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(54) **Custom fitting assembly for helmet with protective hood**

Anpassbare Ausrüstung für Helm mit Schutzhaube

Equipement personnalisé pour casque muni d'une cagoule de protection

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Description

[0001] The invention relates to a custom fitting assembly for a helmet equipped with a protective hood. The system is particular suited for use with helmet mounted devices which support military air and ground operations.

[0002] In general, helmets are designed to meet requirements for comfort, stability, and head impact protection during flight, egress and ejection, and to fit an anthropometric range of heads. With the advent of helmet mounted devices (HMDs) an increased demand for optical stability was required to keep the HMD in the operator's field of view. This created various designs of inner liners and improved suspension systems to meet the comfort, stability and weight bearing requirements of the many HMDs.

[0003] Improvements in electro-optics technologies promised to transfer aircraft mounted head up displays and HMD imagery to the inner surface of the helmets visor or to other optical display combiner or device. With new Helmet Mounted Display (HMD) technologies comes a new and even tighter requirement for optical stability. Current helmets have been used to launch these new technologies with Little success. The weights and center of gravity of new HMD systems displace the helmet out of the "eyebow" thereby negating the HMD's operational effectiveness as well as causing aircrew fatigue, neck strain, and during ejection possible sever injury and death.

[0004] An example of a prior art design is described in US Patent 5,584,073, upon which the pre-characterising clause of claim 1 is based. That system comprises a helmet having a support frame with straps attached thereto by means of which the frame is adjustable, coupled to the helmet. A serious drawback with such platform is that to achieve a high level of stability, the suspension has to be tightened to the point of wearer discomfort. While the suspension system was tight it still swayed under "G" loading with HMD weights. Due to the narrow headband, the load bearing areas around the head created numerous areas of discomfort, known as "hot spots". Additionally, each HMD system requires exact and repeatable placement of the image in front of the wearer's eyes, which must be maintained during the entire mission and over many missions. Designers concluded that meeting such criteria with existing systems could not be practically achieved and would require an impractical number of helmet sizes to properly fit a large anthropometric head population.

[0005] Accordingly, it would be desirable to provide an inner helmet assembly in just a few sizes which could be easily custom-fitted to military personnel for use with various outer helmet systems for a variety of modern combat applications. Such an inner helmet would figuratively lock onto the wearer's head thereby insuring reproducible alignment of the "eyebow" to the eventual HMD.

[0006] According to the present invention there is provided a system for adjusting an enclosed support panel

comprising: a helmet having an interior, and a fitting adjustment system operationally coupling said support panel to the helmet said fitting adjustment system being operable to adjust to the relative position between said support panel and said helmet; characterised by a protective hood positioned inwardly of the interior of the helmet so, in use, to be located between said interior and the user, said support panel being disposed within said protective hood and said adjustment system coupling said support panel to said helmet through said hood.

[0007] More particularly, the present invention provides a helmet fitting assembly in one or two sizes with custom-fitted inserts that can be adapted to various helmets. The invention allows easy positioning of the helmet with positive locking devices. The preferred embodiments provide an insert which is molded or formed in situ to conform to a portion of the wearer's head. The preferred helmet is equipped with a hood that provides protection against chemical agents and biological agent, as may occur during chemical or biological warfare or industrial accidents.

[0008] These and other related features are provided by a semi-rigid suspension system of independent components which contacts the head over large surface areas. The system includes a custom-contoured component and positive lock components which cooperatively allow repeated engagement of the desired design eye position.

[0009] The preferred embodiment of the system revolves around an inner helmet comprising a front forehead dome and side sections. A semi-rigid rear panel engages the wearer's nape and has adjusting straps which extend generally forwardly to engage positive locking clips located on the inner helmet side sections. The inner helmet is positioned in the fore and aft directions by the rear panel adjusting straps. A contoured pad then supports the forehead dome on the user's forehead. The contoured pad includes an inner comfort layer, a primary layer which is custom fitted in situ, and an outer impact absorbing layer. Because the primary layer is essentially a mold of the wearer's forehead it always seats in the same position.

[0010] A semi-rigid crown pad has adjusting straps which extend generally downward to engage positive locking clips located on the inner helmet side panels. The inner helmet assembly is suspended from the crown pad via the straps which are adjusted to bring the inner helmet to the desired vertical position. The inner helmet is restricted from upward movement by a chin strap or breathing mask.

[0011] The components of the helmet fitting assembly are adjusted along the horizontal and vertical axes to position the wearer's eyes in the proper orientation and distance from the ultimate display. In use the helmet fitting assembly also resists forward rotation caused by the weight of the display systems located in front of the wearer's forehead within the helmet. Forward rotation is characterized by the forehead dome sliding down while the

rear portion of the helmet rides up. These forces are resisted by the brow pad which is molded to a particular part of the forehead, the nape panel, and by the chin strap or breathing mask which opposes any tendency of the rear part of the helmet to pivot away from the wearer's chin.

[0012] It can be seen that we have met the various objects of the invention by providing a custom molded insert which complements the positive lock components used for alignment. The semi-rigid crown pad and nape panel are strong, lightweight and conformable to individual sizes and shapes. All inserts are designed to distribute weight and stresses over large surface areas avoiding sensitive regions of the head. The inserts work in conjunction with the chin strap or breathing mask and nape strap to resist pivoting forces thereby locking the helmet in its desired position.

[0013] In order that the invention may be well understood, there will now be described an embodiment thereof, given by way of example, reference being made to the accompanying drawings, in which:

FIG. 1 is an exploded view of the preferred embodiment showing an outer helmet separated from an embodiment of an inner helmet which includes the fitting assembly according to the invention;

FIG. 2A is a cross-sectional view of the inner helmet taken along the line 2-2 from FIG. 1;

FIG. 2B is a cross-sectional view similar to FIG. 2A showing the protective hood according to the invention;

FIG. 3A is an enlarged view of the front brow pad taken from FIG. 2A;

FIG. 3B is a front side elevational view of the brow pad illustrating a foaming operation for custom fitting the brow pad to the wearer's forehead;

FIG. 3C is an enlarged view similar to FIG. 3A showing the protective hood in relation to the brow pad;

FIG. 4A is an enlarged view of the nape strap taken from FIG. 2A;

FIG. 4B is a front side elevational view of the nape strap;

FIG. 4C is an enlarged view similar to FIG. 4A showing the protective hood in relation to the pivotal connection of the support panels;

FIG. 5 is a top plan view of the crown pad taken along the line 5-5 from FIG. 2A;

FIG. 6A is a cross-sectional view of a retention clip engaging a strap taken along the line 6a-6a from FIG. 2; and

FIG. 6B is a further view cross-sectional view of the retention clip taken along the line 6B-6B from FIG. 6A.

[0014] Referring now in detail to drawings, and in particular FIG. 1, there is shown an outer helmet 10 separated from an inner helmet 20. Outer helmet 10 may, for example, be formed of ballistic material of any suitable

type known to the art to afford the wearer protection against injury from flying fragments and the like. Outer helmet 10 may consist of a basic protective helmet for infantry, a standard helmet for air crew provided with visors, or an advanced helmet for air crew provided with HMD technologies. Inner helmet 20 may be permanently attached within outer helmet 10, for example, by screws or adhesives. Alternatively inner helmet 20 may be clipped, latched or otherwise removably secured within outer helmet 10, for example by an interchangeable latch assembly described in a commonly-owned, copending patent US-A-6 292 953. Total weight for the inner helmet and an HMD equipped outer helmet is in the order of 2 kg (4 1/2 lbs).

[0015] Inner helmet 20 is a rigid frame made of a strong yet lightweight material, for example, graphite or fiberglass. Inner helmet 20 is characterized by a broad forehead dome 21, side sections 22a and 22b, a rear panel 25 and a crown aperture 26. Side section 22a includes a first pair of retention clips 23a and 23b and a second pair of retention clips 23c and 23d. A similar set of retention clips are mounted onto side panel 22b. A chin strap 19 extends between the lower portions of side panels 22a and 22b.

