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(54) Title: AIR BAG MODULE WITH T-DIFFUSER FOR INFLATOR

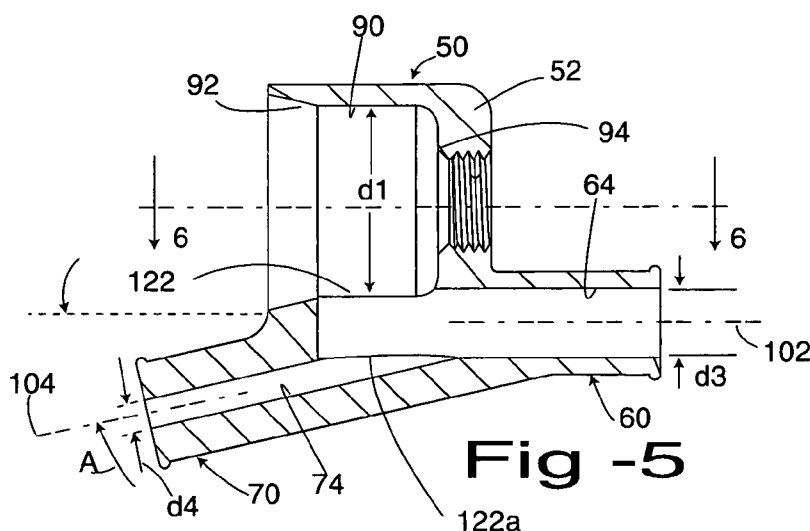


Fig -5

(57) Abstract: A diffuser (50) for use in an air bag system has a connector part (52) configured to be connected to an air bag inflator, the connector part including a side wall (53); and a gas distribution part formed as an integral extension of the connector part and configured to deliver gas from the connector part to the air bag (150), and the distribution part including a first outlet (60) and a second outlet (70), the two outlets configured to give the diffuser a low profile.

AIR BAG MODULE WITH T-DIFFUSER FOR INFLATOR

The present invention relates to air bags, inflators for air bags and diffusers that distribute inflation gas to one or more parts of an air bag.

An inflator by itself or the combination of an inflator and a diffuser is used to provide inflation gas to an air bag. The air bag may include one or more separate or connected inflatable chambers. To distribute inflation gas directly to these various inflatable chambers, a diffuser having a single input and multiple outlets has been used. Such diffusers have been used in seat-mounted, side impact air bag systems, as well as curtain air bag systems. Prior art diffusers have been made of cast or machined metal and are often relatively expensive components. The prior art also discloses the use of diffusers having a general Y-shape. Those portions of the diffuser forming the outlet passages or outlet ports extend significantly beyond a longitudinal axis of the inflator and create difficulties in packaging curtain module systems within a roof rail of certain vehicles.

A diffuser of the type disclosed herein in Claim 1 addresses the difficulties of the prior art by providing a plastic Y-shaped diffuser having a narrow profile. The Y-shaped diffuser is configured to be molded by a tool where the outlet passages can be formed utilizing linear slides within the molding tool, thereby making it easier to manufacture a part for lower cost, as well as yielding a manufacturing (molding) tool of lower cost.

Figure 1 is an exploded view of the major components of the present invention including a diffuser configured to mount to an air bag inflator.

Figure 2 shows the diffuser mounted to the inflator.

Figure 3 illustrates the diffuser and inflator operatively connected to a multi-chambered curtain air bag.

Figure 3a shows an alternate embodiment of the invention.

Figure 3b shows another embodiment of the invention.

Figure 4 is an end plan view of a diffuser.

Figure 5 is a cross-sectional view through section 5-5 of Figure 4.

Figure 5a shows another embodiment of the invention.

Figure 6 is a cross-sectional view through section 6-6 of Figure 5.

Figures 7 and 8 illustrate the use of a tool for tightening the diffuser about the inflator.

Figure 1 illustrates the major features of an air bag system 20, which includes an inflator 30 and a diffuser 50. The inflator 30 can be of any type including hybrid or cold gas inflator but can also be a solid fuel inflator. The inflator has a narrow body 32 and an exit end 34. The exit end 34 includes a plurality of exit ports 36 that may be arranged in a thrust-neutral manner. The inflator proximate the exit end includes a hollow stub or projection 40, with threads 42. Electrical connectors 44 of an igniter subassembly extend out of the threaded projection 40. As known in the art, the inflator includes within its body stored gas or solid propellant.

