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(54) Title: NECK PROTECTION DEVICE

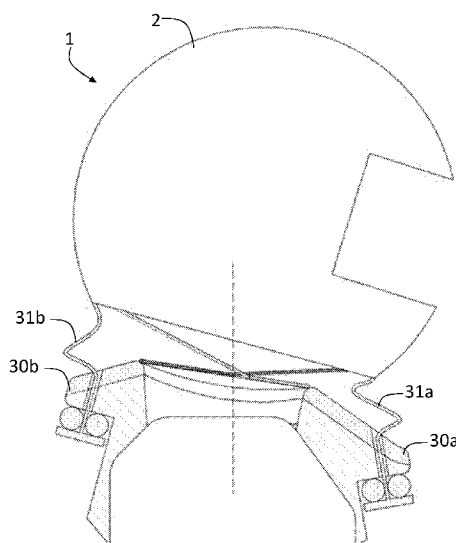


Fig. 1

(57) Abstract: The present invention relates to a device (1) for personal protection comprising a helmet (2) and a jacket (3) wearable by a user, connected to each other through flexible connections (4a,4b,4c,4d), said device (1) comprising at least four flexible connections (4a/4b/4c/4d) each coupled with a portion of the jacket that, when worn, is located on the opposite side with respect to the helmet.



NECK PROTECTION DEVICE

DESCRIPTION

TECHNICAL FIELD

The present invention relates to the field of neck protection devices to be used in combination with helmets or the like.

PRIOR ART

It is known from prior art that in some sports, such as motor racing (Formula
5 One or rally), motorcycling, motorboating, bobsleigh, and the like, it is convenient for the user to wear a protective helmet.

With no restrictions these helmets can be open face ones (so called "jet" type) or full face ones, depending on needs.

Although the helmet generally turns out to be able to protect the user head,
10 in cases of heavy stresses that generate violent accelerations (such as impacts or the like) users wearing the helmet are subjected to important trauma, often involving the neck.

The neck muscles of a user are not sufficient to completely support the stresses generated in such sports in cases of accidental events and that
15 generate said heavy accelerations (or decelerations): the head of a user has in fact a considerable weight that is further increased by the weight of the helmet possibly worn by the user.

Such stresses are thus transferred on the spine, with the possibility of causing even very severe injuries to the user.

20 Such injuries usually take place because the user's head is projected to non-ergonomic angles, where exactly the aforesaid spine injuries take place.

With no intention to enter into mainly biomechanical matters relating to such injuries, it is here merely noted that they generally are present every time the head (with or without the helmet) of a user is subjected to a violent (rapid
25 and heavy) acceleration, in any direction.

Different devices have been developing over time to limit the neck

movement.

Currently in the motor racing field there is the so called "HANS" system (Head and Neck Safety System), which provides a holding cable that binds the rear portion of the helmet to a rigid jacket suitably shaped and worn by the rider.

Beyond other considerations, such system has the drawback of being able to limit the spine injuries practically only in case of frontal impacts.

For instance, in the case of rally riders this solution could not be sufficient: in such sports field, in fact, it is not rare for the car to be subjected to heavy side impacts and/or overturnings that therefore stress the spine in a non-frontal direction; shortly, the same is valid for motorcycling, bobsleigh and similar sports activities.

Some collars are marketed in the motor cycling field that may also be harmful in some cases.

Such collars (that do not hold the helmet through a belt system) determine a stroke end point that should limit the angle of movement of the spine and reduce/cancel possible traumas thereto; these systems are generally known by the English term "neck-brace".

However, in practice, such systems are not earning the expected success and their diffusion is decreasing.

Other prior art examples on the matter can be found in patent applications nos. US20080209617, W0201330858, W0201330859.

All these systems have in common the fact that they have a jacket wearable by the user connected with the helmet by means of rigid elements.

The weight and the overall dimensions are clear also at a first sight.

Another drawback is that the Inventors of the present invention have ascertained, after long studies, that the hooking points of the (rigid or soft) connection between the helmet and the jacket are essential for protecting the spine from harmful stresses and for allowing, at the same time, the user's

neck to accomplish a correct movement.

OBJECTS AND SUMMARY OF THE INVENTION

It is the object of the present invention to overcome the drawbacks of the prior art.

5 Particularly, it is the object of the present invention to provide a neck protection device to be used in combination with helmets or the like and a helmet equipped with such device that are able to overcome the drawbacks mentioned above.

10 The idea underlying the invention is to provide a device protecting the neck of a user wearing it; the device at issue comprises two distinct and synergic systems, one providing to force the neck to accomplish physiologically correct movements during an impact and the other one providing to limit the maximum movement of the neck and to dissipate the energy due to the impact by limiting the value of the forces and moments on the neck.

15 Specifically, the two systems are the following:

- System for forcing the neck to accomplish physiologically correct movements: a system of cables arranged so as to limit as much as possible the translation movements of the neck while leaving rotations free. Such rotations have to take place in such a manner not to let the neck taking
20 harmful positions.