[0016] Referring now to FIG. 2A side panel 22b is shown with a first pair of side panel slots 24a and 24b disposed immediately rearwardly of the first pair of retention clips, and a second pair of side panel slots 24c and 24d disposed immediately above the second pair of retention clips. A crown pad 50, which will be described in greater detail below, includes adjusting straps that extend through slots 24c and 24d and into respective retention clips. These adjusting straps permit vertical positioning of inner helmet 20 relative to the crown of the wearer's head. A breathing mask may be attached to side panels 22a and 22b via adjustable length straps 27a. While not shown for the sake of clarity, the central portion of each side panel may comprise a depression for accommodating ear phones.

[0017] Adjacent the interior of forehead dome 21 is a brow pad 30 which will be discussed in greater detail below in connection with FIGS. 3A and 3B. A rear pad 25a of impact absorbing material is attached to the interior of rear panel 25. Interior of rear pad 25a is a nape panel 40 which will be discussed in greater detail in connection with FIGS. 4A and 4B. In use, the adjusting straps of nape panel 40 are employed to set the fore and aft position of inner helmet 20 with respect to the nape of the wearer's neck. Brow pad 30 is subsequently fitted to the contours of the wearer's forehead. Points within brow pad 30, nape panel 40 and chin strap 19 or breathing mask 27 form the apices of an imaginary triangle 28. Upon installation of brow pad 30, leg 28a of triangle 28 assumes a fixed length. When tightened, chin strap 19 or breathing mask 27 essentially fixes the distance of legs 28b and 28c. The significance of the fixed triangle geometry is as follows.

[0018] The straps of nape panel 40 and crown pad 50

may be adjusted to establish a particular exit pupil distance for an outer helmet mounted display (HMD). The position is retained by brow pad 30 which fills the entire space between forehead dome 21 and the wearer's forehead. An outer helmet mounted display typically adds significant weight to the front portion of the helmet. Such weight is evenly distributed across large surface areas via brow pad 30 and crown pad 50. The moment of this forwardly-mounted weight generally urges forehead dome 21 downwardly over the wearer's eyes. Since leg 28a is of a fixed length, such movement would require nape panel 40 to pivot counter-clockwise. However, since leg 28b is of fixed length the torque applied to nape panel 40 is resisted by chin strap 19.

[0019] FIG. 2B is another cross-sectional view showing a protective hood 70 that is completely integrated with the components of the custom fitting assembly. The hood forms a protective bubble around the head. With the introduction of chemically- and biologically-filtered breathing and ventilation air into the hood, aircrew can safely operate, and exit their vehicles, in hostile environments.

[0020] FIG. 2B illustrates the positioning of protective hood 70 with respect to the nape panel 40 and crown pad 50, both of which shall be generically referred to as support panels. Brow pad 30 is first fitted and then placed inside hood 70. Nape panel 40 and crown pad 50 are also placed inside hood 70 with their straps located outside hood 70. Hood 70 is sealed around the pivotal connection between the support panels and their straps, as will be described in further detail below. The straps are shown in dotted line indicating that in the view of FIG. 2B they are behind hood 70.

[0021] To seal across the open front of the helmet, there is provided a visor 74 having a visor periphery 74a. A visor duct 74b is disposed within periphery 74a and is fed ventilating air through the front or side of visor 74, for example, at a location 74c outside the hood. Below the visor is a respiration system 76 having the following conventional components: a stiff outer shell 76a; a rubber inner facepiece 76b; a breathing air supply hose 76c; an exhalation valve 76d; a microphone cable 76e; a drink tube 76f; and adjustable length straps 27a and 27b removably coupling outer shell 76a to helmet side sections 22a and 22b. The hood is layered between outer shell 76a and inner facepiece 76b. Components 76c, 76d, 76e and 76f pass through holes in the hood and are secured to inner facepiece 76b, effectively clamping the hood between facepiece 76b and outer shell 76a. Hose 76c and the tubular portion of valve 76d may be secured to facepiece 76b with threaded nuts 76g and 76h, for example. Any openings between the holes and the components are filled with an appropriate sealant.

[0022] A pair of earphones 78 are placed inside the hood, whereby the hood provides increased attenuation of external ambient noise allowing improved communication. The earphones have a communications cable 78a which passes through a hole in the hood. Any opening between the hole and cable 78a is filled with an appropriate

sealant. Further down, hood 70 has a lower edge 70a near which is attached a neck dam 70b. Optionally, a shoulder shroud 70c may be attached onto lower edge 70a. Neck dam 70b is an air barrier preventing exchange of air between the head cavity and the atmosphere or the lower portion of a flight suit or other garment. A dump valve 70d is located above neck dam 70b for releasing excess pressure from within the head cavity. Shroud 70c may be attached to the flight suit or other garment with a slide fastener or simply tucked inside. Hood 70 is made from a chemically resistant and biologically resistant material, like rubber or butyl rubber. The hood is molded to the contours of the interior of the helmet.

[0023] Referring now to FIGS. 3A and 3B, brow pad 30 is shown comprising an outer pouch 31 equipped with a closeable flap 31a. Pouch 31 is removably affixed to the inner surface of forehead dome 21, for example, by hook and loop fasteners or other suitable means. Pouch 31 is made from a material which has characteristics of durability and comfort when contacting the wearer's skin, e.g. leather or other suitable materials. Within the pouch there is an outer liner 32 made of an impact absorbing material, for example, polystyrene, which conforms to the interior of forehead dome 21. There is also an inner layer 34 made of compressible, comfort material, for example, foam rubber. Once nape panel 40 and crown pad 50 are adjusted to the proper exit pupil, the interior of pouch 31 is filled with a liquid foaming agent which expands and solidifies to conform to the contours of the wearer's forehead and the outer liner 32. As can be seen in FIG. 3B an expandable foam may be used wherein the foaming agent in liquid form 33 is injected or poured into the interior of pouch 31 and expands to fill the cavity. A minimally exothermic polyurethane foam having a relatively fast rise time may be used, for example, foams made from polyether polyol resin combine with pre-reacted diphenylmethane diisocyanate.

[0024] In FIG. 3C, protective hood 70 is shown between forehead dome 21 and brow pad 30. Brow pad 30 is first fitted, as described above, in the absence of hood 70. Brow pad 30 is then placed inside hood 70 and attached with a hook and loop fastener to the hood 70 instead of forehead dome 21.

[0025] In FIG. 4A, nape panel 40 is shown comprising a semi-rigid frame 41 made, for example, from a composite resin. Very thin, flexible composite resin layers are laminated together resulting in lightweight, yieldable panels. Interior of frame 41 is a comfort layer 42 made from a compressible material, for example, foam rubber. Further interior is a cover layer 43 made from a comfortable, durable material, for example, leather. Cover layer 43 holds comfort layer 42 in place by extending through apertures 44 or around the outer perimeter where its edges are adhered on the exterior side of frame 41. FIG. 4B shows apertures 44 along with straps 46a, 46b, 46c and 46d which are attached respectively to four quadrants of nape panel 40 via pivoting connection points 47a, 47b, 47c and 47d.

[0026] FIG. 4C shows the pivotal connection between the support panels and their straps in detail. A portion of comfort layer 42 is removed and a hole is formed in frame 41 to accommodate a threaded female post 80 which terminates at its left side in a retention plate 80a. Hood material 70 is fitted around post 80 with any openings being filled by an appropriate sealant. Strap 46 is pivotally connected to post 80 via screw 46e. Hence, the pivotal connections for both support panels are maintained with the hood material completely sealing the support panels therein. The benefit of this configuration is that the support panels, as well as the brow pad, serve to lift the hood material off the wearer's head providing greater comfort. This configuration also maintains the contact surfaces between the brow pad and the wearer as well as between the support panels and the wearer. Therefore, the wearer's head can be completely sealed against the environment while maintaining the reproducible alignment of the eyebox, which is critical for HMD systems.

[0027] Referring again to FIG. 2B, this lifting of the hood results in a gap 50c between webbing strips 50a and 50b of the support panel or a space 50d adjacent the support panel. A duct 90 having an exhaust vent 90a directed toward gap 50c or space 50d is provided. Duct 90 extends through a hole in the hood. Any spaces around the hole are filled with an appropriate sealant. Ventilating air is provided to duct 90 to cool the wearer's head.

