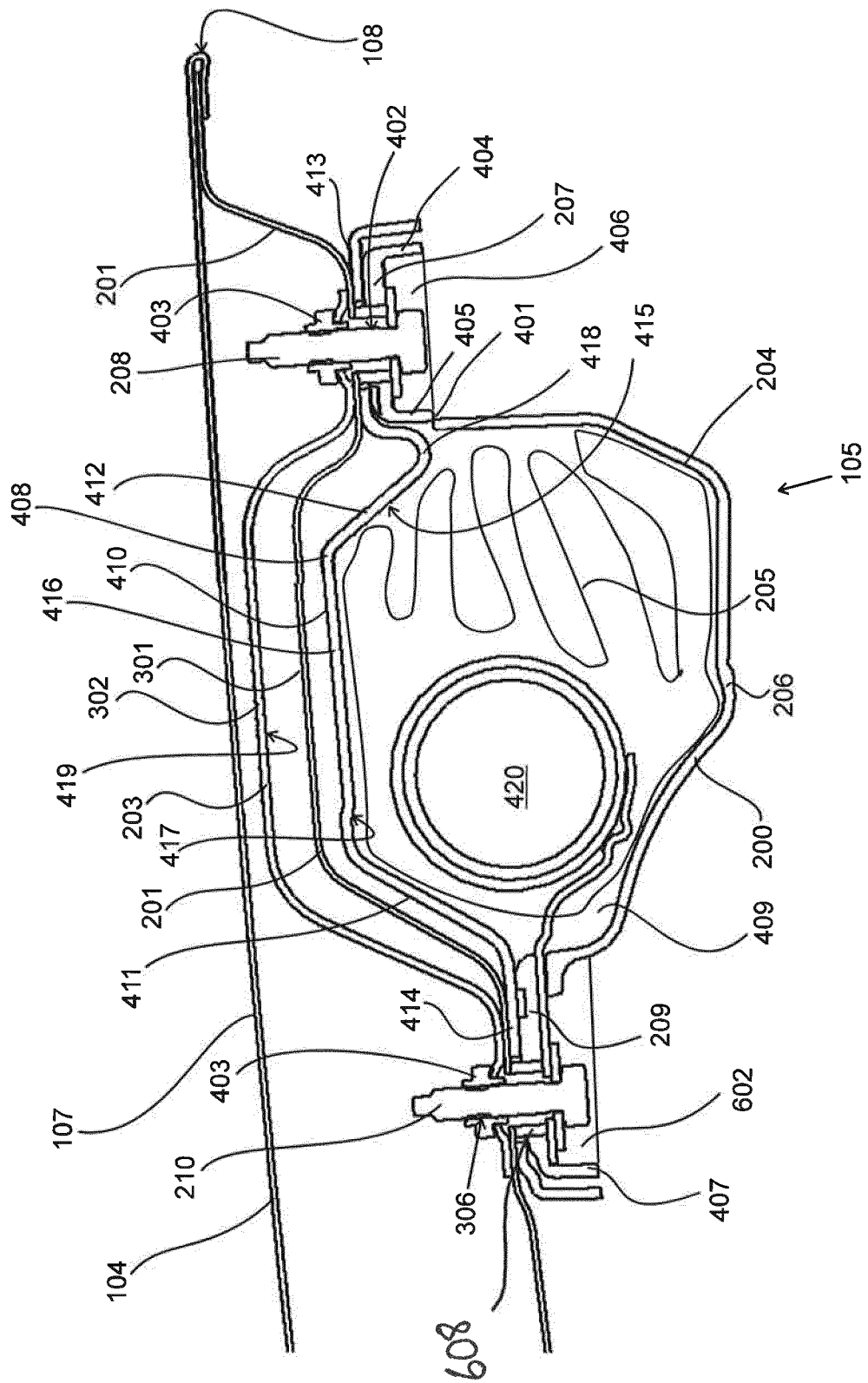


Fig. 4

