(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 353 110 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.04.2024 Bulletin 2024/16

(21) Application number: **23202810.0**

(22) Date of filing: **10.10.2023**

(51) International Patent Classification (IPC):
A41D 13/018 *(2006.01)* ***F16L 37/00*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
A41D 13/018

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **12.10.2022 IT 202200021045**

(71) Applicant: **Dainese S.p.A.**
36064 Colceresa (Vicenza) (IT)

(72) Inventor: **AZZOLIN, Andrea**
36064 Colceresa (Vicenza) (IT)

(74) Representative: **Manfrin, Marta et al**
Società Italiana Brevetti S.p.A.
Stradone San Fermo 21 sc. B
37121 Verona (VR) (IT)

(54) **PERSONAL PROTECTION DEVICE INCLUDING A BUSHING CONNECTION DEVICE**

(57) The present disclosure relates to a personal protection device (200) comprising an inflatable element (12) and an inflation device, wherein the inflation device comprises a gas generator (15) and a bushing connection device (10) configured to connect said gas generator (15) together with said inflatable element (12), wherein the bushing connection device (10) comprises a tubular body (100) extending between a first mouth (110a) and a second mouth (110b) and defining an internal cavity (105) able to house a portion (15a) of the gas generator (15) intended for the outflow of the gas. A first end region (101a) of the tubular body defines the first mouth (110a) and second end region (101b) of the tubular body (100) defines the second mouth (110b). In particular, the bushing connection device (10) further comprises a vent channel (120) extending along at least a portion of the tubular body (100) for venting a fluid of the inflatable element (12). Furthermore, the vent channel (120) has a cross-section with a smaller area than the second mouth (110b). The present disclosure also relates to a personal protection device (200) comprising the bushing connection device (10), a gas generator (15) and an inflatable element (12). The present disclosure relates, finally, to a connection method for connecting a gas generator (15) to an inflatable element (12).

Furthermore, the gas generator (15) is configured to allow inflation of the inflatable element (12), wherein the portion (15a) of the gas generator (15) is inserted into the internal cavity (105) from the side of the first mouth (110a), and the portion (15a) of the gas generator (15) leaves the vent channel (120) free to vent an inflation fluid.

Furthermore, the inflatable element (12) is configured to be able to assume a deflated or rest configuration and an inflated or active configuration, wherein the gas generator (15) is configured to allow inflation of the inflatable element (12) from the deflated configuration into the inflated configuration, wherein the second mouth (110b) opens out into the inner chamber of the inflatable element (12).

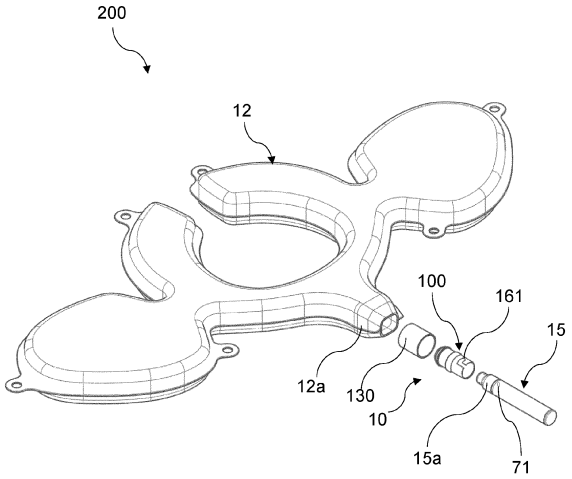

FIG. 1

EP 4 353 110 A1

Description

[0001] The present disclosure relates in general to the sector of personal protection devices. In particular, such a protection device includes an inflatable element, namely a so-called airbag.

[0002] More particularly, the inflatable element is inflated in the event of an impact by an inflation device which is placed in fluid communication with the said inflatable element. Generally, said inflation device includes a fluid source, such as a compressed gas cylinder, which is generally referred to as a gas generator. Subsequently, the inflatable element must be deflated in order to allow removal of the device, for example for replacement of the inflatable element, or in any case for continuation of an activity which a user was performing before the impact, eliminating the volume created by the inflatable element in the inflated condition. For this purpose, generally the personal protection devices are provided with a venting device associated with the inflatable element for favouring the outflow of the inflation fluid and for allowing therefore deflation of the inflatable element. The venting device includes an additional tube which is inserted in an edge of the inflatable device and which places the inside of the inflatable element in communication with the outside and is provided with an on/off valve which can be opened manually in order to favour the outflow of the fluid.

[0003] The present disclosure is based on a recognition by the inventor of the present disclosure that the personal protection devices, as provided hitherto by the prior art, while being advantageous from many points of view, have a number of drawbacks in terms of constructional efficiency and, in particular, the need for an additional production step in order to provide the inflatable element with the venting device.

[0004] The starting point of the present disclosure is the technical problem of reducing at least one of the steps for production of a personal protection device involving the provision of a venting device, thereby improving the constructional and structural efficiency, without negatively affecting the inflation capacity to ensure protection in accordance with the requirements mentioned above with reference to the prior art, and/or achieving further advantages.

[0005] Such a technical problem is solved by providing a personal protection device and a connection method according to the respective independent claims. Secondary characteristics forming the subject of the present disclosure are defined in the corresponding dependent claims.

[0006] In particular, in accordance with the present disclosure, in order to improve the deflation of the inflatable element, it is proposed providing a personal protection device comprising an inflatable element, and an inflation device, which in turn comprises a gas generator and the improved bush connection device, which is configured both to connect the gas generator and the inflatable element and at the same time to allow deflation of the inflatable element, and to act as a venting device. As a result, according to one aspect of the present disclosure, the venting device forms part of - namely is integrated or incorporated in - a bushing connection device configured to connect the gas generator to the inflatable element.

[0007] More particularly, in accordance with the present disclosure a personal protection device is provided, said device comprising the inflation device (including, as mentioned, the bushing connection device described and the gas generator) and the inflatable element configured to be able to assume a deflated or rest configuration and an inflated or active configuration. The gas generator is configured to allow inflation of the inflatable element from the deflated configuration into the inflated configuration.

[0008] More particularly, the bushing connection device comprises a tubular body extending between a first mouth and a second mouth. Furthermore, the tubular body defines an internal cavity able to house a portion of the gas generator and intended to allow the outflow of the gas. In particular, a first end region of the tubular body defines the first mouth and a second end region of the tubular body defines the second mouth. Furthermore, the bushing connection device further comprises a vent channel which extends along at least a portion of the tubular body so as to vent a fluid of the inflatable element, i.e. a fluid contained in the inflatable element. In particular, the vent channel has a cross-section with a smaller area than the second mouth. In particular, the second mouth opens out into the inner chamber of the inflatable element, namely on the opposite side where the gas generator portion is connected/inserted. As regards the geometry of the parts described above, the inflation device comprises the bushing connection device described here and the gas generator configured to allow inflation of the inflatable element, wherein a portion of the gas generator intended to inflate the inflatable element is inserted inside the internal cavity of the tubular body from the side of the first mouth.

[0009] Preferably, the vent channel is arranged at least partially inside the tubular body.

[0010] In some embodiments, the vent channel is in the tubular body and extends inside the tubular body, over a limited portion thereof. In some embodiments, the vent channel is completely incorporated in the tubular body.

[0011] The gas generator portion and the tubular body are suitably configured to leave the vent channel free for venting the inflation fluid. In other words, the insertion of the gas generator portion into the tubular body is performed so as to leave free a passage (vent channel) for venting the inflation fluid.

[0012] The vent channel may be partly in the tubular body and partly formed by an interstice which is present between the gas generator and the tubular body. Again alternatively, the vent channel may be partly in the tubular body and partly formed by a groove which is present on an inner side of the tubular body facing the gas generator.

[0013] Preferably, the personal protection device according to the present disclosure may include furthermore a clamping device for clamping the inflatable element portion on the tubular body of the bushing connection device. The clamping device may include a sleeve, for example, as well as a seal. A seal may also be provided between the portion of the gas generator housed inside the internal cavity of the tubular body and the tubular body itself.

[0014] Finally, in accordance with the present disclosure, a connection method for connecting a gas generator to an inflatable element by means of the aforementioned bushing connection device is described. Said connection consists of a connection both for mechanically connecting the gas generator to the inflatable element and for placing the gas generator in fluid communication with the inflatable element at the time of inflation and for placing the inflatable element in fluid communication with an environment outside the inflatable element and the gas generator at the time of deflation.