The diffuser 50 includes a main body 52 having an end wall 54. The end wall 54 includes a threaded bore 56. The inflator includes a first outlet 60 formed of a cylindrical wall 62 having a passage 64 that intersects the interior of the main body 52. The end of the cylindrical wall 62 is formed into a lip 66 to assist in connecting the diffuser to the air bag. The diffuser 50 additionally includes a second outlet 70 comprising a cylindrical wall 72 having a passage 74 therethrough. The end of the cylindrical wall 72 is formed into a lip 76. The diffuser 50 may additionally include a seal 80 in the form of an annular, truncated cone separate from the main body or the main body can provide the sealing function.

Reference is now also made to Figures 2 through 6. In Figure 2, the diffuser 50, shown in cross-section, has been mounted to the inflator 30. The inflator 30 includes a first tapered external surface 46 and second tapered external surface 48. In Figures 2 and 5, the main body 52 of the diffuser 50 is hollow and includes a bore 90 having an internal diameter d_1 larger than an external diameter d_2 of the exit end of the inflator. The main body 52 of the

diffuser additionally includes a first tapered internal surface 92 and second tapered internal surface 94. Figure 2 shows the use of an independent seal 80, which has been placed upon the first tapered external surface 46 of the inflator. Subsequently, diffuser 50 is mounted to inflator 30 by screwing the diffuser 50 to the threaded projection 40. When the diffuser 50 is in place upon the inflator, the first internal tapered surface 92 of the main body of the diffuser presses against a tapered external surface 82 of the seal 80, and a tapered interior surface 84 of the seal presses upon the first tapered external surface 46 of the inflator. The seal provides a fluid tight interface between the diffuser and the inflator. If a separate seal 80 is not used, the first internal tapered surface 92 of the main body of the diffuser will form a fluid tight seal with the first tapered external surface 46 of the inflator. One or both of the mating tapered surfaces 92, 46 must be repositioned from the relative positions shown to provide the sealing function. The second tapered external surface 48 of the inflator provides a fluid tight seal with the second tapered internal surface 94 of the diffuser.

Numeral 100 designates both a longitudinal axis of the main body of the diffuser and a longitudinal axis of the inflator. Numeral 102 designates a longitudinal axis of a first outlet 60 of the diffuser while numeral 104 designates a longitudinal axis of a second outlet 70 of the diffuser. To maintain a low profile shape of diffuser 50, the longitudinal axis 102 of the first outlet 60 is maintained parallel to and closely spaced relative to the longitudinal axis 100 of the inflator 50. The second outlet 70 extends either oppositely from the first outlet 60, as shown in Figure 5, or in generally the same direction as shown in Figure 5a. The longitudinal axis 104 of the second outlet of the diffuser is maintained at an angle A with respect to the longitudinal axis 102 of the first outlet of the diffuser as shown in Figure 5. The angle A is in a range of 10 to 160 degrees.

In Figure 2 the inner wall 53 of the main body 52 of the diffuser, in cooperation with the exterior of the exit end 34 of the inflator, creates an angular gas receiving chamber 120. In Figure 2 and Figure 5 an interior diameter, d_3 , (or cross-sectional area) of passage 64 of the first outlet 60 is greater than an interior diameter d_4 , (or cross-sectional area) of passage 74 of the second outlet 70. The

preferred spacing between the longitudinal axes 100, 102 of the inflator and the first outlet of the inflator is sufficiently close that a cylindrical surface defining the interior wall of the main body 52 of the diffuser intersects the passage 64 of the first outlet in a region designated by numeral 122. The passage 64 of the first outlet also intersects a lower portion of the rear wall as shown in Figure 4. The shape of this intersecting region 122 is substantially rectangular, as illustrated in Figure 6, which is another cross-sectional view. In one embodiment of the invention, the area of region 122 is equal to or greater than the cross-sectional area of the passage 64 of the first outlet plus the passage 74 of the second outlet. To assist in maintaining the low profile of diffuser 50 and to promote proper gas flow, the passage 74 of the second outlet intersects the passage 64 of the first outlet at a location generally opposite the location of region 122; this opposite location is noted by numeral 122a.