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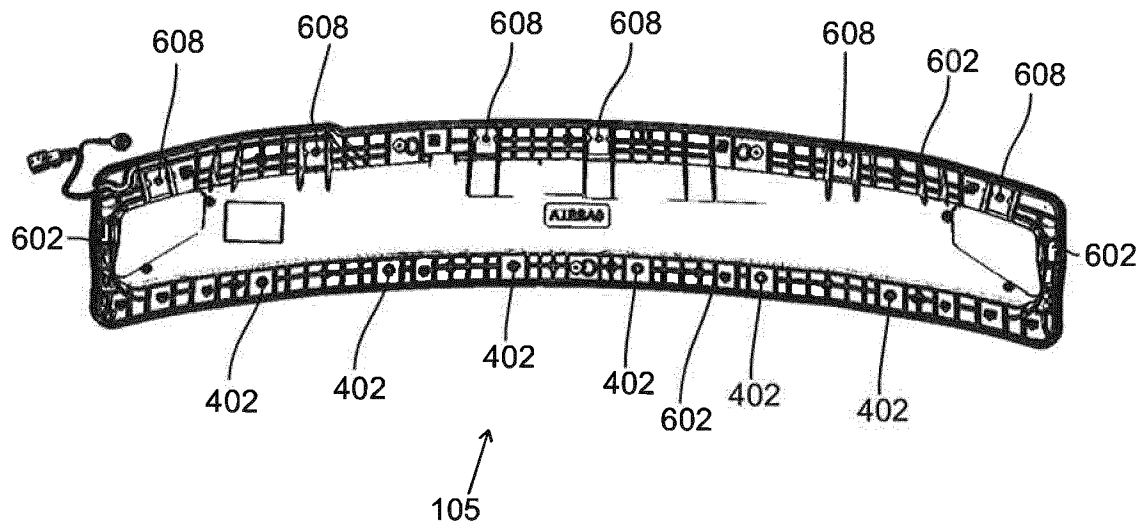