- System for limiting the maximum movement, for dissipating energy and for reducing the forces on the neck: this system is composed of compression and traction stroke ends.

25 The compression stroke ends are realized by a (monolithic or in several parts) collar resting on the trunk.

The jacket is compressed by the helmet when the angle between head and trunk exceeds a preset maximum value.

The combination between the jacket (or collar) and the cable system is useful for guaranteeing the proper movement of the neck.

Moreover, in order to avoid not balanced torques with a considerable value to arise, in addition to the jacket that forms the compression stroke end, it is also possible to provide strings (at least three) arranged so as to act as traction stroke ends contemporaneously (or in such a manner to cooperate anyway) with the compression stroke ends.

These strings allow the forces on the neck to be kept balanced (or not too much unbalanced anyway) and to avoid harmful moments to arise.

Possibly, the strings and the collar may be made so as to dissipate energy when the neck reaches the stroke end.

In a more developed version, the strings could be dampers (traditional ones or made of a suitable material, or even adjustable ones) able to dissipate energy also before reaching the stroke end.

Therefore, a first object of the invention is a protection device according to the annexed first claim.

Further advantageous features of the device of the invention or of the process are the subject matter of the annexed dependent claims that are an integral part of the present description.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described hereinbelow with reference to non-limiting examples, provided by way of explanatory and not-limiting example in the annexed drawings. These drawings show different aspects and embodiments of the present invention and, where appropriate, reference numerals showing similar structures, components, materials and/or elements in different figures are denoted by similar reference numerals.

Figure 1 shows a simplified side view of the device of the invention;

Figures 2 and 3 show simplified side views of the device of fig. 1 in two stroke end conditions;

Figure 4 shows a simplified phantom top view of details of the device of the invention;

Figure 5 shows a simplified phantom top view of other details of the device of the invention;

Figures 6-11 are force diagrams of tests carried out on the device of the invention, compared with the results of tests without the device of the invention.

DETAILED DESCRIPTION OF THE INVENTION

While the invention is susceptible of various modifications and alternative forms, some illustrated relevant embodiments are shown in the drawings and will be described hereinbelow in detail. It should be understood, however, that there is no intention to limit the invention to the specific illustrated embodiment, but, on the contrary, the invention intends to cover all modifications, alternative constructions and equivalents falling within the scope of the invention as defined in the claims.

The use of "for example", "etc", "or" denotes non-exclusive alternatives without limitation unless otherwise defined. The use of "including" means "including, but not limited to" unless otherwise defined.

With reference to the annexed figures 1-5, a non-limiting example of the personal protection device 1 of the invention is shown therein.

It comprises a helmet 2 and a jacket 3 wearable by a user, connected with each other through four flexible connections 4a,4b,4c,4d that can be seen individually in figs. 4 and 5 for illustrative clarity.

Said flexible connections 4a,4b,4c,4d are each one coupled with a portion of the jacket 3 that, when worn, is located at the opposite side with respect to the helmet 2.

Specifically, the four flexible connections are each connected to a front, rear, right side and left side portion of the helmet 2 and to a rear, front, left side and right side portion of said jacket 3, respectively.

Essentially, with reference to fig. 4 the flexible connection 4a is coupled with the jacket 3 at its front portion 3a and is coupled with the helmet 2 at its rear

portion 2c.

Likewise, the flexible connection 4c is coupled with the jacket at the rear portion 3c and is coupled with the helmet at its front portion 2a.

5 The two connections 4a and 4c cross with each other in two points placed on the opposite sides of the helmet and substantially aligned in a side view with the axis of the neck of a user who is wearing the device 1.

Making now reference to fig. 5, the flexible connection 4b is coupled with the jacket 3 at its right portion 3b and is coupled with the helmet 2 at its left portion 2d.

10 Likewise the flexible connection 4d is coupled with the jacket at the left portion 3d and is coupled with the helmet at its right portion 2b.

The two connections 4b and 4d cross with each other in two points placed on the opposite sides of the helmet 2 and substantially aligned in front view with the axis of the neck of a user who is wearing the device 1.

15 Each of the flexible connections 4a,4b,4c,4d comprises a cable with two free ends and a sheath within which the cable is free to slide.

As an alternative the free ends are connected to the helmet 2, such as in the shown example, or to the jacket 3 (not shown) and the sheath is coupled with the jacket 3 such as in the shown example, or with the helmet 2 (not shown).

Thus the coupling of the flexible connections 4a,4b,4c,4d with the helmet 2 and with the jacket 3 is such to allow a rotation of the helmet 2 and to prevent or reduce a translation movement of the helmet 2 relative to the jacket 3, to eliminate or reduce shear forces acting on the spine of a user who is wearing the device 1 in case of impact in any direction.

Making now reference to figs. 1-3 it is noted that in the device 1 according to the invention, the jacket 3 comprises at least one, preferably a plurality of compression stroke stops 30a, 30b to stop an angular displacement of the helmet towards the jacket 3 by means of the interference with the helmet 2

itself.