[0028] As can be seen in FIG. 5 crown pad 50 has a similar construction to nape panel 40 including a semi-rigid frame 51, a comfort layer similar to 42 and a cover layer similar to 43. As can be seen from this top plan view, the cover layer has edges 53a and 53b which extend through apertures 54 before being adhered on the exterior surface of frame 51. Each of the quadrants 55a, 55b, 55c and 55d includes a strap 56a, 56b, 56c and 56d pivotally attached to frame 51 via screws 57a, 57b, 57c and 57d. The apertures create web-like strips in panel 40 and pad 50 that extend from the adjacent quadrants out to the strap connection points. This web-like configuration allows each quadrant to conform to the contours of the wearer's crown and nape as the straps bend to extend through the side panel slots in the inner helmet. In other words, the straps and the connection points of FIGS. 4B and 5 have a further independent degree of flexibility into and out of the page.

[0029] FIG. 6A shows an exemplary bendable, plastic strap extending initially through a side panel slot 24 formed within side panel 22a or 22b and further through clip frame 60 made of rugged plastic. Mounting screws 61 secure clip frame 60 to the exterior of side panel 22. Extending outwardly from clip frame 60 is a cantilevered retention arm 62 having a fixed end 62b and a free end 62c with downwardly extending wedges 62a therebetween. Locking element 63, as can be seen more clearly in FIG. 6B is slideably mounted to clip frame 60. Locking element 63 is slideable in direction 62d from a position adjacent rear stop 62e, over detent 62f, to a position ad-

jacent front stop 62g. Ordinarily the free end 62c of cantilevered retention arm 62 is free to rise upwardly as wedges 62a ratchet over corresponding wedges 58 on the strap. Once the final adjusted position is obtained, locking element 63 is slid to its left most locking position whereby the free end 62c is prohibited from riding upwardly to lock the strap in position. In a practical embodiment, wedges 58 on the strap and arm were spaced 2mm apart.

[0030] FIG. 2 shows a positioning fixture 29 with a reference point 29a. Positioning fixture 29 is dimensioned and configured to align reference point 29a on the exact line of sight of the ultimate display. The crown pad straps and nape panel straps are adjusted in 2mm increments to locate reference point 29a directly in front of the wearer's eyes at a predetermined distance. If a strap is inserted too far through clip 60, free end 62c is raised and the strap is retracted. Once aligned, locking elements 63 are moved to their locking positions over free ends 62c. While maintaining the aligned position on the wearer's head, brow pad 30 is filled with the appropriate amount of foaming agent. The resulting foam 33 expands to fill the gap and press the head firmly against nape panel 40. Brow pad 30 and nape panel 40 are generally diametrically opposed. Accordingly, the inner helmet may be easily donned and doffed while simultaneously reestablishing the exact eyebox alignment every time. Upon tightening chin strap 19, the inner helmet assembly becomes locked in position on the head. Centrifuge testing was performed with head movements up to 4G and forwardly-positioned stationery head positioning up to 9G. Overall the approximately 2 kg (4 1/2 lbs.) complete inner/outer helmet was displaced a maximum of 4mm with the average for 10 aircrew between 1.5 and 3mm.

[0031] It will be seen that we have provided a lightweight inner helmet with conformable panels and a complementary contoured pad that can be easily custom fitted to a large population. The helmet fitting assembly effectively distributes weight and resists displacement forces by locking the assembly to the head over large surface areas. The positive lock retention system and molded brow pad insure reproducible alignment to the eyebox thereby meeting critical requirements for HMD utilization.

[0032] It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims. It is further obvious that various changes may be made in details within the scope of the claims without departing from the invention as defined in the appended claims.

Claims

1. A system for adjusting an enclosed support panel comprising: a helmet having an interior; and a fitting

- adjustment system (46,56) operationally coupling said support panel (40,50) to the helmet (70), said fitting adjustment system (46,56) being operable to adjust the relative position between said support panel (40,50) and said helmet (70);
characterised by a protective hood (70) positioned inwardly of the interior of the helmet so, in use, to be located between said interior and the user, said support panel being disposed within said protective hood and said adjustment system coupling said support panel to said helmet through said hood (70).
2. A system according to claim 1, wherein said fitting adjustment system (46,56) is pivotably connected to said support panel (40,50) and wherein said protective hood (70) is sealed around the pivotal connection.
 3. A system according to claim 2, wherein said fitting adjustment system (46,56) comprises straps pivotally connected to said support panel (40,50) and strap retaining clips (23a,23b,23c,23d) mounted to said helmet.
 4. A system according to any of the preceding claims, wherein said support panel (40,50) comprises a nape panel (40).
 5. A system according to claim 4, wherein said fitting adjustment system (46,56) adjusts the front-to-back position of said nape panel (40) relative to said helmet.
 6. A system according to any of the preceding claims, further comprising a brow pad (30) disposed within said protective hood.
 7. A system according to claim 6, wherein said brow pad (30) comprises a primary layer (31) moulded to the contours of the wearer's forehead, said primary layer (31) comprising an expanding foam compound (33) having an initial liquid state and a final, cured solid state, said compound (33) being introduced to the initial liquid state into a gap formed between a forehead dome (21) of the helmet 20 and the wearer's forehead and wherein said compound expands to substantially occupy the gap in the final, cured solid state.
 8. A system according to claim 7, further comprising an inner layer (34) of compressible material disposed between said primary layer (31) and the wearer's forehead, said brow pad (30) further comprising an outer impact absorbing layer (32) disposed between said primary layer (31) and said dome (21), said inner (31) and outer (32) layers cooperatively forming a receptacle for containing said primary layer (21).
 9. A system according to claim 7 or claim 8, wherein said brow pad (30) further comprises a pouch made of a material adapted for skin contact, wherein said pouch encases said primary layer (31), said inner layer (34) and said outer layer (32).
 10. A system according to any of the preceding claims, wherein said support panel (40,50) comprises a crown panel (50).
 11. A system according to claim 10, wherein said fitting adjustment system (40,50) adjusts the height of said crown panel (50) relative to said helmet.
 12. A system according to claim 10 or claim 11, wherein said crown panel (50) comprises webbing strips with a gap formed therebetween.
 13. A system according to any of claims 10 to 12, further comprising a crown duct (90) equipped with an exhaust vent (90a) directed between the interior of the helmet (20), said hood (70) being sealed around said crown duct (90).
 14. A system according to any of claims 10 to 13, wherein said crown panel (50) creates a space, in use, between said protective hood (70) and a wearer's head.
 15. A system according to any of the preceding claims, wherein said helmet includes a visor (74) having an interior surface and a periphery (74a) and said protective hood (70) is sealed to said visor periphery (74a).
 16. A system according to claim 15, wherein said visor includes a visor duct (74b) along at least a portion of said visor periphery (74a), and wherein said visor duct (74b) is equipped with vent holes directed toward the interior surface of said visor (74).
 17. A system according to any of the preceding claims, further comprising a respiration system (76) including a stiff outer shell (76a) equipped with a breathing air supply hose (76c) and an exhalation valve (76d), wherein said outer shell (76a) overlies a portion of said protective hood (70).
 18. A system according to claim 17 when dependent on claim 2, wherein said outer shell (76a) overlies a portion of the hood (70) disposed below said visor (74), and wherein said protective hood (70) seals around said breathing air supply hose (76c) and said exhalation valve (76d).
 19. A system according to claim 17 or claim 18, wherein said respiration system (76) additionally includes an adjustable length strap (27a,27b) removably coupled between said outer shell (76a) and said helmet.