Fig. 5

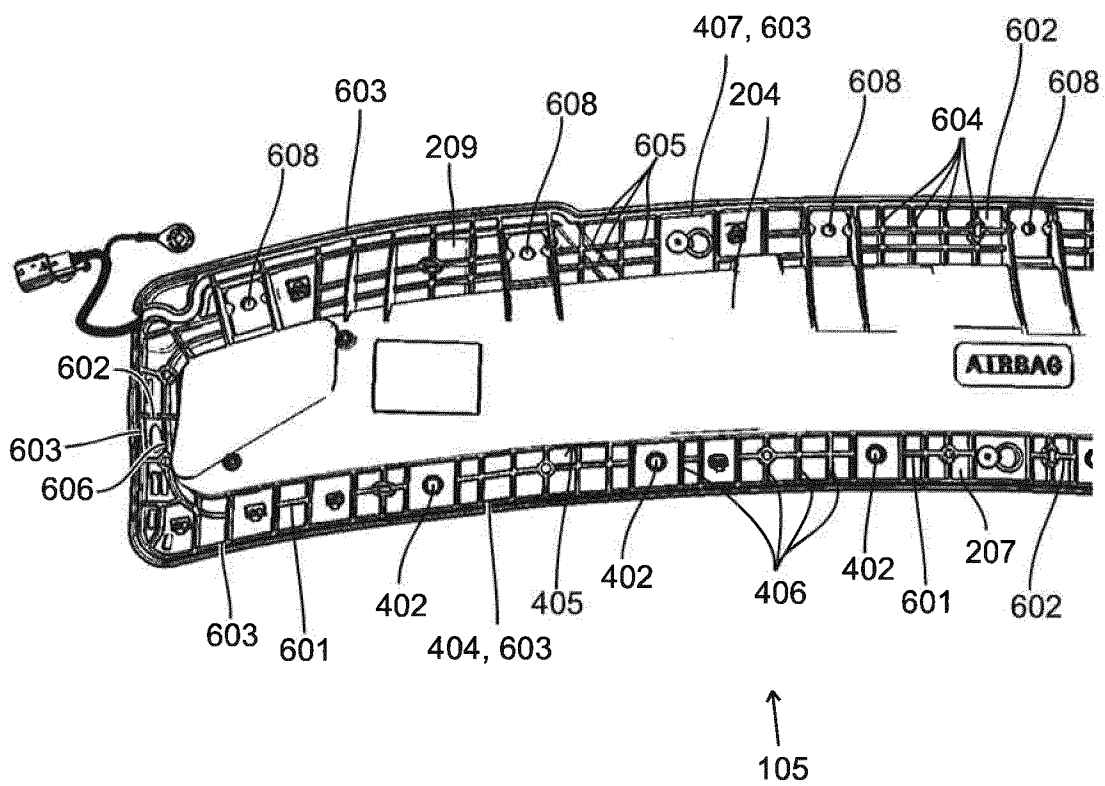


Fig. 6

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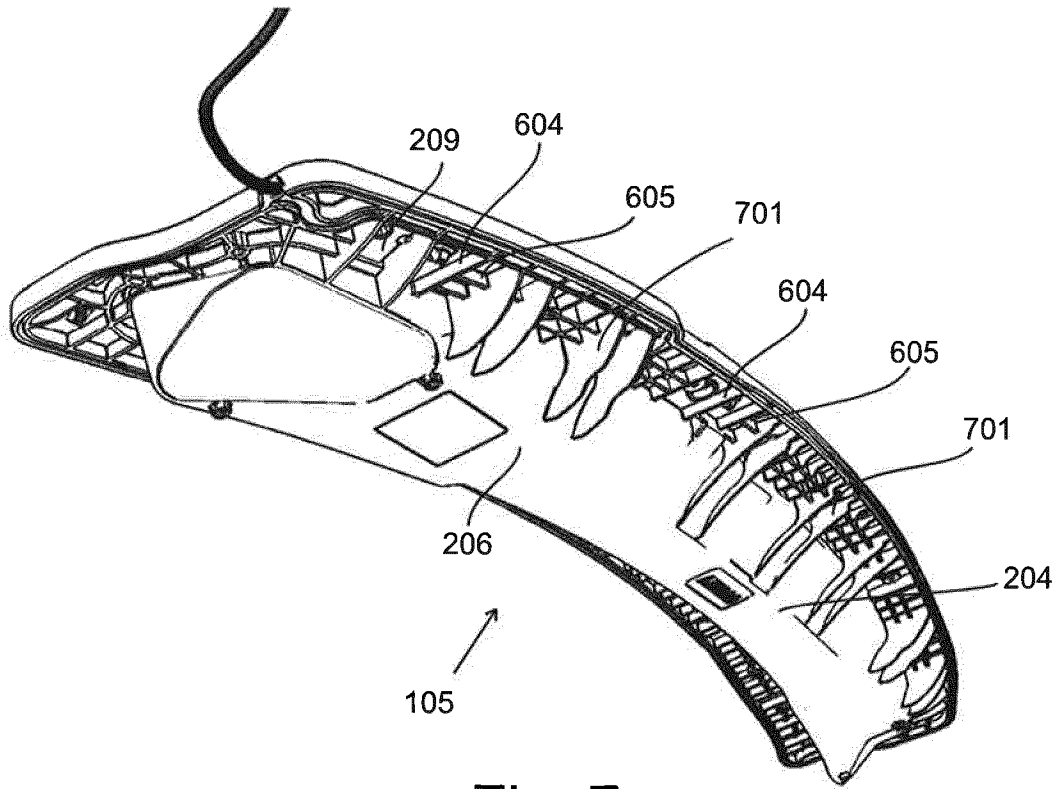