The example shows a front compression stroke stop 30a and a rear one 30b.

They are configured as support planes against which the helmet hits during a backward-to-forward rotation or vice-versa, in order to limit the rotation angle of the neck and to prevent the spine of the user from being injured.

5 Likewise, side stroke stops (not shown) could be also provided on the right and on the left, at the shoulders of the jacket 3.

There are further optionally provided also traction stroke stops 31a and 31b, such as for example textile ribbons or the like, that connect the helmet 2 to the jacket 3 at the front and at the rear, such as in the example.

10 Thus, such as shown in figs. 2 and 3, in case of a movement of the helmet, the rotation is limited not only thanks to the compression stroke stops 30a and 30b, but also thanks to the traction stroke stops 31a and 31b, which cooperate with the former for reducing the stresses on the user's neck.

15 In a particularly advantageous solution, at least one, preferably all the traction stroke stops comprise a damper. According to this solution, the traction stroke stops would have also the function of dissipating energy during the movement phase of the helmet relative to the jacket before reaching the allowed maximum displacement. This solution allows accelerations on head and neck to be drastically reduced during the phase of relative motion between head and jacket 3.

20 The traction stroke ends are made so that they begin to dissipate energy as soon as a relative movement takes place and they continue the dissipation during all the relative movement up to becoming real stroke ends and till stopping the motion.

25 To this aim it is possible to use strings made of special materials able to dissipate energy till reaching a maximum length (for example twisted cables

that dissipate energy while the strands get aligned with each other and till reaching a predetermined length, frictional devices with stop points or systems similar to “descendeurs” for mountaineering) or conventional dampers that have to be suitably housed.

5 In a still more developed solution, at least one of said dampers is adjustable to vary its damping properties.

In this case, each damper is able to vary its property depending on the position, speed or acceleration (or a combination thereof) so as to optimize the energy dissipation during an impact and to let the movements free
10 during the normal driving.

In use the flexible connections 4a,4b,4c,4d operate in pairs 4a/4c and 4b/4d to guide the head with respect to the trunk in the plane.

Specifically, it has to be noted how the coupling of the connections with the helmet occurs at symmetric points thereof: the flexible connection 4a is
15 connected by both the free ends to the front and lower region of the helmet 2 symmetrically with respect to the frontal plane.

The flexible connection 4a is then fastened to the jacket through the sheath within which it slides at the sides of the neck of the latter.

The flexible connection 4c is connected by both the free ends to the rear and
20 lower region of the helmet symmetrically with respect to the frontal plane.

The flexible connection 4c is then fastened to the jacket through the sheath within which it slides at the sides of the neck.

The axes of the two cables, seen as a projection on the side plane, cross with each other close to the neck axis; this guarantees that, during flexion and
25 extension, a correct rotation of the neck is maintained with limited translation values.

Likewise the other pair of flexible connections 4b/4d is used for guiding the

head with respect to the trunk in the side plane.

The two flexible connections 4b/4d are placed symmetrically with respect to the frontal plane.

5 The flexible connection 4b is connected by both the free ends to the right lower region of the helmet.

The flexible connection 4b is then fastened to the jacket through the sheath within which it slides in the regions ahead and behind the neck.

The flexible connection 4d is connected by both the free ends to the left lower region of the helmet.

10 The flexible connection 4d is then fastened to the jacket through the sheath within which it slides in the regions ahead and behind the neck.

The axes of the two flexible connections 4b,4d, seen as a projection on the frontal plane, cross with each other close to the neck axis; this guarantees that, during the side movement, a correct rotation of the neck is maintained with limited translation values.

The movements different from front flexion, extension and side flexion are guided in a combined manner by the two pairs of flexible connections.

20 The length of the sheath with respect to the cable is adjusted so as to allow the head to rotate with respect to the neck axis by an angle sufficient for driving the vehicle.

Lower region of the helmet preferably means a 50 mm band from the helmet base.

Front region of the neck means ahead of the neck axis.

25 The effectiveness of the device 1 has been tested by the inventors, with the results shown in figs. 6-11.

In order to verify the operation of the device as a stroke end able to discharge the forces acting on the neck, static operating tests have been performed.

The device has been worn by a crash test dummy of the Hybrid III type.

The dummy has been then rigidly fastened to a fixed support and a known force has been applied to the helmet.

The test has been repeated with and without the device in the front, rear and side directions.

The force applied to the helmet has been measured by a uniaxial load cell, while the forces on the neck have been measured by the six-component cell placed inside the dummy.

The figures show the force applied by the load cell and the force components on the neck significant for the type of test (vertical and longitudinal one for the front and rear tests and vertical and side one for the side test).

From the diagrams it is possible to see that, without the device 1, the forces completely pass through the neck, reaching high values.

If the device is worn, when the stroke end is reached, the forces on the neck do not increase, as evidence of the fact that the device effectively opposes them.

Thus the objects mentioned above are achieved.

Obviously several changes are possible to what described so far, all to be intended within the knowledge of the person skilled in the art in the light of the teachings herein set forth.