[0015] Basically, according to the present disclosure, it is possible to provide a personal protection device which is provided, in a single assembly, namely as one piece, with a venting device and a connection device. The latter in fact comprises a vent channel able to allow deflation of the inflatable element in such a way as to overcome the drawbacks of the prior art whereby an additional step is required for the venting device.

[0016] Similarly, the method described in the present disclosure is able to improve the connection between the gas generator and the inflatable element so as to favour deflation of the latter, in such a way as to overcome the problems encountered in the devices of the prior art.

[0017] The personal protection device according to the present disclosure may be a wearable personal protection device, i.e. one which is configured to be worn, or is in the form of a protective garment.

[0018] Further advantages, characteristic features and modes of use forming the subject of the present disclosure will become clear from the following detailed description of embodiments thereof, provided by way of a non-limiting example.

[0019] It is in any case clear that each embodiment forming the subject of the present disclosure may have one or more of the advantages listed above; in any case it is not required that each embodiment should have simultaneously all the advantages listed.

[0020] Reference will be made to the figures of the attached drawings in which:

- Figure 1 shows a view of a personal protection device according to an embodiment of the present disclosure with parts separated, wherein in particular an inflation device is attached to an inflatable element by means of a bushing connection device;
- Figure 2 shows a view of the protection device according to Figure 1 with parts assembled;
- Figure 3 shows an axonometric view, on a larger scale, of a bushing connection device according to an embodiment of the present disclosure for the protection device according to Figures 1 and 2;
- Figure 4 shows another axonometric view of the bushing connection device of Figure 3 according to the present disclosure, on an even larger scale;
- Figure 5 shows a side view of the bushing connection device of Figure 3 on an even larger scale;
- Figure 6 shows an axonometric view, on a larger scale, of a bushing connection device according to an alternative embodiment of the present disclosure for the protection device according to Figures 1 and 2;
- Figure 7 shows another axonometric view of the bushing connection device according to Figure 6;
- Figure 8 shows a detailed view of the personal protection device according to Figures 1 and 2 comprising the bushing connection device according to Figure 6;
- Figure 9 shows a cross-sectional view along the line V-V of the protection device according to Figure 8.

[0021] With reference to the attached figures, some embodiments of a bushing connection device for connecting a gas generator 15 to an inflatable element 12 are indicated - overall - by the reference number 10. As indicated below, the bushing connection device 10 forms part of an inflation device which, in turn, forms part of a personal protection device 200, preferably of the wearable type or in the form of a protective garment. In other words, the personal protection device 200 comprises the bushing connection device 10 according to one of the embodiments described above.

[0022] In particular, the bushing connection device 10 comprises a tubular body 100, namely a sleeve-shaped body or more generally a hollow cylindrical body, which extends between a first mouth 110a and a second mouth 110b and defines an internal cavity 105 able to house a portion 15a of the gas generator 15, intended to allow the outflow of gas.

[0023] The tubular body has a first end region 101a and a second end region 101b.

[0024] The first end region 101a of the tubular body 100 defines the first mouth 110a, namely opens out into the first mouth 110a, and the second end region 101b of the tubular body 100 defines the second mouth 110b, namely opens out into the second mouth 110b. In other words, the tubular body 100 is a hollow body, i.e. defining the internal cavity 105, comprising a first end portion 101a, which delimits or defines the first mouth 110a, and a second end portion 101b, which delimits or defines the second mouth 110b.

[0025] Moreover, according to the present invention, the bushing connection device 10 further comprises a vent channel 120 arranged inside the tubular body 100 and extending along at least a portion of the tubular body 100, for venting a fluid of the inflatable element 12. In other words, the vent channel 120 is a venting through-

opening arranged at least partially inside the tubular body 100 and is configured to create an independent channel which places the inflatable element and the external environment in fluid communication with each other and does not involve, namely is independent of, the aforementioned portion 15a of the gas generator 15 when the latter is connected to the inflatable element. In particular, the vent channel 120 has a cross-section with a smaller area than the second mouth 110b. Namely, the cross-section of the second mouth 110b, intended to allow the passage of an inflation fluid towards the inflatable element 12, has a greater area, in fact a much greater area, than the cross-sectional area of the vent channel 120 intended to allow the passage of a fluid exiting the inflatable element 12.

[0026] Preferably, the area of the second mouth 110b in relation to the cross-sectional area of the vent channel 120 is in a ratio of between 1000:1 and 2000:1, preferably between 1400:1 and 1800:1, and even more preferably the ratio is about 1600:1.

[0027] In this way, owing to the fact that the through-flow cross-sections are very different and owing to the principles of fluid dynamics and mass conservation, at the time of inflation, since the initial pressure of the air is identical inside the inflatable element and outside, the pressurised inflation fluid passes through the larger cross-section and fills mainly the inflatable element until the pressure inside the inflatable element is at a maximum; once this condition is reached, the fluid rapidly exits the vent channel, because of the difference in pressure between the inside and outside.

[0028] This process is compatible with the need to keep the inflatable element sufficiently inflated for a predetermined period of time, so as to ensure protection for a user at the moment of the impact or blow and then allow venting and deflation of the inflatable element after the impact or blow.

[0029] Preferably, the vent channel 120 has a cross-sectional area smaller than that of both the second mouth 110b and the first mouth 110a.

[0030] Preferably, in general, the vent channel 120 is configured to define a through-opening extending between the first end region 101a and the second end region 101b. In other words, the vent channel 120 is preferably a through-opening at least partially inside the tubular body 100 and extending substantially between the first mouth 110a and the second mouth 110b.

[0031] In particular, preferably the first end region 101a and the second end region 101b are free end regions of the tubular body 100 and the through-opening defined by the vent channel 120 may place in fluid communication with each other an outer zone on the side of the first free end and an outer zone on the side of the second free end.

[0032] Preferably, the vent channel 120 opens out in the first end region 101a alongside the first mouth 110a and opens out in the second end region 101b alongside the second mouth 110b, or in the second mouth 110b. Namely, the vent channel 120 may open out in the first end region 101a and in the second end region 101b, respectively, by means of an opening or aperture adjacent or close to the first mouth 101a and the second mouth 101b, respectively.

[0033] Preferably, the tubular body 100 comprises a side wall 160 or covering portion having a first thickness and incorporating at least partially the first end region 101a. Furthermore, the tubular body 100 comprises preferably an interface rim 170 having a second thickness and incorporating at least partially the second end region 101b of the tubular body 100. Namely, the interface rim 170 forms preferably an interface between the two opposite portions of the tubular body 100 which are configured to be associated respectively with the portion 15a of the gas generator 15 and the inflatable element 12.

[0034] In particular, preferably the second thickness of the interface rim 170 is greater than the first thickness of the side wall 160 so as to define an internal step 171 of the tubular body, namely a step directed towards the internal cavity 105 of the tubular body 100. Even more particularly, preferably the vent channel 120 extends continuously in the interface rim 170 at least between the second end region 101b and the step 171. In other words, the internal step 171 is defined by the difference in thickness between the second thickness of the interface rim 170 and the first thickness of the side wall 160 and in particular the internal step 71 preferably faces the inside of the tubular body 10, namely is located in the internal cavity 105.

[0035] In other words, preferably, the tubular body 100 of the bushing connection device 10 is divided essentially into at least two portions with a different thickness which interface with each other so as to define the internal step 171 with a height equal to the difference between the second thickness of the interface rim 170 and the first thickness of the side wall 160. The vent channel 120 is confined preferably within the interface rim 170. This embodiment has the advantage of a smaller extension of the vent channel, thus facilitating the production steps for formation of the vent channel.

[0036] In the embodiment shown in Figures 7, 8 and 9, the vent channel 120 includes a through-hole 121 arranged in the interference rim 170 and open between a first opening 121a positioned in the second end region 101b, alongside the second mouth 110b, and a second opening 121b positioned in the internal step 171. Namely the first opening and the second opening emerge or open out in the end region 101b and in the internal step 171. The device is configured to allow venting of the inflation fluid by means of a passage across the through-hole and from the through-hole 121 towards the first mouth 110a, passing preferably across the internal cavity 105, for example along an interstice or clearance formed between a wall of the portion 15a of the gas generator and the side wall 160 of the tubular body 100.

[0037] In accordance with an alternative embodiment of the device shown for example in Figure 4, the vent channel 120 includes, in addition to the through-hole 121,

a groove 122 in the side wall facing the internal cavity 105 of the tubular body 100 and configured to be in fluid communication with the through-hole 121 of the vent channel 120 arranged in the interface rim 170. Furthermore, preferably the groove 122 is formed along the inner surface of the side wall 160, namely a surface of the side wall facing the internal cavity 105, and furthermore the groove 122 extends preferably between the second opening 121b of the through-hole 121 and the first mouth 110a of the tubular body 100.