Fig. 7

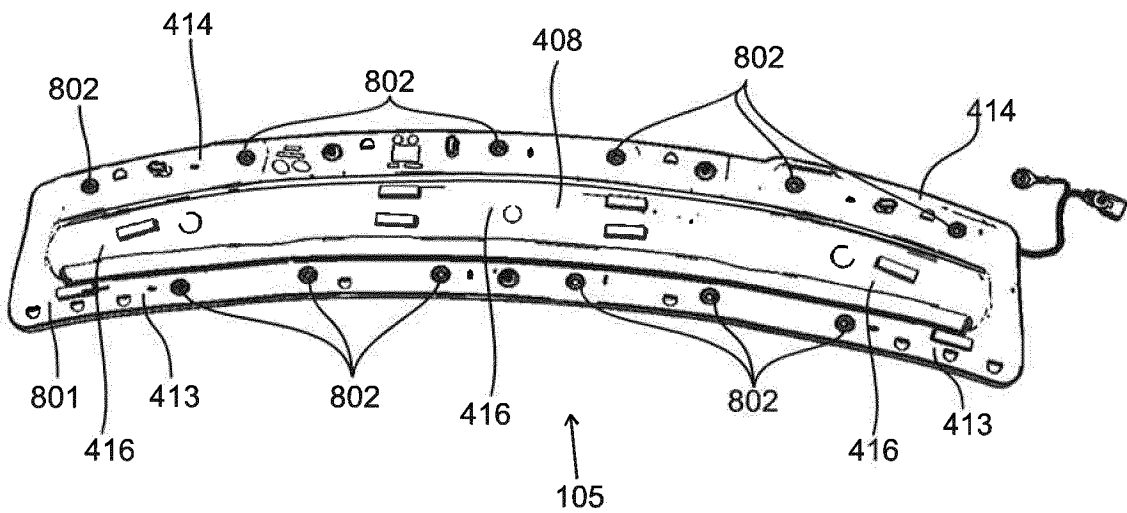


Fig. 8

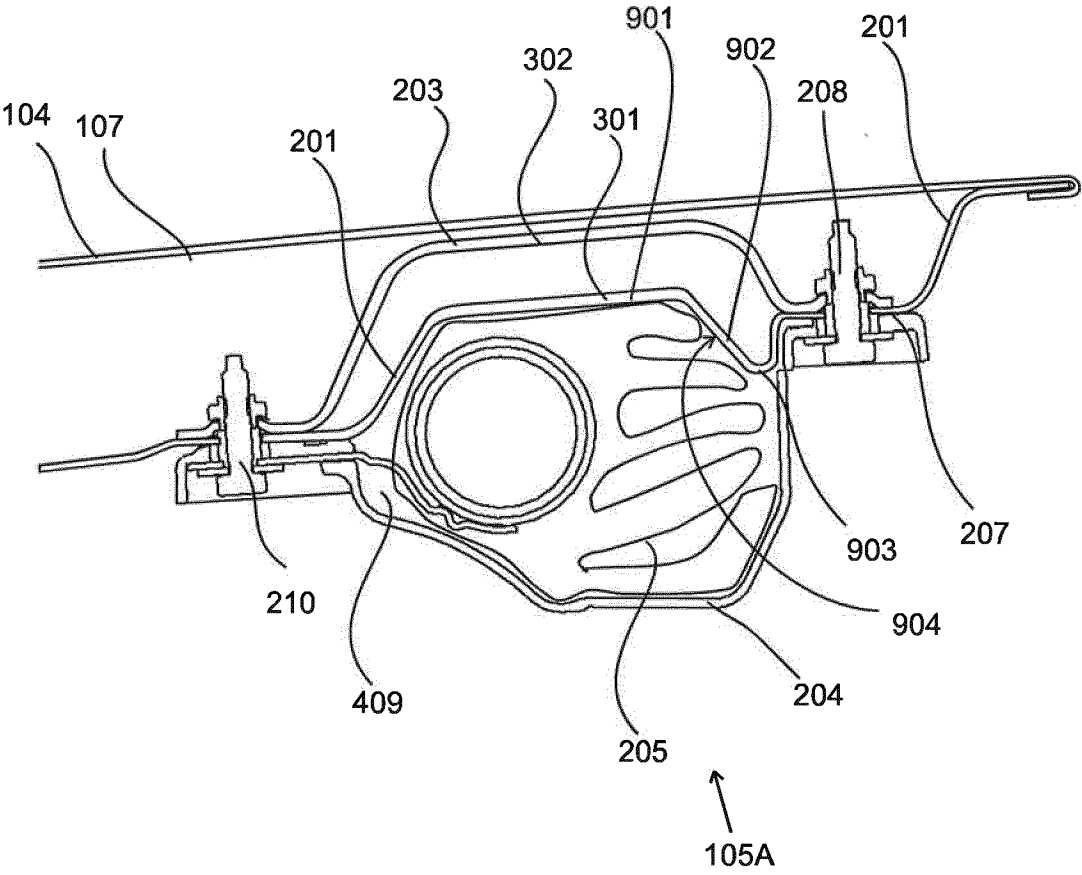