Figure 3 shows the inflator 30 and diffuser 50 connected to a curtain air bag 150 having a plurality of inflatable chambers. Figure 3a shows the inflator and diffuser connected to a single chambered air bag, while Figure 3b shows the inflator and diffuser connected to two air bags. Returning to Figure 3, the air bag 150 includes a first inlet 152 in communication with the first or forward inflatable chamber 154. When the air bag is mounted to a vehicle, the inflatable chamber 154 will be located between the A-pillar and B-pillar of the vehicle. The air bag 150 additionally includes a second inlet 160 in communication with another inflatable chamber 162 located to the rear of the inflatable chamber 154. Arrows 170 and 172 show the location of clamps, which will clamp the respective inlets 152, 160 to the first and second outlets 60, 70 of the diffuser. The air bag 150 additionally includes a non-inflatable region 180. The air bag 150 has in a top, border region a plurality of openings 190 that are used to mount the air bag to a roof rail, headliner or appropriate portion of the vehicle. In the context of Figure 3, the low-profile nature of the diffuser can be better appreciated. The diffuser does not have to be connected directly to the air bag but can be connected to the air bag via tubes and the like.

Figure 3a shows a diffuser within an air bag 150a having a single inflatable chamber 158. In this embodiment the diffuser simultaneously directs gas to flow in two directions within the air bag having a single inflatable chamber. In Figure 3b one outlet of the diffuser is connected to a first air bag 150, while the other outlet of the diffuser is connected to a second air bag. For example, the first air bag 150 can be sized to extend from the A-pillar to the C-pillar of a vehicle, while the second air bag can be sized to fit between the C and D pillars of the vehicle. Each of these air bags can have one or more inflatable chambers such as shown in Figure 3.

The preferred material or class of materials used to manufacture a diffuser 50 is a plastic. The diffuser can use glass reinforced nylon, nylon 6-6, aluminum or steel, each of which is amenable to molding. Using these materials the diffuser can be machined, but this is not preferred as it is often more costly than molding. In order for the diffuser to work effectively it must create a fluid tight seal with the inflator. At a minimum, if the diffuser does not include the threaded bore 56, the diffuser could be welded to the inflator. In this case the threads on the projection 40 of the inflator and the threads in the bore 56 would be removed. The projection would be welded to the end wall 54. The illustrated diffuser needs to be tightly screwed onto the inflator to create the seal. During assembly, the diffuser may be rotated by a tool into a tight-fitting relation with the inflator; hand tightening would probably not suffice. Care must be taken not to damage the diffuser during this tightening process. Figures 7 and 8 represent one such tool that has been successfully used in combination with the present diffuser to tighten the diffuser onto the inflator. This tool is especially useful with the diffuser made from plastic. Figure 7 shows a cross-sectional view of diffuser 50 as well as a cross-sectional view of a tightening tool 200. Arrow 201 is provided for the purpose of illustration to show the relative movement between the tool and diffuser as the diffuser is received in the tool. Also shown in Figure 8 is a tightening tool 200, which includes a cup-shaped body 202 having a cross-sectional shape substantially identical to the cross-section taken through the diffuser 50, such as shown in Figure 5. Figure 8 illustrates the shape of the

interior of body 202. The tightening tool 200 additionally includes an integrally formed nut 210, which may be hexagonally shaped or of some other shape so the tool and diffuser can be tightened manually or with a wrench. The interior shape of body 202 provides a sufficiently large contact area with the diffuser 50, to lessen creating large forces that might tend to crack or otherwise deform the diffuser 50; this would be especially important if it is made from a plastic that is not particularly strong.

The body 202 includes a thickened top 204 with an open bore 206 therethrough. The tightening tool is slid over the diffuser, with the first outlet 60 entering through opening 204, and with end surface 54 abutting the thickened portion 204. If the diffuser is already partially threaded upon the inflator, the tightening tool is rotated until the diffuser 50 mates with the inflator to create a fluid tight seal. If the diffuser is not yet on the inflator, the diffuser can be inserted first into the tightening tool and then the diffuser, still in the tightening tool, is placed on the inflator, and thereafter the tightening tool is rotated to seat the diffuser upon the inflator.

In summary, the present invention provides a diffuser for use in an air bag system, the diffuser comprising: a main body 52 configured to be connected about an exit port of an air bag inflator to receive gas from the inflator, the main body including an outer wall 53; and a first outlet 60 formed as an integral extension of the main body and configured to deliver gas from the connector part to a first portion of the air bag; the first outlet 60 including a first side wall 62 with a first passage 64 therethrough, the first side wall being contiguous with the outer wall 53 of the main body 52, the first side wall at one end thereof intersecting the main body 52, the first passage having an effective first area; the first side wall, at an end opposite the end that intersects the main body, terminates at a distal end 66 configured to be connected to the air bag, the intersection of the first side wall with the outer wall of the main body, a first opening communicating the connector part and the first passage;

the main body including a second outlet 70 including a second side wall 72 with a second passage 74 therethrough, a distal end connectable to the air

bag; the second side wall 72 intersecting the first side wall 60 at a location generally opposite the location where the first side wall intersected the outer side of the main body forming a second opening communicating the first passage with the second passage.