[0038] In other words, the vent channel 120 may be formed by the through-hole 121, arranged inside the interface rim 170 between the first opening 121a and the second opening 121b, and by the interspace formed between the side wall 160, as shown in the embodiment of Figure 7, or by the through-hole 121, arranged inside the interface rim between the first opening 121a and the second opening 121b, and by the groove 122, arranged along the side wall 169 and extending preferably between the second opening 121b of the through-hole 121 and the first mouth 110a of the tubular body 100, as in the embodiment of Figure 4.

[0039] Consequently, in the embodiment shown in Figures 7, 8 and 9, the vent channel 120 is formed by the through-hole 121 and by the clearance formed between the side wall 160 and the gas generator 15, and the side wall 160 does not have the groove 122.

[0040] Preferably, the side wall 160 of the tubular body 100 comprises an L-shaped insertion seat 161 which extends from the first mouth 11a along the first end region 101a, namely along the side wall 160. Preferably, moreover, the side wall 160 is shaped so as to allow a stable connection with the gas generator 15, in particular with the portion 15a of the gas generator 15 configured to be removably associated with the bushing connection body 10. For example, the side wall 160 has, at least along the surface facing the internal cavity, a form which mirrors that of the gas generator in such a way as to allow at least partial insertion of the gas generator 15 inside the internal cavity 105 in a stable manner. The connection between the gas generator 15 and the tubular body 100 does not obstruct the vent channel 120.

[0041] Consequently, the bushing connection device 10 as described here in its embodiments, is also a venting device, namely a device which allows venting of the inflatable element so as to empty it at least partially of the inflation fluid.

[0042] As mentioned above, the bushing connection device 10 according to one of the embodiments described forms part of an inflation device comprising also the gas generator 15 configured to allow inflation of the inflatable element 12. In particular, the portion 15a of the gas generator 15 is inserted in the internal cavity 105 from the side of the first mouth 110a and the portion 15a of the gas generator 15 leaves the vent channel 120 free for venting of the inflation fluid.

[0043] Preferably, in the embodiment shown in Figure 4, as mentioned above, the portion 15a of the gas generator 15 is inserted in the internal cavity 105 so as to adhere to a portion of the tubular body 100, and the groove 122 forms a venting passage with a wall of the portion 15a of the gas generator 15. Furthermore, the venting passage is preferably open towards the first mouth 110a.

[0044] Alternatively, and again preferably, as mentioned above, in the embodiment shown in Figures 7, 8 and 9, the portion 15a of the gas generator 15 is inserted in the internal cavity 105 with play so as allow venting from the interface rim 170 towards the first mouth 110a. Namely, a wall of the portion 15a of the gas generator 15 forms a clearance thickness, i.e. allowing the passage of a fluid, with an inner surface of the inner wall 106 of the tubular body 100, i.e. a surface facing the internal cavity.

[0045] In other words, the portion 15a of the gas generator 15 is configured in general to allow the passage of the venting fluid. For example, according to a first embodiment of the bushing connection device 10, the portion 15a of the gas generator is inserted in the internal cavity 105 in an adhering manner and the inflation fluid may cross the groove 122 of the side wall 160 of the tubular body 100. Alternatively, according to another embodiment of the bushing connection device 10, the inflation fluid may move along an interspace or clearance thickness present between the portion 15a of the gas generator 15 and the side wall 160.

[0046] In all the embodiments, as shown by way of example in Figure 9, the inflation device is completed by seals 150, 152. In particular, a first seal 150, of the O-ring type or with a similar ring-like form, is arranged between the portion 15a of the gas generator 15 and the tubular body 100, and a second seal 152, also with a ring-like form, is arranged between the outer surface of the tubular body 100 and the inflatable element 12.

[0047] With regard to the components of the personal protection device 200, it is pointed out that the personal protection device 200 also comprises, in addition to the bushing connection device 10 according to one of the embodiments described above, the inflatable element 12 configured so as to be able to assume a deflated or rest configuration and an inflated or active configuration, namely a configuration in which it is able to protect at least partially a user of the device from blows or impacts. The personal protection device 200 also comprises a gas generator 15 configured to allow inflation of the inflatable element from the deflated configuration into the inflated configuration, for example by means of an outflow of pressurised gas from the gas generator 15 towards an inner chamber of the inflatable element 12 following a blow or impact. In particular, in addition the second mouth 110b of the bushing connection device 10 opens into the inner chamber of the inflatable element. In other words, when the inflatable element 12 is associated with the bushing connection device 10 the second mouth 110b leads into the inner chamber of the inflatable element 12, so as to allow a fluid to pass from the internal cavity 105

of the tubular body 100 towards the inner chamber of the inflatable element 12. Furthermore, the portion 15a of the gas generator 15 is inserted inside the internal cavity from the side of the first mouth 110a. Namely, the personal protection device 200 is structured in such a way that the portion 15a of the gas generator 15, which is preferably configured for the outflow of gas, is removably associated with the first mouth 110a of the tubular body 100 and in such a way that the inflatable element is removably associated with the bushing connection device 10 at the second mouth 110b of the tubular body 100, so as to allow fluid communication between the internal cavity 105 of the tubular body and the inner chamber of the inflatable element 12.

[0048] According to one embodiment, such as that shown in Figure 4, the portion 15a of the gas generator 15 is inserted in the internal cavity 105 so as to adhere to at least a portion of the tubular body 100, and the groove 122 forms a venting passage with a wall of the portion 15a of the gas generator 15. Furthermore, the venting passage is preferably open towards the first mouth 110a.

[0049] In other words, the portion 15a of the gas generator 15, which is preferably configured for the outflow of gas, adheres to at least a portion of the tubular body 100 and the groove 122 forms a venting passage - namely passage configured to allow the through-flow of a fluid - with a wall of the portion 15a of the gas generator 15. In particular, the venting passage formed by the groove 122 preferably opens out towards the first mouth 110a. In other words, preferably the portion 15a of the gas generator 15 is inserted so as to mate at least partially with the inner surface of the tubular body 100, in particular with the inner surface of the first end region 101a. In this way the outer wall of the portion 15a of the gas generator 15 adheres to or is adjacent to at least a portion of the inner surface of the tubular body 100 and defines together with the groove 122 a venting passage configured to allow fluid to pass through between the through-hole 121 arranged in the interface rim 170 and the first mouth 110a. Namely, preferably, when the gas generator 15 is removably associated with the bushing connection device 10, a fluid is allowed to pass along a venting passage situated between the groove 122 and the outer wall of the portion 15a of the gas generator 15.

[0050] According to an alternative embodiment, shown in Figures 7, 8 and 9, the wall of the portion 15a of the gas generator 15 forms a venting thickness with the tubular body 100 inside the internal cavity 105, so as to form a venting passage together with the through-hole 121. Furthermore, the venting passage preferably open out towards the first mouth 110a. Namely the venting passage extends along the though-hole 121 formed in the interface rim 170 and along the interspace formed by the wall of the portion 15a of the gas generator 15 with the tubular body 100.

[0051] Preferably, the inflatable element 12 comprises a connecting portion 12a which envelops or surrounds the tubular body 100 at least partially on one side. Namely, preferably the inflatable element 12 is removably associated with the tubular body 100 by means of the connecting portion 12a which is positioned so as to envelop and/or surround at least partially the tubular body 100 in the second end region 101b. Moreover, preferably, as shown by way of example in Figure 9, the personal protection device 200 comprises a sleeve 130 or a band-like element configured to be wrapped around the connecting portion 12a of the inflatable element 12 so as to keep said portion associated with the tubular body 100, and for example consists of an elastic sleeve.

[0052] Preferably, the gas generator 15 comprises a pin-like component 71, for example positioned along an outer wall of the generator.

[0053] In particular, the L-shaped insertion seat 161 of the side wall 160 of the tubular body 100, described above, is configured to allow the insertion or passing movement of the pin-like component 71 inside it so as to removably associate the gas generator 15 together with the bushing connection device 10. For example, the pin-like component 71 may be inserted along a first portion of the L-shaped insertion seat 161 by means of displacement of the gas generator 15 during insertion inside the internal cavity 105 of the tubular body 100, and the pin-like component 71 may be inserted along a second portion of the L-shaped insertion seat 161 by means of rotation of the gas generator once inserted inside the internal cavity 105 of the tubular body 100.