Fig. 9

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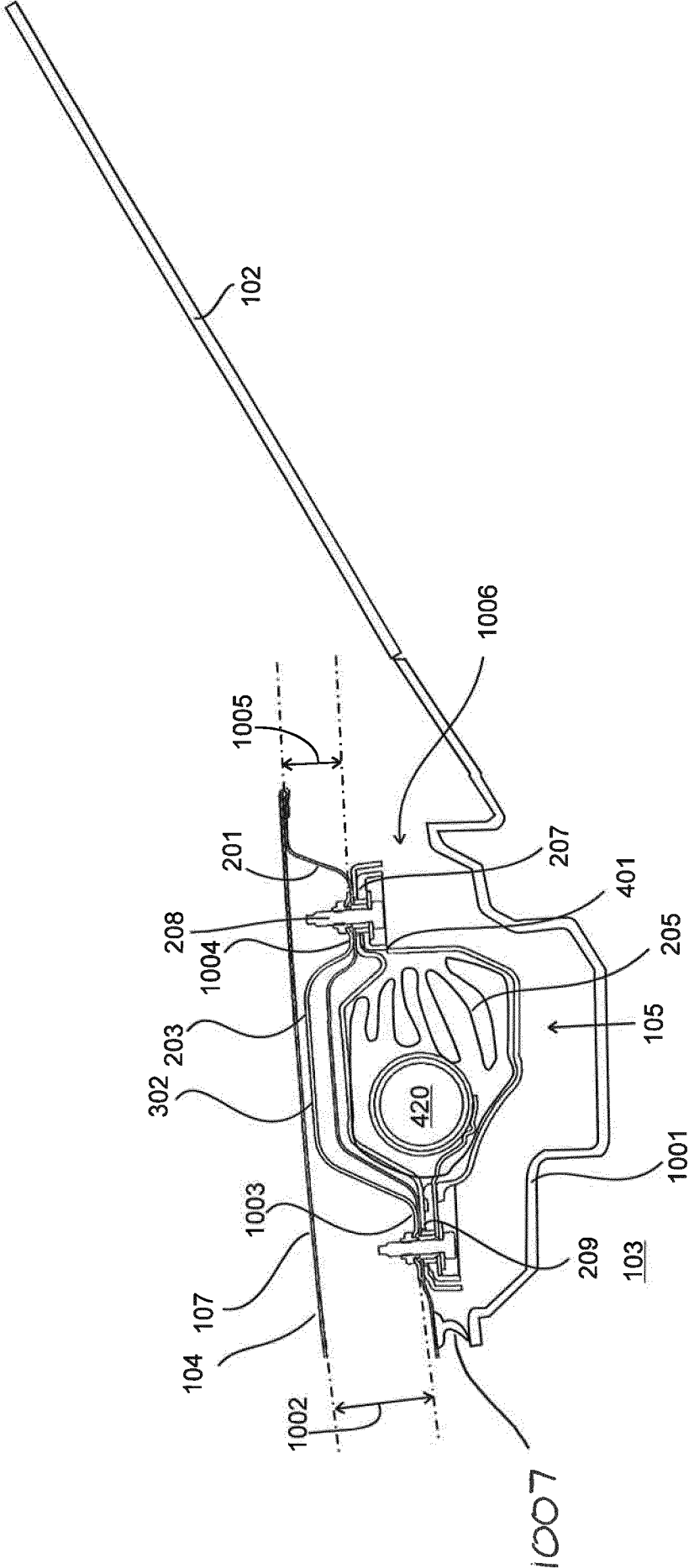
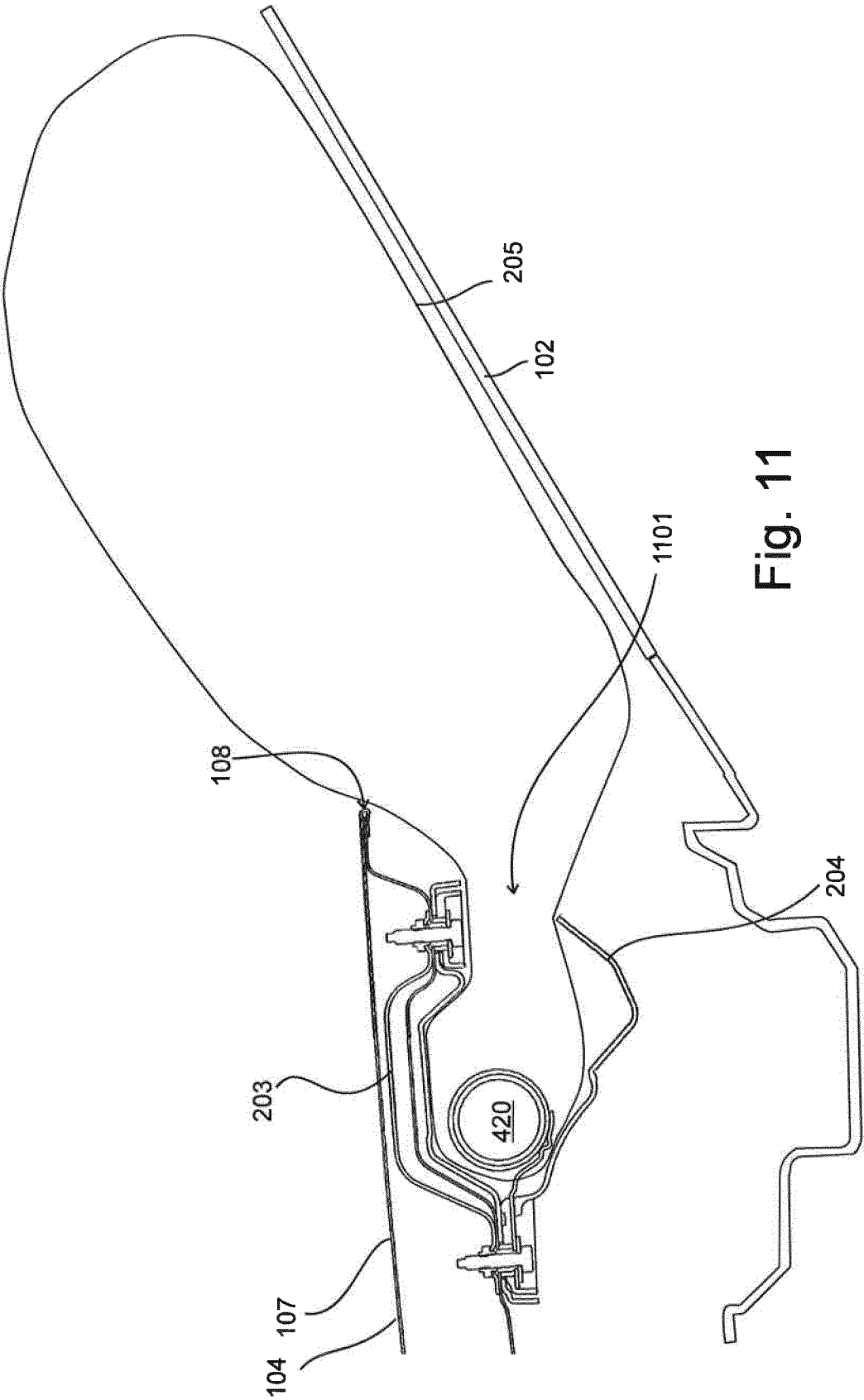


