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(54) Title: AIRBAG UNIT AND MOTOR VEHICLE

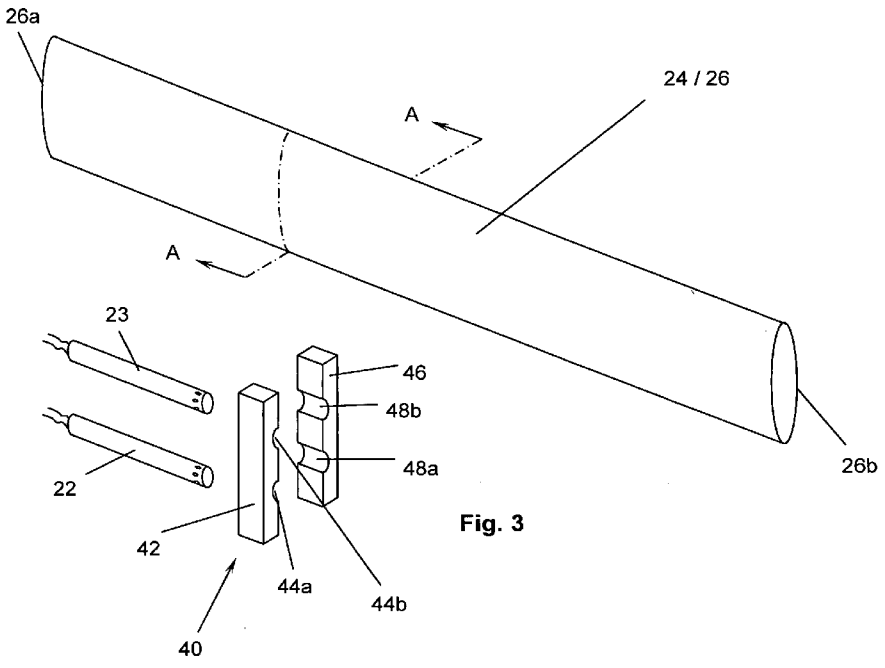


Fig. 3

(57) Abstract: An airbag unit comprising an airbag and at least one inflator is described. The airbag of this airbag unit is especially suitable for preventing an element located outside the passenger compartment of a vehicle from intruding into the passenger compartment during an accident. The airbag is made of a hose extending from a first end to a second end, said hose comprising a one-pieced woven hose element extending from the first end to the second end. The hose is bent or folded, such that two parallel sections (24a, 24b) of the airbag are formed with each section (24a, 24b) enclosing a chamber. The airbag is very robust and can be designed such that in its deployed state its thickness is large in relation to its volume.

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Airbag unit and motor vehicle

Description

The invention concerns an airbag unit according to the preamble of claim 1 and a motor vehicle with such an airbag unit according to claim 9.

The use of airbag units is widespread in today's automotive technology. An airbag unit always comprises at least one airbag enclosing at least one chamber and at least one inflator – in most cases in form of a gas generator – for filling this at least one chamber such that the airbag deploys.

Currently most airbag units are used for protecting an occupant (driver or passenger) sitting inside the passenger compartment of a motor vehicle. This means that the airbag of such an airbag unit deploys into the passenger compartment in order to restrain the occupant. Consequently the airbag of such an airbag unit must be relatively soft and the airbag usually has to comprise a ventilation, such that kinetic energy can be dissipated.

Recently so called pedestrian airbags serving for the protection of a pedestrian involved in an accident have been introduced. Such pedestrian airbags usually cover at least a part of the windshield and/or a part of at least one A-pillar in order to prevent the pedestrian's head from hitting the windscreen / an A-pillar. Such pedestrian airbags usually also need to be relatively soft in order to give the desired protection.

From EP 0 757 634 B1 it is known to place the airbag of an airbag unit between an element outside the passenger compartment and the passenger compartment in order to prevent that element from intruding into the passenger compartment in

case of an accident. This element can for example be a wheel or the motor block. This measure can especially be useful for small and lightweight motor vehicles.

It is an object of the invention to provide an improved airbag unit, especially for the use described in the generic EP 0 757 634 B1.

This task is solved by an airbag unit according to claim 1.

It is a further object of the invention to provide a motor vehicle with such an improved airbag unit.

This task is solved by a motor vehicle according to claim 9.

An airbag that is used to prevent an element (for example a wheel) from intruding into a passenger compartment needs to possess several characteristics: First, it needs to be very sturdy, since high forces can be applied to it during the accident and because the airbag needs to be filled with a high pressure (for example 10 bars) in order to prevent the element from intruding into the passenger compartment. "Classic" airbags as described above are very likely to burst under such conditions. Second, the airbag should not have a ventilation.

