



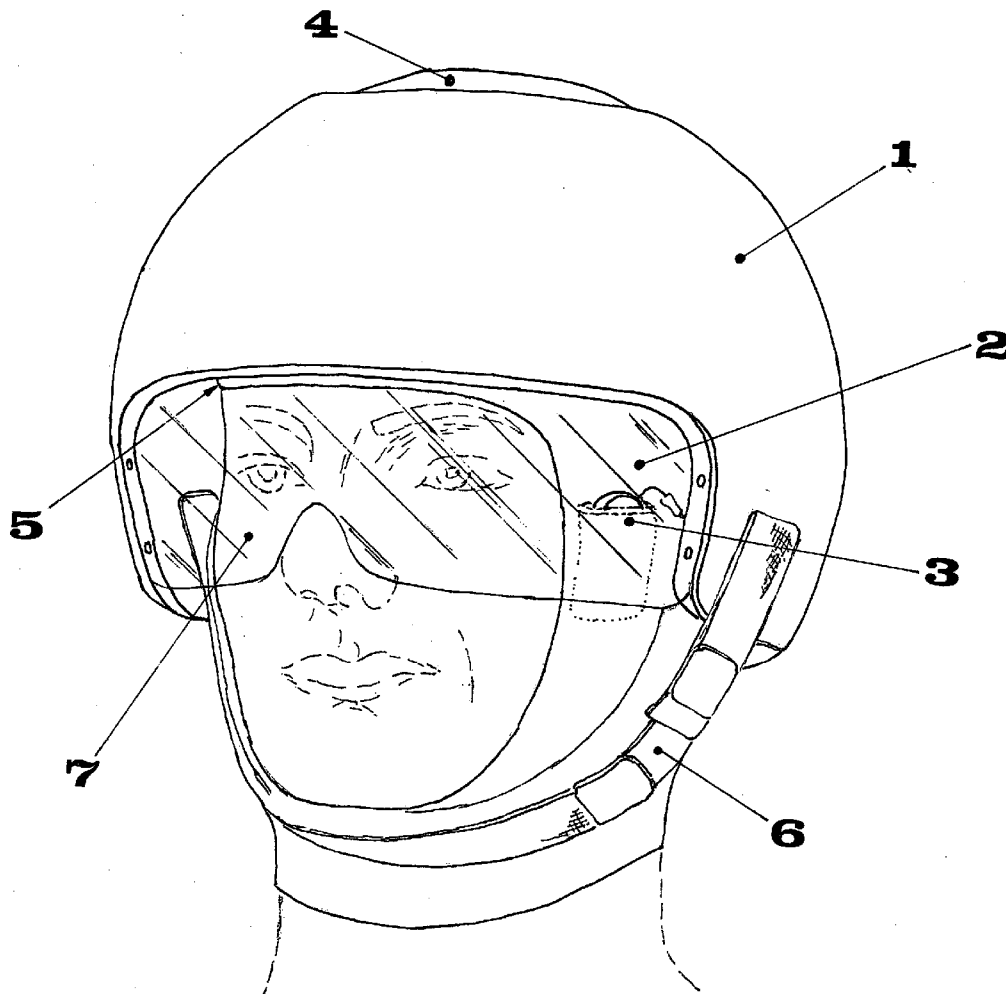
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(19) **United States**(12) **Patent Application Publication****Akhtar et al.**(10) **Pub. No.: US 2006/0277664 A1**(43) **Pub. Date: Dec. 14, 2006**(54) **MULTIFUNCTIONAL HELMET**(52) **U.S. Cl. 2/410**(76) Inventors: **Saman Rahila Akhtar**, Ellicott City,
MD (US); **M. Salim Akhtar**, Ellicott
City, MD (US)(57) **ABSTRACT**

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Saman R. Akhtar**10005 Culverene Drive****Ellicott City, MD 21042 (US)**(21) Appl. No.: **11/188,252**(22) Filed: **Jul. 22, 2005****Related U.S. Application Data**(60) Provisional application No. 60/591,255, filed on Jul.
26, 2004. Provisional application No. 60/591,497,
filed on Jul. 27, 2004.**Publication Classification**(51) **Int. Cl.**
A42B 1/06 (2006.01)

The Multifunctional Helmet is a fully modular, mission-tailorable system designed for military and non-military use to further enhance protection and comfort. The Multifunctional Helmet uses advanced human factors methodologies to form a new shape that allows maximum coverage and protection of the head, face, and neck. When fully integrated, the Multifunctional Helmet protects against a full range of personal threats. The Multifunctional Helmet offers five independent Modularities: 1) a fabric Skullcap to maintain thermal comfort; 2) a Bone Conduction Communication System that offers fully duplex communication housed within the Skullcap; 3) an Impact Liner that absorbs impacts and blunt trauma; 4) a Ballistic Shell that protects against ballistic fragments; and 5) a Helmet Add-on that ricochets small arms fire. The Ballistic Shells are to be produced using special aramid fabrics and resins, and are laser cut, vacuum preformed, and molded.