CLAIMS

1. A device (1) for personal protection comprising a helmet (2) and a jacket (3) wearable by a user, connected to each other through flexible connections (4a,4b,4c,4d),

characterized in that

said device (1) comprises four flexible connections (4a,4b,4c,4d) each coupled with a portion of the jacket that, when worn, is located on the opposite side with respect to the helmet (2).

2. A device (1) according to the preceding claim, wherein each of said flexible connections (4a,4b,4c,4d) comprises a cable (40a,40b,40c,40d) with two free ends and a sheath (41a,41b,41c,41d) within which the cable (40a,40b,40c,40d) is free to slide, said free ends being connected to the helmet (2) or alternatively to the jacket (3) and said sheath (41a,41b,41c,41d) being coupled with the jacket (3) or alternatively with the helmet (2).

3. A device (1) according to claim 1 or 2, wherein the coupling of the flexible connections (4a,4b,4c,4d) with the helmet (2) and with the jacket (3) is such to allow a rotation of the helmet (2) and to prevent or reduce a translation movement of the helmet (2) relative to the jacket (3), to eliminate or reduce shear forces acting on the spine of a user who is wearing the device (1) in case of impact.

4. A device (1) according to one or more of the preceding claims, wherein said jacket (3) comprises at least one, preferably a plurality of compression stroke stops (30a,30b) to stop an angular displacement of the helmet towards the jacket (3) by means of interference with the helmet (2) itself.

5. A device (1) according to one or more of the preceding claims, wherein said jacket (3) comprises at least one, preferably a plurality of traction stroke stops (31a,31b) to stop an angular displacement of the helmet towards the jacket (3).

6. A device (1) according to one or more of the preceding claims, wherein said flexible connections are connected to a front, rear, right side and left side

portion of said helmet (2) respectively, each of said flexible connections (4a,4b,4c,4d) being connected to a portion of the jacket (3) opposite to the coupling portion of the corresponding flexible connection (4a,4b,4c,4d) to the helmet (2), to a rear, front, left side and right side portion of said jacket (3) respectively.

7. A device (1) according to claim 5 or 6, wherein the flexible connection (4a) coupled with the jacket (3) at the front portion (3a) and coupled with the helmet (2) at its rear portion (2c), crosses, in at least two points, the flexible connection (4c) coupled with the jacket at the rear portion (3c) and coupled with the helmet at its front portion (2a), said crossing points being placed on opposite sides of the helmet and substantially aligned in a side view with the axis of the neck of a user who is wearing the device (1).

8. A device (1) according to claim 6 or 7, wherein the flexible connection (4b) coupled with the jacket (3) at the right portion (3b) and coupled with the helmet (2) at its left portion (2d), crosses, in at least two points, the flexible connection (4d) coupled with the jacket at the left portion (3d) and coupled with the helmet at its right portion (2b), said crossing points being placed on opposite sides of the helmet and substantially aligned in a front view with the axis of the neck of a user who is wearing the device (1).

9. A device (1) according to one or more claims 4 to 8, wherein at least one of said traction and/or compression stroke stops (30a,30b,31a,31b) comprises a damper.

10. A device (1) according to the preceding claim, wherein at least one of said dampers is adjustable to vary its damping characteristics.