[0054] It is clear, therefore, that a fluid, for example an inflation gas, output from the portion 15a of the gas generator 15 may move along the internal cavity 105 of the tubular body 100 and enter into the inner chamber of the inflatable element 12 via the second mouth 110b, in such a way as to inflate the inflatable element into the inflated configuration. Subsequently, the inflation fluid may flow out of the inner chamber of the inflatable element via the vent channel 120, exiting from the first mouth 110a.

[0055] In particular, the fluid may enter from the inner chamber of the inflatable element 12 into the through-hole 121. Depending on the embodiment of the present invention, the fluid may cross the venting passage formed by the groove 122 and the outer wall of the portion 15a of the gas generator 15, or the venting passage formed by the clearance present between the outer wall of the portion 15a of the gas generator 15 and the tubular body, and then exit from the internal cavity 105 of the tubular body 100 via the first mouth 110a, allowing therefore deflation of the inflatable element.

[0056] The present invention also relates to a connection method for connecting a gas generator 15 to an inflatable element 12. The inflatable element 12 may form part of a personal protection device 200 such as that described above, preferably of the wearable type, according to any embodiment. In particular, the connection is such as to ensure fluid communication between the gas generator 15 and the inflatable element 12. The method involves providing a bushing connection device

10 comprising a tubular body 100 extending between a first mouth 110a and a second mouth 110b and defining an internal cavity 105. The method furthermore involves:

- inserting a portion of the gas generator 15, intended for the outflow of the gas, into the internal cavity 105 from the side of a first end region 101a of the tubular body 100 defining the first mouth 110a;
- placing in fluid communication an inner chamber of the inflatable element 12 by means of a second end region 101b of the tubular body 100 defining the second mouth 110b.

[0057] In particular, in order to inflate the inflatable element 12, the gas generator 15 emits a gas which passes from the second mouth 110b towards the inner chamber of the inflatable element 12. Furthermore, in order to deflate the inflatable element 12, the gas flows out via a vent channel extending between the first end region 101a and the second end region 101b. In particular, the vent channel 120 has a cross-section with a smaller area than the second mouth 110b, and preferably also than the first mouth 110a.

[0058] Preferably, according to the method, the gas may flow out of the inner chamber of the inflatable element 12 by means of the vent channel 120, passing from a first opening 121a, positioned in the second end region 101 alongside the second mouth 110n, towards a zone alongside the first mouth 110a. For example, the zone alongside the first mouth 110a may be a tangential zone of the first mouth 110a, i.e. therefore located on an outer edge of the first mouth 110a.

[0059] The subject-matter of the present disclosure has been described hitherto with reference to its embodiments. It is to be understood that other embodiments relating to the same inventive idea may exist, all of these falling within the scope of protection of the claims which are attached below.

Claims

1. Personal protection device (200) comprising an inflatable element (12) and an inflation device, wherein the inflation device comprises a gas generator (15) and a bushing connection device (10) configured to connect said gas generator (15) with said inflatable element (12), wherein said bushing connection device (10) comprises a tubular body (100) extending between a first mouth (110a) and a second mouth (110b) and defining an internal cavity (105) able to house a portion (15a) of the gas generator (15) intended for the gas outflow,

   wherein a first end region (101a) of the tubular body defines said first mouth (110a) and a second end region (101b) of the tubular body (100) defines said second mouth (110b), and wherein said portion (15a) of the gas generator (15) is inserted into said internal cavity (105) from the side of said first mouth (10a) of the tubular body, said inflatable member (12) is configured to be able to assume a deflated or rest configuration and an inflated or active configuration, wherein the gas generator (15) is configured to allow inflation of said inflatable element (12) from said deflated configuration into said inflated configuration, wherein said second mouth (110b) of the tubular body opens into the inner chamber of said inflatable element (12)
   and wherein said bushing connection device (10) further comprises a vent channel (120) extending along at least a portion of said tubular body (100) for venting an inflation fluid of said inflatable element (12), wherein said vent channel (120) has a cross-section with a smaller area than at least said second mouth (110b), and said portion (15a) of the gas generator (15) is configured to leave said vent channel (120) free to vent the inflation fluid.

2. Personal protection device (200) according to the preceding claim, wherein the vent channel (120) is arranged at least partially inside said tubular body (100).

3. Personal protection device (200) according to claim 1 or 2, wherein the tubular body (100) comprises a side wall (160), or covering portion, having a first thickness and at least partially incorporating said first end region (101a) and the tubular body (100) comprises an interface rim (170) having a second thickness and at least partially incorporating said second end region (101b) of the tubular body (100), wherein the second thickness of the interface rim (170) is greater than the first thickness of said side wall (160), so as to define an internal step (171), and wherein said vent channel (120) extends at least into said interface rim (170).

4. Personal protection device (200) according to the preceding claim, wherein said vent channel (120) includes a through-hole (121) arranged in the interface rim (170) and open between a first opening (121a) positioned in said second end region (101b) alongside said second mouth (110b) and a second opening (121b) positioned in said internal step (170).

5. Personal protection device (200) according to any one of the preceding claims, wherein said vent channel (120) is configured to define a through-gap extending between the first end region (101a) and the second end region (101b).

6. Personal protection device (200) according to any one of the preceding claims, wherein said vent chan-

nel (120) opens out in the first end region (101a) alongside the first mouth (110a) and in the second end region (101b) alongside the second mouth (110b).

7. Personal protection device (200) according to any one of the preceding claims in combination with claim 4, wherein said vent channel (120) further includes a groove (122) in said side wall (160), said groove (122) facing said internal cavity (105) and being in fluid communication with said through-hole (121), and wherein the groove (122) is formed along the internal surface of said side wall (160), wherein said groove (122) extends between said second opening (121b) of said through-hole (121) and said first mouth (110a).

8. Personal protection device (200) according to one of the preceding claims in combination with claim 3, wherein said side wall (160) of the tubular body (100) comprises an L-shaped insertion seat (161) which extends from said first mouth (110a) along said first end region (101a), and wherein said vent channel (120) is independent of said insertion seat (161).

9. Personal protection device (200) according to one of the preceding claims, wherein said bushing connection device (10) is also a venting device.

10. Personal protection device (200) according to one of the preceding claims in combination with claim 7, wherein said portion (15a) of the gas generator (15) is inserted inside said internal cavity (105) so as to adhere with at least a portion of said tubular body (100), and said groove (122) forms a vent passage with a wall of said portion (15) of the gas generator (15a), said vent passage being open towards said first mouth (110a).

11. Personal protection device (200) according to one of the preceding claims in combination with claim 3, wherein said portion (15a) of the gas generator (15) is inserted into said internal cavity (105) with clearance so as to allow venting from said interface rim (170) towards said first mouth (110a).

12. Personal protection device (200) according to one of the preceding claims, wherein said inflatable element (12) comprises a connecting portion (12a) which envelops and surrounds said tubular body (100) on an outer side.

13. Personal protection device (200) according to the preceding claim in combination with claim 8, wherein said gas generator (15) comprises a pin-like component (71), and wherein said L-shaped insertion seat (161) is configured to allow passage of said pin-like component (71) inside it so as to removably associate said gas generator (15) with said bushing connection device (10).

14. Personal protection device (200) according to one of the preceding claims, wherein said protection device is a wearable device or is in the form of a protective garment.

15. Connection method for connecting a gas generator (15) with an inflatable element (12), wherein a bushing connection device (10) is provided, said device comprising a tubular body (100) extending between a first mouth (110a) and a second mouth (110b) and defining an internal cavity (105), wherein said method involves:

- inserting a portion (15a) of the gas generator (15) intended for the outflow of the gas into said internal cavity (105) from the side of a first end region (101a) of the tubular body (100) defining said first mouth (110a),
- placing an inner chamber of the inflatable element (12) in fluid communication by means of a second end region (101b) of the tubular body (100) defining said second mouth (110b),

wherein, in order to inflate said inflatable element (12), the gas generator (15) emits gas passing from the second mouth (110b) towards the inner chamber of the inflatable element (12), and wherein, in order to deflate said inflatable element (12), said gas flows out through a vent channel (120) extending at least partially along said tubular body (100), wherein the vent channel (120) has a cross-section with a smaller area than at least said second mouth (110b).

16. Method according to the preceding claim, wherein said gas flows out from the inner chamber of the inflatable element (12) through said vent channel (120) passing through an opening (121a), positioned in said second end region (101b) next to said second mouth (110b).

17. Method according to the preceding claim, wherein the vent channel (120) extends from the opening (121a) into a through-hole (121) and as far as an interspace between the tubular body (100) and the gas generator (15), or wherein the vent channel (120) extends from the opening (121a) into a through-hole (121) and as far as a groove (122) formed on an inner side of the tubular body (100).