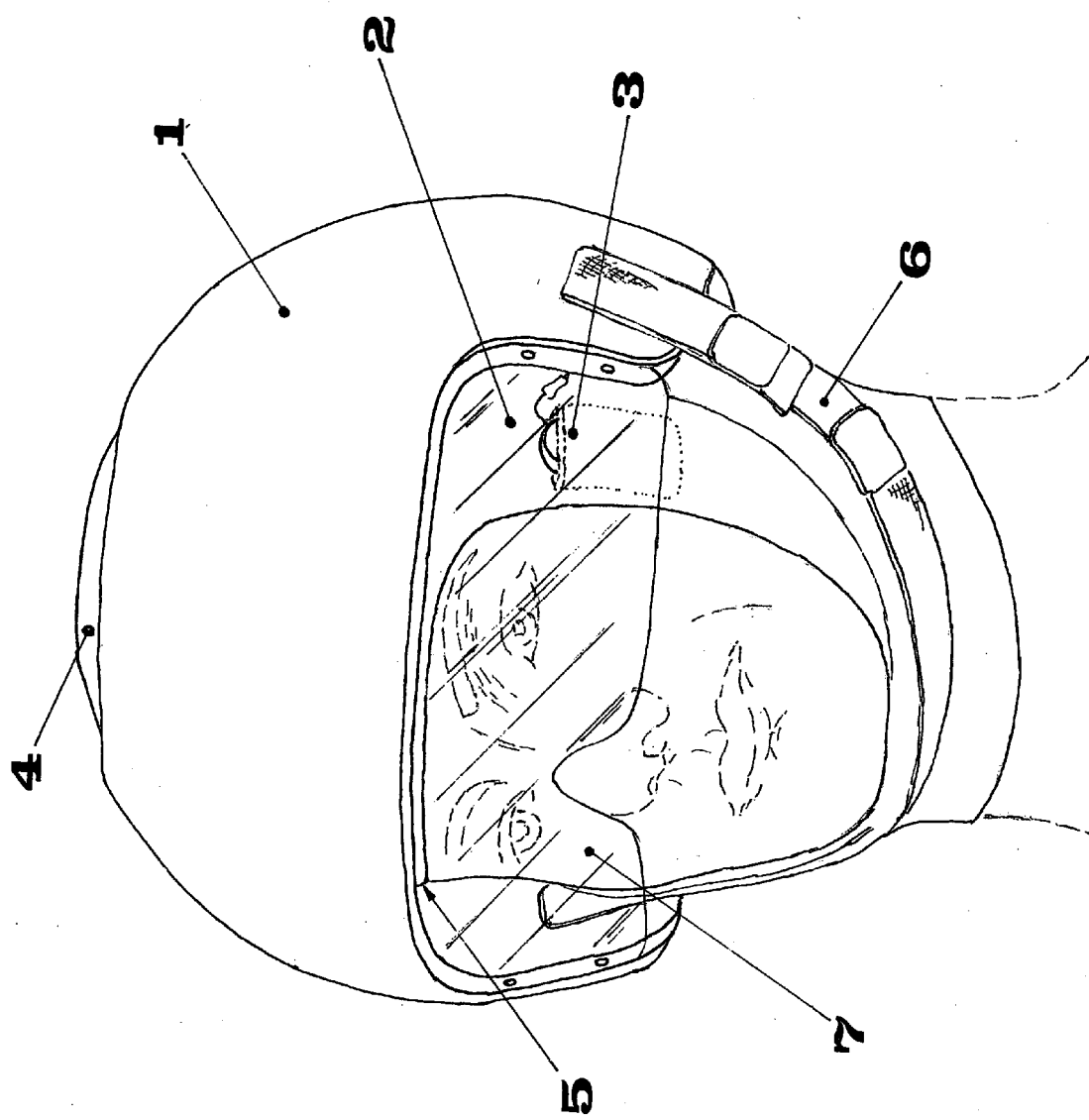


FIG 1

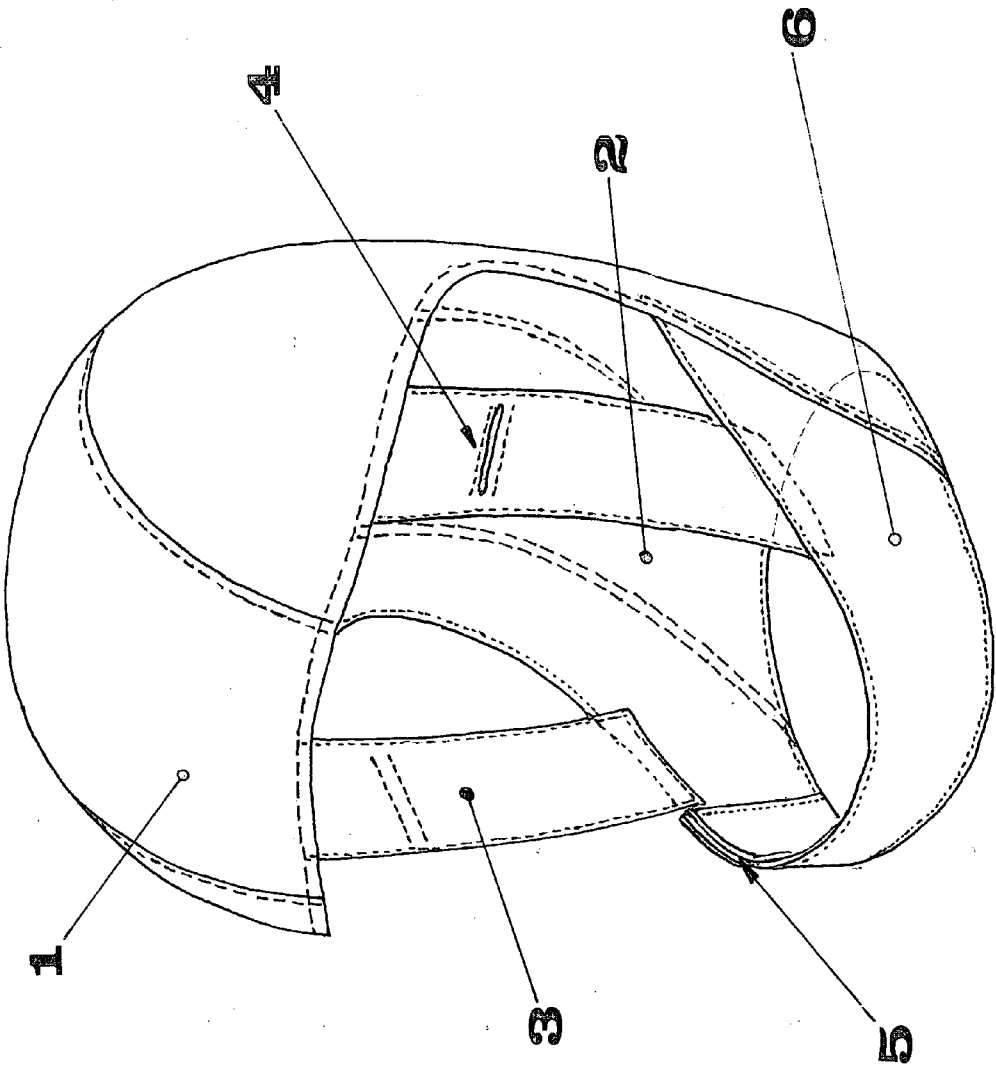


FIG 2