Claims

1. A diffuser (50) for use in an air bag system, the diffuser comprising:
a main body (52) configured to be connected about an exit port of an air bag inflator to receive gas from the inflator, the main body including an outer wall (53); and

a first outlet (60) formed as an integral extension of the main body and configured to deliver gas from the connector part to a first portion of the air bag;

the first outlet (60) including a first side wall (62) with a first passage (64) therethrough, the first side wall being contiguous with the outer wall (53) of the main body (52), the first side wall at one end thereof intersecting the main body (52), the first passage having an effective first area; the first side wall, at an end opposite the end that intersects the main body, terminates at a distal end (66) configured to be connected to the air bag, the intersection of the first side wall with the outer wall of the main body, a first opening (122) communicating the connector part and the first passage;

the main body including a second outlet (70) including a second side wall (72) with a second passage (74) therethrough, a distal end connectable to the air bag; the second side wall (72) intersecting the first side wall (60) at a location generally opposite the location where the first side wall intersected the outer side of the main body forming a second opening communicating the first passage with the second passage.

2. A diffuser (50) according to claim 1 wherein an interior diameter (d3) of the passage (64) of the first outlet (60) is greater than an interior diameter (d4) of the passage (74) of the second outlet (70).

3. A diffuser (50) according to either of claims 2 or 3 wherein the main body of the diffuser includes a threaded bore (56) to enable the threaded connection to the inflator.

4. A (50) diffuser according to any of the preceding claims wherein the first opening (122) is generally rectangular in plan view.

5. A diffuser (50) according to any of the preceding claims wherein the first outlet (60) intersects the main body (52) proximate an edge of the main body.