18. Method according to any one of claims 15 to 17, wherein the inflatable element (12) is the inflatable element of a wearable personal protection device.

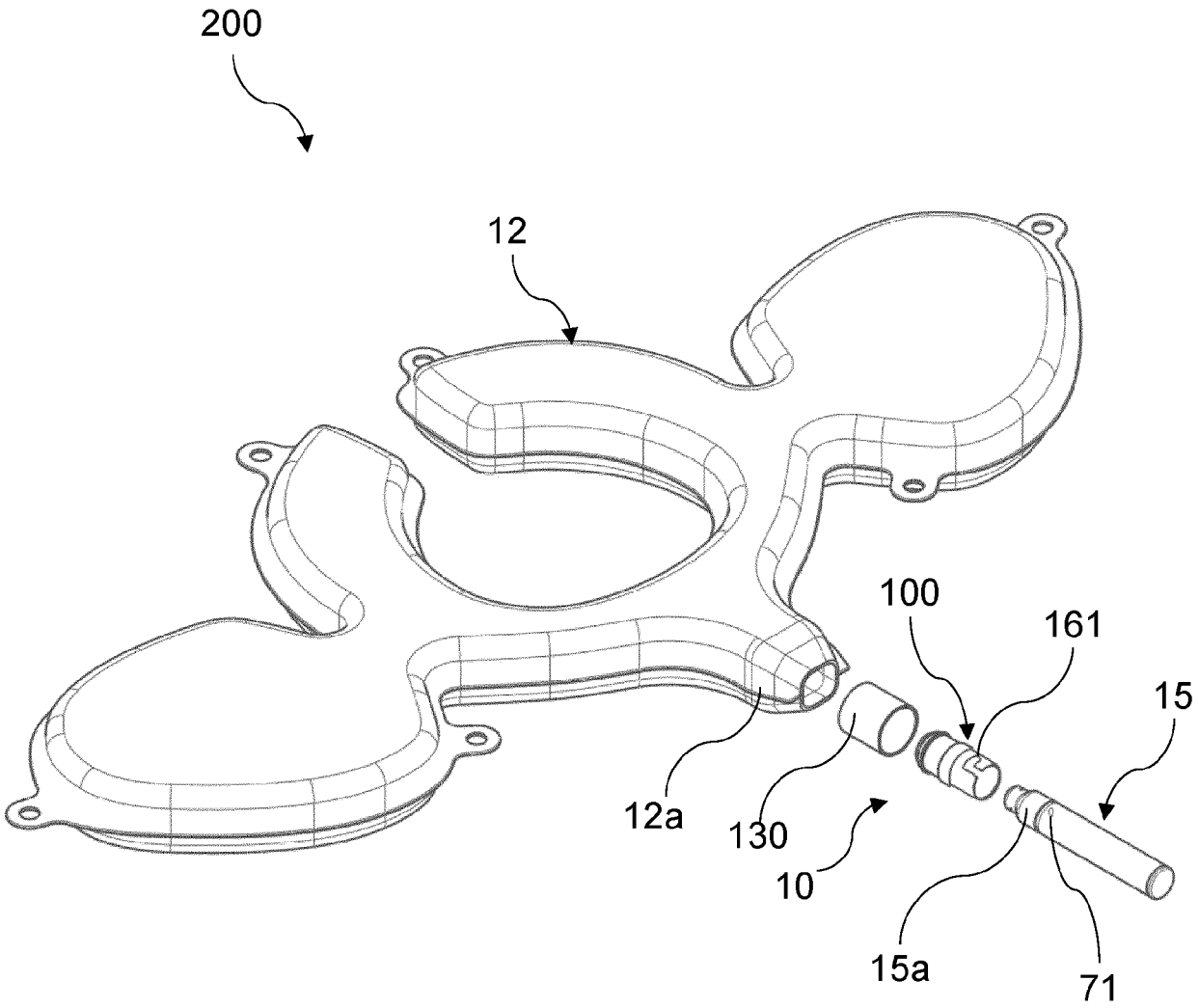

FIG. 1

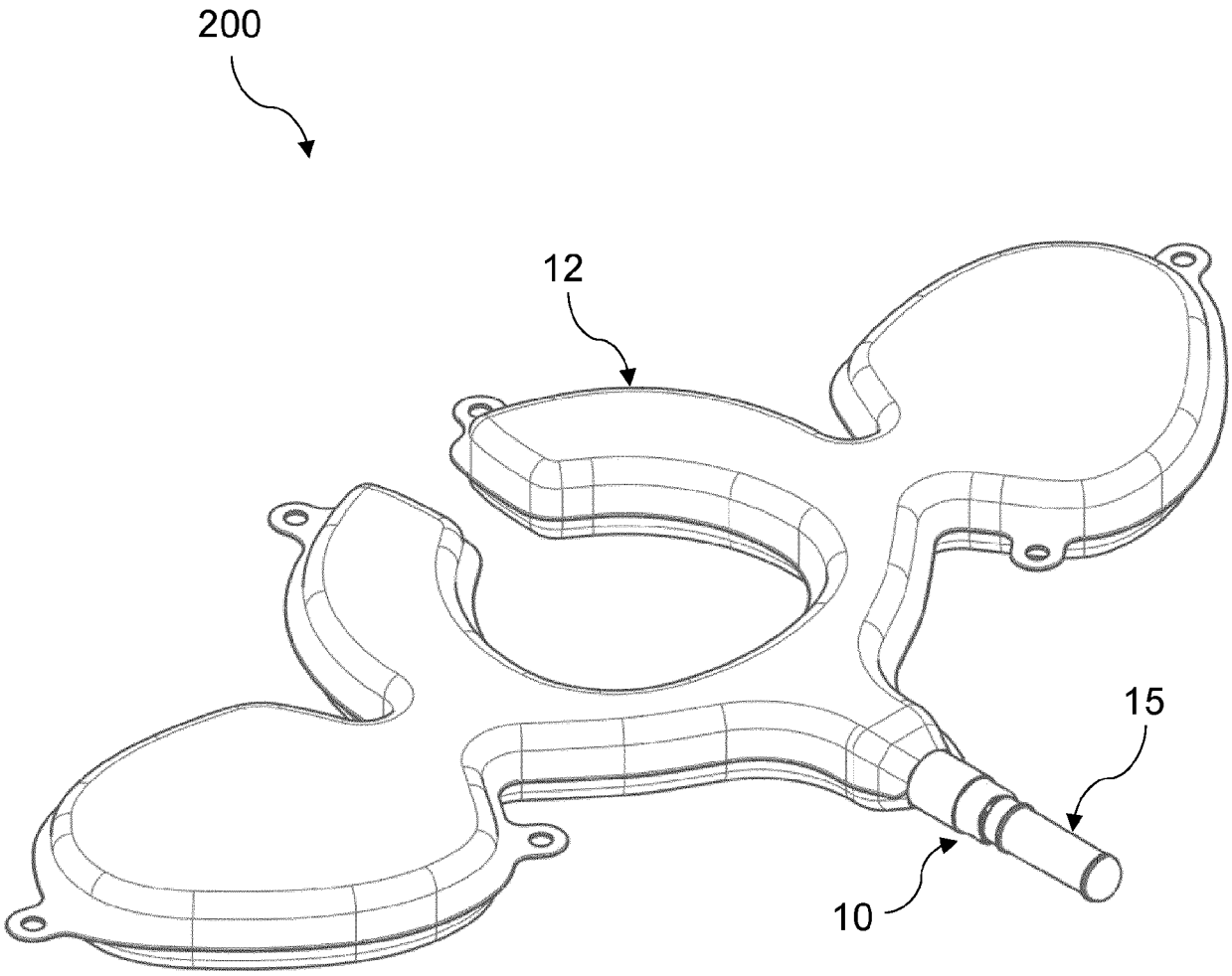

FIG. 2

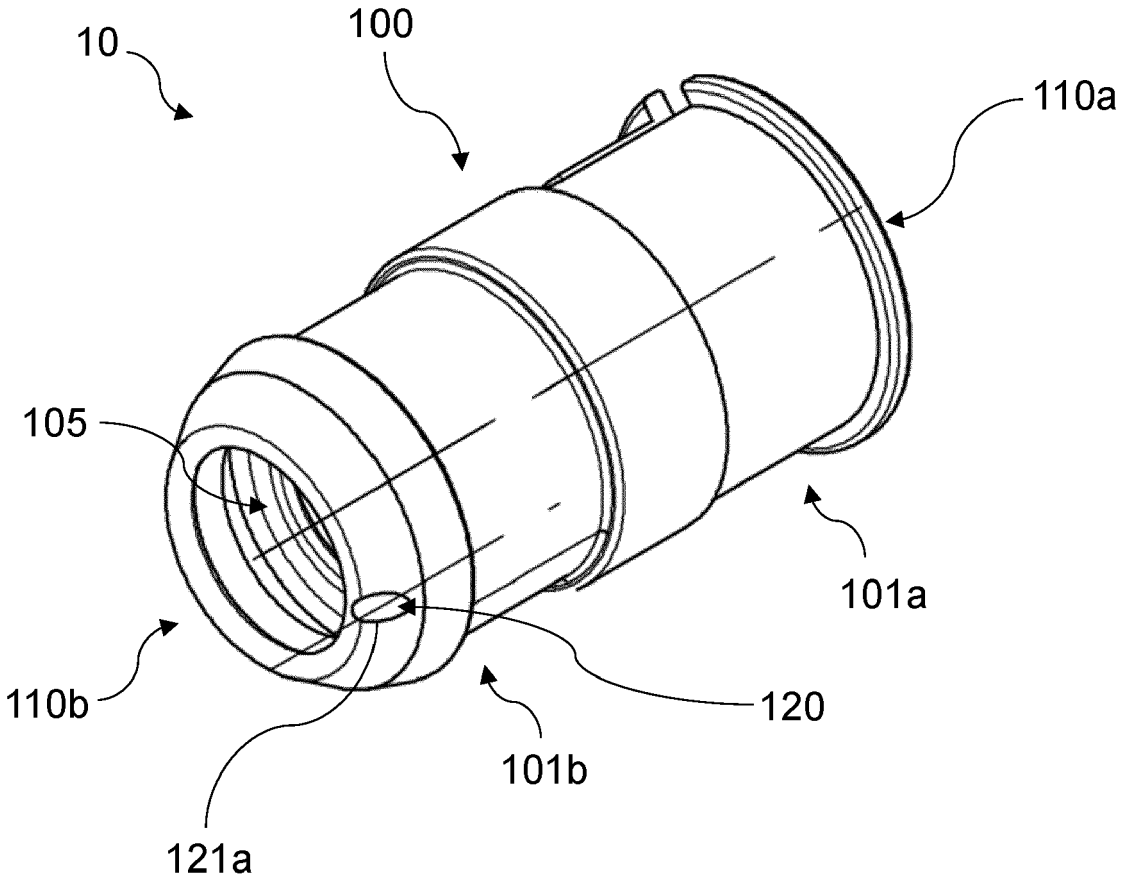

FIG. 3

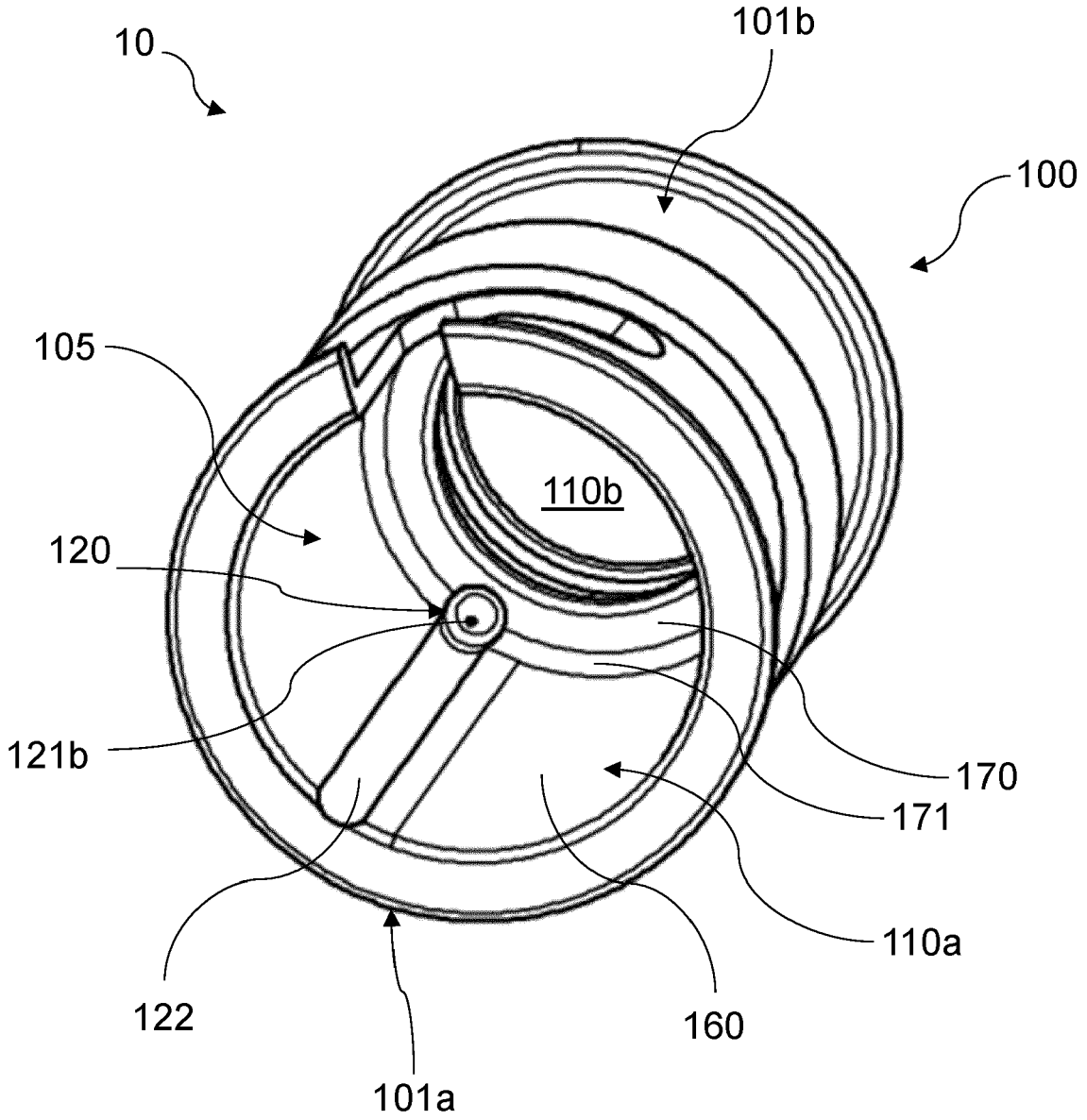

FIG. 4

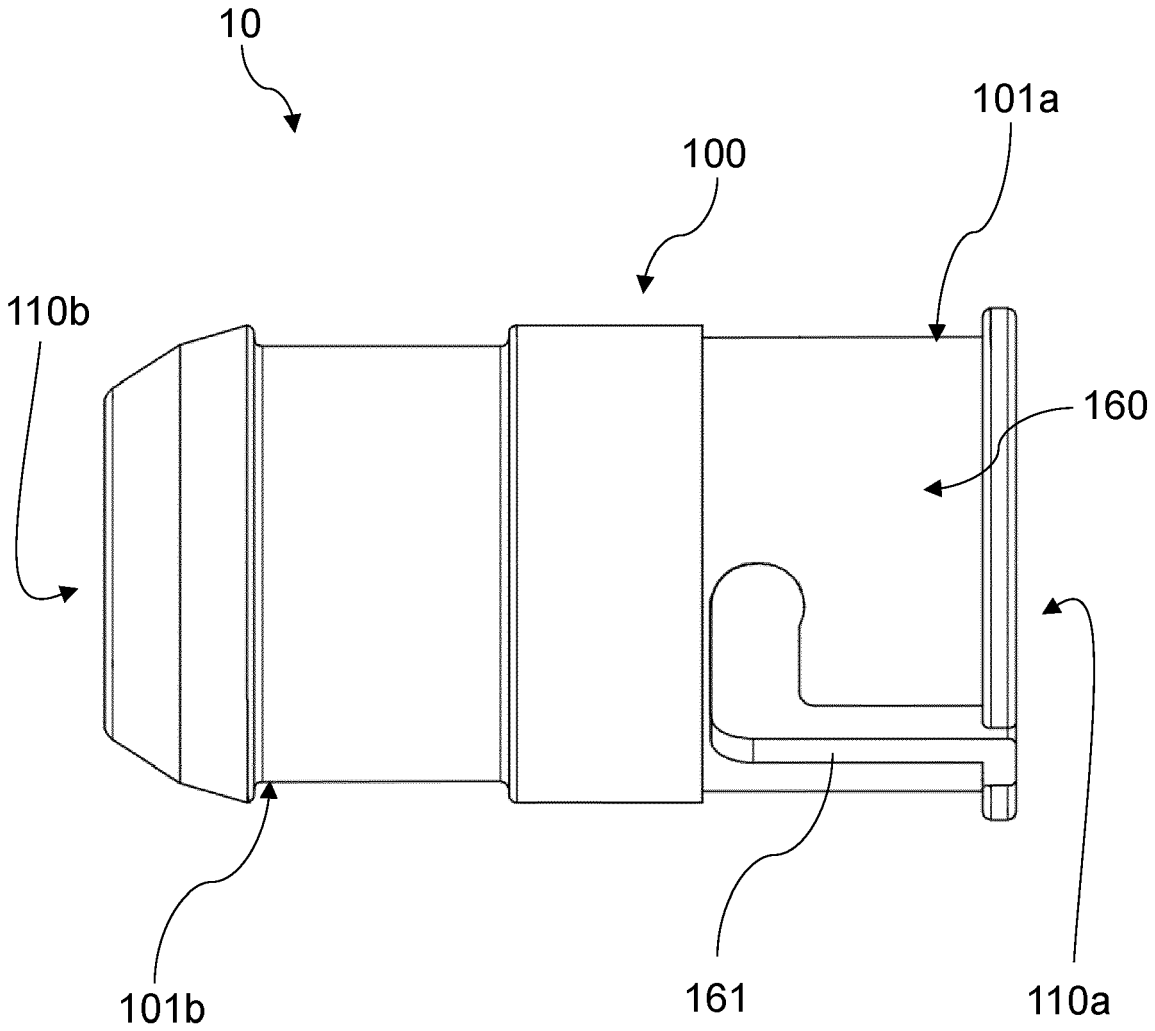

FIG. 5

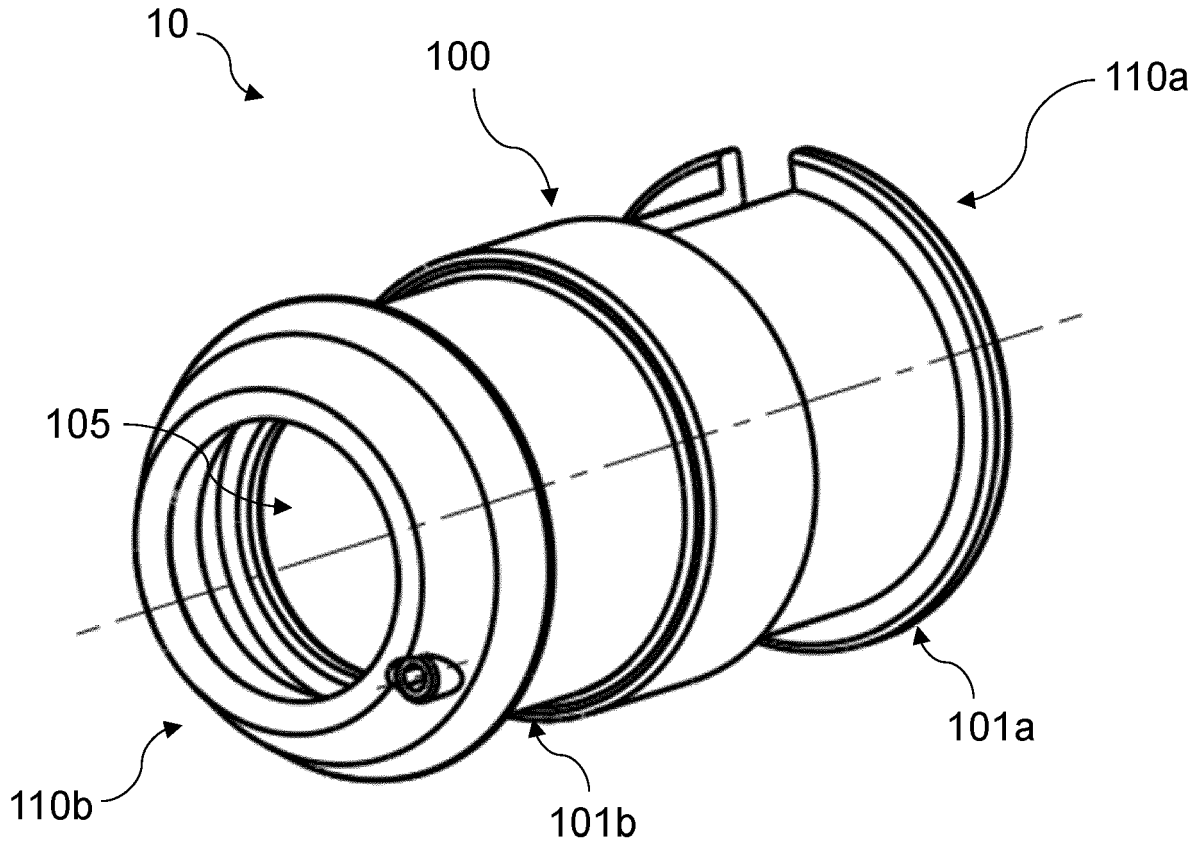

FIG. 6

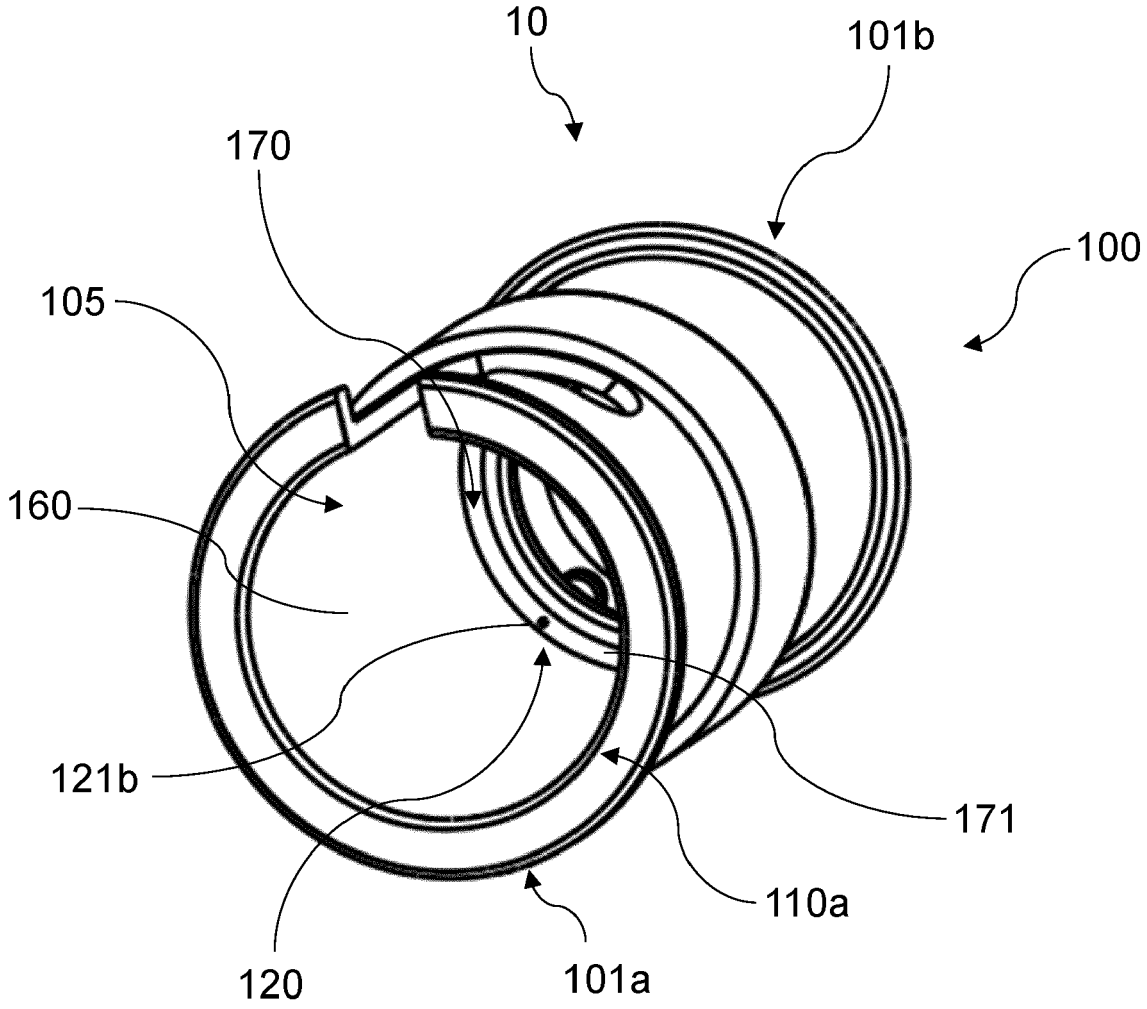

FIG. 7

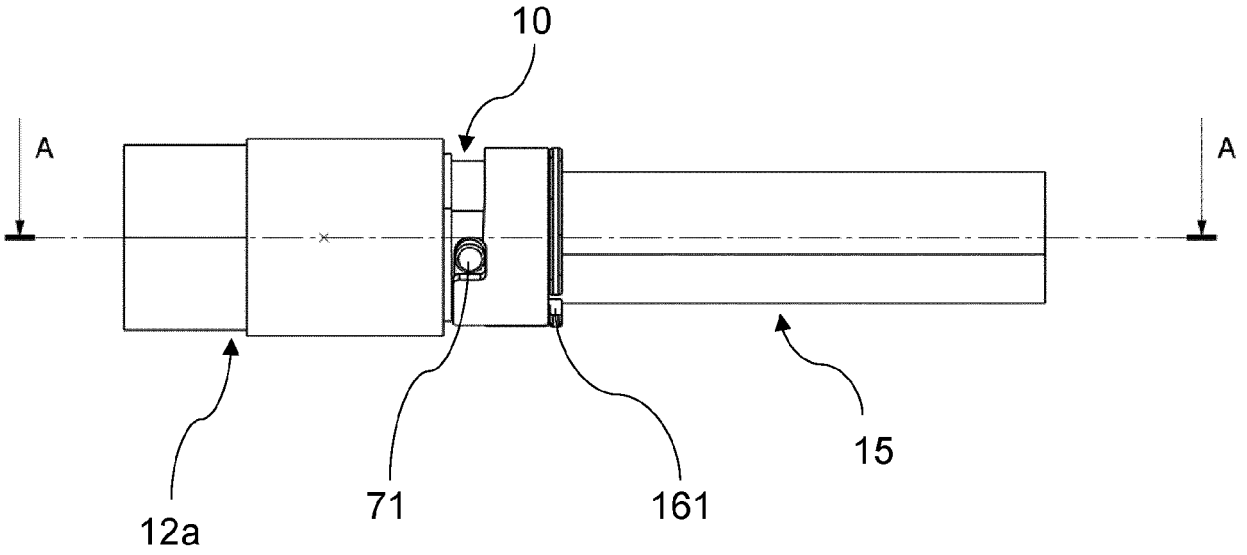