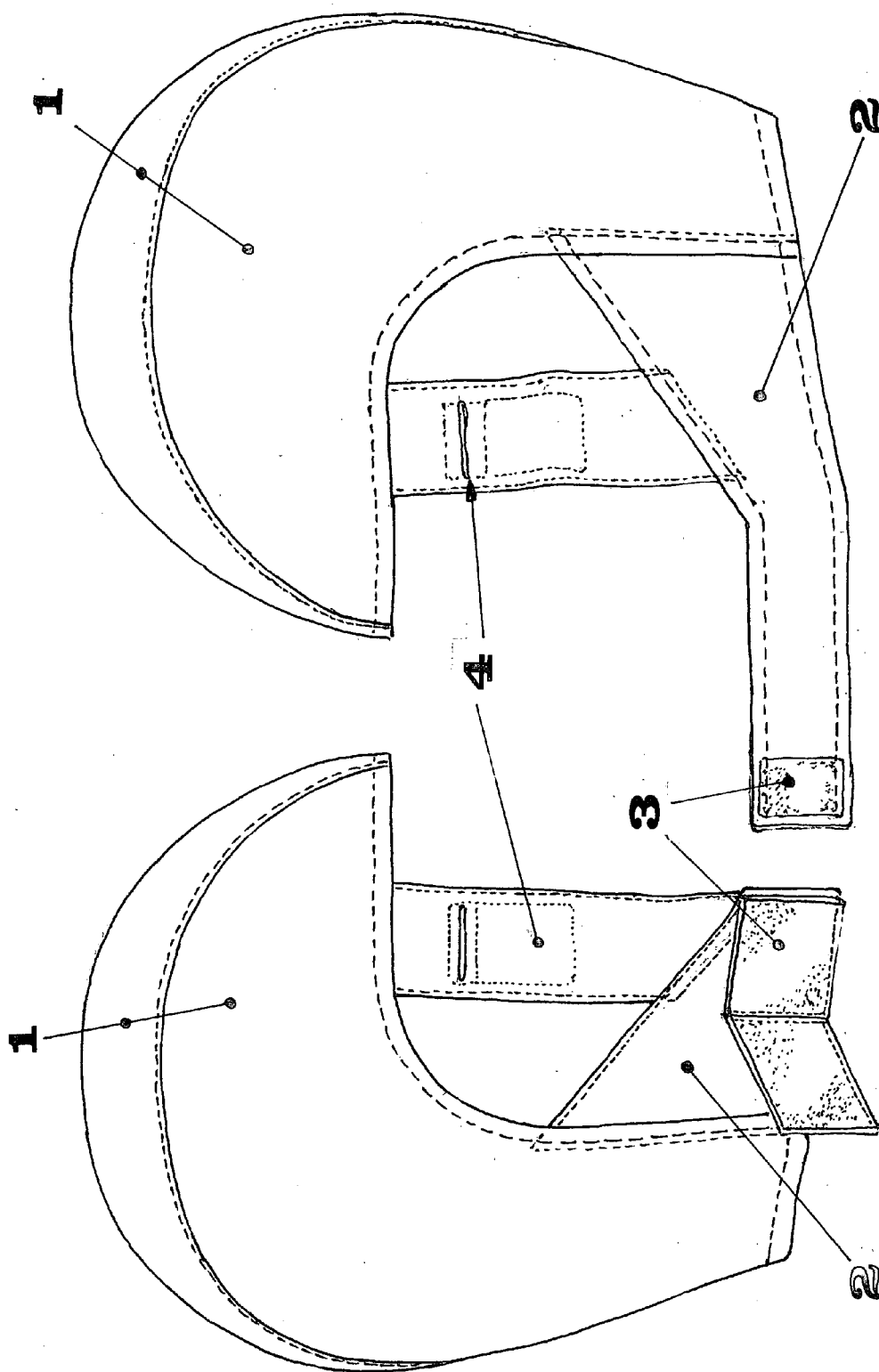
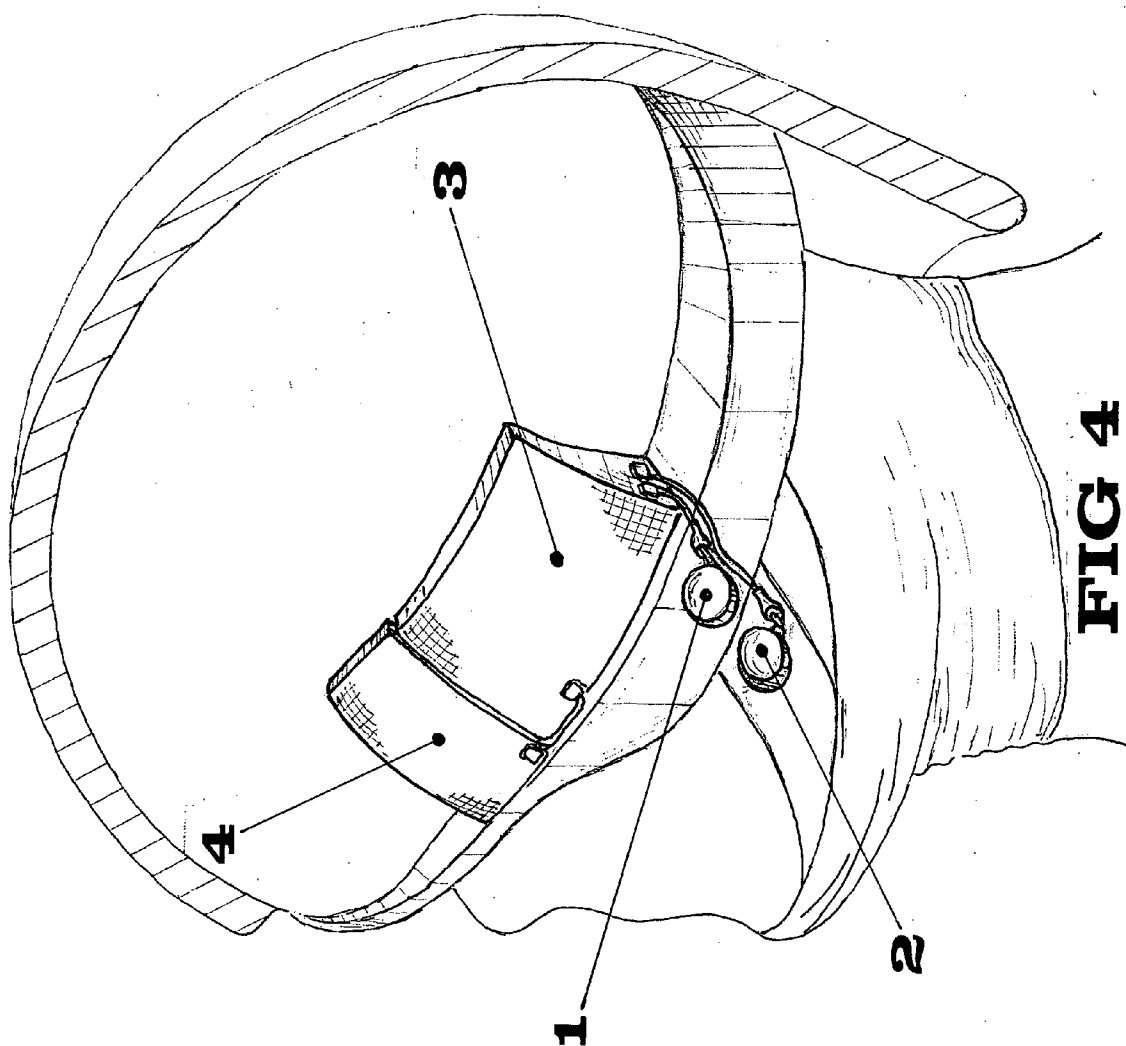
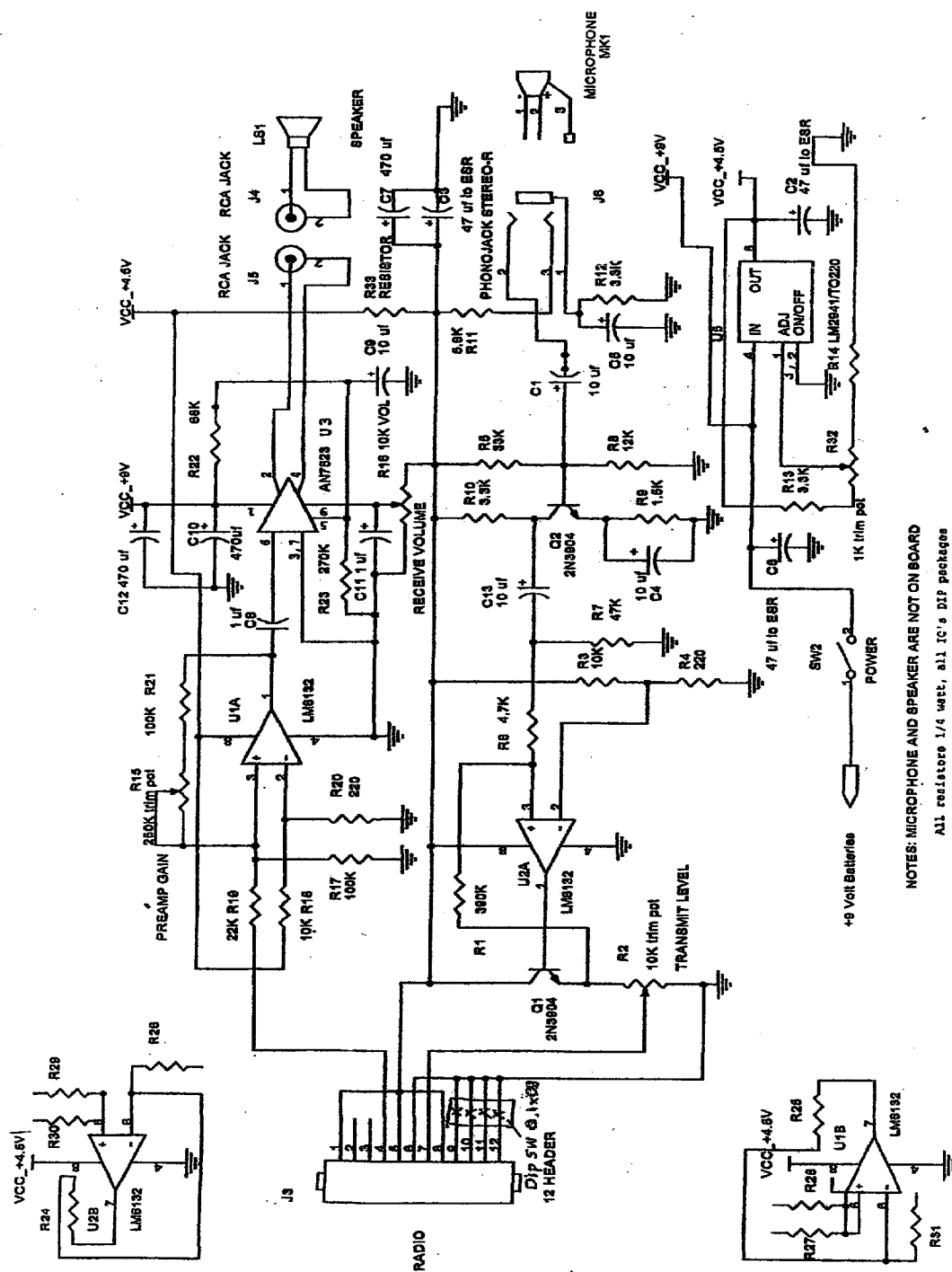