20. A system according to any of claims 17 to 19, wherein said outer shell (76a) is equipped with a microphone cable (76e), said protective hood (70) sealing around said microphone cable (76e); and/or said outer shell is equipped with a drink tube (76f), said protective hood sealing around said drink tube (76f); and/or said helmet (20) includes earphones (78) having communications cables (78a); wherein said earphones (78) are disposed within said hood and said hood (70) is sealed around said communications cables (78a).
21. A system according to any of claims 1 to 17, further comprising a respiration system (76) including a stiff outer shell (76a) and an inner facepiece (76b) adapted to enclose a mouth and nose of a wearer, wherein said stiff outer shell (76a) and said inner facepiece (76b) sandwich a portion of said protective hood (70) therebetween, said respiration system (76) including a breathing air supply hose (76c) and an exhalation valve (76d), wherein said protective hood (70) seals around said breathing air supply hose (76c) and said exhalation valve (76d).
22. A system according to any of the preceding claims, wherein said protective hood (70) has a lower edge (70a), and comprising an elastic neck dam (70b) connected near said lower edge (70a) of said protective hood (70), a shoulder shroud (70c) being connected to said lower edge (70a) of said protective hood (70).
23. A system according to any of the preceding claims, wherein said protective hood (70) is made from a chemical resistant and biological resistant material that is moulded to the shape of the helmet interior.

Revendications

1. Système de réglage d'un panneau de support intégré, comprenant : un casque ayant un intérieur ; et un système de réglage d'équipement (46, 56) couplant fonctionnellement ledit panneau de support (40, 50) au casque (70), ledit système de réglage d'équipement (46, 56) étant actionnable pour régler la position relative entre ledit panneau de support (40, 50) et ledit casque (70) ;
caractérisé en ce qu'une cagoule de protection (70) est positionnée en dedans de l'intérieur du casque de manière à être, à l'usage, positionné entre ledit intérieur et l'utilisateur, ledit panneau de support étant disposé à l'intérieur de ladite cagoule de protection et ledit système de réglage couplant ledit panneau de support audit casque à travers ladite cagoule (70).
2. Système selon la revendication 1, dans lequel ledit système de réglage d'équipement (46, 56) est relié

de manière pivotante au dit panneau de support (40, 50) et dans lequel ladite cagoule de protection (70) est scellée autour de ladite connexion pivotante.

3. Système selon la revendication 2, dans lequel ledit système de réglage d'équipement (46, 56) comprend des sangles reliées de manière pivotante audit panneau de support (40, 50) et des pinces de retenue de sangle (23a, 23b, 23c, 23d) montées sur ledit casque.
4. Système selon l'une quelconque des revendications précédentes, dans lequel ledit panneau de support (40, 50) comprend un panneau de nuque (40).
5. Système selon la revendication 4, dans lequel ledit système de réglage d'équipement (46, 56) règle la position d'avant en arrière dudit panneau de nuque (40) par rapport audit casque.
6. Système selon l'une quelconque des revendications précédentes, comprenant en outre un bourrelet sourcilier (30) disposé à l'intérieur de ladite cagoule de protection.
7. Système selon la revendication 6, dans lequel ledit bourrelet sourcilier (30) comprend une couche principale (31) moulée sur les contours du front de l'utilisateur, ladite couche principale (31) comprenant un mélange de mousse expansée (33) ayant un état liquide initial et un état solide final durci, ledit mélange (33) étant introduit à l'état liquide initial dans un écart formé entre une calotte frontale (21) du casque 20 et le front de l'utilisateur, et dans lequel ledit mélange se dilate pour combler sensiblement l'écart dans l'état solide final, durci.
8. Système selon la revendication 7, comprenant en outre une couche interne (34) de matériau comprimable disposée entre ladite couche principale (31) et le front de l'utilisateur, ledit bourrelet sourcilier (30) comprenant en outre une couche externe d'absorption des impacts (32), disposée entre ladite couche principale (31) et ladite calotte (21), ladite couche interne (31) et ladite couche externe (32) formant en coopération un réceptacle destiné à contenir ladite couche principale (21).
9. Système selon la revendication 7 ou 8, dans lequel ledit bourrelet sourcilier (30) comprend en outre une poche faite d'un matériau adapté au contact avec l'épiderme, dans lequel ladite poche enchâsse ladite couche principale (31), ladite couche interne (34) et ladite couche externe (32).
10. Système selon l'une quelconque des revendications précédentes, dans lequel ledit panneau de support (40, 50), comprend un panneau de sommet (50).

11. Système selon la revendication 10, dans lequel ledit système de réglage d'équipement (40, 50) règle la hauteur dudit panneau de sommet (50) par rapport au dit casque.
12. Système selon la revendication 10 ou 11, dans lequel ledit panneau de sommet (50) comprend des bandes formant sangle avec un écart formé entre celles-ci.
13. Système selon l'une quelconque des revendications 10 à 12, comprenant en outre un conduit de sommet (90) équipé d'un orifice d'évacuation (90a) dirigé entre l'intérieur du casque (20), ladite cagoule (70) étant scellée autour dudit conduit de sommet (90).
14. Système selon l'une quelconque des revendications 10 à 13, dans lequel ledit panneau de sommet (50) crée un espace, à l'usage, entre ladite cagoule de protection (70) et la tête d'un utilisateur.
15. Système selon l'une quelconque des revendications précédentes, dans lequel ledit casque comprend une visière (74) ayant une surface intérieure et une périphérie (74a) et ladite cagoule de protection (70) est scellée sur ladite périphérie de la visière (74a).
16. Système selon la revendication 15, dans lequel ladite visière comprend un conduit de visière (74b) le long d'au moins une partie de ladite périphérie de visière (74a), et dans lequel ledit conduit de visière (74b) est équipé d'orifices d'aération dirigés vers la surface intérieure de ladite visière (74).
17. Système selon l'une quelconque des revendications précédentes, comprenant en outre un système de respiration (76) comprenant une coquille externe rigide (76a) équipée d'un tuyau d'apport d'air respirable (76c) et d'une soupape d'exhalation (76d), dans lequel ladite coquille externe (76a) recouvre une partie de ladite cagoule de protection (70).
18. Système selon la revendication 17 en ce qu'elle dépend de la revendication 2, dans lequel ladite coquille externe (76a) recouvre une partie de la cagoule (70) disposée en dessous de ladite visière (74) et dans lequel ladite cagoule de protection (70) se scelle autour dudit tuyau d'arrivée d'air (76c) et ladite soupape d'exhalation (76d).
19. Système selon la revendication 17 ou 18, dans lequel ledit système de respiration (76) comprend de plus une sangle de longueur réglable (27a, 27b) couplée de manière amovible entre ladite coquille externe (76a) et ledit casque.
20. Système selon l'une quelconque des revendications 17 à 19, dans lequel ladite coquille externe (76a) est

équipée d'un câble de microphone (76e), ladite cagoule de protection (70) se scellant autour dudit câble de microphone (76e) ; et/ou dans lequel ladite coquille externe est équipée d'un tube d'ingurgitation (76f), ladite cagoule de protection se scellant autour dudit tube d'ingurgitation (76f) ; et/ou ledit casque (20) comprend des écouteurs (78) ayant des câbles de communications (78a), dans lequel lesdits écouteurs (78) sont disposés à l'intérieur de ladite cagoule et ladite cagoule (70) est scellée autour desdits câbles de communications (78a).

21. Système selon l'une quelconque des revendications 1 à 17, comprenant en outre un système de respiration (76) comprenant une coquille externe rigide (76a) et un masque interne (76b) adapté pour renfermer une bouche et un nez d'un utilisateur, dans lequel ladite coquille externe rigide (76a) et ledit masque interne (76b) prennent en sandwich une partie de ladite cagoule de protection (70) entre ceux-ci, ledit système de respiration (76) ayant un tuyau d'apport d'air respirable (76c) et une soupape d'exhalation (76d), dans lequel ladite cagoule de protection (70) se scelle autour dudit tuyau d'apport d'air respirable (76c) et de ladite soupape d'exhalation (76d).
22. Système selon l'une quelconque des revendications précédentes, dans lequel ladite cagoule de protection (70) a un bord inférieur (70a) et comprend un bouclier cervical élastique (70b) relié à proximité dudit bord inférieur (70a) de ladite cagoule de protection (70), un blindage d'épaule (70c) étant relié audit bord inférieur (70a) de ladite cagoule de protection (70).
23. Système selon l'une quelconque des revendications précédentes, dans lequel ladite cagoule de protection (70) est faite d'un matériau résistant aux agents chimiques et biologiques, qui est moulé sur la forme de l'intérieur du casque.