Fig. 10

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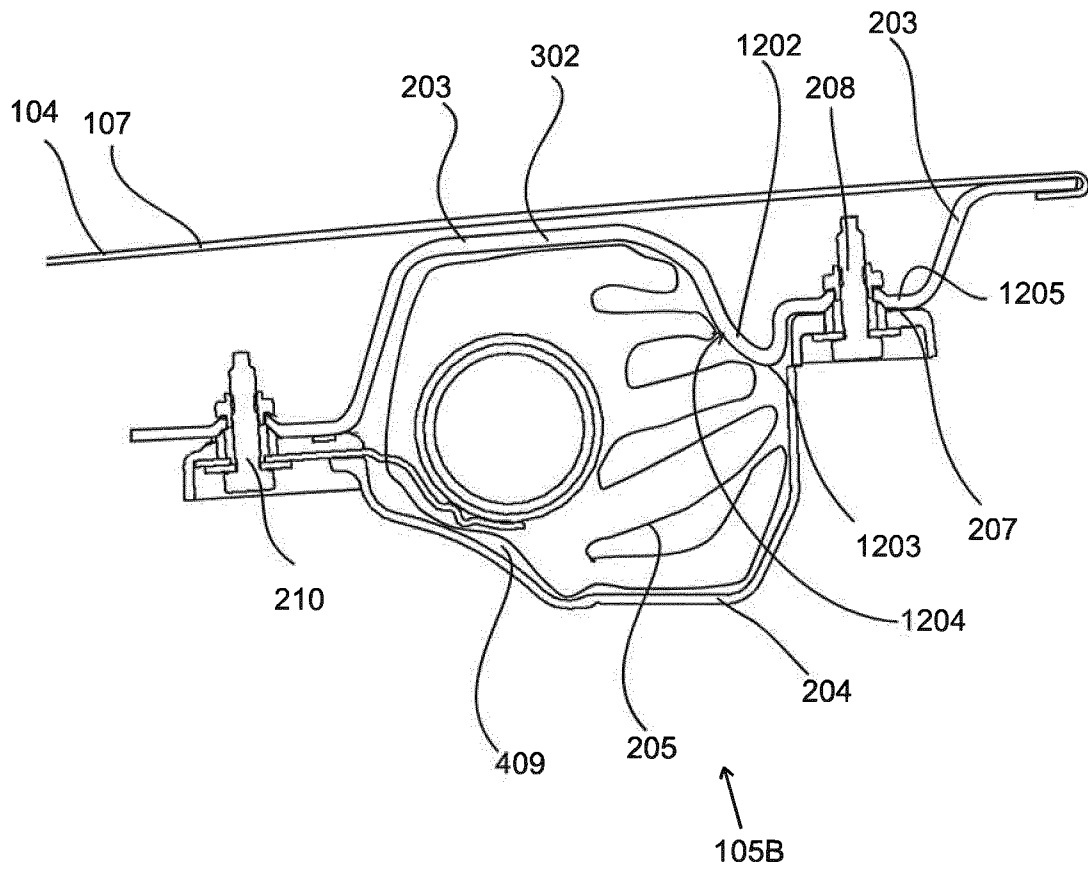


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/061572

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R21/36
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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	DE 10 2011 088779 A1 (BAYERISCHE MOTOREN WERKE AG [DE]) 20 June 2013 (2013-06-20) paragraph [0013]; figures -----	1,3-9, 22,24,25 23
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A	DE 10 2011 085330 A1 (TAKATA PETRI AG [DE]) 2 August 2012 (2012-08-02) paragraph [0049] - paragraph [0050]; figure 3 -----	1,23
A	EP 3 012 161 A1 (TOYODA GOSEI KK [JP]) 27 April 2016 (2016-04-27) paragraph [0028]; figure 5 ----- -/--	1



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 another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

17 September 2018

Date of mailing of the international search report

27/09/2018

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Wiberg, Sten

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/061572

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2016/120148 A1 (TAKATA AG [DE]) 4 August 2016 (2016-08-04) abstract; figure 2 -----	1,23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2018/061572

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-22, 24-31

(when claims 24-31 are depending on claim 1)

The problem of controlling the direction of the deploying airbag is solved by the special technical feature of using a ramp.

2. claims: 23-31

(when claims 24-31 are depending on claim 22)

The problem of avoiding that the airbag contacts the connection means is solved by the special technical feature of using a lip.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/061572

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