FIG. 8

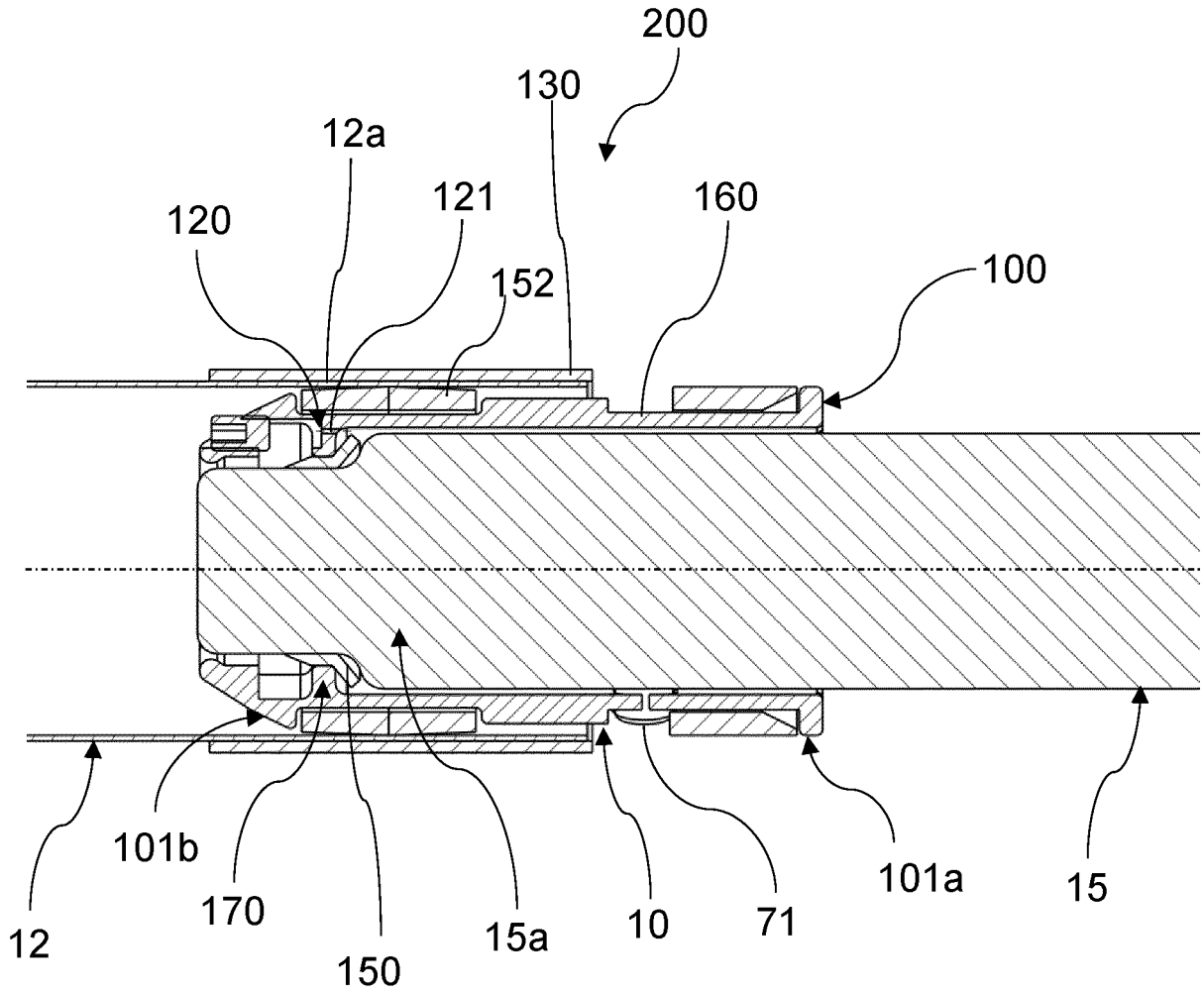

FIG. 9

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 20 2810

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 4 046 514 A1 (DAINESE SPA [IT]) 24 August 2022 (2022-08-24) * figure 1 *	1-18	INV. A41D13/018 F16L37/00
A	EP 2 373 189 B2 (DAINESE SPA [IT]) 6 January 2021 (2021-01-06) * figure 1 *	1-18	
A	EP 1 845 298 B1 (NOVALUNG GMBH [DE]) 11 January 2012 (2012-01-11) * figures 1-3 *	1-18	

TECHNICAL FIELDS SEARCHED (IPC)

A41D
