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(54) **BODY PROTECTIVE CLOTHING**

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Description

[0001] The invention relates to a body protective clothing, comprising a hard shell for covering the body part to be protected and an impact protection arranged at the inside of the body protective clothing wherein the impact protection comprises an impact absorbing foam enclosed by an airtight casing and at least a valve arranged at the airtight casing.

[0002] Conventional body protective clothing, for example crash helmets for the head, consist of a hard outer shell and an impact absorbing layer at the inside, thus at the side closer to the respective body part to be protected, wherein the impact absorbing layer is mostly produced from polystyrene.

[0003] A drawback is that polystyrene is quite stiff and little impact absorbing whereby the force in case of a crash cannot be softly cushioned.

[0004] Rather, the crash energy is directly transmitted to the body part, for example in the case of a crash helmet, to the head, which may lead to more or less severe injuries, as for example craniocerebral traumas.

[0005] Further, a hard polystyrene inner shell is little comfortable but hard and inflexible so that it cannot adapt to the different shapes of the body parts to be protected in different humans.

[0006] For example, there are crash helmets only with few different sizes for outer or inner shell, respectively, thus an adaptation to the very varied head shapes in humans being possible only to a limited extent.

[0007] For this adaptation to the respective user, in helmets are mostly used systems which are size-adjustable by pull cords.

[0008] For improving the above mentioned drawbacks, helmets with inner air cushion are already described where, however, in practice has been proven that the air is displaced by the pressure in case of a crash only into other zones of the air cushion, the head thereby directly bumping onto the helmet's outer shell.

[0009] For the priority scope of crash damping, such an air cushion is thus not suited. A further drawback of such body protective clothing, in particular of such crash helmets with inner air cushion, is that a pump is necessary for filling the cushion. If such a pump is integrated in the helmet, as for example in EP 0 423 711, a complex construction of the helmet is necessary for this purpose. Furthermore, a pump represents a component at risk of failure and defect. Taking along an external pump is, however, equally laborious and not desired by the consumers.

[0010] EP 1 316 264, too, shows a helmet with an air cushion in the interior of the helmet wherein a pump is necessary for filling the cushion. But this invention again has the drawback that in case of a crash the air is pushed from the front side of the helmet backside and that thus the head is directly bumping onto the outer shell of the helmet.

[0011] Additionally, the air cushion is filled with air only

after putting on the helmet, whereby it is possible that an overpressure forms in the helmet whereby pressure points and following headache may develop.

[0012] US 5,890,232 as well as EP 0 393 238 A1 show a further helmet with an inflatable air bag with the same, just above described drawbacks.

[0013] In the last mentioned document the pump, for example, is integrated in the chin bar what involves a high constructive effort and is accompanied by an important risk of defect.

[0014] US 6,681,408 describes a helmet with an impact protection, which has an air and a foam cushion. Further, a valve is provided with which air can be introduced and let out and thus the air density in the cushion can be regulated. Again, in case of a crash the air in the cushion is displaced, the head thereby directly bumping onto the hard outer shell of the helmet.

[0015] Document US 4 023 213 A discloses a shock absorbing system comprising a plurality of flexible plastic compartments containing foam, which are interconnected by means of orifices for redistributing air between the compartments during an impact.

[0016] Document DE 35 30 396 A1 describes an impact protection pad provided with air chambers comprising outlet throttle apertures to let air escaping under the action of a locally bounded impact force.

[0017] Document US 3 849 801 A discloses a hydraulic energy absorbing liner for a protective gear, comprising an array of interconnected compressible walled compartments provided with porous inserts.

[0018] Scope of the invention is to provide a body protective clothing, in particular a helmet, where an impact protection is present which can in the best-possible mode absorb the crash energy as a result of an accident thereby significantly increasing the security of the user of such a body protective clothing and avoiding - in case of the version as helmet - the drawbacks of the above mentioned helmets.

[0019] Furthermore, the invention should increase the wearing comfort of conventional body protective clothing, particularly of conventional crash helmets.

[0020] This is obtained by a body protective clothing with the features of claim 1. Materials known per se are used for the hard shell which during use of the body protective clothing at least partially surrounds the body part to be protected and therefore serves for covering the body part to be protected and thus in case of a crash represents the first protective layer.

[0021] At the inside of these outer shell an impact protection is arranged, which therefore during the use of the body protective clothing is located between the body parts to be protected and the hard shell.

[0022] The impact protection can here be fixed to the hard shell, whereby the type of fixing is basically arbitrary and methods known in the prior art can be used.

[0023] Additionally, at the side of the impact protection facing the body part to be protected a textile layer can be arranged which produces a comfortable contact be-

tween the body protective clothing and the body part and hereby is also beneficial for the hygiene by being for example sweat absorbing and being designed as to be removable from the impact protection for cleaning.

[0024] The impact protection itself comprises an airtight casing and at least a valve arranged at this airtight casing.

[0025] Inside the airtight casing a foam is arranged which is especially configured for absorption of impacts. The foam can be constructed in variegated form for example multi-layered, it can be designed as gas permeable, open-pored, and more or less compact.

[0026] The shape of the foam is variable because the foam is soft and also partially elastic, the impact protection thereby can adapt and nestle to the body part to be protected so that in case of a crash the crash energy can be distributed relatively uniformly across the whole abutting body area.

[0027] Because of an accident and of a crash that goes along with it the impact protection is strongly and rapidly compressed building up an overpressure in the impact protection. In particular, the air present in the impact protection, which for example is located in the pores of the foam, is compressed.

[0028] In order to dissipate now the energy built up thereby in the impact protection and so to attenuate the crash, the valve arranged at the airtight casing is realized as a pressure relief valve and lets air escape thereby dissipating the crash energy. The crash is attenuated via this energy dissipation by the escaping air in addition to the impact absorption by the compression of the foam. In order to avoid a possible erroneous activation of the valve realized as a pressure relief valve, the valve is designed in such a way that it opens only from a certain inner pressure in the impact protection.

[0029] Further advantageous embodiments of the invention are defined in the dependent claims and are described in detail below.

[0030] In a preferred embodiment of the invention, it is foreseen that an inlet valve is further provided at the airtight casing for the inlet of air into the impact protection.

[0031] This valve can be foreseen separately from the valve realized as a pressure relief valve for the pressure reduction. However, it may be also provided that both valves are realized as a single, common valve with a function for pressure reduction in case of overpressure in the impact protection and with a function for the inlet of air, thus reducing the number of components.

[0032] If the respective user applies the body protective clothing according to the invention, for example puts it on - if the body protective clothing is realized as a crash helmet, the foam variable with respect to its shape and size can adapt to the respective user possibly producing an overpressure in the impact protection.

[0033] Contrary to the compression as a result of a crash or an accident this pressure built-up in case of putting on or applying the body protective clothing is much smaller and takes place more slowly.

[0034] To avoid pressure points during use, it may be provided that also this overpressure not developed by a crash is degraded by means of a valve. Hereby, this function can be implemented in the inlet valve, for example if this is formed as check valve.