FIG 3





NOTES: MICROPHONE AND SPEAKER ARE NOT ON BOARD
All resistors 1/4 watt, all IC's DIP packages

FIG 5

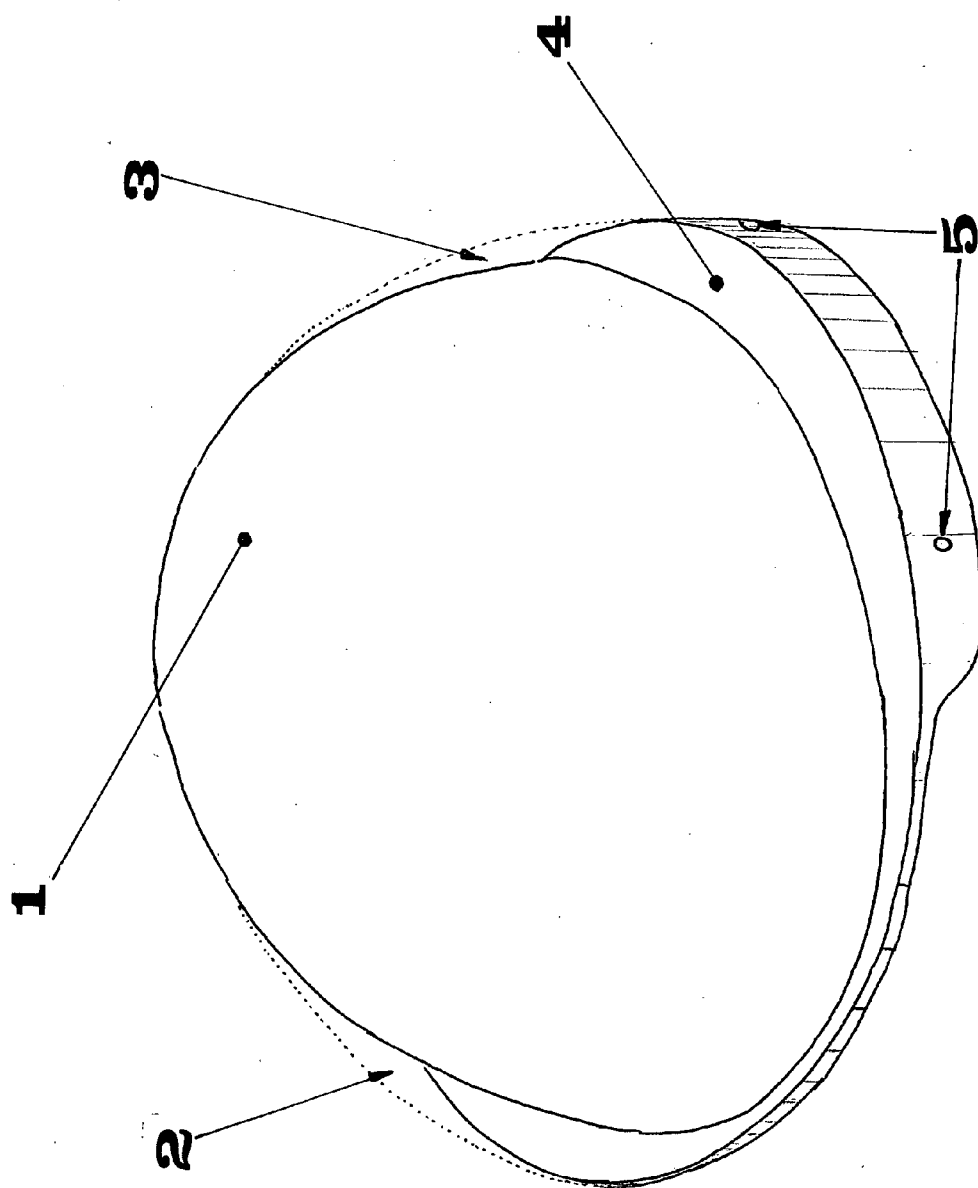


FIG 6

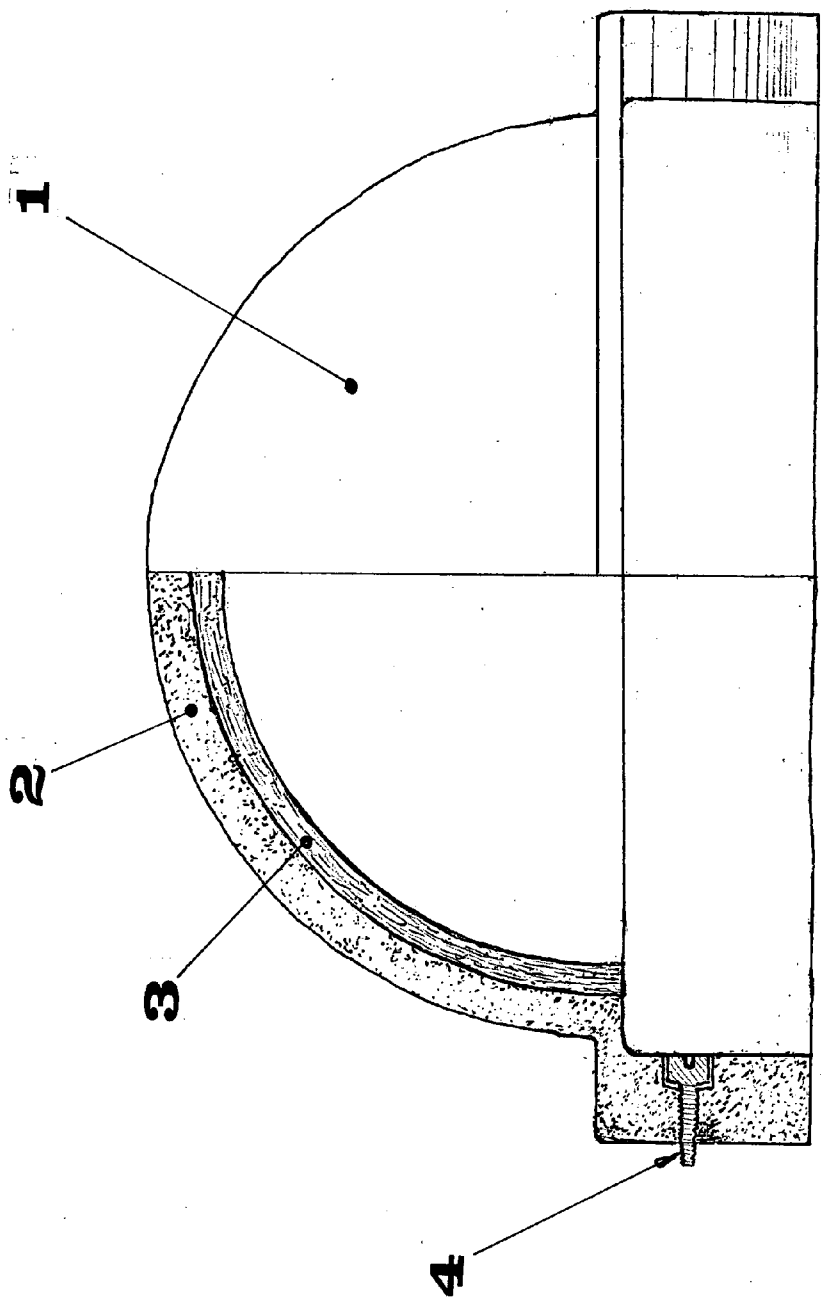


FIG 7

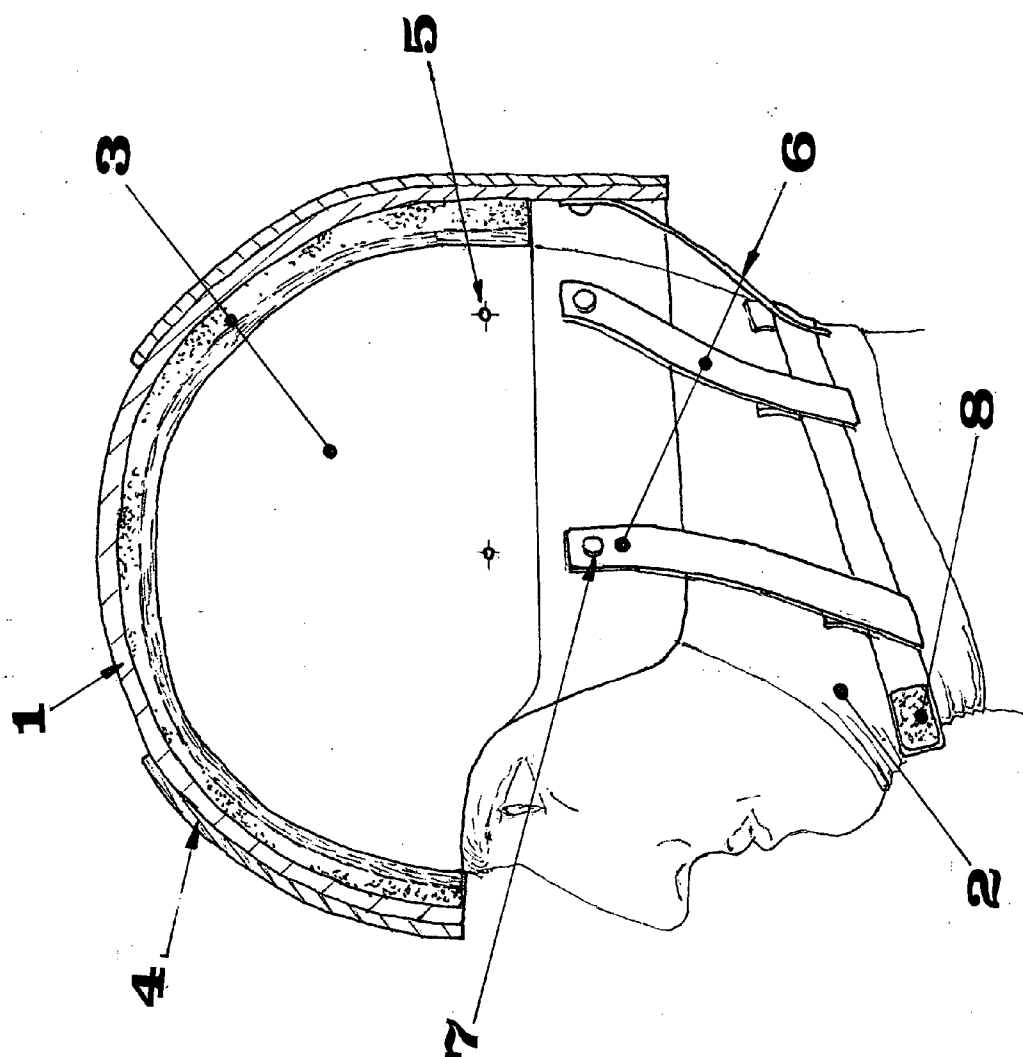
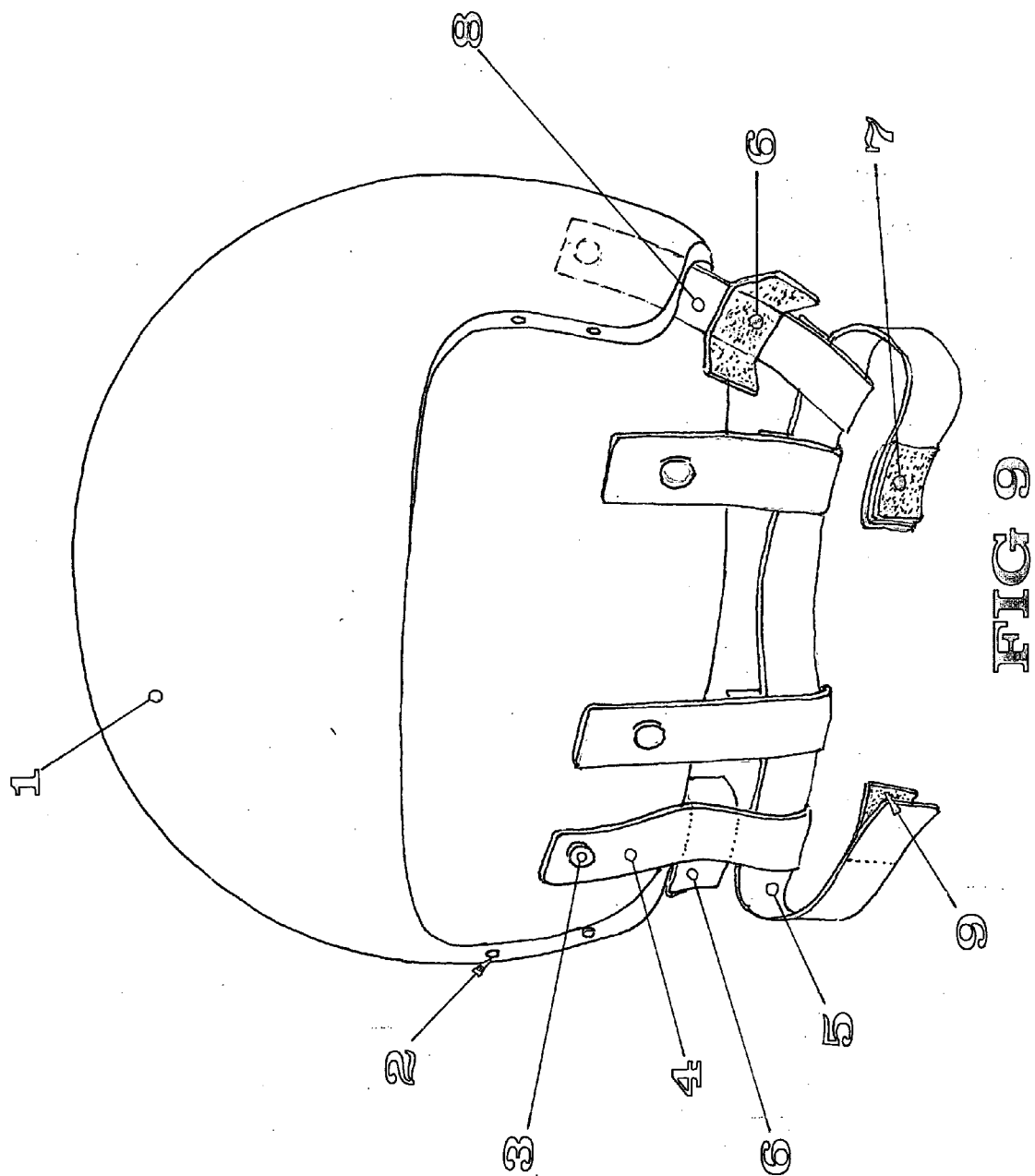