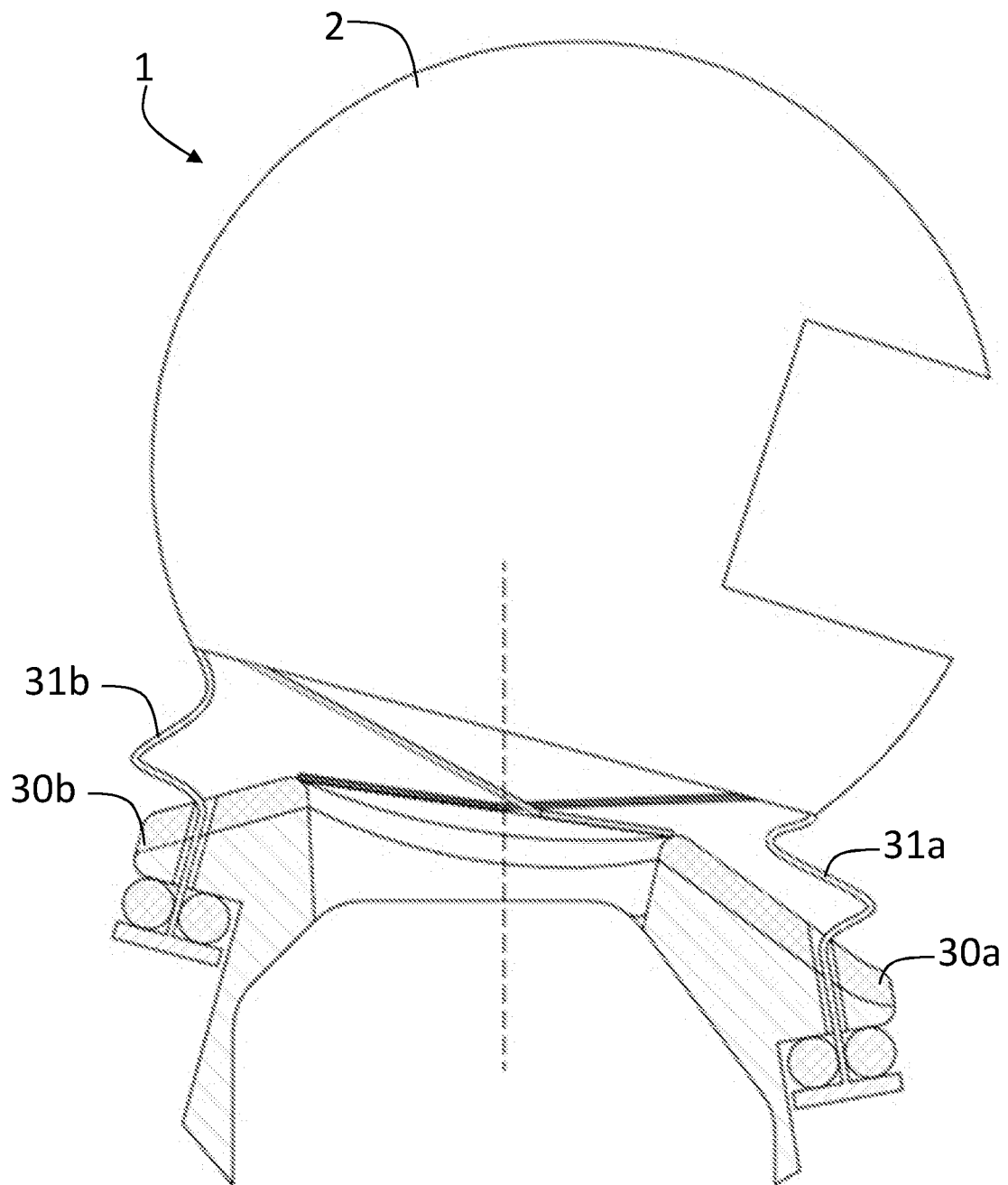
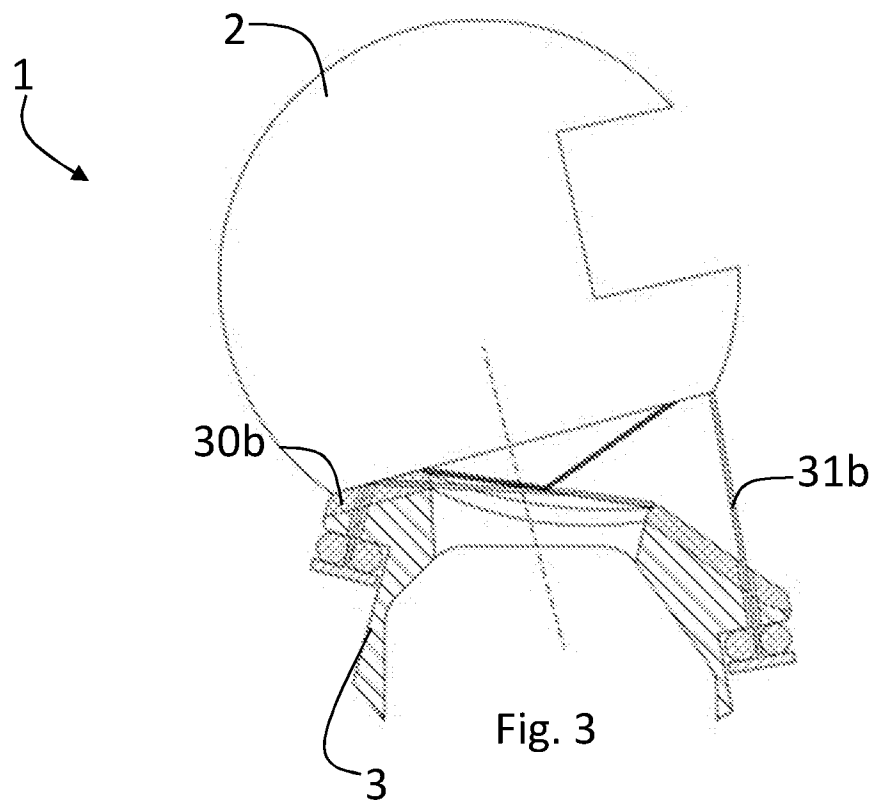
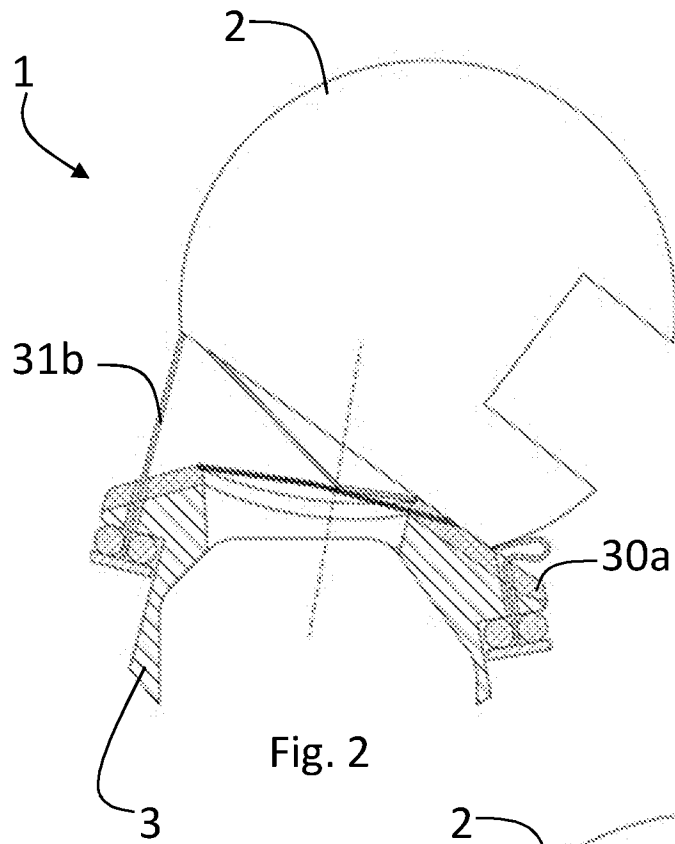