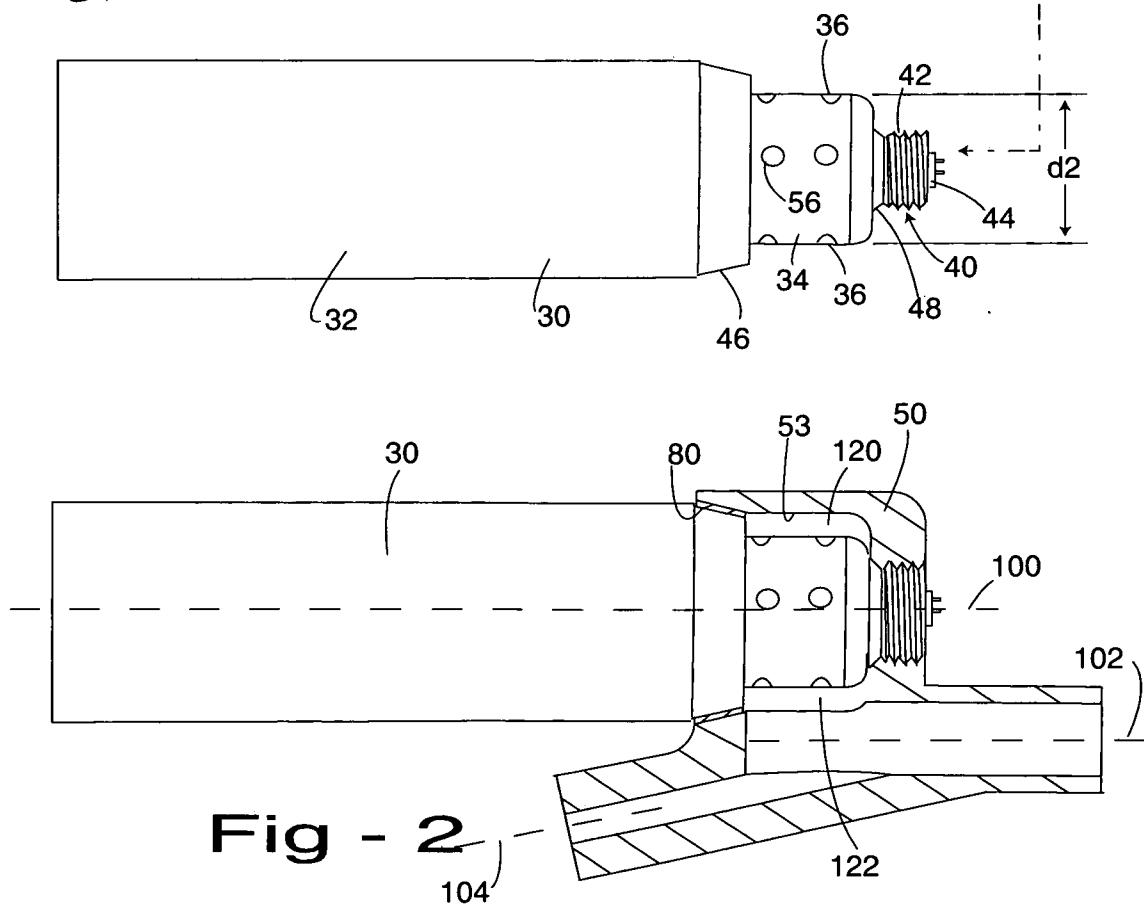
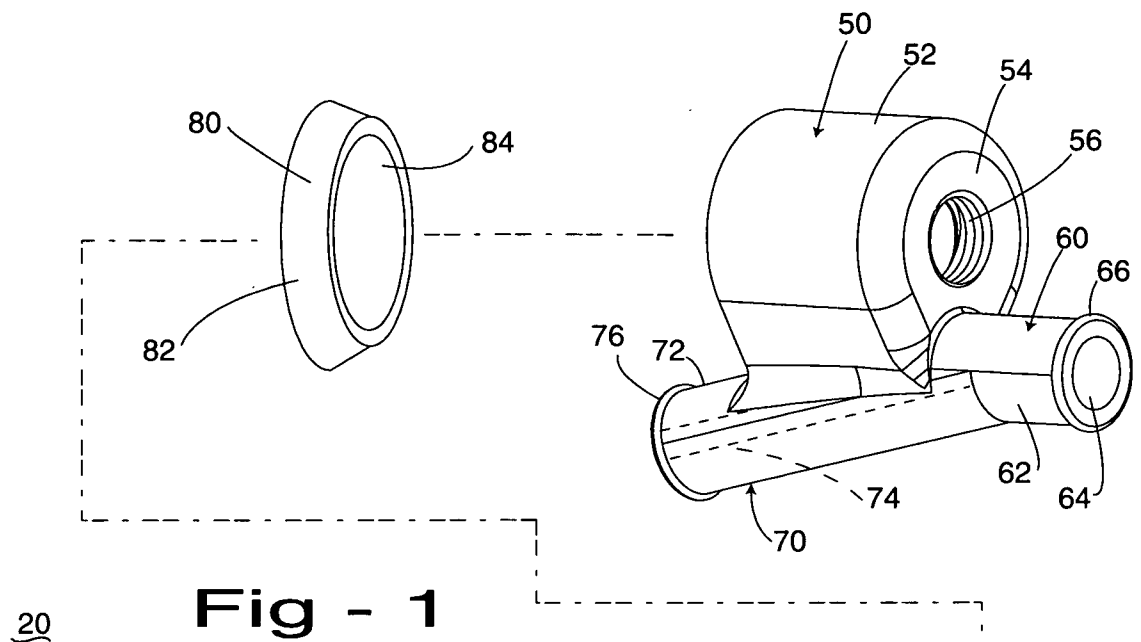
6. A diffuser (50) according to any of the preceding claims wherein a longitudinal axis (102) of the first outlet (60) and a longitudinal axis (100) of the main body are parallel to one another.