In order to comply with these requirements, the airbag of the airbag unit is made of a hose extending from a first end to a second end, wherein this hose comprises a one-pieced woven hose element. This one-pieced woven hose element can be of the type as is used for fire hoses. Due to the one-piece woven structure such a hose element can withstand very high forces.

Often, a relatively large thickness will be desired. In order to provide such a large thickness, it would in principal be possible to use a hose with a large diameter, but this would have several drawbacks. One of those is, that a doubling of the thickness (this means the doubling of the diameter of the hose) would lead to quadruplication of the volume to be filled by the inflator. So, according to the invention, an airbag with two parallel sections is provided. These two sections are generated

by folding the hose such that it is divided into the two sections with each section enclosing a chamber.

In order to retain the gas-tightness and robustness it is usually preferred to provide a separate gas feeding for each chamber. This makes it possible to fill both chambers through the ends (face-sides) of the hose, such that no additional holes in the lateral area of the hose - that could weaken the airbag - are necessary.

In order to get a simple, sturdy and compact design, it can further be preferred to provide a separate inflator for each chamber.

It is further preferred to provide a joint clamp for the two end areas of the hose. The two inflators or two tubes for filling the chambers can extend through this clamp, leading to a very compact design with a minimum of parts.

In order to improve the gas-tightness of the airbag, it can be preferred that the one-pieced-woven hose element is coated, especially on its inside. Silicone can be used for the coating.

As has already been mentioned, the airbag of the airbag unit according to the invention is especially useful for preventing an element of a motor vehicle which is located outside the passenger compartment from intruding into the passenger compartment during an accident. This element can especially be a wheel, a motor block, a battery or a part of the transmission of the vehicle.

In the case that the element to be restrained is a wheel, the airbag will be located inside a wheel housing in most applications, but the invention can also be applied to motor vehicles that does not have a wheel housing, which can be the case especially with ultra-light electric cars.

Another application of the inventive airbag unit can be the use of the airbag as a seat lifter. Seat lifters can be used to help to restrain the pelvis of a passenger.

The invention will now be described in detail in view of preferred embodiments with reference to the figures. The figures show:

Figure 1: a schematic representation of a front part of a motor vehicle, especially of a small passenger car,

Figure 2: what is shown in Figure 1 after a side collision,

Figure 3: all parts of a preferred embodiment of an airbag unit used in the motor vehicle shown in Figure 1,

Figure 3a: a sectional view of the airbag of Figure 3 along plane A-A,

Figure 4: the airbag unit of Figure 3 in its assembled state,

Figure 4a: a sectional view along plane B-B of Figure 4,

Figure 4b: a sectional view along plane C-C of Figure 4,

Figure 5: what is shown in Figure 4a in the deployed state of the airbag.

Figure 1 shows the right front of a motor vehicle, especially of a small passenger car in a strongly schematic representation. The car body 10 encloses a motor compartment 12 and a passenger compartment 14. A wheel housing 15 is adjacent to both, the motor compartment 12 and the passenger compartment 14. A wheel 16 is located inside the wheel housing 15 with an axle 17 and a steering linkage 18 extending from the wheel 16.

In order to prevent the wheel 16 from intruding into the passenger compartment 14 in case of a front or a side collision, an airbag unit 20 is provided with the airbag 24 of this airbag unit 20 being placed between the wheel 16 and the passen-

ger compartment 14. As will be described later in view of the Figures 3 to 6, the airbag 24 comprises two sections 24a, 24b with each section 24a, 24b enclosing a chamber. Each of these chambers is in gas flow connection with an inflator, namely a gas generator. One of these gas generators, namely the first gas generator 22 is shown in Figures 1 and 2.

If a critical accident occurs, the gas generators are triggered and fill the chambers of the airbag 24 with gas, such that this airbag 24 protects the passenger compartment 14, as is schematically shown in Figure 2. As has already been mentioned, this basic concept is known from generic EP 0 757 634 B1, but this concept can only work successfully, if an airbag unit is provided whose airbag is very sturdy and that can be filled with gas of high pressure, for example ten bars or more.

A preferred embodiment of a suitable airbag unit is now described with reference to Figures 3, 3a, 4, 4a, 4b and 5. This airbag unit is basically comprised of only four elements, namely an airbag 24 in form of a hose 26 extending from a first end 26a to a second end 26b, a joint clamp 40 being comprised of a first element 42 and the second element 46, and two gas generators 22, 23 serving as inflators.