Fig. 1



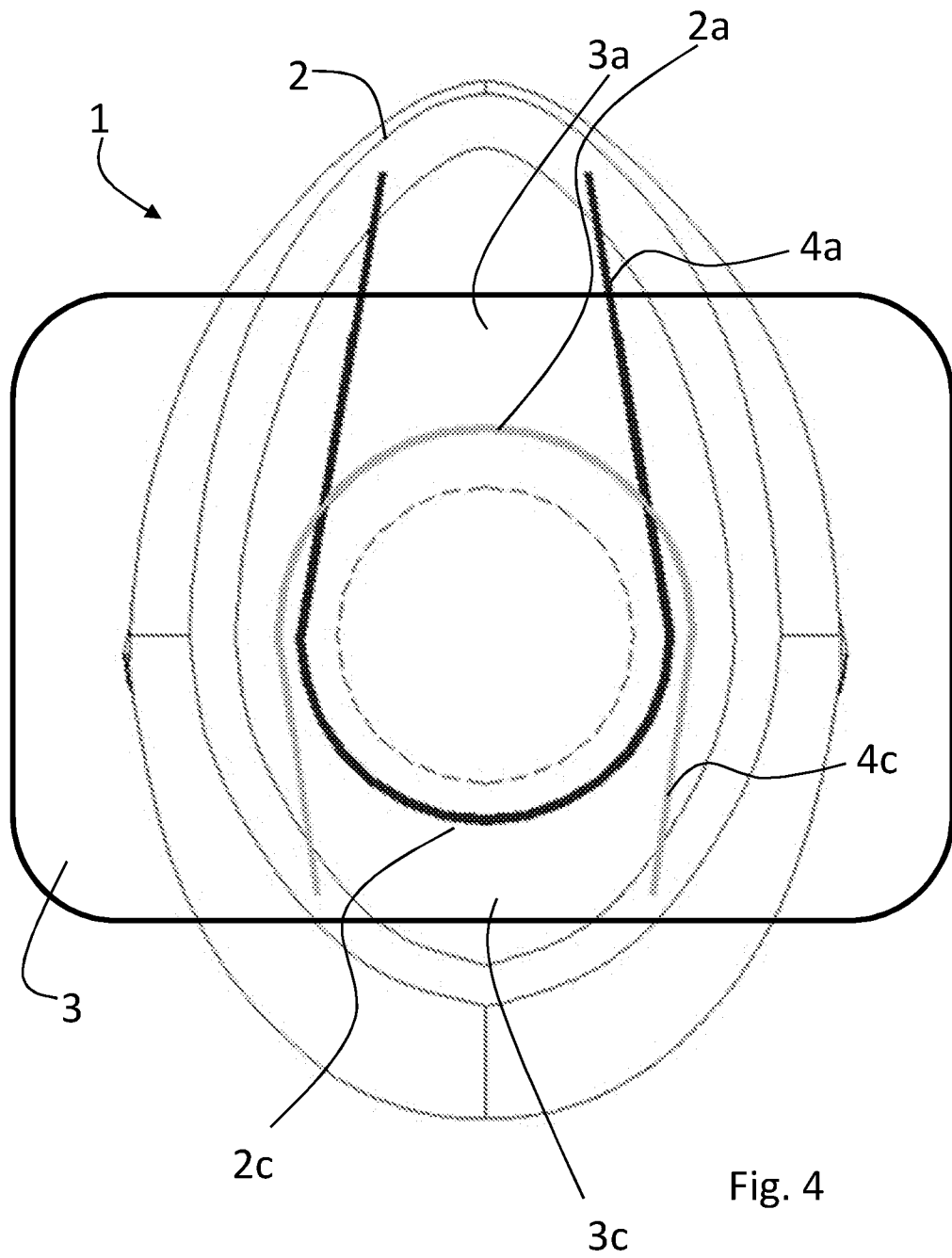


Fig. 4

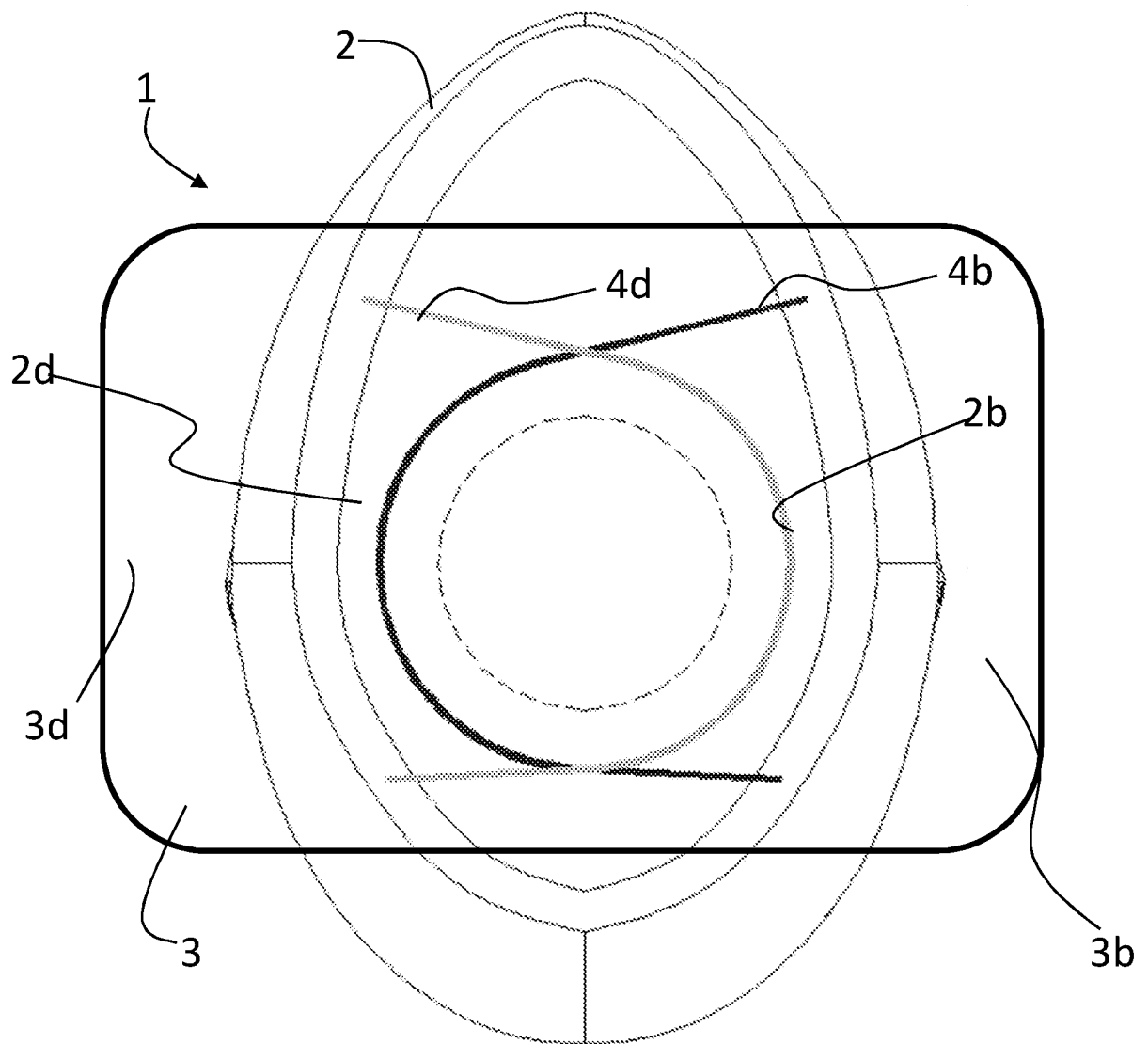
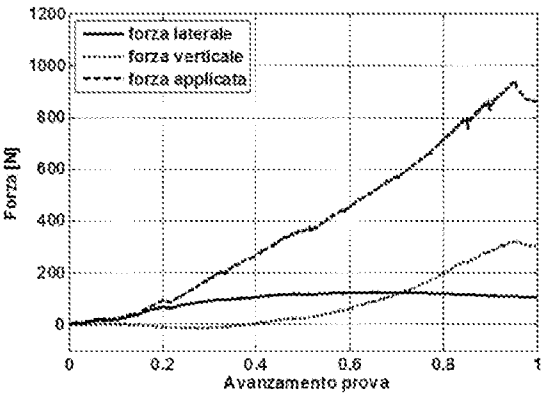
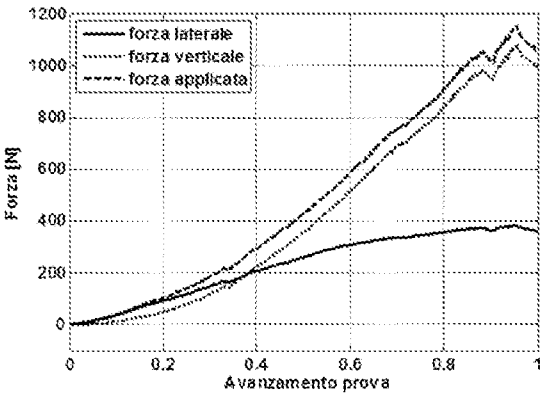
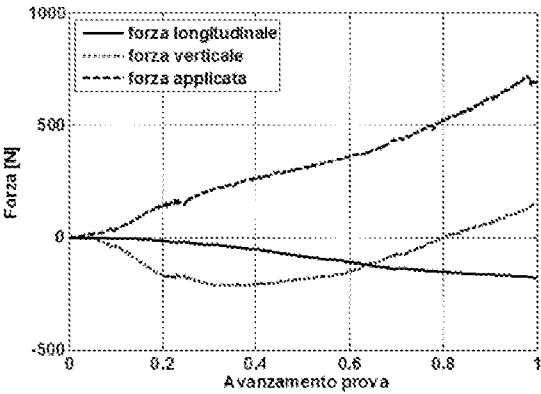
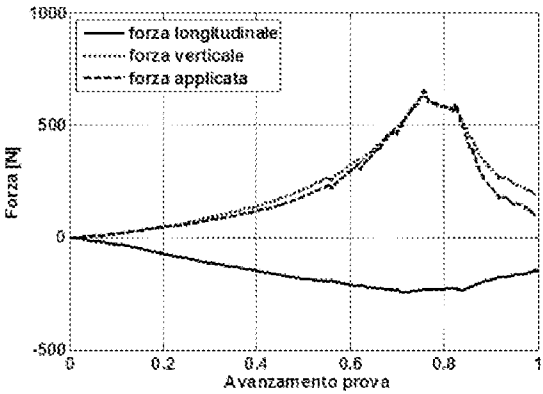
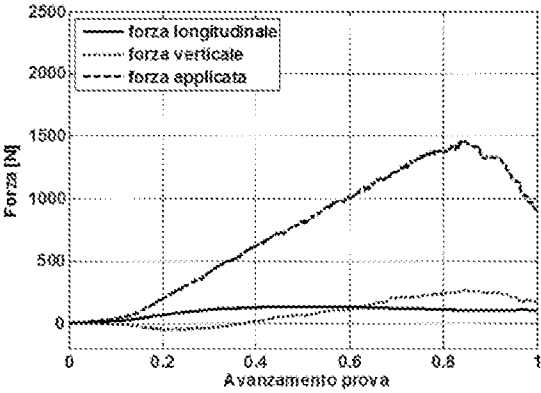
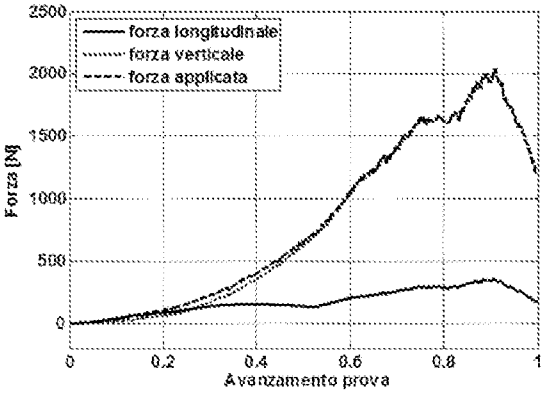


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2015/050840

A. CLASSIFICATION OF SUBJECT MATTER

INV. A42B3/04

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)

A42B A61F

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	paragraphs [0052] - [0057], [0088] - [0093]; figures 3,25	4,5,9,10
Y	----- US 2013/317403 A1 (SIEGLER SORIN [US] ET AL) 28 November 2013 (2013-11-28) paragraphs [0045] - [0054]; figures 1a,1d,2	4,5,9,10
X	----- US 2011/277225 A1 (SALKIND MICHAEL [US] ET AL) 17 November 2011 (2011-11-17) paragraphs [0024] - [0030]; figures 1,2	1,3,6
X	----- US 2006/260027 A1 (RHODES CARROL L [US] ET AL RHODES CARROL LEON [US] ET AL) 23 November 2006 (2006-11-23) paragraphs [0031] - [0035]; figure 1a	1,3,6
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

4 May 2015

Date of mailing of the international search report

11/05/2015

Name and mailing address of the ISA/

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D'Souza, Jennifer

INTERNATIONAL SEARCH REPORT

International application No
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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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INTERNATIONAL SEARCH REPORT

Information on patent family members

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