FIG 8



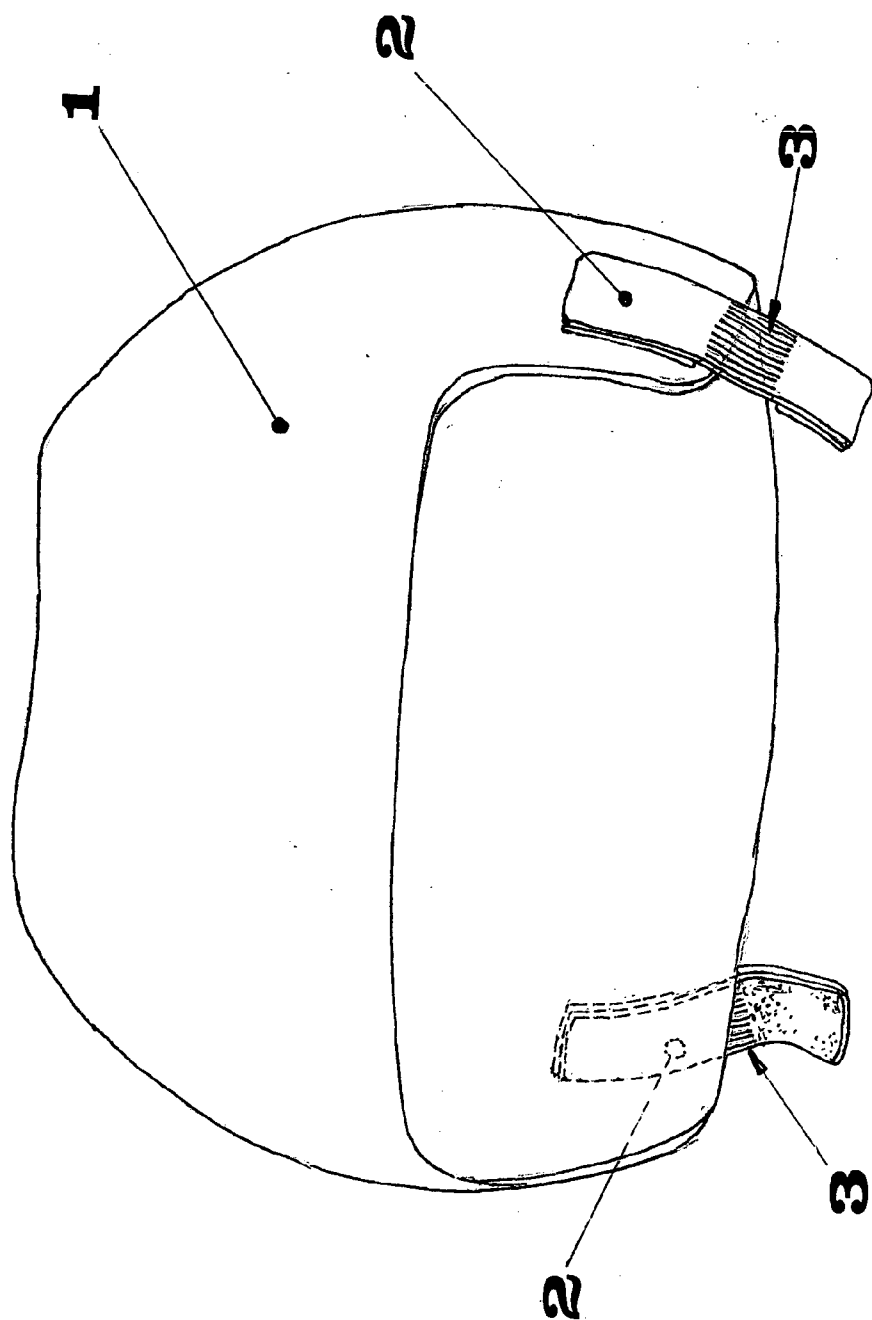
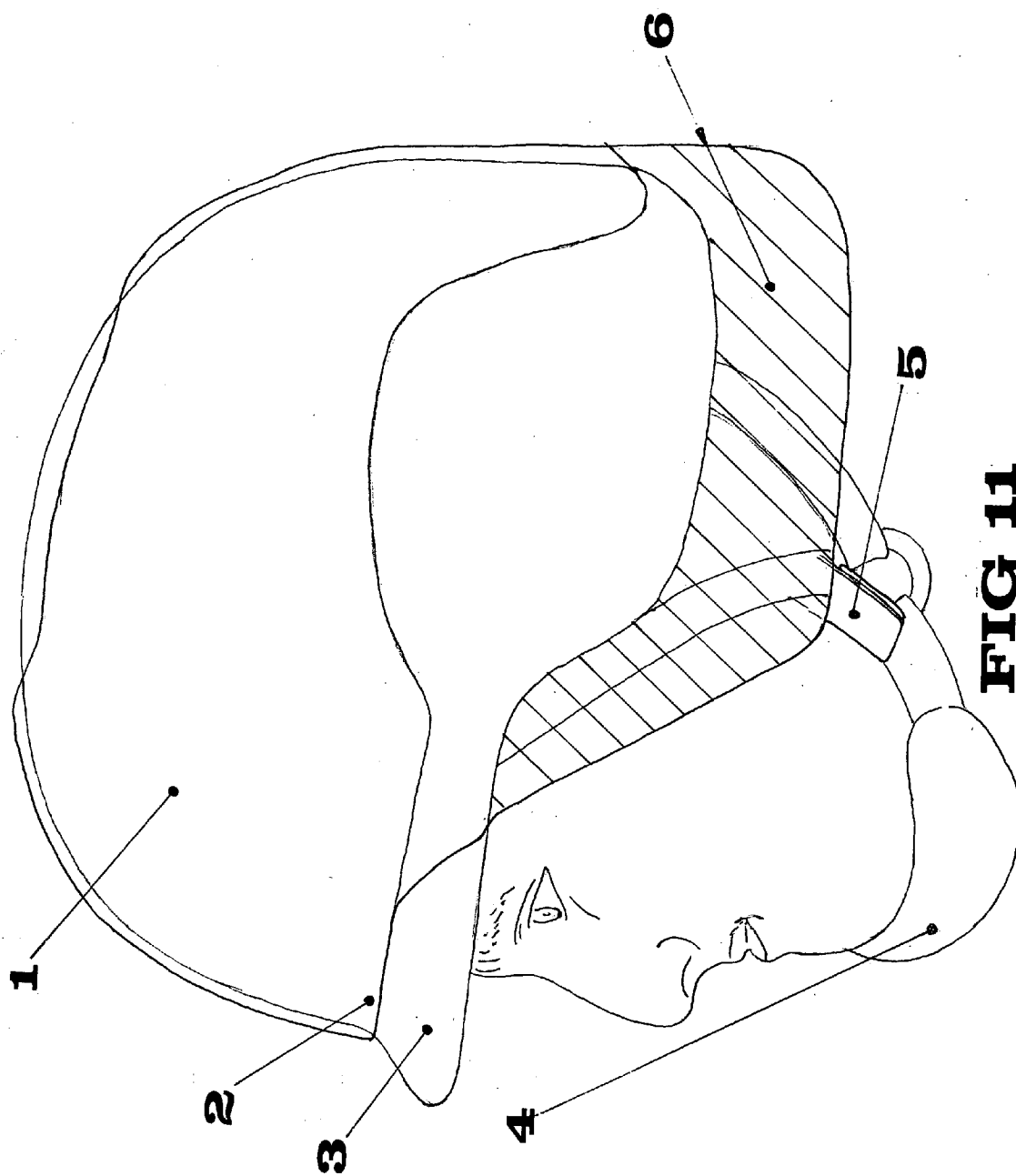


FIG 10



MULTIFUNCTIONAL HELMET

RELATED APPLICATIONS

[0001] This application claims the benefit of priority under 35 U.S.C. sectn. 119(e) of U.S. Provisional Application No. 60/591,255, filed Jul. 24, 2004 is now abandoned the entire contents of which are incorporated herein by reference. And

[0002] This application claims the benefit of priority under 35 U.S.C. sectn. 119(e) of U.S. Provisional Application No. 60/591,497, filed Jul. 27, 2004 is now abandoned the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0003] 1. The present invention relates generally to protective ballistic Multifunctional Helmet for protecting head, face, and neck from impact, blunt trauma, flying fragments, firearms, for mainly military and non-military users including, but not limited to, first responders, law enforcements, medics, paratroopers, civil contractors in combat zones, sports, and motorcycle users. The helmet is designed for military and non-military use containing subcomponents/units to further enhance protection.

[0004] 2. This invention relates to ballistic helmet for use by both military and non-military subjects that offers increased protection, safety, and comfort, and decreased weight load to the total head, full face, and whole neck. The existing ballistic helmet, the Personnel Armor System Ground Troops (PASGT) (U.S. Pat. No. Des. 242,088 issued on Nov. 2, 1976) was a copy of the World War II Nazi helmet, following the same contours and coverage with several reverse engineering by changing steel materials to aramid fabrics done by the existing helmet's designers. Its recent minimally redesigned and modified derivative, Advanced Combat Helmet (ACH), while offering only basic levels of ballistic protection. PASGT redesign to ACH entailed an 11% removal of front and peripheral lips, reducing coverage provided to PASGT that is being considered inadequate (Reference: The Wall Street Journal, Aug. 25, 2005). The historic role of the helmet—to provide protection—has not changed but recent redesigned ACH has somewhat compromised its primary requirement by reducing the helmet coverage. This has increased deaths and injuries (The Wall Street Journal, Aug. 25, 2004). Yet, the role of the helmet has been expanded to serve as a platform for NVG, GPS thus changing its biodynamic characteristic (mass and center of mass). Therefore, a critical need exists for a lightweight ballistic helmet that provides adequate protection. The helmet needs to offer as much comfort as possible from the severe climatic elements to both military and non-military subjects in all regions. The multifunctional helmet (as in claim 1) has been designed with fullest consideration of human factors and ergonomics.

[0005] 3. The use of the Multifunctional Helmet (as in claim 1) for the military has greatly improved and increased benefits over the current PASGT/ACH helmet currently in use. For instance, the military had roughly 150,000 troops plus 120,000 US civilian support contractors deployed overseas in 2005 where U.S. Army soldiers make up the large number of deaths and wounded. In Afghanistan and Iraq, summer temperatures can have a heat index as high as 147° F. (in the shade) leading to heat stroke; winters are cold and damp, and molds and fungi can run rampant. Spring and fall

are notorious for dust storms and sandstorms—causing chafing, cuts and infections that carry many health risks. Coughing, nosebleeds, and wheezing are common side effects, and any area of the body where sand can collect—ears, armpits, knees, and feet—is at risk. Inadequate helmets can also pose serious threats leading to concussion, head injuries, and even death. The global burden of death due to head injuries is ranked number nine in the list of the most frequent diseases in the world (Murray and Lopez, 1996, The Global Burden of Disease—Summary, The Harvard School of Public Health, Harvard University Press, Cambridge, Mass., p. 43). Concerned military physicians believe there are weaknesses in the current helmet, which may be costing lives. The heavy weight and poor contours of the helmet may restrict head movement, exacerbate neck strain, and downgrade situation awareness while conducting assigned tasks. A critical need has been identified for a lightweight, ergonomically designed helmet that provides adequate ballistic protection from larger threats, offers sufficient situation awareness and superior comfort to US troops. The inventors have completely designed a brand new lightweight total head modular system, which increases protection and improves human factors. The helmet system incorporates a speech communication subsystem facilitating binaural radio communication and enhances the ballistic protection level of the existing helmet without a weight, comfort, or protection penalty.

[0006] 4. Applicable References:

[0007] Murray and Lopez. (1996). The Global Burden of Disease—Summary, The Harvard School of Public Health, Harvard University Press, Cambridge, Mass., p. 43.

[0008] Jaffe, Greg. (Aug. 25, 2004). Battlefield Debate: An Army Surgeon Says New Helmet Doesn't Fit Iraq: The Wall Street Journal.