[0035] However, it may also be provided that the valve present for the reduction of the overpressure formed as a result of a crash also reduces the small overpressure originating from the application of the body protective clothing. The pressure relief valve can here be realized in such a way that it can distinguish between a rapid compression and a slow compression and thus also opens if the small overpressure originating from the application of the body protective clothing appears.

[0036] However, it may also be provided that the inlet valve or the valve realized as a pressure relief valve is opened manually before and/or after the application or putting on of the body protective clothing, respectively, and that thereby the pressure formed by the adaptation of the impact protection to the body shape of the user is reduced. Thus, an as optimal as possible fit and a high wearing comfort of the body protective clothing can be obtained.

[0037] In this case thus, one of the above-mentioned valves is opened before and/or during donning slightly compressing the foam in the impact protection during donning and the foam thereby adapting to the body shape of the user.

[0038] The opened valve reduces the thereby developed overpressure.

[0039] If the fit of the body protective clothing is satisfying, the valve is closed again so that air can only escape via the valve realized as a pressure relief valve, when in case of a crash a certain pressure is reached or exceeded in the impact protection, respectively.

[0040] It may also be provided that the valve realized as a pressure relief valve responds additionally or alternatively to an increase in pressure and opens from a certain pressure increase rate.

[0041] Furthermore, it may be provided that the valve closes again from a certain pressure after the increased pressure has been reduced.

[0042] Particularly preferred is that the inlet valve is realized in such a way that it can absorb air because of a low pressure present in the impact protection. Thereby, it can be rendered possible that no pump is necessary to pump up the impact protection with air thereby strongly increasing the ease of use of the body protective clothing according to the invention.

[0043] Here it is advantageous that the inlet valve has to be opened manually to permit the suction procedure.

[0044] In a particularly preferred embodiment of the invention, the impact absorbing foam arranged in the impact protection is viscoelastic and has a shape memory function.

[0045] That means that the foam, after the impact protection during use of the body protective clothing has nestled to the body part to be protected and thereby has

at least partially assumed its external shape, forms back again by essentially reassuming again its original shape via expansion after use of the body protective clothing.

[0046] The impact protection thus has a restoring effect whereby restoring its original shape can take place, depending on the construction of the inlet valve, automatically or after manual operation.

[0047] Such foams are known per se in the prior art and are referred to as "memory foams" on the market and are used for example in latex mattresses.

[0048] The restoring effect of the foam according to the invention is advantageous also in case of a crash.

[0049] As outlined above, an overpressure is produced in the impact protection as a result of a crash which is degraded by the valve realized as a pressure relief valve via air outlet.

[0050] Thereby, the cushioning of the impact energy is supported additionally to the pressure reduction via air outlet by means of the compression of the viscoelastic foam in the impact protection.

[0051] After a crash, the foam in the impact protection is compressed. But the foam, because of its shape memory function, has the tendency to return into its original form whereby inside the airtight casing of the impact protection a low pressure develops which can automatically open the inlet valve and the foam can restore together with the airtight casing its original shape.

[0052] Nevertheless, it may also be provided that the inlet valve has to be operated manually to permit an air inlet. It is essentially that no pump is needed what strongly increases the ease to use of the body protective clothing according to the invention.

[0053] For this purpose, of course it is useful that the material of the airtight casing is flexible and variable in its shape thereby not standing in the way of a change of shape of the impact protection. This ensures that on the one hand different users can use the body protective clothing because the foam and therewith the impact protection can adapt to the respective user and no predetermined shape of the inside of the body protective clothing is present for all users. Thus, a particularly high and especially for a plurality of users equal wearing comfort is given.

[0054] The airtight casing of the impact protection itself, however, has to be little or not elastic, in particular not tensile and not tensionally elastic as otherwise in case of a crash an expansion bubble could form at the weakest point of the impact protection.

[0055] In addition, the function as impact protection is particularly well given as the foam fits by means of the adaptability as uniformly as possible around the body part to be protected and thereby can absorb much energy in case of a crash. In a particularly preferred embodiment of the invention this restoring and expansion of the foam is obtained letting in air via a valve arranged at the airtight casing of the impact protection.

[0056] During use of the body protective clothing, in particular if this is more or less strongly fixed to the user,

forces are acting on the impact protection, which have caused an adaptation of the impact protection to the outer body shape and a small compression of the foam.

[0057] If the user puts off the body protective clothing these forces are missing so that in the impact protection there is low pressure which absorbs air via the above described inlet valve wherein in a preferred embodiment of the invention for this purpose the inlet valve has to be opened, whereon air then is absorbed spontaneously into the impact protection.

[0058] A pump arranged in the helmet or a pump taken along externally is not necessary thereby increasing considerably the comfort of use and the absence of breakdowns of the body protective clothing according to the invention.

[0059] In one embodiment of the invention it is foreseen that the impact protection is not only formed by a single chamber enclosed by an airtight casing with the impact absorbing foam but has a plurality of chambers, several of these chambers being filled with the impact absorbing foam.

[0060] Particularly, in extensive body protective clothing, as in a helmet, it can thereby be permitted that the adaptation to the body part to be protected is even better possible and that in case of a crash single chambers selectively have an energy absorbing or energy dissipating effect, respectively.

[0061] Thereby it may be foreseen that several chambers are equipped with a valve for pressure reduction and/or an inlet valve, whereby again a single valve can exert both functions, thus autonomously having effect as impact protection. However, it may also be advantageous that several chambers are communicating with each other via an air conduit system thereby permitting that not each of the chambers filled with an impact absorbing foam has to include such valves and that the pressure can be directed across several chambers to the valve.

[0062] If the chambers are interconnected, it may be provided to arrange the inlet valve or the inlet valves and additionally or alternatively, the pressure relief valve or the pressure relief valves at the connections between the chambers, which are also part of the impact protection.

[0063] In a further embodiment of the invention it is foreseen that between the hard shell and the impact protection a further impact absorbing layer, preferably of polystyrene, is arranged.

[0064] Such polystyrene layers are the only impact-absorbing layer in conventional helmets. By means of the additional arrangement of such an impact absorbing layer the energy dissipation or the energy absorption, respectively, can be additionally increased in case of a crash. Since this additional impact absorbing layer is arranged between the impact protection according to the invention and the hard shell, the advantages of the impact protection, i.e. the adaptation to the respective user, are, however, not diminished.

[0065] In an advantageous embodiment of the invention it is provided that the impact absorbing foam is vis-

coelastic and consists, for example, of polyurethane, in particular of a polyurethane foam.

[0066] Furthermore, it may be provided that the hard shell also comprises synthetic material. Such cured synthetic materials can for example also comprise polyurethane.

[0067] However, it may also be provided to use elastomers or other thermoplastic synthetic materials because these are particularly easy to produce by means of injection molding. In general, however, all hard materials (for example, also metals like titanium or aluminum or wood) are useable as hard shells. Composite materials are possible, too. Advantageous are here materials, which have a sufficient hardness but a low weight.

[0068] In a particularly preferred embodiment of the invention, fixing means are provided at the body protective clothing for fixing the body protective clothing to the body.