The hose 26 comprises a hose element 28 which is one-pieced woven, as it is for example known from fire hoses. As is shown in Figure 3a, the one-pieced woven hose element 28 can be coated by a coating 29, especially on the inside, in order to improve the gas tightness. This coating can for example be comprised of silicone. The hose element 28 extends over the complete length of the hose 26.

The joint clamp 40 has a first element 42 and a second element 46. The two elements can be separate elements in the unassembled state or they can be connected to one another, for example by a hinge. In the embodiment shown the joint clamp 40 consists of separate elements which can be connected by screws or similar elements. The two elements 42, 46 of the joint clamp 40 both show two grooves 44a, 44b, 48a, 48b, one for each gas generator 22, 23. The grooves have

a semi-circular cross section. The joint clamp 40 can be made of metal or plastic, especially fibre-reinforced plastic.

The assembly process is as follows: First, the hose 24 is folded or bent in the middle between the two ends 26a, 26b of the hose, such that the two ends 26a, 26b of the hose are placed next to each other and a bent 27 is created. Then, the first gas generator 22 is inserted through the first end 26a of the hose 26 and the second gas generator 23 is inserted through the second end of the hose 26b (or vice versa), such that each gas generator is in fluid communication with one chamber. Finally, the joint clamp is applied to the end areas of the hose such that the gas generators 22, 23 are gas-tightly connected to their respective end area of the airbag 24 formed by the hose 26. So, a two-chambered airbag is created by very simple means. If it is not desired to insert the gas generators 22, 23 themselves into the chambers of the airbag, it would also be possible to connect each gas generator 22, 23 via a tube with the chamber of the airbag in a similar way, namely such that the joint clamp 40 forms openings through which the tubes extend. In the case that tubes are used, it would also be possible to use only one gas generator and split its gas stream via a (for example T- or Y-shaped) divider into two gas streams (one for each tube).

The described connection of the gas generators with the chambers (directly or via a tube) is strongly preferred since by this it is not necessary to penetrate through the lateral surface of a hose which might lead to a local weakening of the hose.

When the gas generators 22, 23 are triggered, both chambers are filled with gas such that the two sections 24a, 24b of the airbag 24 expand. Due to the high pressure (preferable 10 bar or more), there is no or only very little gas exchange between the two chambers through the bent 27.

In principal it would also be possible to provide a separate clamp for each end of the hose, but since in most applications this would lead to an increased weight, this is in most cases not preferred.

The described airbag unit with the two-chamber-airbag has several advantages: First, the thickness of the deployed airbag is doubled. Second, only one joint clamp is needed. And finally, the end of the airbag remote from the joint clamp can be free of any heavy parts such as a clamp. This makes the mounting easy and it is prevented that a heavy part hits other parts of the vehicle when the airbag deploys. When the described airbag module is mounted, it is preferred that the joint clamp and/or the gas generators are permanently (often also rigidly) connected to the car body. In many applications it will also be necessary to connect the end of the airbag remote from the joint clamp with the car body, but, since the airbag (the hose) will shorten when filled with gas, it is preferred that the connection of this remote end with the car body is such that it can be deformed or destroyed when the airbag deploys. For example, this connection can comprise a breakable plastic part.

Of course it is possible that to each wheel of the motor vehicle, especially to each front wheel, an airbag unit as described herein is allocated.

As has already been mentioned, the inventive airbag unit can be used for other purposes, for example for preventing an element being located inside the motor compartment, from intruding into the passenger compartment. Even applications inside the passenger compartment are possible, for example the use as a seat-lifter.

List of reference numbers

10	car body
12	motor compartment
14	passenger compartment
15	wheel housing
16	wheel
17	axle
18	steering linkage
20	airbag unit
22, 23	gas generator
24	airbag
24a	first section
24b	second section
26	hose
26a	first end
26b	second end
27	bent
28	hose element
29	coating
40	joint clamp
42	first element of the joint clamp
44a, 44b	groove
46	second element of the joint clamp
48a, 48b	groove

Claims

1. Airbag unit (20) comprising an airbag (24) and at least one inflator, wherein said airbag (24) is made of a hose (26) extending from a first end (26a) to a second end (26b), said hose (26) comprising a one-pieced woven hose element (28) extending from the first end (26a) to the second end (26b),
characterised in that the hose (26) is bent or folded, such that two parallel sections (24a, 24b) of the airbag (24) are formed with each section (24a, 24b) enclosing a chamber.