F16L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 February 2024	van Voorst, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 20 2810

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-02-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 4046514 A1	24-08-2022	NONE	
EP 2373189 B2	06-01-2021	EP 2373189 A1	12-10-2011
		EP 2373190 A1	12-10-2011
		EP 2373524 A1	12-10-2011
		ES 2388411 T3	15-10-2012
		ES 2390011 T3	05-11-2012
		ES 2390647 T3	15-11-2012
		JP 5486607 B2	07-05-2014
		JP 5671472 B2	18-02-2015
		JP 5841843 B2	13-01-2016
		JP 2012511457 A	24-05-2012
		JP 2012511458 A	24-05-2012
		JP 2012511637 A	24-05-2012
		US 2012007344 A1	12-01-2012
		US 2012011642 A1	19-01-2012
		US 2012032422 A1	09-02-2012
		WO 2010067285 A1	17-06-2010
		WO 2010067288 A1	17-06-2010
		WO 2010067393 A1	17-06-2010
EP 1845298 B1	11-01-2012	AT E541154 T1	15-01-2012
		DE 102006016211 A1	04-10-2007
		EP 1845298 A2	17-10-2007
		JP 5065736 B2	07-11-2012
		JP 5216055 B2	19-06-2013
		JP 2007275593 A	25-10-2007
		JP 2010234087 A	21-10-2010
		US 2007249197 A1	25-10-2007
		US 2011276036 A1	10-11-2011

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82