BRIEF SUMMARY OF INVENTION

[0009] 1. This invention relates to ballistic helmet for use by both military and non-military subjects that offers increased protection, safety, and comfort, and decreased weight load to the total head, full face, and whole neck. This modular ballistic helmet has been designed to increase protection, safety, and comfort, and decrease weight load to the total head, full face, and whole neck. The modular system is specifically designed to meet threat levels from zero to low to high. The helmet consists of 5 Modularities: 1) a Skullcap to provide ultimate comfort and regulate body temperature, 2) a Bone Conduction Duplex Communication placed in the skullcap to service noisy/whisper situations without enemy detection, 3) an Impact Liner to protect head from bumps and to provide extreme comfort, 4) a lightweight Helmet Shell to provide more than adequate protection from blunt trauma and flying fragments, 5) a Helmet Add-on to provide protection from small arms.

[0010] 2. The military and non-military user can determine, based on need and threat level, what Modularities they need or wish to utilize at that time. Accordingly, the Modularities and benefits of the invention are integrated into the design in order to provide increased ballistic protection from small arms and fragmentation, to provide increased protection from blunt trauma and impacts, to provide increased comfort from bumps, impact, and temperature, to provide an

increased user-friendly system, which takes into account both military and non-military users' needs and desires, and lastly, to provide a lower cost, higher protection, and comfort alternative to the current helmets in both military and non-military markets.

BRIEF DESCRIPTION OF DRAWING VIEWS

[0011] The drawings of preferred embodiment of this invention are described in the following details:

[0012] **FIG. 1** is a perspective view of the Multifunctional Helmet (as in claim 1) from right side showing the geometric configuration where [1] is Helmet Add-on (as in claim 6), [2] is the Skullcap (as in claim 3), [3] is the Bone Conduction Duplex Communication System Microphone and Speaker (as in claim 4), [4] is Helmet (as in claim 7), [5] is the Impact Liner (as in claim 5), [6] is the suspension system, [7] are the eyes safety plate.

[0013] **FIG. 2** is a perspective view of Skullcap (as in claim 3) where [1] are pieces sewn that form the crown, [2][3] are the pieces that cover sides of the face, [4] are the pockets for the Duplex Communication System, [5] are the pieces that tie in the under the chin suspension with Velcro®, and [6] is the under the chin connector.

[0014] **FIG. 3** is a perspective view of left side view & right side view of Skullcap (as in claim 3) shown on the same page for the reason that tie-in of the two pieces can be easily seen, where [1] are the pieces that form crown, [2] are the side and back pieces, [3] are the locking Velcro®, and [4] are the pockets for the communication system.

[0015] **FIG. 4** is a perspective view of Bone Conduction Communication System (as in claim 4) where [1] is the bone conduction microphone, [2] is the bone conduction speaker, [3] is the electronic board as shown on schematic, and [4] is the long-life rechargeable power pack.

[0016] **FIG. 5** is a schematic spreadsheet of Bone Conduction Duplex Communication System (as in claim 4) used to build a board. The system is based on where (a) voice comes in from bone conduction microphone into voice CODEC for analog compression, (b) compressed voice is converted into digital format and is digitally compressed using algorithms in the processor to get the data rate low enough for the radio's bandwidth, (c) digitized voice is transmitted via a 900 MHz digital frequency hopping radio, (d) receiving radio sends bit stream to processor which then de-compresses the bit stream, (e) decompressed bit stream is converted into analog signal, and (f) CODEC converts compressed analog voice into normal voice that is sent to the bone conduction speakers.

[0017] **FIG. 6** is a perspective view of Impact Liner (as in claim 5), where Impact Liner rim is exactly that circular piece that fits into the Multifunctional Helmet (as in claim 1), with a collar to provide larger periphery surface interface with Multifunctional Helmet (as in claim 1) with the dome that follows the shape of human head [1], [2][3] the space between the spherical helmet and at dome on right and left sides, [4] is the flat platform areas on both right and left sides on top of which the miniature electronic components will be located [5] are the 5 equally spaced screws which fit the impact liner into the multifunctional helmet. The Impact Liner (as in claim 5) is removable.

[0018] **FIG. 7** is a half section front view of the Impact Liner [1] (as in claim 5), is the cross-section of Impact Liner (as in claim 5) showing hybrid foams [2] (R-MER® II Resin Grade 27), and [3] Sensatemp® 835), and [4] are machine screws.

[0019] **FIG. 8** is a side cross-sectional view showing general assembly where [1] is the Ballistic Shell (as in claim 6), [2] is the Skullcap (as in claim 3), [3] is the Impact Liner (as in claim 5), [4] is the helmet add-on (as in claim 7), [5] are screws that attach Impact Liner (as in claim 5) to Multifunctional Helmet (as in claim 1) to enable the Impact Liner (as in claim 5) to be removed, [6] is the suspension, [7] are the snaps, [8] is the Velcro®.

[0020] **FIG. 9** is a perspective view of the Ballistic Shell (as in claim 6) [1], [2] are the five receptive where faceplate will fit in, [3] are the snaps that attach suspension system to the Multifunctional Helmet (as in claim 1), [4][8] are the four suspension system bands, [5] is the suspension system band that attaches the helmet with the user under the chin, [6] are the Velcro® safety locking, [7] is the Velcro®, and [9] is the Velcro® safety locking.

[0021] **FIG. 10** is a perspective view of the Helmet Add-on (as in claim 7), where [1] is the Helmet Add-on (as in claim 7) with suspension system bands [2], and [3] weak points that snap break when the energy on the helmet add-on reaches the breaking point without physically hurting the neck column from pressure.

[0022] **FIG. 11** is a side view of Helmet Add-on (as in claim 7) for current PASGT/ACH where [1] is Helmet Add-on (as in claim 7), [2] is the front of the ACH with the PASGT front lip removed, [3] is the formed PASGT lip, [4] is the reference suspension system for PASGT/ACH, [5] are the two suspension bands that fit the Helmet Add-on (as in claim 7) with PASGT/ACH by connecting two Velcro® pieces to PASGT/ACH, and [6] shows the additional protection coverage shaded area.

DETAILED DESCRIPTION OF THE INVENTION

[0023] 1. Duly taking into consideration the inadequacies of the PASGT/ACH, the inventors have developed a multifunctional helmet (as in claim 1), using advanced human factors methodology, which meets and improves the current conditions as well as the expanding demands on the existing military and non-military applications. The resulting multifunctional helmet (as in claim 1) offers a new geometric configuration, more coverage, added protection and is modular, lightweight with enhanced human factors, i.e., comfort, situational awareness, agility, and movement. The multifunctional helmet (as in claim 1) incorporates a light-weight hands-free duplex Bone Conduction Communication System without a weight penalty. The new geometric configuration offers the users complete range of motion, allows them to lay in prone position and engage targets, and is fully compatible with fielded and developmental body armor and rucksack systems as well as head mounted devices.

[0024] 2. The helmet offers the unique feature of being mission-tailorable. The study of advanced material technologies and know-how has produced composite materials combinations that are lighter in weight and are able to defeat or neutralize threats at notably higher ballistic levels. In the

multifunctional helmet (claim 1), the inventors have sought to reduce as much injury as possible to neck when a high-energy object hits the helmet creating dangerous whip-lash on the neck. Existing medical injury records show that this trauma leads to various long-term and/or permanent disabilities, neck-down paralyzes, and even death. The inventors have also sought to improve speech intelligibility by designing the suspension system to fit under the chin rather than on the chin. The present PASGT/ACH suspension system/chinstrap, worn on the chin itself, is inadequate.

[0025] 3. The inventors have designed certain aspects of the Multifunctional Helmet (as in claim 1) using the innovative application of biomimetics, the mimicking of nature and natural phenomenon are applied to man-made technology. The multifunctional helmet (as in claim 1) has applied biomimetics by mimicking nature's shield mechanism for the protection of the human head from injuries resulting from impacts and linear and rotational energies. The intricate exterior structure comprising of scalp muscles, the cranium bone structure, and the evenly distributed cerebrospinal fluid that maintains uniform pressure, compresses on impact, absorbs energy, deflects the impacting object, rebounds and limits the resulting energies to reach the brain and the cranium bone with its remarkable resilience, withstands as much external loading as possible.

[0026] 4. The inventors have designed, developed, and tested a means by which small arms strikes can be absorbed and ricocheted to avoid, convert, and deflect as much energy as possible and help prevent injuries and deaths. Head injury statistics from the recent Afghanistan and Iraq conflicts have accounted for a rising number of casualties, and U.S. Army medical neurosurgeons have shown a growing concern for the injuries and deaths (Reference: The Wall Street Journal, Aug. 25, 2004).

[0027] 5. The inventors find that in the aforementioned casualties, the helmet in service is mainly the PASGT, which is being replaced by ACH. With the changing threats and style of war (from front-to-front rural setting to urban warfare), enemy roadside bombing tactics, and changes in the type of ammunition used, these existing helmets provide less than desired protection. A Helmet Add-on (as in claim 7) has been designed as a means of enhancing ballistic protection (from incoming bullets and small arms while meeting the threats) for interim use with the current PASGT/ACH to ensure the safety of the military and non-military users. The Helmet Add-on (as in claim 1) is added on top of the PASGT/ACH to get additional ballistic protection and unite into one combined structure. The solution uses the biomimetic principles, wherein the solution mimics nature and the natural phenomenon of head's three layers of protection mechanisms—the scalp 1, the cerebrospinal fluid 2, and the cranium 3. The Helmet Add-on (as in claim 7) mimics the scalp 1, the air gap and the dry lubricant (as in claim 7) between the Helmet Add-on (as in claim 7) and PASGT/ACH suspension system mimics the cerebrospinal fluid 2, and the PASGT/ACH helmet mimics the cranium 3.

[0028] 6. The inventors have designed the multifunctional helmet (as in claim 1) SOLELY with the end-users demands and criteria in mind and for all threats ranging from non-critical to critical to highly critical environments (i.e., on post, in transition, during combat where the command demands specific, increased head protection). Keeping the

user as the primary focus, the Multifunctional Helmet (as in claim 1) is completely modular and suited to the action context: only two lightweight modular units are carried, worn, and consumed: assembled fourth (as in claim 6) and fifth (as in claim 7) modularities. The Multifunctional Helmet (as in claim 1) offers full protection to the total head, including the face and neck. The Multifunctional Helmet (as in claim 1) modular design approach offers protection against the full range of personal threats.