[0069] These are fixing means known per se like for example, in case of a crash helmet, chin bars or further belt-like fixing systems. Belt systems are also useful for other body protective clothing. However, velcro closures or other strap-like fixing means may be provided.

[0070] It may also be advantageous that further external devices for adapting the fit to the body part to be protected are provided at or in the body protective clothing, respectively. These are also devices known per se in the prior art.

[0071] In a further advantageous embodiment of the invention, means for aeration are arranged in the body protective clothing. Thus, an air exchange between body and outside air is possible, what can induce a cooling.

[0072] This is particularly useful in extensive body protective clothing, like in a helmet, because a heat accumulation can develop due to the airtight impact protection what negatively affects the wearing comfort.

[0073] In the case of aeration means, these may be for example holes in the hard shell as well as holes in the impact protection, in particular between several of the impact protection chambers. In addition, channels are conceivable which direct the air to a certain area.

[0074] This is again particularly true for crash helmets where the airstream of the front side can be used for the aeration of the head. It may also be provided that the body protective clothing, in particular the impact protection, has openings for determined body parts. For example, a helmet according to the invention can have recesses for the ears.

[0075] Such a body protective clothing particularly concerns a crash helmet for the protection of the head, elbow protectors, knee protectors, wrist protectors and different protectors, like for example back protectors.

[0076] More details and benefits of the present invention are illustrated in more detail in the following by means of the figure description with reference to the drawings that show:

- in **FIG. 1**, a partially cut-away side view of a conven-

tional helmet of the prior art;

- in **FIG. 2**, a partially cut-away side view of a body protective clothing according to the invention realized as a helmet;
- in **FIG. 3**, a side view of a body protective clothing according to the invention realized as a helmet;
- in **FIG. 4**, a detailed view of the detail labeled with **A** of **FIG. 3**;
- in **FIG. 5**, a further detailed view of the body protective clothing according to the invention realized as a helmet;
- in **FIG. 6**, a partially cut-away view of an inlet valve for an impact protection according to the invention;
- in **FIG. 7**, a partially cut-away view of a valve realized as a pressure relief valve for an impact protection according to the invention;
- in **FIGS. 8a** and **8b** a cross-section and a side view of two embodiments of the impact protection with vent holes;
- in **FIGS. 9a** and **9b** a front view and a rear view of a body protective clothing according to the invention realized as a back protector; and
- in **FIGS. 10a** and **10b** a front view and a rear view of a body protective clothing according to the invention realized as a knee protection.

[0077] **FIG. 1** shows a partially cut-away side view of a conventional helmet **1** of the prior art. Here a hard shell **2** with a subjacent impact absorbing polystyrene layer **3** as a preventive measure against injuries in case of a crash with the head is provided. The only energy absorbing medium represents in this case the marginally shape variable polystyrene layer **3**.

[0078] Furthermore, a flexible ear member **5** with vent holes **12** and a chin bar **4** for fixing the helmet **1** is illustrated.

[0079] Apart from the drawback, that only the polystyrene layer **3** has an impact absorbing effect, it was found that also the wearing comfort of the conventional helmet **1** cannot be optimal, as - because of the only small number of different helmet sizes - mostly a gap **8** remains free behind the head, where the textile layer **11** arranged at the inside of the polystyrene layer **3** not abuts on the head. An often inadequate and cumbersome size adjustment is carried out by a pull cord system **6** with a regulation device **7**.

[0080] On the other hand, in **FIG. 2** in a partially cut-away side view of a body protective clothing according to the invention realized as a helmet **9** it can be seen how the impact protection **10** filled with partially elastic, particularly viscoelastic foam conforms oneself to the head shape so that the textile layer **11** arranged for hygiene and for wearing comfort fits all over the head.

[0081] Here again, a flexible earflap **5** with vent holes **12** as well as a chin bar **4** for fixing the helmet **9** is arranged. A pull cord system **6** with regulation device **7**, however, can be abandoned. The points in the foam of the impact protection **10** here represent pores of the

foam. In case of a compression of the foam, these pores are more or less closed, thus increasing the foam density and the pressure inside the impact protection 10.

[0082] FIG. 3 shows in a side view the helmet 9 according to the invention with hard shell 2 and flexible ear member 5.

[0083] In this case, the impact protection 10 arranged under the hard shell 2 consists of two chambers 13, 13' which are filled with partially elastic, in particular viscoelastic foam. The chambers 13, 13' are represented in hatched form. In addition, a connection 14 between the chambers 13, 13' which permits an air exchange between these chambers 13, 13' is illustrated. This connection 14 is also part of the impact protection 10.

[0084] In FIG. 4, the area labeled with A of FIG. 3 is shown in a detailed view. At this connection 14, an inlet valve is arranged. However, additionally it may be provided that this inlet valve 15 is arranged at the front chamber 13 or at the rear chamber 13', because an air exchange between the chambers 13 and 13' is rendered possible by the connection 14.

[0085] After use of the helmet 9 or after a crash, when the foam located in the chambers 13, 13' has been compressed and when, because of its tendency given by the shape memory function to return into its original shape, a low pressure emerges in the impact protection 10, i.e. in the chambers 13 and/or 13', a pressure compensation can take place by means of this inlet valve 15. This inlet valve 15 can be manually operated so that it is opened for example by means of finger pressure onto this inlet valve 15. However, it may also be provided that from a certain low pressure this valve 15 automatically opens and then, in case of pressure compensation, it automatically closes again. This inlet valve 15, however, can additionally also reduce a small overpressure in the impact protection 10 therefore letting escape air when the impact protection 10 adapts to the head shape by putting on the helmet and the foam in the impact protection 10 is somewhat compressed.

[0086] On the rear side of the helmet 9 not represented in FIG. 3, two valves 16, 16' realized as pressure relief valves are arranged between the chambers 13, 13'. However, it may also be provided that here too only one of these pressure relief valves is arranged on a connection between the chambers 13, 13'.

[0087] It is also possible that the inlet valve 15 itself is realized as a pressure relief valve 16, thus permitting both functions, the release of air as well as the inlet of air.

[0088] By means of the autonomous pressure release valves 16, 16' it is in any case guaranteed that a localized energy dissipation of the impact energy is possible, while in case of a crash on the front side only the front pressure release valve 16 opens or in case of a crash more in the rear area of the helmet 9 only the pressure relief valve 16' of the rear chamber 13' opens.

[0089] In case of a high impact energy, these pressure relief valves 16, 16' permit a further energy absorption or energy dissipation, respectively, in addition to the vis-

coelastic foam being compressed in the chambers 13, 13'.

[0090] The valves 16, 16' may be designed so that they open only from a certain overpressure which forms as a result of the compression of the foam in the chambers 13, 13'.

[0091] In case of a crash with only small energy, the impact absorption in this case merely takes place by means of the foam being compressed. However, it may also be provided that the pressure relief valves 16, 16' open already at a small overpressure so that in case of small impact energy the air exciting the valves 16, 16' is sufficient as impact absorption.