Patentansprüche

1. System zum Anpassen einer umschlossenen Stützplatte, umfassend: einen Helm mit einem Helmfutter und ein Anpasssystem (46, 56), das die Stützplatte (40, 50) betriebsfähig mit dem Helm (70) verbindet, wobei das Anpasssystem (46, 56) die relative Position zwischen der Stützplatte (40, 50) und dem Helm (70) anpasst; **gekennzeichnet durch** eine Schutzhaube (70), die von dem Helmfutter nach innen gerichtet angeordnet ist, so dass sie in Gebrauch zwischen dem Helmfutter und dem Benutzer angeordnet werden kann, wobei die Stützplatte innerhalb der Schutzhaube angeordnet ist und das Anpasssystem die Stützplatte **durch** die Haube (70) mit dem Helm

verbindet.

2. System nach Anspruch 1, wobei das Anpasssystem (46, 56) schwenkbar mit der Stützplatte (40, 50) verbunden ist und wobei die Schutzhaube (70) um die drehgelenkige Verbindung herum abgedichtet ist. 5
3. System nach Anspruch 2, wobei das Anpasssystem (46, 56) Riemen umfasst, die drehbar mit der Stützplatte (40, 50) verbunden sind, sowie Riemenhalteklammern (23a, 23b, 23c, 23d), die an dem Helm befestigt sind. 10
4. System nach einem der vorangegangenen Ansprüche, wobei die Stützplatte (40, 50) eine Nackenplatte (40) umfasst. 15
5. System nach Anspruch 4, wobei das Anpasssystem (46, 56) die Tiefenposition der Nackenplatte (40) in Bezug auf den Helm anpasst. 20
6. System nach einem der vorangegangenen Ansprüche, weiterhin umfassend eine Stirnplatte (30), die in der Schutzhaube angeordnet ist. 25
7. System nach Anspruch 6, wobei die Stirnplatte (30) eine Hauptschicht (31) umfasst, die auf die Kontur der Stirn des Trägers geformt ist, wobei die Hauptschicht (31) eine Quellschaumverbindung (33) umfasst, die einen flüssigen Anfangszustand und einen ausgehärteten, festen Endzustand aufweist, wobei die Verbindung (33) in dem flüssigen Anfangszustand in einen Spalt eingeführt wird, der zwischen der Stimkuppel (21) des Helmes 20 und der Stirn des Trägers ausgebildet wird, und wobei sich die Verbindung ausdehnt, um im Wesentlichen den Spalt in dem ausgehärteten, festen Endzustand auszufüllen. 30 35
8. System nach Anspruch 7, das weiterhin eine innere Schicht (34) von zusammendrückbarem Material umfasst, die zwischen der Hauptschicht (31) und der Stirn des Trägers angeordnet ist, wobei die Stirnplatte (30) weiterhin eine äußere Stoßdämpfungsschicht (32) umfasst, die zwischen der Hauptschicht (31) und der Kuppel (21) angeordnet ist, wobei die innere Schicht (31) und die äußere Schicht (32) zusammenwirkend eine Aufnahme für die Hauptschicht (21) ausbilden. 40 45
9. System nach Anspruch 7 oder Anspruch 8, wobei die Stirnplatte (30) weiterhin eine Tasche aus für Hautkontakt angepasstem Material umfasst, wobei die Tasche die Hauptschicht (31), die innere Schicht (31) und die äußere Schicht (32) umhüllt. 50 55
10. System nach einem der vorangegangenen Ansprüche, wobei die Stützplatte (40, 50) eine Kronenplatte

(50) umfasst.

11. System nach Anspruch 10, wobei das Anpasssystem (40, 50) die Höhe der Kronenplatte (50) in Bezug auf den Helm einstellt.
12. System nach Anspruch 10 oder Anspruch 11, wobei die Kronenplatte (50) Streifen aus Gurtbandgewebe mit einem dazwischen ausgebildeten Spalt umfasst.
13. System nach einem der Ansprüche 10 bis 12, weiterhin umfassend einen Kopfkanal (90), der mit einer Entlüftungsöffnung (90a), die in dem Helmfutter des Helmes (20) angeordnet ist, ausgerüstet ist, wobei die Haube (70) um den Kopfkanal (90) herum abgedichtet ist.
14. System nach einem der Ansprüche 10 bis 13, wobei die Kronenplatte (50) in Gebrauch einen Raum zwischen der Schutzhaube (70) und dem Kopf des Trägers erzeugt.
15. System nach einem der vorangegangenen Ansprüche, wobei der Helm ein Helmvisier (74) umfasst, der eine Innenfläche und einen Umfang (74a) umfasst, und wobei die Schutzhaube (70) gegen den Umfang (74a) des Helmvisiers abgedichtet ist
16. System nach Anspruch 15, wobei das Helmvisier einen Visierkanal (74b) entlang wenigstens eines Abschnittes des Umfanges (74a) des Helmvisiers umfasst und wobei der Visierkanal (74b) mit Entlüftungsöffnungen versehen ist, die zu der Innenfläche des Helmvisiers (74) hin ausgerichtet sind.
17. System nach einem der vorangegangenen Ansprüche, weiterhin umfassend ein Atmungssystem (76), das eine steife äußere Hülle (76a) umfasst, die mit einem Atmungsluft-Zuführschlauch (76c) ausgerüstet ist, sowie ein Ausatmungsventil (76d), wobei die äußere Hülle (76a) einen Abschnitt der Schutzhaube (70) überlagert.
18. System nach Anspruch 17, wenn abhängig von Anspruch 2, wobei die äußere Hülle (76a) einen Abschnitt der Haube (70), angeordnet unterhalb des Helmvisiers (74), überlagert und wobei die Schutzhaube (70) um den Atmungsluft-Zuführschlauch (76c) und das Ausatmungsventil (76d) herum abgedichtet.
19. System nach Anspruch 17 oder Anspruch 18, wobei das Atmungssystem (76) zusätzlich einen in der Länge verstellbaren Riemen (27a, 27b) umfasst, der abnehmbar zwischen der äußeren Hülle (76a) und dem Helm verbunden ist.
20. System nach einem der Ansprüche 17 bis 19, wobei

die äußere Hülle (76a) mit einem Mikrofonkabel (76e) ausgerüstet ist, wobei die Schutzhaube (70) um das Mikrofonkabel (76e) herum abdichtet; und/oder wobei die äußere Hülle mit einem Trinkrohr (76f) ausgerüstet ist, wobei die Schutzhaube um das Trinkrohr (76f) herum abdichtet; und/oder wobei der Helm (20) Ohrhörer (78) umfasst, die Kommunikationskabel (78a) aufweisen, wobei die Ohrhörer (78) in der Schutzhaube angeordnet sind und die Schutzhaube (70) um die Kommunikationskabel (78a) herum abgedichtet ist.