[0029] 7. The ergonomic design of each Modularity seriously considered: the addition of weight on the head due to expanded platform, the weight distribution (for an optimum center of gravity, muscle stress and strain during the combat postures and movements), freedom of head movement (wires and cables, electronic connections, unimpaired situation awareness), position stability (restriction of helmet-to-heads movement may mean uncomfortable harnesses), micro-climate control (managing heat load), and user acceptance (accepting helmet as a safety device and taking pride in it) are ergonomic feature built in the multifunctional helmet (as in claim 1).

[0030] 8. This modular ballistic multifunctional helmet (as in claim 1) has been designed in order to increase protection, safety, and comfort to the total head, full face, and whole neck with decreased weights and loads. The modular system is specifically designed to meet threat levels from zero to low to high threat solutions. Zero Threat requires modular solutions for users serving barrack duties (e.g. food kitchen, mailroom, post guard, and military police applications). Low Threat requires modular solutions for users in deployment mode for blunt-trauma and fragmentation protection (e.g. on foot, in ground vehicles, rotorcraft, and aircraft). High Threat requires modular solutions for users in combat environments (e.g. very high survivability factor versus direct hits from small arms threats such as M16 and AK47 rifles). The Multifunctional Helmet (as in claim 1) comprises of five modularities that can be block built to meet zero to low to medium to high threats and has both military and nonmilitary applications. The inventors claim that the Multifunctional Helmet (as in claim 1) weighs less and provides equal or greater ballistic protection than the existing PASGT/ACH helmets and covers most of the cranium. The Multifunctional Helmet (as in claim 1) weighs between 1.87 lbs and 1.95 lbs (as compared to PASGT's 3.41 lbs and ACH 2.86 lbs) and also provides equal or better protection to the head from shock trauma; the helmet provides protection from blunt trauma, fragmentation, and shock resulting from crashes and impacts. The multifunctional helmet (as in claim 1) also provides non-ballistic and impact protection. The multifunctional helmet (as in claim 1), designed by the inventors, offers 5 (five) Modularities:

[0031] a. First Modularity (as in claim 1) is the Skullcap (as in claim 3) for total cranium, back of the neck, and under the chin, touching the head and neck of the user. The skullcap is designed to provide ultimate comfort while adjusting to body temperature changes. The inventors have creatively used common available phase change materials (116 g/m² 100% polyester and combined with 210 g/m² 53% cotton/47% acrylic to form a new hybrid material. This new composite material absorbs, stores, and releases energy in response to body heat (keeps warm in cold and cool in the heat). The Skullcap (as in claim 3) regulates and maintains the users body temperature at around 98.5° F., and prevents

both heat stroke/stress and cellular damage to the human body. The Skullcap (as in claim 3) allows users to work in environments with zero threats such as sheds, barracks, and in indoor and outdoor locations during transition and combat, etc. The Skullcap (as in claim 3) will be fabricated by cutting the flat material and sewing into a skullcap. First Modularity is for the Zero to Low to Threats for users serving barrack and combat duties.

[0032] b. Second Modularity (as in claim 1) is the Bone Conduction Duplex Communication System (as in claim 4) designed by inventors is placed in the Skullcap (as in claim 3). The Bone Conduction Duplex Communication System (as in claim 4) can also be used without the Skullcap (as in claim 3), by being installed into a headset worn on the head. The Bone Conduction Duplex Communication System (as in claim 4) is limited for operation by a military unit of 4 participants where in the Skullcap (as in claim 3) or the headsets touch the skull and neck bones of the user allowing communication between two or more participants (maximum four) in noisy/whisper situations. The inventors have used the bone conduction principle to transmit advanced duplex (listen and talk at the same time as opposed to the current simplest system where the Push-To-Talk is used to listen or talk) communication using cranium/temporal bones as well as other surfaces of the face and neck to transmit the sound waves coming from the sender to the receiver and vice versa. The inventors have performed speech intelligibility studies for optimum head and facial locations for different subjects; the optimum location differs from subject-to-subject. The inventors have designed and developed new super lightweight bone conduction speakers and bone conduction microphones that clearly transmit the sound in duplex. The Bone Conduction Duplex Communication System (as in claim 4) offers 80% speech intelligibility in a high noise environment (greater than 85-115 dBA); exchanges between four (4) parties has been transmitted, received, and fully understood. The advantage of the Bone Conduction Duplex Communication System (as in claim 4) is an improved signal. Since bone conduction calls for radio transmission, the inventors determined that the normal military radio frequency bands normally used HF and VHF. Inventors used VHF (900 MHz) for short-range ($\frac{1}{2}$ mile) tactical command nets where high quality voice reproduction was required without line of sight. In the Bone Conduction Duplex Communication System (as in claim 4), a) Voice comes in from bone conduction microphones into voice CODEC for analog compression, b) compressed voice is converted into digital format and is further digitally compressed using algorithms in the processor to get data rate low enough for the radio's bandwidth, c) digitized voice is transmitted via a 900 MHz digital frequency hopping radio (which has an approximate range of $\frac{1}{2}$ mile), d) receiving radio sends bit stream to processor which then de-compresses the bit stream, e) decompressed bit stream is converted into analog signal, f) CODEC converts compressed analog voice into normal voice which is sent to the bone conduction speakers. Commercially available transducers and duplex radios are to be used in low volume production. Second Modularity is for the Zero Threats for users serving barrack duties where the ability to communicate has been hindered.

[0033] c. Third Modularity is the Impact Liner (as in claim 5) serves two primary functions: first, the Impact Liner (as in claim 5) provides constant protection from external bumps and impacts at 360° of cranium (top and sides)

surface. The function of the Impact Liner (as in claim 5) is to reduce as much blunt trauma as possible to the cranium that could cause concussion leading to pain, short-term and long-term physical and psychological known and unknown disabilities; second, the Impact Liner (as in claim 5) provides extreme comfort to the cranium. Since the fit relationship between the Impact Liner (as in claim 5) and cranium is important, the inventors conducted detailed anthropometric studies of military and non-military consumers to determine the most useable anthropometric percentile—95 Percentile is most widespread. Since one-size-fits-all is a design objective, the Impact Liner (as in claim 5) adjusts from 100 to 5 percentile head without additional weight premium through the Impact Liner (as in claim 5) materials. The inventors developed a hybrid of two commercial-off-the-shelf (COTS) foams joined together through adhesive ironing: the Impact Liner (as in claim 5) hybrid consists of external foam (R-MER® II Resin Grade 27) and internal (head-side) foam (Sensatemp® 8350). The Impact Liner (as in claim 5) external foam R-MER® is a high performance expandable resin with enhanced fracture resistance for dynamic impact cushioning: flexural strength (45 psi), compressive strength (18 psi), peak deformation (1.19 inches), and peak energy (6.9 ft.lbs.). The Impact Liner (as in claim 5) internal foam Sensatemp® is a breathable hydrophilic polyurethane foam containing micro-encapsulated phase change materials. The combination of these two COTS technologies advanced materials makes for a foam product that not only manages moisture, but also regulates heat. Sensatemp® foam regulates this heat energy by actually absorbing, storing, and releasing heat energy. The R-MER® and Sensatemp® are joined together to form the Impact Liner (as in claim 5) from a flat sheet cut into preforms in order to shape the Impact Liner (as in claim 5). These preforms are set into the Impact Liner (as in claim 5) through a steam molding process. The lower circular rim of the Impact Liner (as in claim 5) fits into the Ballistic Shell (as in claim 6) and is held in place (both by tight fit and small machine screws). The Impact Liner (as in claim 5) is removable. When the Impact Liner (as in claim 1) is assembled into the Ballistic Shell (as in claim 1), two crescent-shape pockets are formed. The two pockets are on the right and left side of the Impact Liner (as in claim 5). These pockets are used as an Electronic Digital Assistant Station (EDAS) where electronics pertaining to the helmet are to be located. Typically, these may include sensory and cognitive devices such as Antenna GPS (geographic positioning system), situation awareness camera (assisting command and facilitating paramedics in case of a long distance injury), future night vision, batteries/power packs, etc., whereas mounting and dismounting of the Impact Liner (as in claim 5) has been made easier for end users in field and provide greater situation awareness and enhanced fighting capabilities. The Impact Liner (as in claim 5) absorbs electromagnetic forces. Third Modularity is for the Low Threats for users in deployment mode for blunt-trauma and fragmentation protection

[0034] d. Fourth Modularity is the Ballistic Shell (as in claim 6). The multifunctional helmet (as in claim 1) comprises of a new Helmet Configuration (as in claim 2) that consists of a half sphere truncated exactly at the great circle (the intersection of the sphere with a plane through the center) and extended and merged into a cylindrical stem (straight circular walls) offering pure structural stability. The Ballistic Shell (as in claim 6) surface is free from any

extrusions in that nothing physical projects externally or outwards. The thickness of the Ballistic Shell (as in claim 6) will vary based on duty each helmet is to perform where higher ballistic shell shall demand a larger number of piles. The inventors considered the ballistic values (values that can successfully stop the penetration of fragments and bullets) to be of maximum importance for the multifunctional helmet (as in claim 1) so as to meet the protection standards set by the National Institute of Justice (NIJ). These standards measure the V_{50} ballistic limit protection ($V_{50}BL[P]$) using .22-caliber FSP7.62×39 mm, 123 grain ball ammunition. To achieve maximum results, the inventors have used treated composite material piles formula (number of piles is inventor's trade secret). Using accepted limits set by Military and NIJ, the multifunctional helmet (as in claim 1) has achieved 37% higher protection values with least possible lower [32%] overall weights as compared to the existing ballistic helmets. The surface of the Ballistic Shell (as in claim 6) is free from any extrusions in that nothing physical projects externally or outwards. The Ballistic Shell (as in claim 6) provides protection from flying grenade and shell fragments as well as from shots from a .22 caliber pistol. The Ballistic Shell (as in claim 6) is fabricated from a series of hybrid aramid materials and resins (the composition of said materials shall remain the custody of the inventors) and where each Ballistic Shell (as in claim 6) shall comprise of a number of aramid material piles combined. The inventors have designed a preform that shall form the Ballistic Shell (as in claim 6). The preforms are hand or laser pre-cut and loaded into a Vacuum Mold whereby an uncured shell is baked and cured in a press under specific temperatures (both during heating and cooling) to be determined by the inventors based on the number of piles. The exterior of the Ballistic Shell (as in claim 6) shall be coated with a dry and powdery lubricant. Fourth Modularity is for the High Threats for users in combat environments. Third Modularity is attached with Fourth Modularity with machine screws for ease and can be detached, if needed without multifunction helmet.