[0092] In FIG. 6 a partially cut-away representation of an embodiment of an inlet valve 15 is illustrated. This is a spring-loaded check valve, wherefore inside the housing 17 a spring 19 is arranged. The closure element 18 is closed in one direction by the spring 19, whereas it is released in the other direction by overcoming the spring force. Thus, the inlet valve 15 can be used for the compensation of the pressure in the chambers 13, 13', i.e. in the impact protection 10.

[0093] Apart from the air inlet function, this inlet valve 15 can also assume the pressure compensation function in case of the small overpressure emerging by the application, i.e. by putting on the body protective clothing, in the impact protection 10, while this adapts to the body shape. If, for example, the helmet 9 is put on, the volume available for the air is reduced and the pressure slightly increased.

[0094] To obtain an optimum wearing comfort, a pressure compensation is carried out via the inlet valve 15.

[0095] This functionality is similar to that of a bicycle valve. After having taken off again the helmet 9 or in general the body protective clothing, a low pressure has formed in the impact protection 10 because of the viscoelastic foam which can also be compensated by this inlet valve 15 automatically or after manual operation.

[0096] Precondition to the operation of this inlet valve 15, which is realized as a check valve, is a not or only slightly tensile, but flexible airtight casing of the impact protection 10.

[0097] In FIG. 7 a pressure relief valve 16 is illustrated which limits the maximum permissible pressure in the chambers 13, 13' of the impact protection. If the pressure in the impact protection 10 exceeds as a result of a compression of the foam by a crash a certain adjustable limit value, this pressure relief valve 16 permits the air outlet so that precisely this maximum pressure is protected against exceeding, thus realizing an overpressure protection.

[0098] In this embodiment the housing 20 comprises again a spring 23. The valve opening 22 realized as a needle valve is provided with a sealing 21.

[0099] In FIG. 8a a partially cut-away side view of a helmet 9 according to the invention is illustrated. Apart from the vent holes 12 in the flexible ear member 5 further vent holes 12' are arranged in the hard shell 2 and in the

impact protection. The impact protection itself again can comprise one or more chambers.

[0100] By means of these vent holes 12' it is possible to feed cooling air to the head so that the helmet 9 according to the invention, for example, is advantageously applicable also for sweat-inducing kinds of sport as cycling.

[0101] In FIG. 8b a further embodiment of the impact protection 10 according to the invention is illustrated. In addition to the vent holes 12' a further opening 24 is provided, serving for including the ears.

[0102] In FIG. 9a a rear view of a body protection clothing realized as a back protector 25 is illustrated. This back protector 25 comprises a hard shell which, in case of use, is arranged at the outside of the body, thus at the side facing away from the body. Two arm slings 26, 26' and an abdominal belt 27 serve for fixing to the user.

[0103] In FIG. 9b a front view of this back protector 25 is illustrated, wherein the impact protection 10 which, where appropriate, directly abuts with a textile strap 11 on the body, is illustrated in hatched form.

[0104] For reasons of clarity, no pressure relief valve 16 and no inlet valve 15 are illustrated.

[0105] In FIG. 10a a further embodiment of a body protective clothing according to the invention is illustrated. A knee protection 28 again has a hard shell 2 arranged at the outside and two fastening straps 29, 29'.

[0106] In FIG. 10b a rear view of the knee protection 28 is illustrated, where the impact protection 10 arranged in the inside is represented as hatched area. The fastening straps 29, 29' are preferably fixable by means of velcro closures. For reasons of clarity, no pressure relief valve 16 and no inlet valve 15 are represented.

[0107] It goes without saying that the body protective clothing according to the invention is not limited to the embodiments represented in the figures, nor shall be limited by them, but is defined by the following claims.

[0108] In particular, the body protective clothing according to the invention is not limited to special kinds of application. Thus, crash helmets according to the invention are conceivable as motorcycle helmets, ski helmets, bicycle helmets, climbing helmet, safety helmets for dangerous work, and the like.

[0109] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. Body protective clothing, comprising a hard shell for covering the body part to be protected and an impact protection (10) arranged at the inside of the body protective clothing, the impact protection (10) com-

prising an impact absorbing foam enclosed by an airtight casing and at least one valve (16, 16') arranged at the airtight casing and capable of letting air escaping from said airtight casing, **characterized by** the valve (16, 16') being realized as a pressure relief valve configured so as to open only from a certain overpressure in said impact protection (10) in such a way that the compression of the impact protection (10) caused as a result of a crash opens the valve (16, 16') for pressure reduction in the impact protection (10).

2. Body protective clothing according to claim 1), **characterized in that** an inlet valve (15) is arranged at the airtight casing.
3. Body protective clothing according to claim 1) or 2), **characterized by** the inlet valve (15) being realized in such a way that it absorbs air by means of a low pressure in the impact protection (10).
4. Body protective clothing according to one of the claims from 1) to 3), **characterized in that** the impact absorbing foam has a shape memory function realized in such a way that the impact protection (10) of the body protective clothing after use expands at least essentially to its original form.
5. Body protective clothing according to one of the claims from 1) to 4), **characterized in that** the inlet valve (15) and the valve (16, 16') for pressure reduction are realized as a single common valve.
6. Body protective clothing according to one of the claims from 1) to 5), **characterized in that** the impact protection (10) has several chambers (13, 13'), a plurality of these chambers (13, 13') being filled with the impact absorbing foam.
7. Body protective clothing according to claim 6), **characterized in that** at least a plurality of these chambers (13, 13'), preferably all of them, are interconnected with each other with an air conduit system (14).
8. Body protective clothing according to claim 6) or 7), **characterized in that** several of the chambers (13, 13') of the impact protection (10) have a valve (16, 16') for pressure reduction as a result of a compression of the relative chamber (13, 13') of the impact protection (10) and/or an inlet valve (15).
9. Body protective clothing according to one of the claims from 1) to 8), **characterized in that** a further impact absorbing layer (3), preferably of polystyrene, is arranged between the hard shell (2) and the impact protection (10).

10. Body protective clothing according to one of the claims from 1) to 9), **characterized in that** the impact absorbing foam consists of polyurethane.
11. Body protective clothing according to one of the claims from 1) to 10), **characterized in that** the hard shell (2) comprises synthetic material, preferably polyurethane or an elastomer, and/or titanium and/or aluminum.
12. Body protective clothing according to one of the claims from 1) to 11), **characterized in that** the hard shell (2) comprises glass fibers and/or carbon fibers.
13. Body protective clothing according to one of the claims from 1) to 12), **characterized in that** fixing means (4, 26, 26', 27, 29, 29') for fixing the body protective clothing, preferably to the body part to be protected, and/or a device (4, 6, 7, 26, 26', 27, 29, 29') for adapting the fit to the body part to be protected is or are arranged at the body protective clothing.
14. Body protective clothing according to one of the claims from 1) to 13), **characterized in that** means for aeration (12, 12', 24) are arranged in the body protective clothing.
15. Body protective clothing according to one of the claims from 1) to 14), **characterized in that** the body protective clothing is realized as a helmet (9).