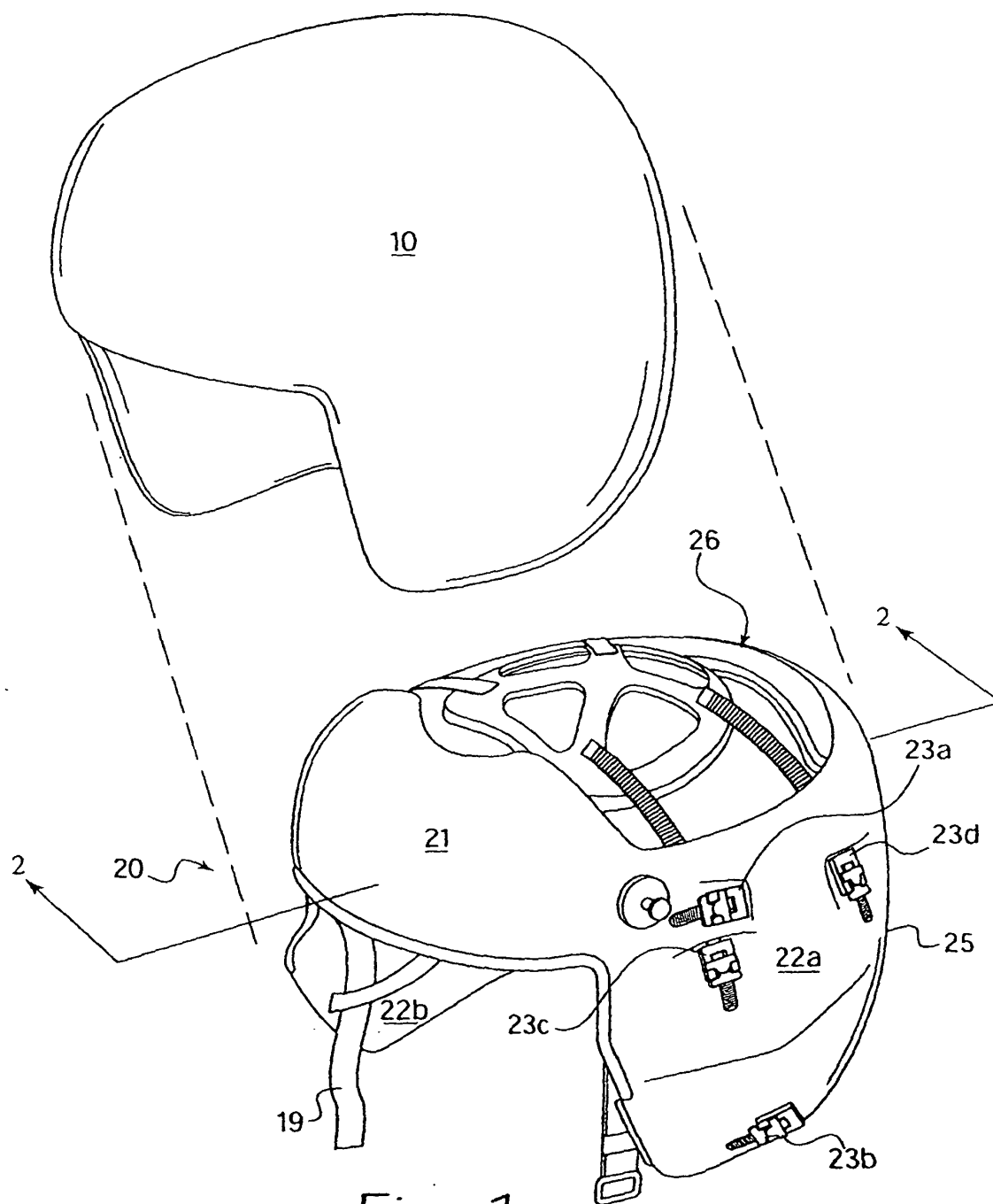
- 21.** System nach einem der Ansprüche 1 bis 17, weiterhin umfassend ein Atmungssystem (76) mit einer steifen äußeren Hülle (76a) und ein inneres Gesichtsteil (76b), das angepasst ist, um den Mund und die Nase des Trägers zu umschließen, wobei die steife äußere Hülle (76a) und das innere Gesichtsteil (76b) zwischen sich einen Abschnitt der Schutzhaube (70) einschließen, wobei das Atmungssystem (76) einen Atmungsluft-Zuführschlauch (76c) und ein Ausatemungsventil (76d) umfasst, wobei die Schutzhaube (70) um den Atmungsluft-Zuführschlauch (76c) und das Ausatemungsventil (76d) herum abdichtet.
- 22.** System nach einem der vorangegangenen Ansprüche, wobei die Schutzhaube (70) einen unteren Rand (70a) aufweist und ein elastisches Nackenkissen (70b) umfasst, das nahe dem unteren Rand (70a) der Schutzhaube (70) verbunden ist.
- 23.** System nach einem der vorangegangenen Ansprüche, wobei die Schutzhaube (70) aus einem chemikalienbeständigen und biologisch beständigen Material besteht, das auf die Form des Helmfutters ausgeformt ist.

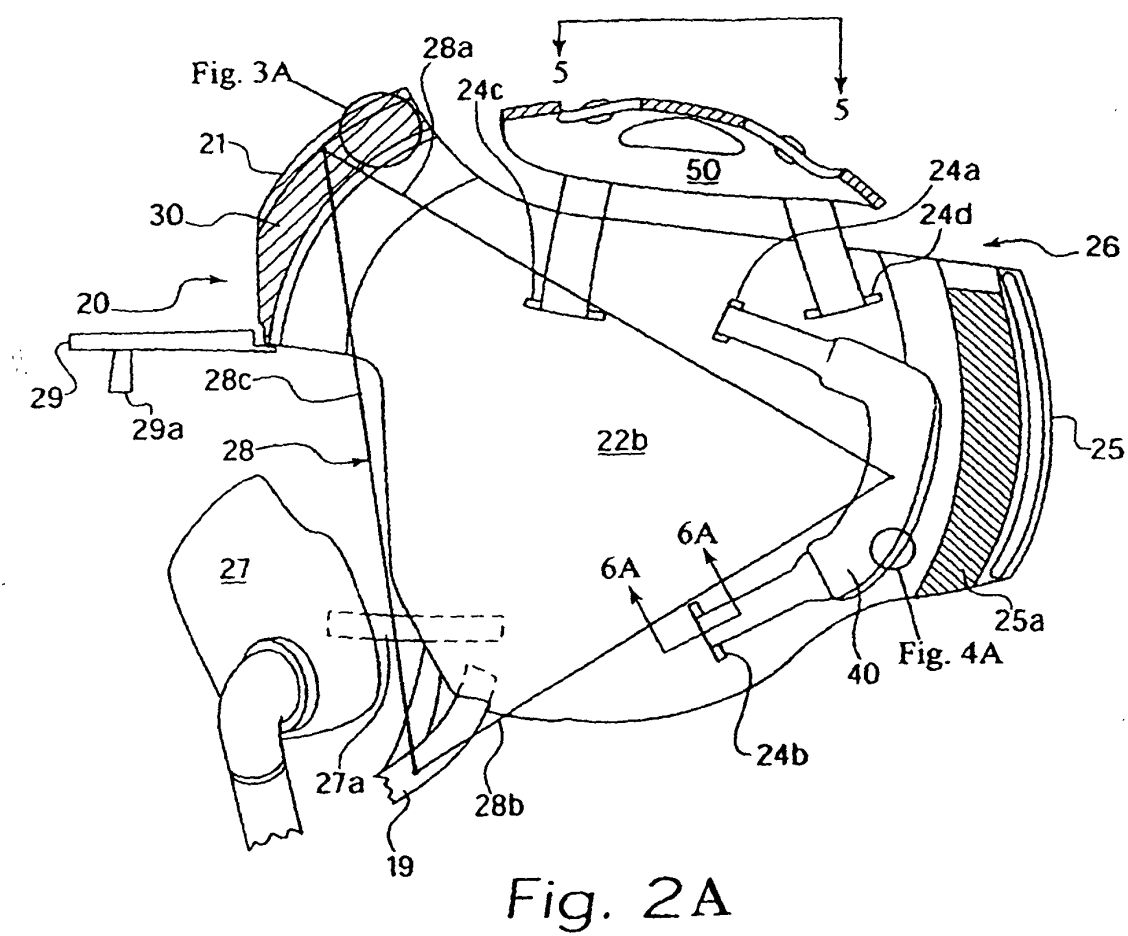
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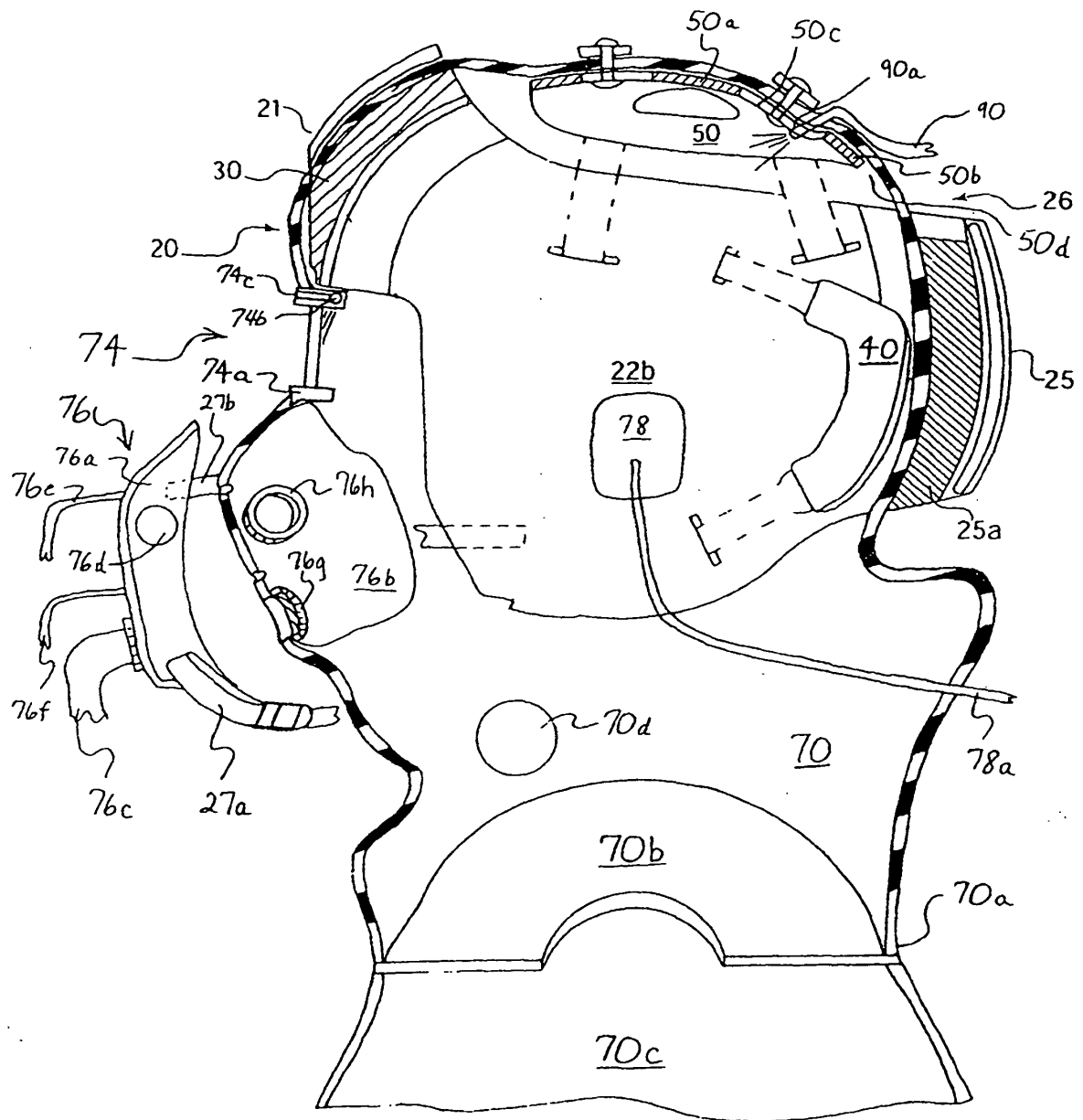