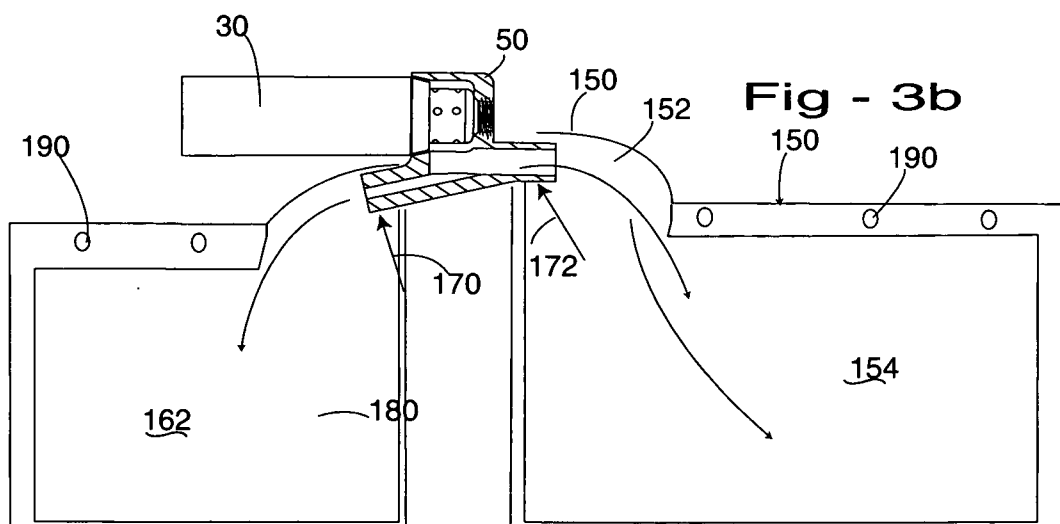
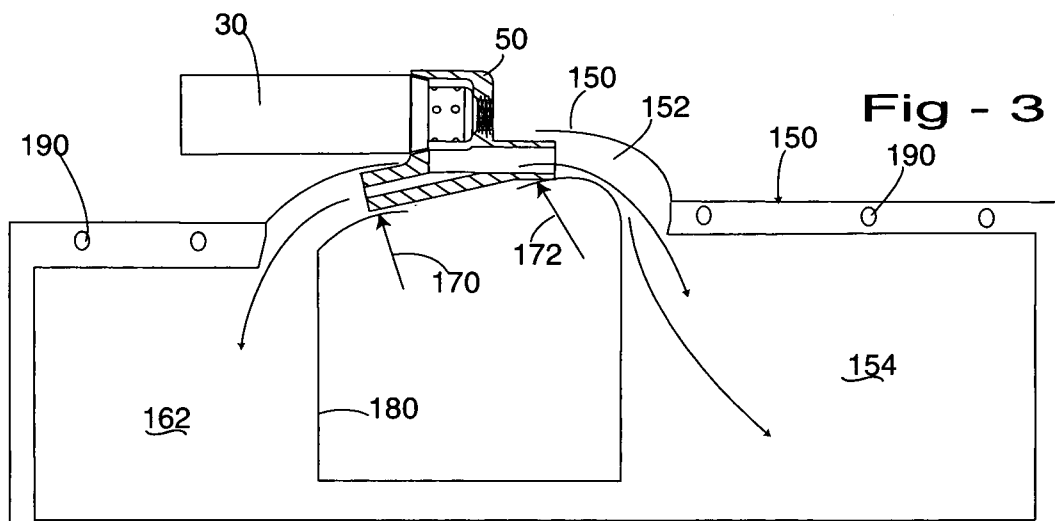
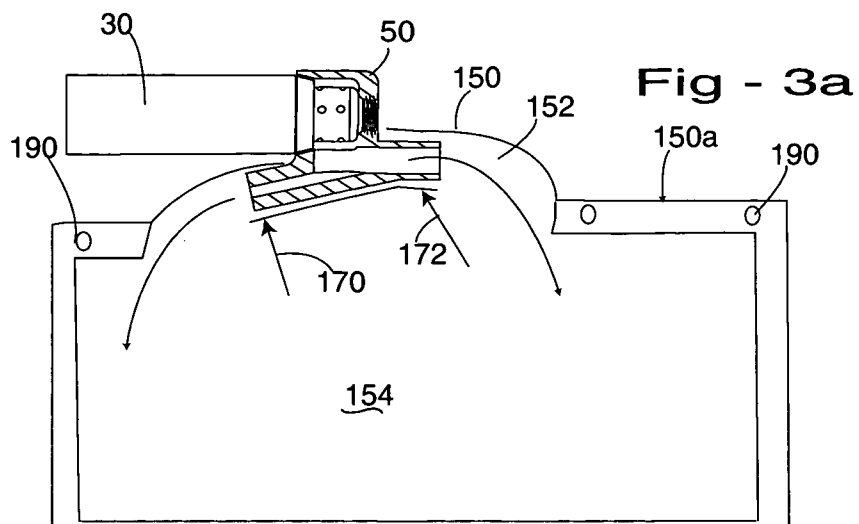
7. A diffuser (50) according to any of claims 1 - 6 wherein a longitudinal axis (104) of the second passage (74) is arranged at an angle (A) to a longitudinal axis (102) of the first passage (64), wherein the angle (A) is in a range of 16 to 160 degrees.