Patentansprüche

1. Körperschutzbekleidung, eine Hartschale zur Bedeckung des zu schützenden Körperteils und einen innerhalb der Körperschutzbekleidung positionierten Aufprallschutz (10) umfassend, wobei der Aufprallschutz (10) einen aufprallabsorbierenden Schaum umfasst, der durch ein luftdichtes Gehäuse umschlossen ist, sowie wenigstens ein Ventil (16, 16'), das am luftdichten Gehäuse angebracht und in der Lage ist, Luft aus besagtem luftdichten Gehäuse entweichen zu lassen, **dadurch gekennzeichnet, dass** das Ventil (16, 16') als Druckbegrenzungsventil konzipiert ist, so dass es sich erst bei einem gewissen Überdruck innerhalb des besagten Aufprallschutzes (10) öffnet, und zwar derart, dass die durch einen Aufprall verursachte Kompression des Aufprallschutzes (10) das Ventil (16, 16') öffnet, um den Druck im Aufprallschutz (10) zu reduzieren.
2. Körperschutzbekleidung gemäß Patentanspruch 1), **dadurch gekennzeichnet, dass** sich am luftdichten Gehäuse ein Einlassventil (15) befindet.
3. Körperschutzbekleidung gemäß Patentanspruch 1) oder 2), **dadurch gekennzeichnet, dass** das Ein-

lassventil (15) derart beschaffen ist, dass es bei niedrigem Druck im Aufprallschutz (10) Luft aufnimmt.

4. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 3), **dadurch gekennzeichnet, dass** der aufprallabsorbierende Schaum ein derart beschaffenes Formgedächtnis besitzt, dass sich der Aufprallschutz (10) der Körperschutzbekleidung nach dem Gebrauch im Wesentlichen wenigstens bis in seine ursprüngliche Form ausdehnt.
5. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 4), **dadurch gekennzeichnet, dass** das Einlassventil (15) und das Ventil (16, 16') zur Druckbegrenzung als ein einziges, gemeinsames Ventil ausgelegt sind.
6. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 5), **dadurch gekennzeichnet, dass** der Aufprallschutz (10) mehrere Kammern (13, 13') aufweist, wobei eine Vielzahl dieser Kammern (13, 13') mit dem aufprallabsorbierenden Schaum gefüllt sind.
7. Körperschutzbekleidung gemäß Patentanspruch 6), **dadurch gekennzeichnet, dass** wenigstens eine Vielzahl der und vorzugsweise alle Kammern (13, 13') untereinander durch ein Luftleitungssystem (14) verbunden sind.
8. Körperschutzbekleidung gemäß Patentanspruch 6) oder 7), **dadurch gekennzeichnet, dass** mehrere der Kammern (13, 13') des Aufprallschutzes (10) ein Ventil (16, 16') zur Begrenzung des durch Kompression der entsprechenden Kammer (13, 13') des Aufprallschutzes (10) entstehenden Drucks und/oder ein Einlassventil (15) aufweisen.
9. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 8), **dadurch gekennzeichnet, dass** zwischen der Hartschale (2) und dem Aufprallschutz (10) eine weitere, aufprallabsorbierende Lage (3), vorzugsweise aus Polystyrol, positioniert ist.
10. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 9), **dadurch gekennzeichnet, dass** der aufprallabsorbierenden Schaum aus Polyurethan besteht.
11. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 10), **dadurch gekennzeichnet, dass** die Hartschale (2) Kunststoffmaterial, vorzugsweise Polyurethan oder einen Elastomer, und/oder Titan und/oder Aluminium umfasst.
12. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 11), **dadurch gekennzeichnet, dass** die Hartschale (2) Glas- und/oder Kohlen-

stofffasern umfasst.

13. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 12), **dadurch gekennzeichnet, dass** ein oder mehrere Befestigungsmittel (4, 26, 26', 27, 29, 29') zur Befestigung der Körperschutzbekleidung vorzugsweise am zu schützenden Körperteil und/oder eine Vorrichtung (4, 6, 7, 26, 26', 27, 29, 29') zur Anpassung der Passform an den zu schützenden Körperteil an der Körperschutzbekleidung angebracht ist oder sind.
14. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 13), **dadurch gekennzeichnet, dass** in der Körperschutzbekleidung Belüftungsmittel (12, 12', 24) angebracht sind.
15. Körperschutzbekleidung gemäß eines der Patentansprüche von 1) bis 14), **dadurch gekennzeichnet, dass** die Körperschutzbekleidung als Helm (9) ausgeführt ist.

Revendications

1. Vêtement de protection corporelle comprenant une coquille dure apte à couvrir la partie du corps à protéger et une protection contre l'impact (10) disposée à l'intérieur du vêtement de protection corporelle, la protection contre l'impact (10) comprenant une mousse absorbante contre l'impact renfermée par une enveloppe hermétique et au moins une soupape (16, 16') disposée sur l'enveloppe hermétique et en mesure de laisser sortir l'air de ladite enveloppe hermétique, **caractérisé en ce que** la soupape (16, 16') est réalisée comme une soupape de réduction de la pression configurée de manière à s'ouvrir seulement d'une certaine surpression dans ladite protection contre l'impact (10) de façon à ce que la compression de la protection contre l'impact (10) résultant d'un choc ouvre la soupape (16, 16') pour la réduction de la pression dans la protection contre l'impact (10).
2. Vêtement de protection corporelle selon la revendication 1), **caractérisé en ce qu'**une soupape d'entrée (15) est disposée sur l'enveloppe hermétique.
3. Vêtement de protection corporelle selon la revendication 1) ou 2), **caractérisé en ce que** la soupape d'entrée (15) est réalisée d'une manière telle à absorber l'air au moyen d'une basse pression dans la protection contre l'impact (10).
4. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 3), **caractérisé en ce que** la mousse absorbante d'impact présente une fonction de mémoire de forme réalisée de manière à ce que la protection contre l'impact (10) du

vêtement de protection corporelle après l'usage s'étende au moins essentiellement à sa forme d'origine.

5. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 4), **caractérisé en ce que** la soupape d'entrée (15) et la soupape (16, 16') pour la réduction de la pression sont réalisées en tant qu'une soupape commune unique.
6. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 5), **caractérisé en ce que** la protection contre l'impact (10) présente de différentes chambres (13, 13'), une pluralité desdites chambres (13, 13') étant remplies avec la mousse absorbante d'impact.
7. Vêtement de protection corporelle selon la revendication 6), **caractérisé en ce qu'**au moins une pluralité desdites chambres (13, 13'), préférablement toutes les chambres, sont reliées entre elles avec un système de conduits d'air (14).
8. Vêtement de protection corporelle selon la revendication 6) ou 7), **caractérisé en ce que** plusieurs chambres (13, 13') de la protection contre l'impact (10) présentent une soupape (16, 16') pour la réduction de la pression résultant d'une compression de la chambre correspondante (13, 13') de la protection contre l'impact (10) et/ou une soupape d'entrée (15).
9. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 8), **caractérisé en ce qu'**une ultérieure couche absorbante d'impact (3), préférablement de polystyrène, est disposée entre la coquille dure (2) et la protection contre l'impact (10).
10. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 9), **caractérisé en ce que** la mousse absorbante d'impact se compose de polyuréthane.
11. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 10), **caractérisé en ce que** la coquille dure (2) comprend du matériel synthétique, préférablement polyuréthane ou un élastomère, et/ou titane et/ou aluminium.
12. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 11), **caractérisé en ce que** la coquille dure (2) comprend des fibres de verre et/ou des fibres de carbone.
13. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 12), **caractérisé en ce que** un ou plusieurs moyens de fixation (4, 26, 26', 27, 29, 29') pour fixer le vêtement de pro-

tection corporelle, préférablement à la partie du corps à protéger, et/ou un dispositif (4, 6, 7, 26, 26', 27, 29, 29') pour adapter l'adhérence à la partie du corps à protéger est ou sont disposés sur le vêtement de protection corporelle.