2. Airbag unit according to claim 1, characterised in that a separate gas-feeding path is provided for each chamber.

3. Airbag unit according to claim 2, characterised in that a separate inflator is provided for each chamber.

4. Airbag unit according to claim 2 or claim 3, characterised in that an inflator or a tube being connected to an inflator extends through each face-side opening of the hose (26).

5. Airbag unit according to one of the preceding claims, characterised in that the two end areas of the hose (26) are held by a joint clamp (40).

6. Airbag unit according to one of the claims 2 to 4 and to claim 5, characterised in that the two inflators or the two tubes extend through the joint clamp (40).

7. Airbag unit according to claim 6, characterised in that the joint clamp (40) comprises a first element (42) and a second element (46) with each element (42, 46) having a first groove (44a, 48a) and a second groove (44b, 48b), wherein the first groove (44a) of the first element (42) and the first

groove (48a) of the second element (46) form a first through-hole for a first gas generator (22) or for a first tube and wherein the second groove (44b) of the first element (42) and the second groove of the second element (46) form a second through-hole for a second gas generator (23) or for a second tube.

8. Airbag unit according to one of the preceding claims, characterised in that the one-pieced woven hose element (28) is coated, preferably on its inside.

9. Motor vehicle comprising
a car body (10),
a passenger compartment (14) inside the car body (10), and
at least one airbag unit (20) according to one of the claims 1 to 8.

10. Motor vehicle according to claim 9, characterised in that the airbag of the at least one airbag unit (20) is located outside the passenger compartment (14).

11. Motor vehicle according to claim 10,
said motor vehicle further comprising a plurality of wheels (16) outside the passenger compartment (14),
wherein said airbag (24) of the at least one airbag unit is located between a wheel (16) and said car body (10).

12. Motor vehicle according to claim 11, characterised in that the airbag (24) is located inside a wheel housing (15).

13. Motor vehicle according to claim 10, characterised that the airbag (24) of the at least one airbag unit (20) is placed between a motor block, a battery, or a part of the transmission of the vehicle and the passenger compartment (14).

14. Motor vehicle according to claim 9, characterised in that the airbag (24) of the at least one airbag unit (20) is located under the seating surface of a vehicle seat.