8. A diffuser (50) according to any of the preceding claims wherein the first opening (122) is has a generally rectangular shape.

9. A diffuser (50) according to any of the preceding claims including a seal (80) between the main body of the diffuser and the inflator.

10. A diffuser (50) according to any of the preceding claims wherein the first and second outlets are each connectable to different inflatable portions of either an air bag with a single inflatable chamber or an air bag with a plurality of inflatable chambers, or to a plurality of air bags.





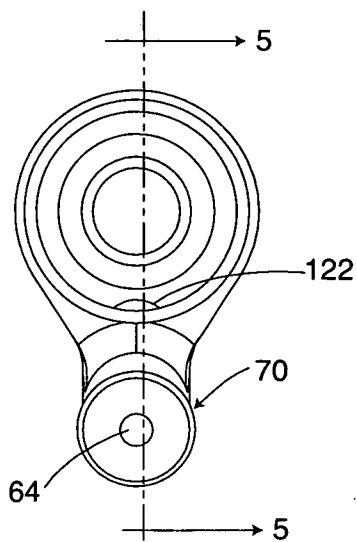


Fig - 4

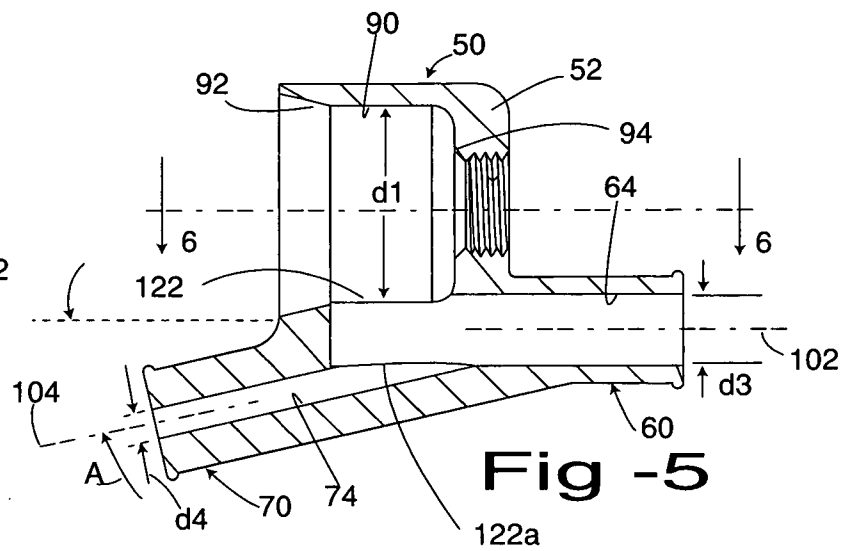


Fig - 5

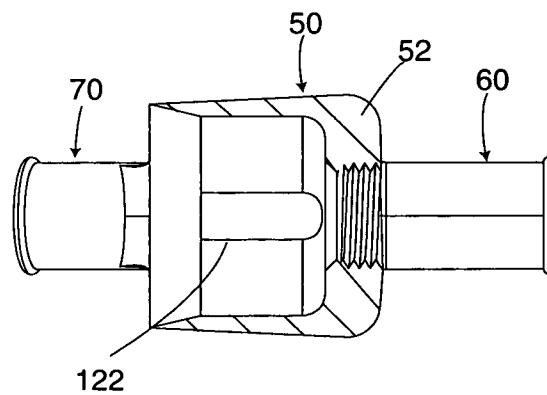


Fig - 6

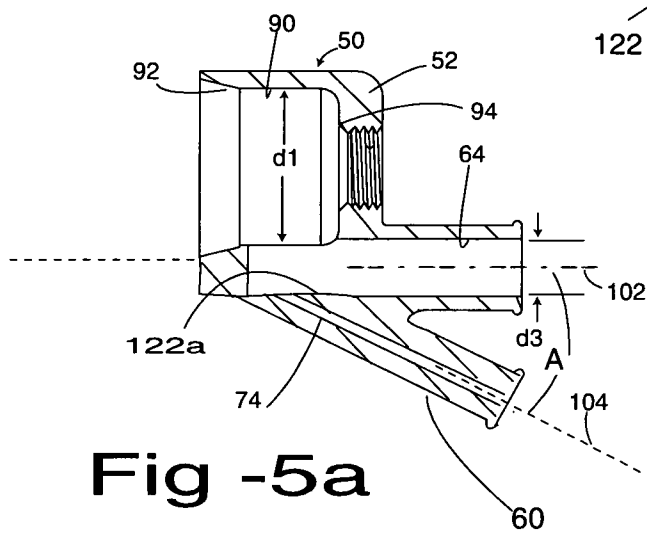


Fig - 5a

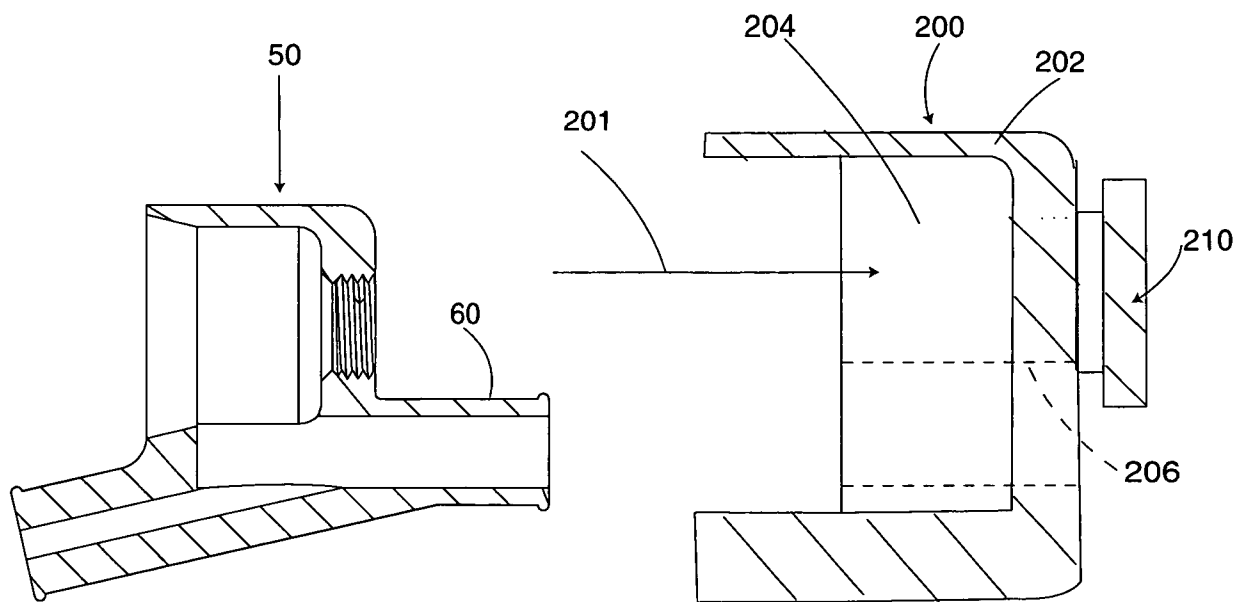


Fig - 7

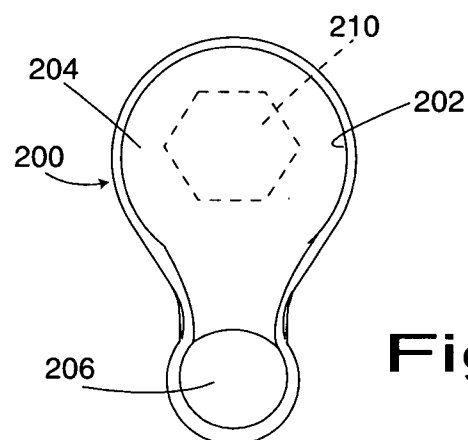


Fig - 8

A. CLASSIFICATION OF SUBJECT MATTER***B60R 21/217(2006.01)i, B60R 21/20(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)

B60R 21/217; B60R 21/22; B60R 21/26; B60R 21/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: diffuser,air,bag,inflator,chamber

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003-0141710 A1 (MATTHIAS ZAHN et al.) 31 July 2003 See the abstract; claims 1-8 and figures 1-8.	1-10
A	JP 2003-063348 A (TOYOTA MOTOR CORP.) 05 March 2003 See the abstract; paragraph [0004] - paragraph [0008]; claims 1-4 and figures 1-5.	1-10
A	JP 2003-034221 A (TOYOTA MOTOR CORP.) 04 February 2003 See the abstract; paragraph [0005] - paragraph [0009]; claims 1-8 and figures 1-6.	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

10 JUNE 2010 (10.06.2010)

Date of mailing of the international search report

11 JUNE 2010 (11.06.2010)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2009/006024

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