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14. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 13), **caractérisé en ce que** des moyens d'aération (12, 12', 24) sont disposés dans le vêtement de protection corporelle.

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15. Vêtement de protection corporelle selon l'une quelconque des revendications de 1) à 14), **caractérisé en ce que** le vêtement de protection corporelle est réalisé comme un casque (9).

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Fig. 1

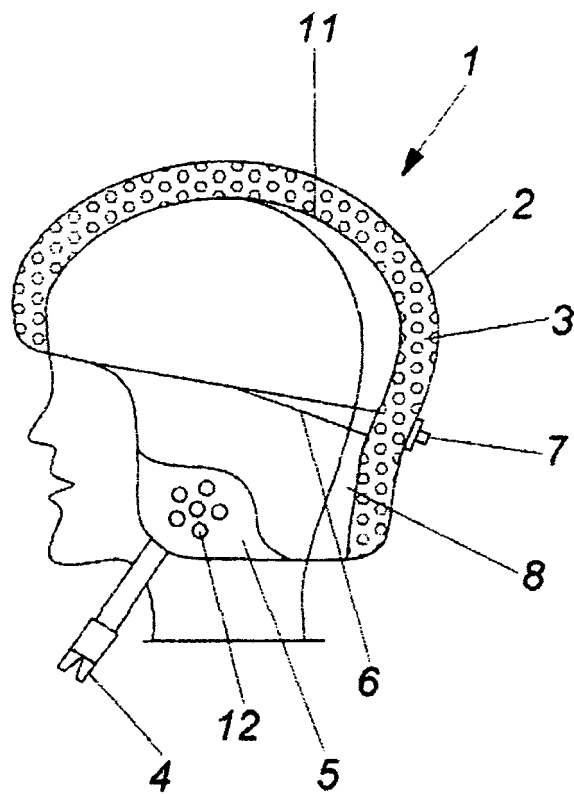


Fig. 2

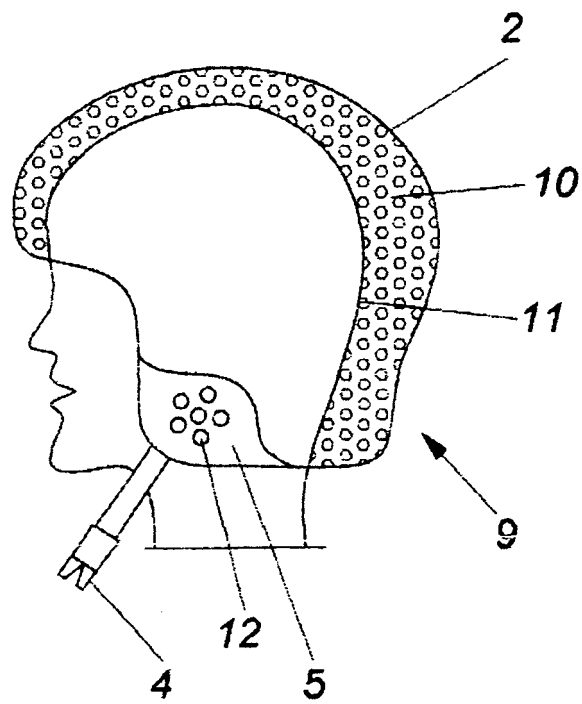


Fig. 3

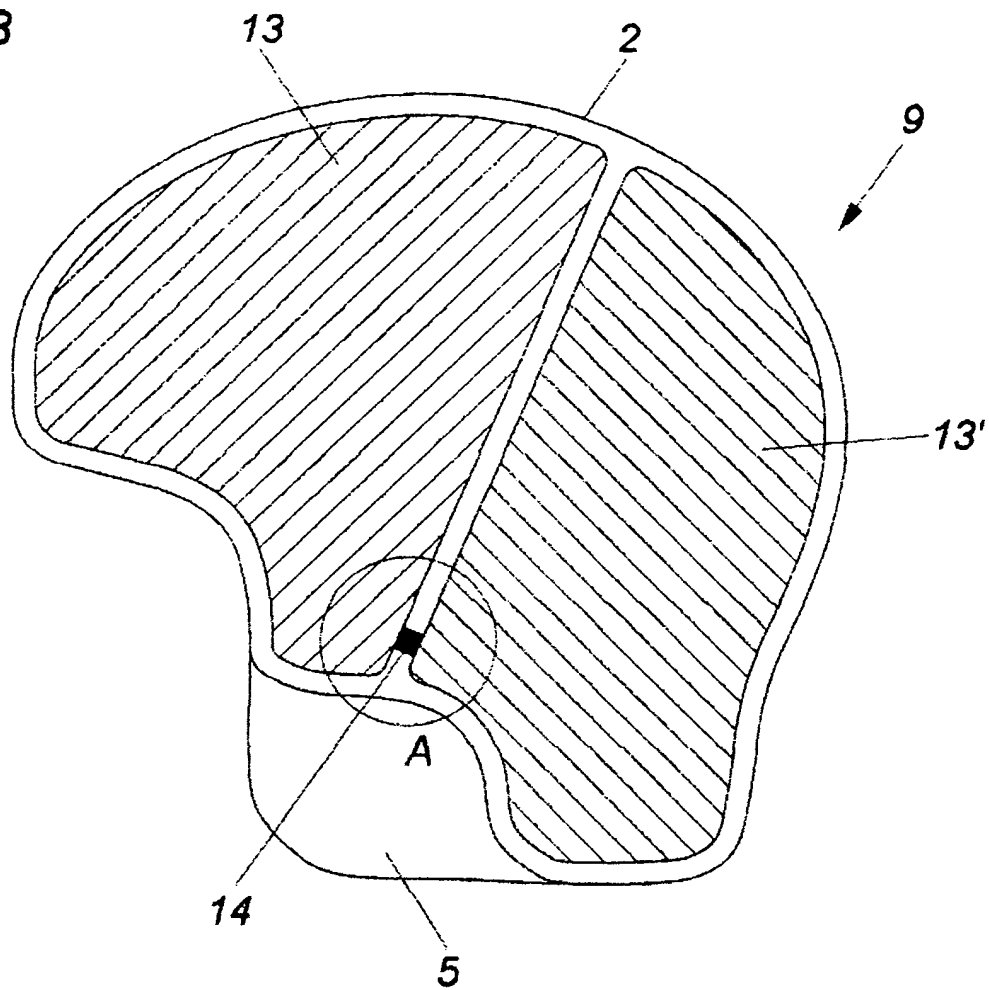


Fig. 4

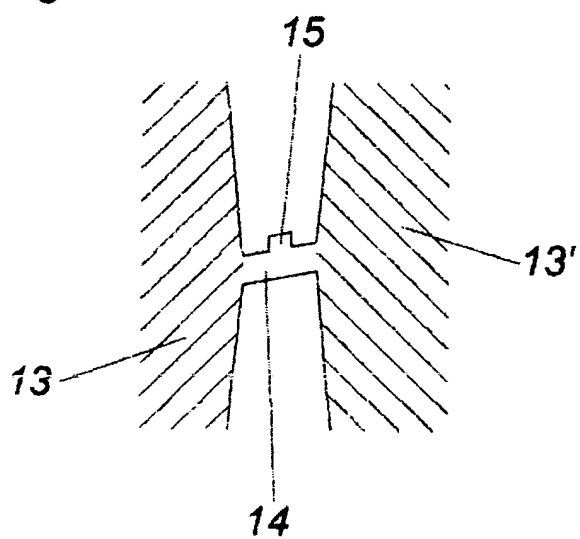


Fig. 5

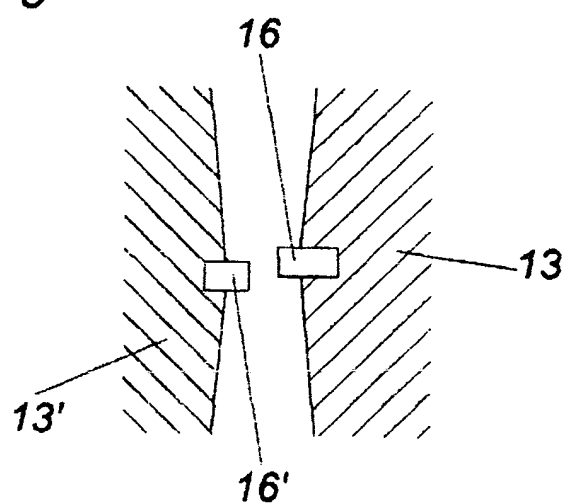


Fig. 6

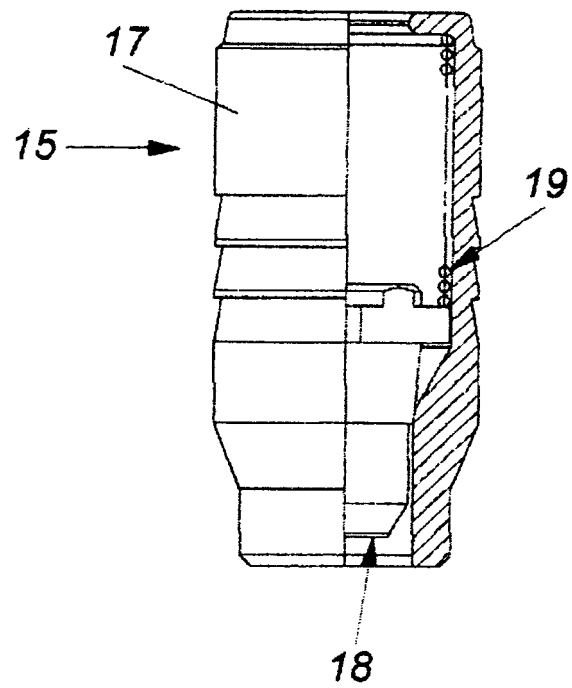


Fig. 7