Fig. 1

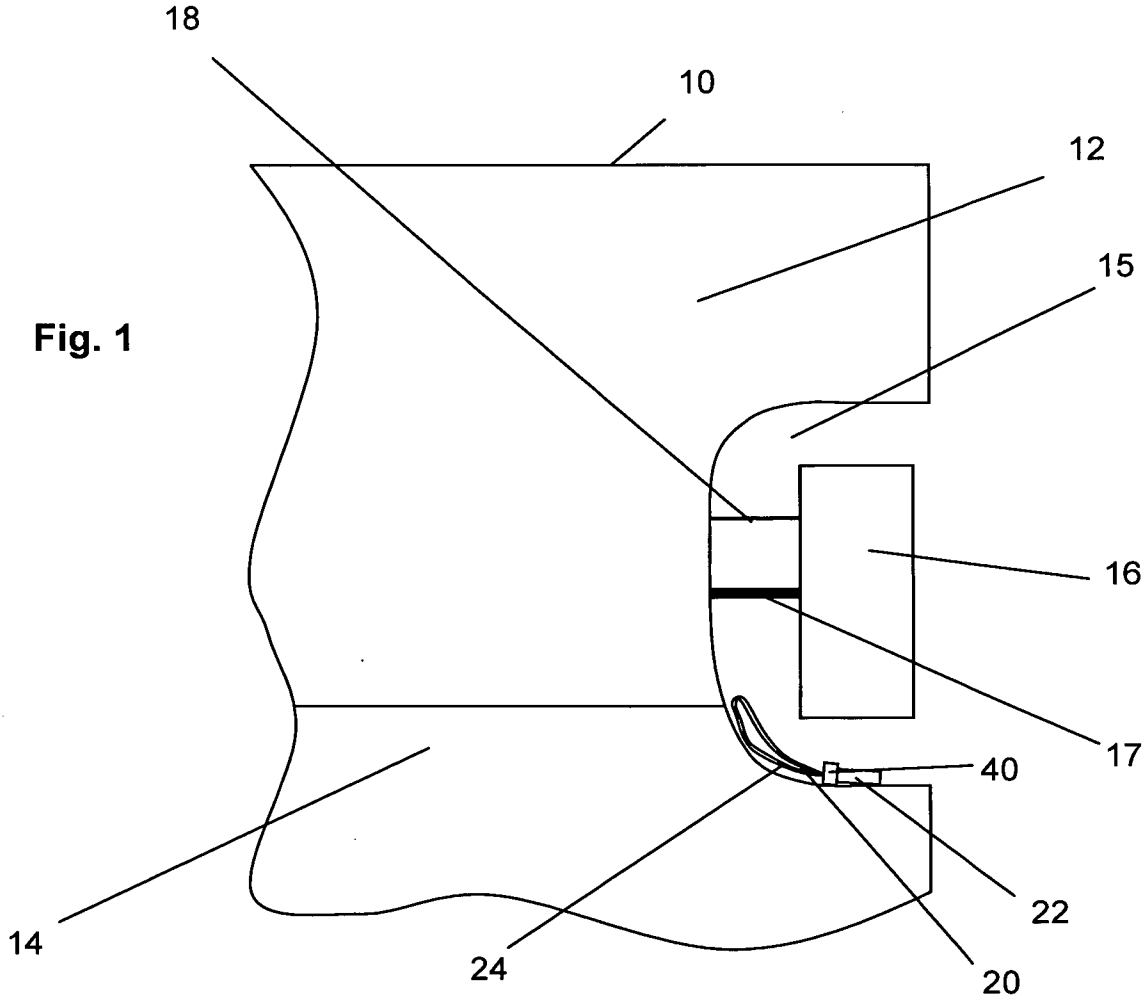
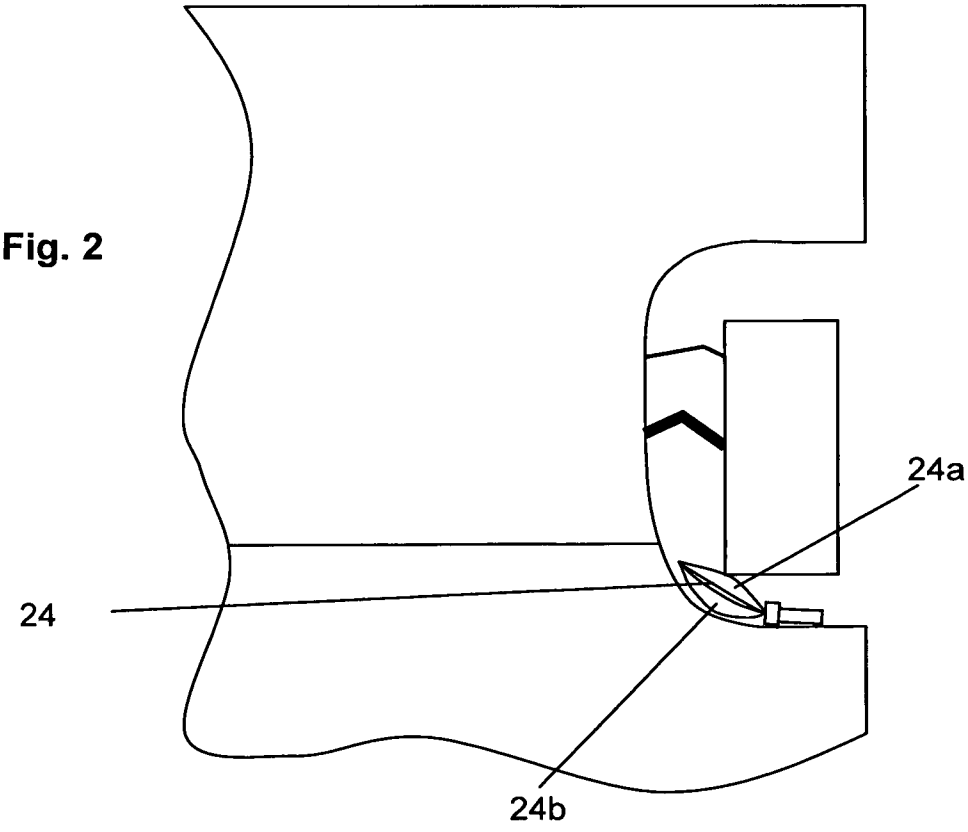