Fig. 2B

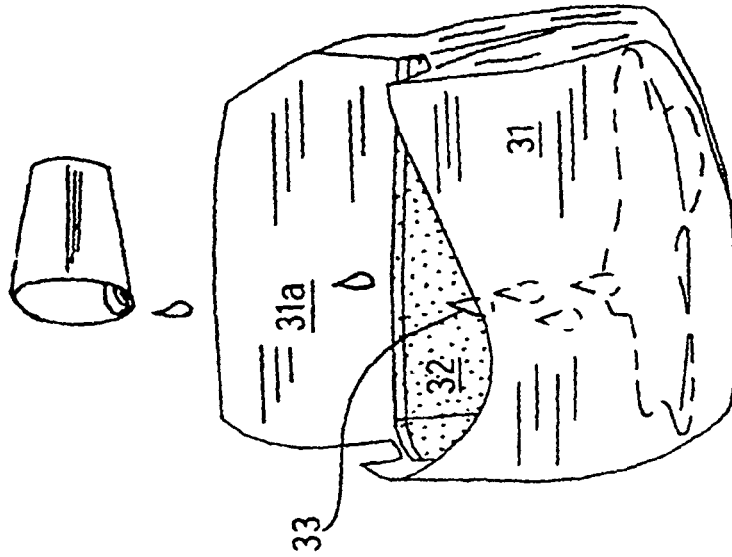


Fig. 3B

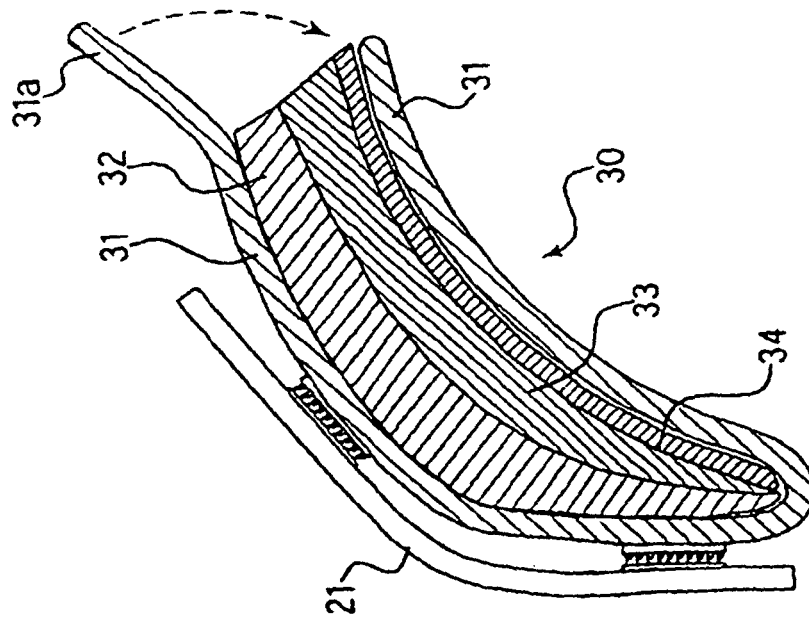


Fig. 3A

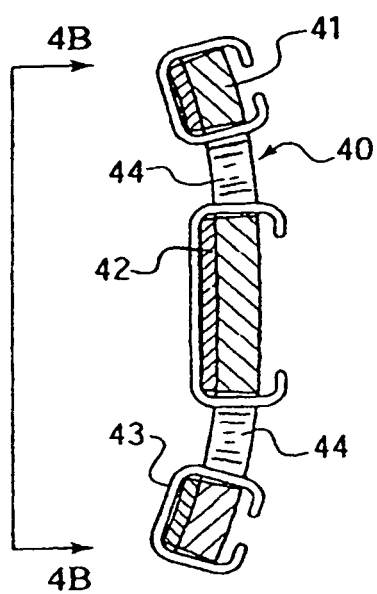


Fig. 4A

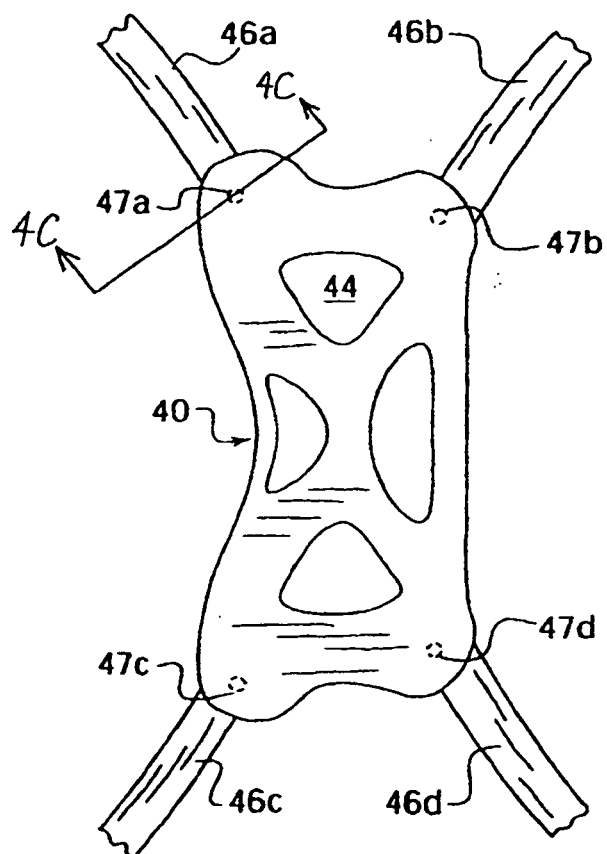


Fig. 4B