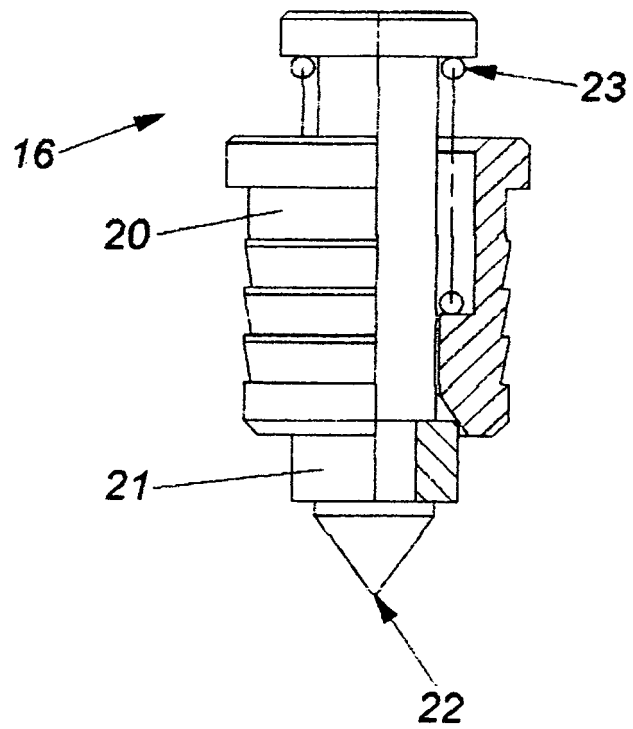


Fig. 8a

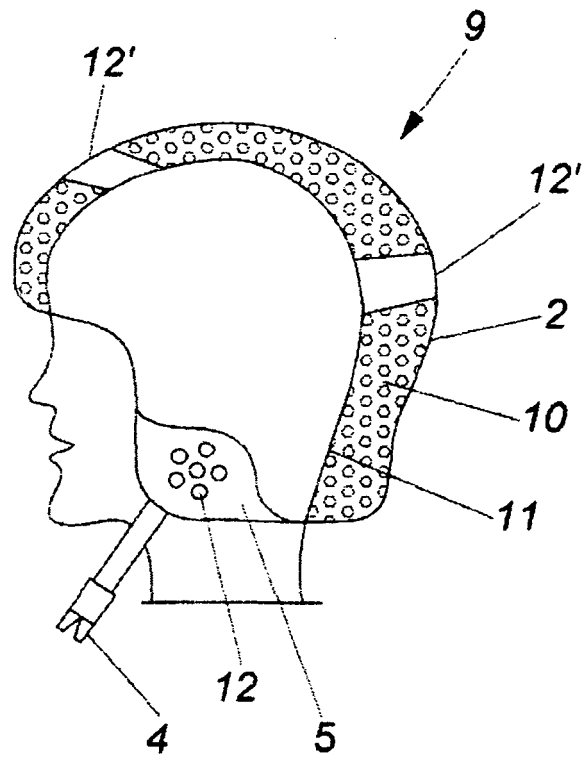


Fig. 8b

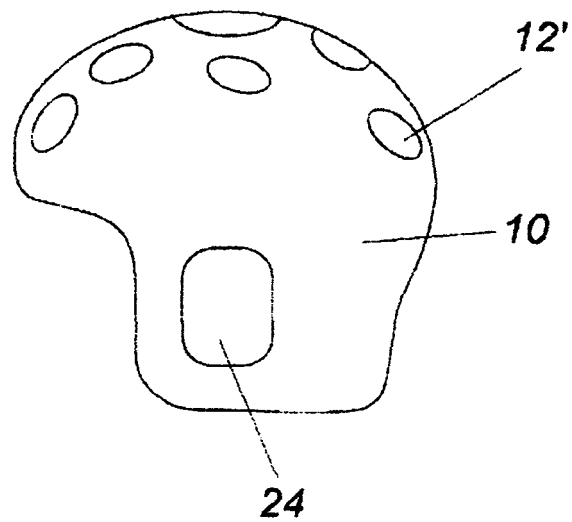


Fig. 9a

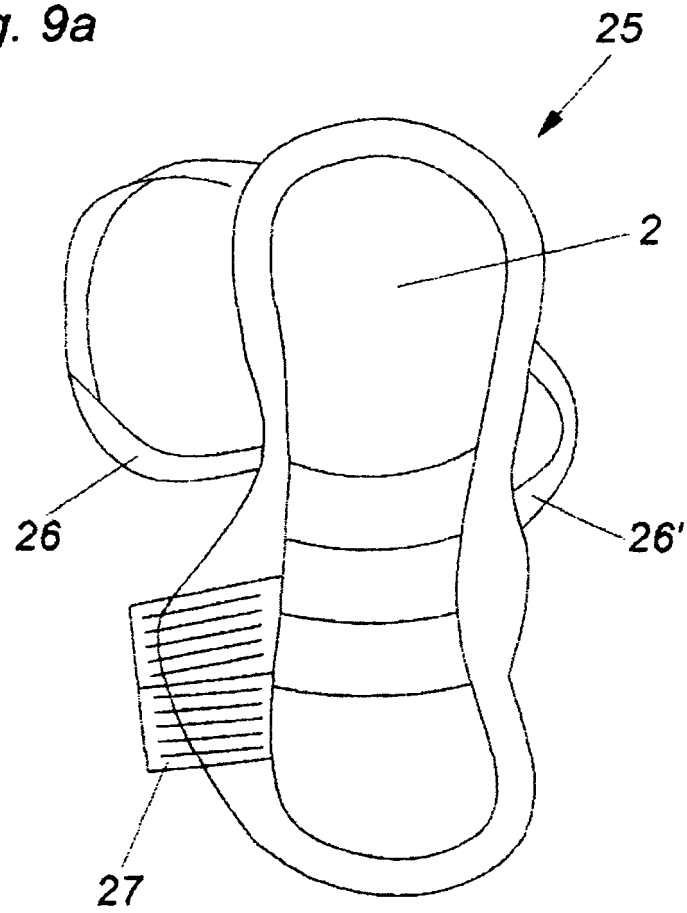


Fig. 9b

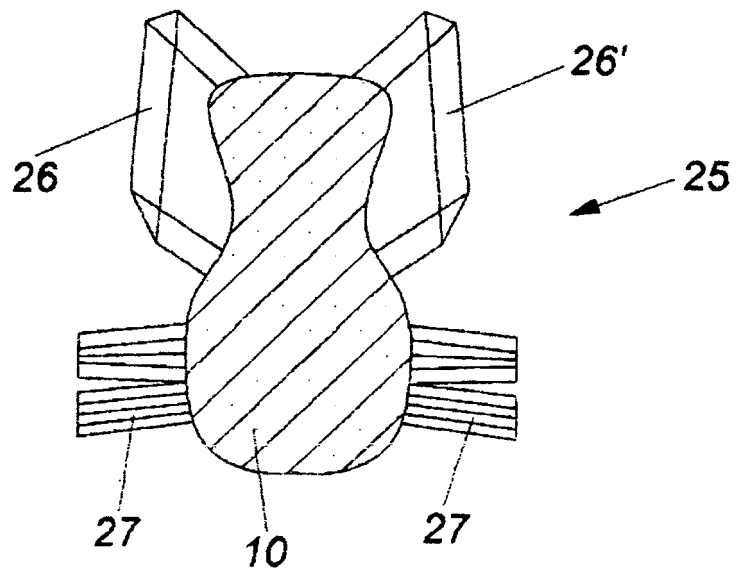


Fig. 10a

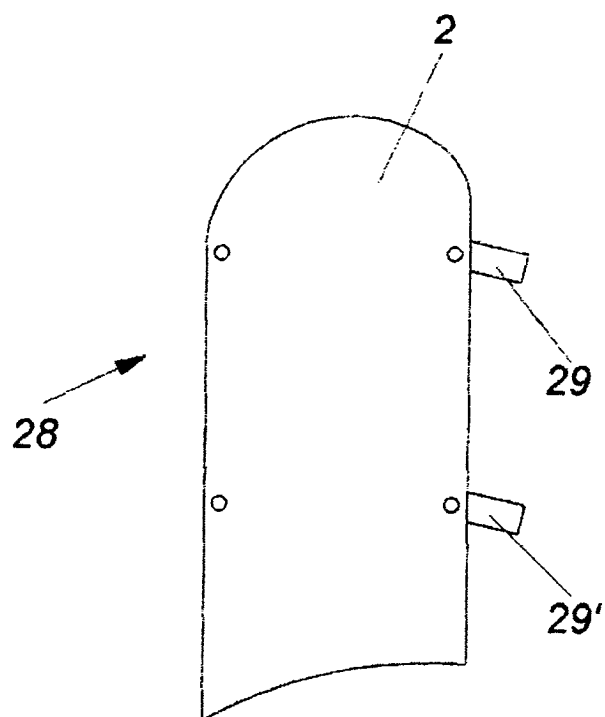
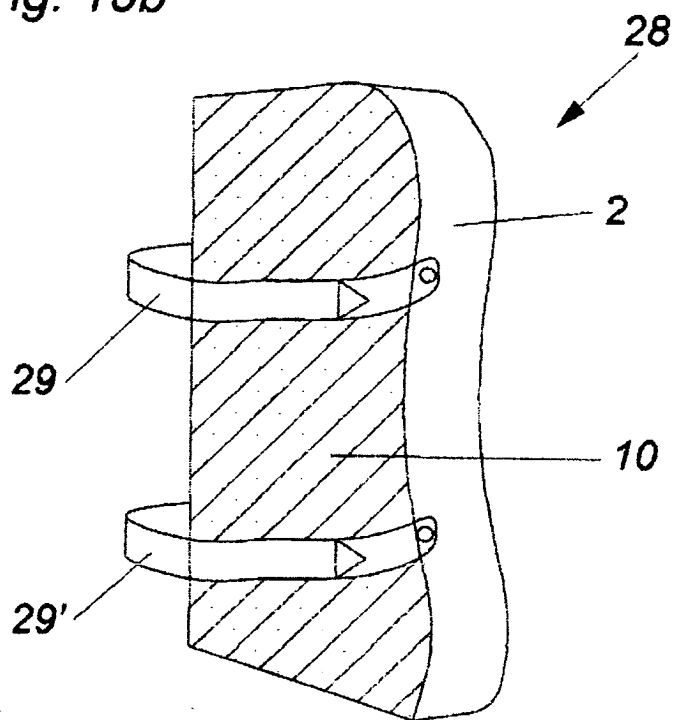


Fig. 10b



REFERENCES CITED IN THE DESCRIPTION

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