Fig. 2



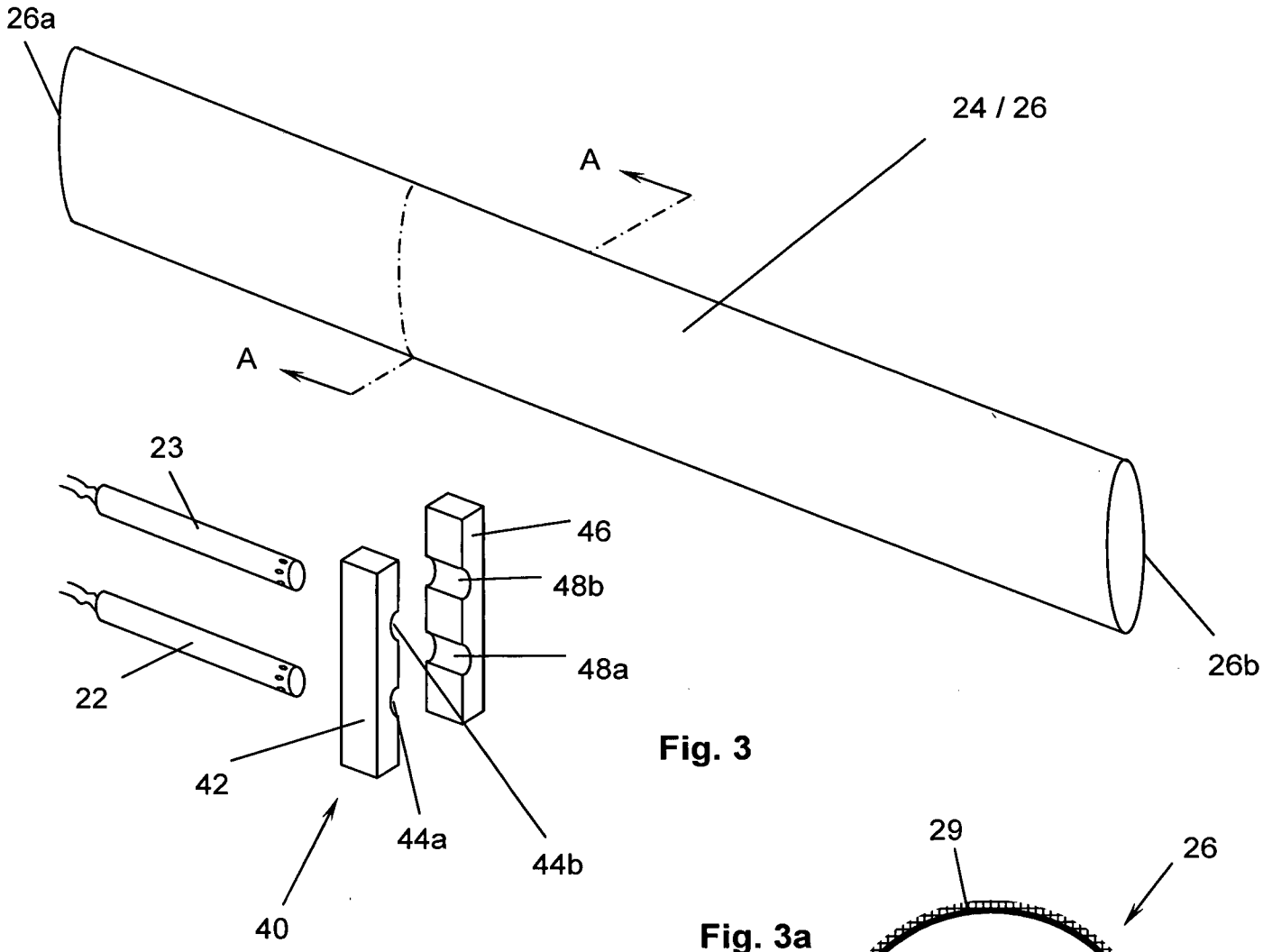


Fig. 3

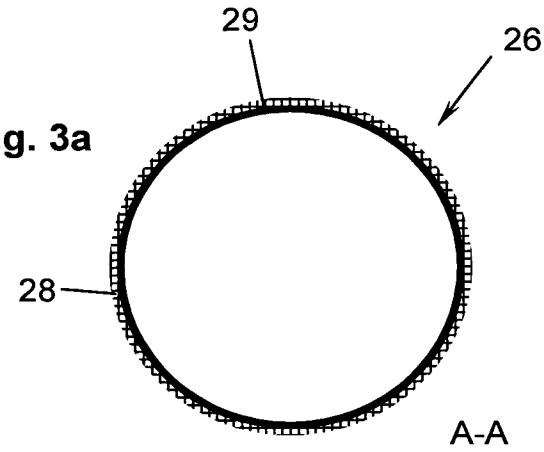


Fig. 3a

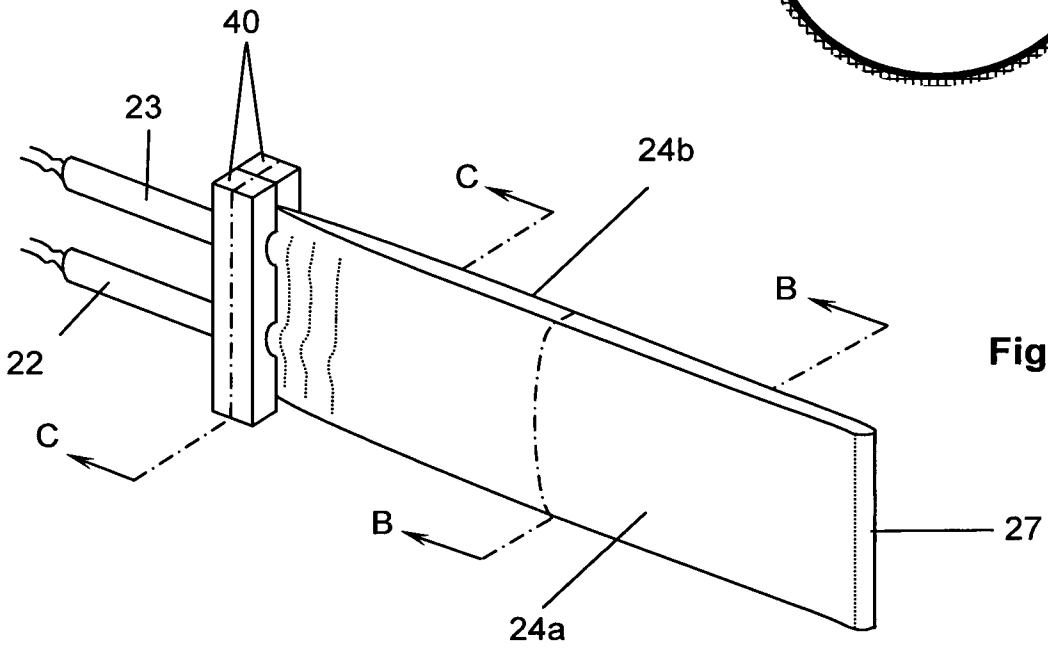


Fig. 4

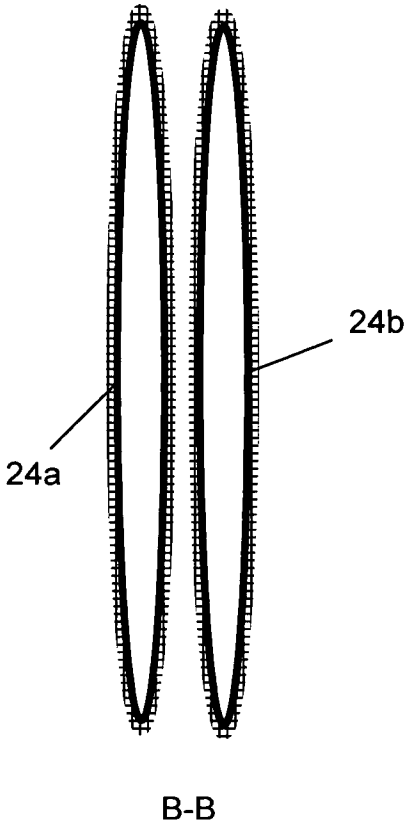


Fig. 4a

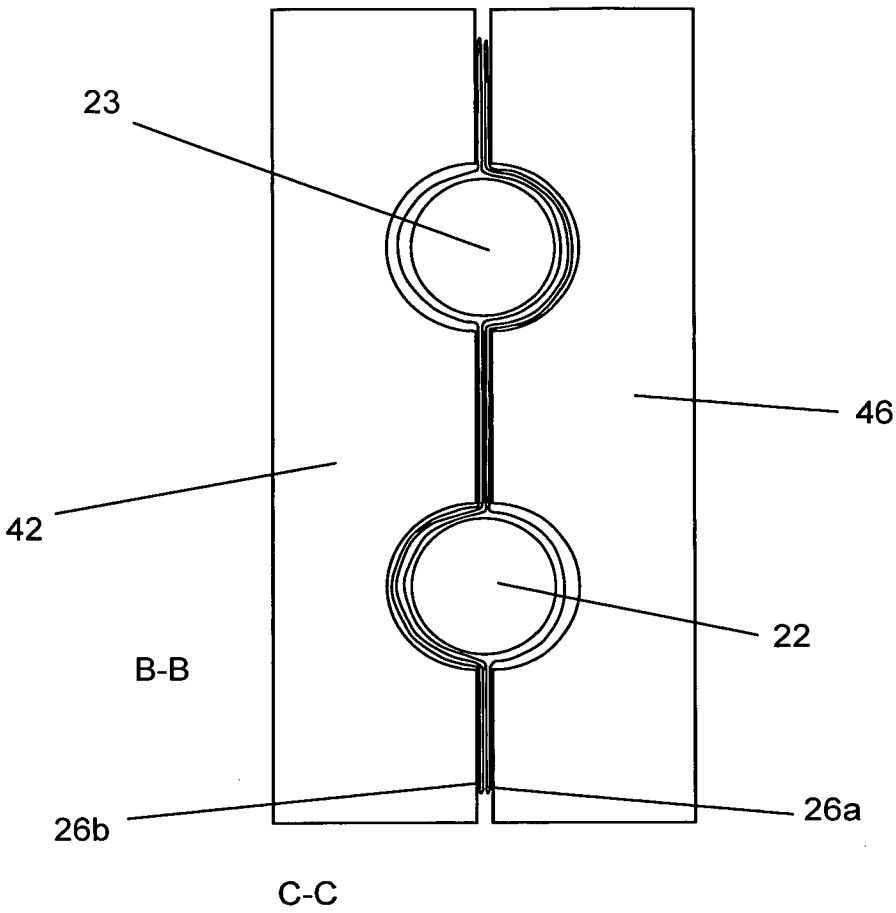


Fig. 4b

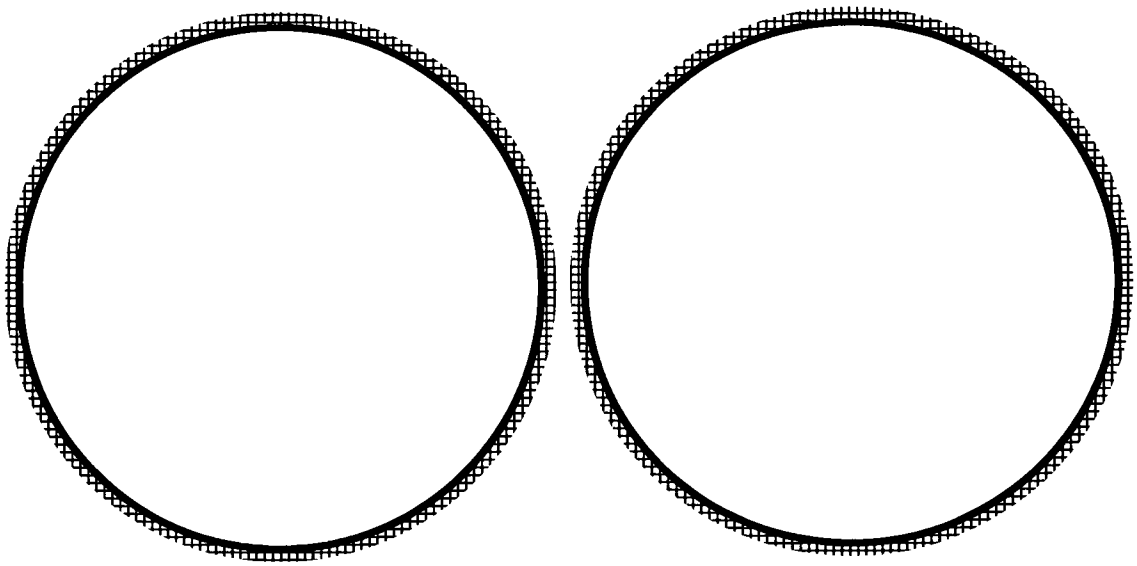


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/000212

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R21/02
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 B62D

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	DE 10 2011 122464 A1 (AUTOLIV DEV [SE]) 27 June 2013 (2013-06-27) the whole document	1-14
Y	EP 0 757 634 B1 (FORD MOTOR CO [GB]; FORD WERKE AG [DE]; FORD FRANCE [FR]; FORD MOTOR C) 30 December 1998 (1998-12-30) cited in the application the whole document	1-14
Y	DE 101 54 026 A1 (OPEL ADAM AG [DE]) 15 May 2003 (2003-05-15) paragraph [0018]; figure 1	1-14

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 March 2015	19/03/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Cãlãmar, George

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/000212

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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