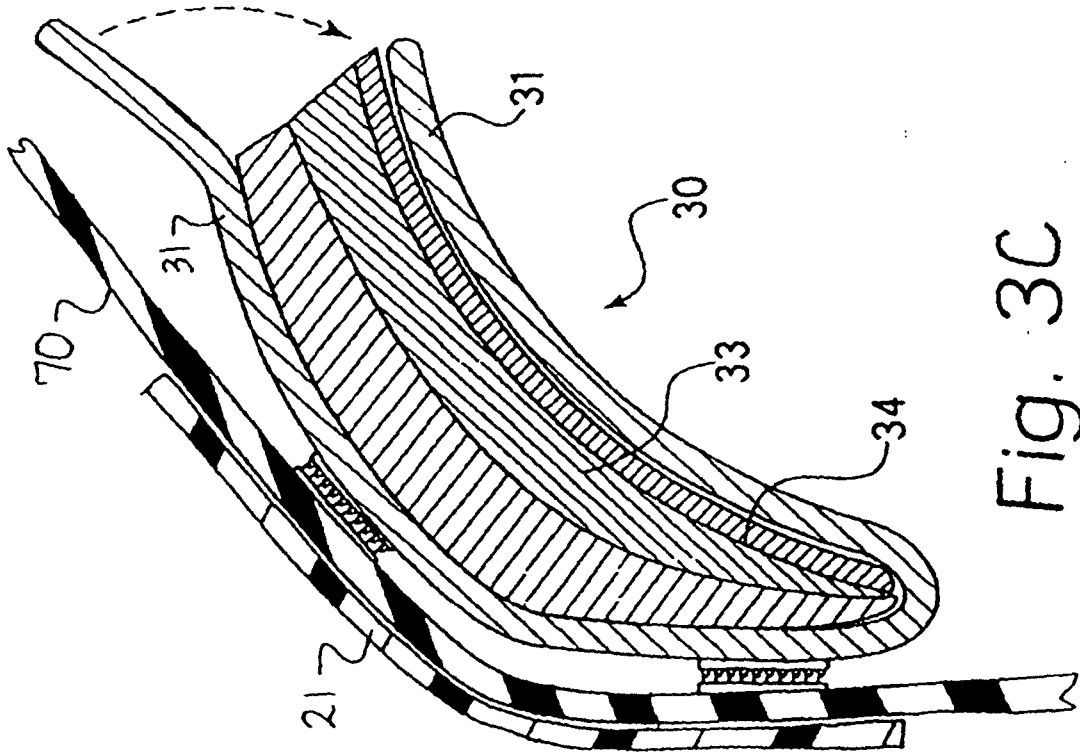


Fig. 3C

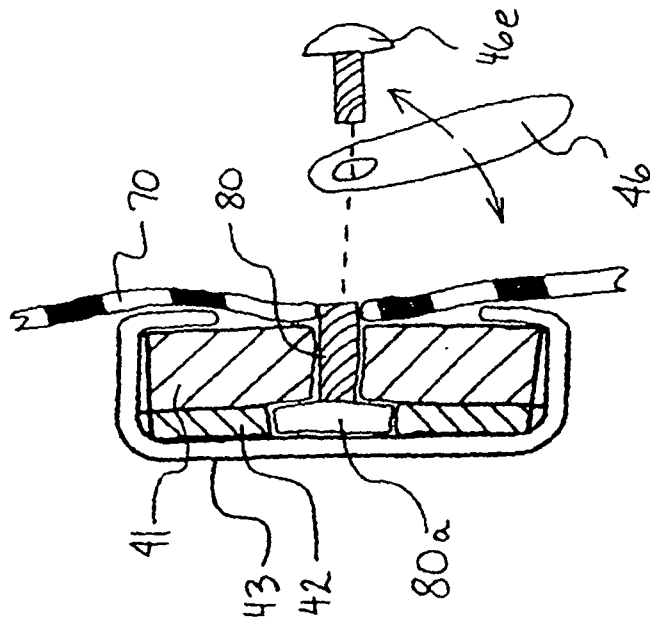


Fig. 4C

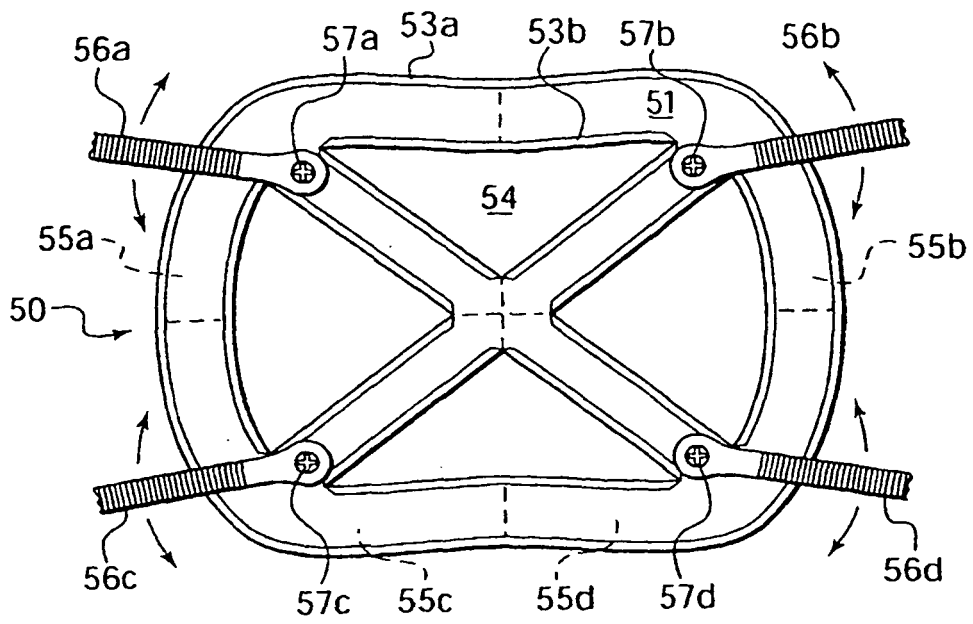


Fig. 5

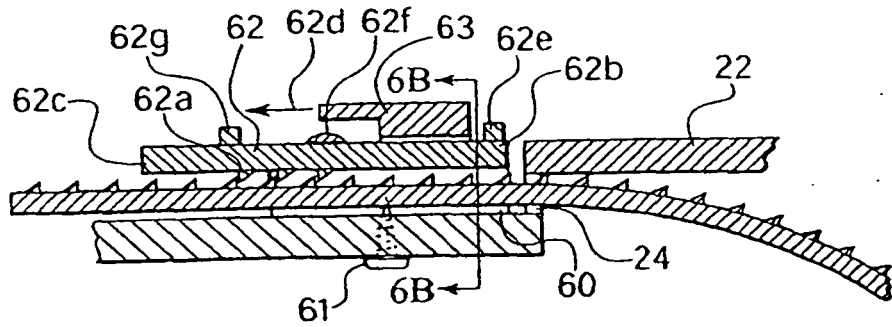


Fig. 6A

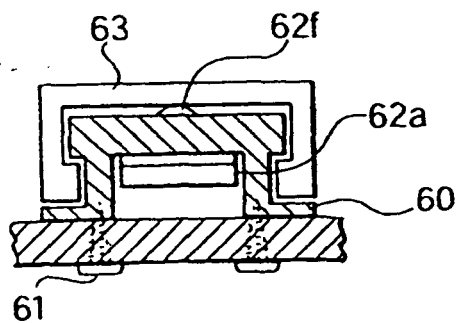


Fig. 6B