[0035] e. Fifth Modularity is the Helmet Add-on (as in claim 7) provides additional ballistic protection from small arms. Fabricated from special aramid materials the Helmet Add-on (as in claim 7) is slipped onto helmet and held into place by a suspension system. The Helmet Add-on (as in claim 7) helps counter direct hit from .22-caliber bullet and/or from small arms fire (such as the AK47) by either ricocheting the incoming lethal weapon and/or absorbing the energy. This Helmet Add-on (as in claim 7) raises protection levels considerably. The Helmet Add-on (as in claim 7) is shaped in the same manner as helmet shell. The Helmet Add-on (as in claim 7) uses aramid materials and is processed and fabricated using the same methodology as the Ballistic Helmet (as in claim 6). The Helmet Add-on (as in claim 7) surface is free from any extrusions in that nothing physical projects externally or outwards. The Helmet Add-on (as in claim 7) surface is held on top of the Helmet Add-on (as in claim 7) and is attached to the Ballistic Shell (as in claim 6) using a suspension system. The suspension subsystem in the Skullcap (as in claim 3), Ballistic Shell (as in claim 6), and Helmet Add-on (as in claim 7) are held in position using a double Velcro® cover to provide an additional safety lock. Fifth Modularity is for the High Threats for users in combat environments and for fullest protection

(as per FIG. 10) and is slipped atop Fourth Modularity with the suspension bands and fixed with bands.

[0036] 9. Military uses of the Multifunctional Helmet (as in claim 1) are typically those that apply to the safety, protection, and comfort of military subjects as in army dismounted and mounted soldier troops, military police on ground, military civilian logistic support contractors, air and sea, naval forces, air force crews, helicopter crews, navy seals, special forces, paramedic, paratroopers, and all others. For the military, the Multifunctional Helmet (claim 1) can be used in its entirety, with all five Modularities. Nonmilitary uses of the Multifunctional Helmet (as in claim 1) typically relates to those first defenders that protect against public disobedience, violence, and threat and include, but are not limited to police officers, SWAT teams, crowd control, prison guards, correction officers, fire fighters, construction sites, and the National Guard. The invention also has potential applications for commercial use for the sports arena such as football players, motorcyclists, mountain climbers, and hikers. Current helmets in nonmilitary applications are extremely uncomfortable and cumbersome, offering minimal protection and leading to head injuries and deaths.

[0037] 10. The multifunctional helmet (as in claim 1), full assembly simply requires First Modularity—Skullcap (as in claim 3), Second Modularity—Bone Conduction Duplex Communication System (as in claim 4) is slipped into the First-Modularity. The Third (Impact Liner (as in claim 5)) Modularity is slipped into the Fourth (Ballistic Shell (as in claim 6)) Modularity. The Skullcap/Communications combination (as in claims 3 and 4, respectively) is donned by the individual. The Third and fourth modularities (as in claims 5 and 6, respectively) are slipped on top of the donned pieces. The suspension system is adjusted to individual and locked in place, and Fifth Modularity (Helmet Add-on (as in claim 7)) is added on top of the Fourth Modularity and the two suspension bands are attached to the suspension system of the Fourth Modularity (as in claim 6) and locked in for ultimate safety, protection, and extreme comfort, and a stable helmet fully adjusted to the comfort level of each user. The duplex communication systems' receiver and/or transceiver is contained in Second Modularity (as in claim 4) and is ready for operation with the small switch located on the skullcap. A (on-off) switch activates the communication system (as in claim 4).

What is claimed is:

1. A multifunctional helmet comprising of five modularities that can be block built to meet zero, low, medium, and high threats.

Wherein said the multifunctional helmet is tailorable to meet military and non-military needs and threats.

Wherein said the multifunctional helmet comprises of five dependent and separate subcomponents/units of the multifunctional helmet.

Wherein said the five modularities that make up the entire multifunctional helmet are: skullcap, bone conduction communication system, impact liner, ballistic helmet shell, ballistic helmet add-on

2. The multifunctional helmet (as in claim 1) wherein said comprises of a new helmet geometric configuration that improves situation awareness and provides maximum possible coverage of total head and back of the neck.

Wherein said all operations can be conducted in standing, kneeling, and prone postures with 270° fore-and-aft, yaw, lateral, pitch vertical, and head roll.

Wherein said the multifunctional helmet (as in claim 2), wherein multifunctional modular helmet comprises of a new helmet configuration that consists of a half sphere truncated exactly at the great circle (the intersection of the sphere with a plane through the center) and extended and merged into a cylindrical stem offering a structural stability.

Wherein said the multifunctional helmet (as in claim 2), wherein said new helmet configuration has no external protrusions to keep the exterior surface free of any weak point on the helmet where bullet entry may be easier, therefore all connections are provided from within the helmet itself.

Wherein said the multifunctional helmet (as in claim 2) has five holes (receptors), one on top and two each on the right and left sides of the helmet into which safety faceplate (with five hooks) is to be fitted.

3. The multifunctional helmet (as in claim 1), wherein said the first modularity comprises of a skullcap that covers the total cranium and back of the neck column.

Wherein said skullcap provides maximum possible support to cranium and neck to maintain normal head temperatures in high and low ranges so as to be able to minimize the maximum possible health hazards as well as to afford extreme comfort leading to productive operations.

Wherein said skullcap encompasses hands free duplex (talk and listen) bone conduction communication system.

Wherein said skullcap comprises of a built-in suspension and chinstrap that allows speech intelligibility when the skullcap is tightly and securely set in place.

Wherein said skullcap is cut and sewn combining of units that cover cranium and back of the neck while exposing both ears, two sewn flats that cover Zygoma and Mandible cranial areas containing two pouching (to house two bone conduction microphones and speakers on either side of the face, and a flat sewn covering the Platysma areas joined to one side and a Velcro® connection to the other for the ease of operation.

4. The multifunctional helmet (as in claim 1), wherein said the second modularity comprises of a hands free duplex (talk and listen) bone conduction communication system that uses the wearer's facial bones to transmit and receive sounds through bone vibrations by means of transducer bone conduction microphones and bone conduction speakers.

Wherein said bone conduction communication system, in direct contact with the bones, allows small units of users on patrol to be able to communicate with maximum discretion and minimum detection from the enemy.

5. The multifunctional helmet (as in claim 1), wherein said the third modularity comprises of an impact liner that provides protection from bumps and impacts.

Wherein said impact liner protects at 360° reducing possible blunt trauma to the cranium that could cause concussions

Wherein said impact trauma provides extreme comfort.

Wherein said impact liner is circular at the base to fit into the helmet perimeter, and merges into the shape of a 100 Percentile (anthropometric) cranium and, as such, provides two crescent-shaped pockets on the right and left side of the impact liner.

Wherein said the circular base (270° of the circular is a flat and deep flange (to accommodate machine screws) and 90° of the circular base towards the front is of nominal thickness to provide support with the helmet.

Wherein said two crescent-shape pockets house electronics pertaining to the functions performed by the helmet users, which may include sensory and cognitive devices such as GPS (geographic positioning system), camera, future night vision, power packs, etc.

Wherein said impact liner uses hybrid foams to provide extreme comfort to the wearer.

Wherein said impact liner circular flange is attached to the multifunctional helmet shell with five machine screws equally spaced on the 270° perimeter for loading and unloading electronics, and when needed.

6. The multifunctional helmet (as in claim 1), wherein said the fourth modularity comprises of a ballistic shell that provides protection from flying fragments from grenades and bombs as well as shots from 0.22 caliber pistol.

Wherein said the shell is fabricated from a series of hybrid aramid materials and resins where the composition of the materials shall remain the custody of the inventors, and where each shell structure shall comprise of a number of hybrid aramid material panels (piles) combined.

Wherein said thickness of the shell will vary by the duty each helmet is to perform whereby a higher ballistic threat shall demand a larger number of piles.

Wherein said suspension components hold the multifunctional helmet (as in claim 1) in place and the suspension system is attached under the chin.

7. The multifunctional helmet (as in claim 1), wherein said the fifth modularity comprises of a ballistic helmet add-on slipped on top of a ballistic shell (as in claim 6) during direct fire from small arms to enhance protection level without constant weight on the head.

Wherein said helmet add-on structure offers enhanced protection to multifunctional (as in claim 1) helmet and also follow the shapes of current existing helmets in use including Personnel Armor System Ground Troops (PASGT) and modified derivative, Advanced Combat Helmet (ACH) and the shapes of other helmets of the same general shape.

Wherein said helmet add-on is easily attached or detached depending on levels of threats by simply placing it on top of the multifunctional helmet as well as existing helmets (including PASGT and ACH) allowing the helmet add-on structure to float atop the prescribed military helmets.

Wherein said helmet add-on is connected to ballistic helmet with two extenders at right and left of the helmet add-on that attaches with the suspension system (as in claim 6) with Velcro®.

A minor dimensional tolerance in the interior of the fifth modularity shell allows helmet shell and helmet add-on to slightly rotate to ricochet the bullet.

To reduce the weight, material has been removed at the crown of the helmet add-on which is designed by taking into consideration the prone position posture where a direct hit is statistically improbable.

Provides protection from larger than .22 caliber pistol weapons (i.e., AK47).

The helmet add-on is fabricated from a series of hybrid aramid materials and resins whereby the composition of the materials shall remain the custody of the inventors, and where each shell shall comprise of a number of composite material panels (plies) combined.

A Helmet add-on for existing helmets (including PASGT and ACH) is to cover the shape of the given helmet from brim to the top, covering right and left temples, and offering a vertical enlargement without interfering with the combatants taking aim in prone position.

To keep the helmet add-on as light as possible, material has been removed from the top of the helmet add-on to reduce the weight, having considered areas of least statistical improbable for being under the direct fire (in prone position).

Helmet add-on internal surface is to be slightly lubricated with dry lubricants not hazardous to health keeping the internal surface slightly slippery to ricochet bullets by slightly rotating at the point of contact.

Internal surface of the helmet add-on is to be adjusted to keep clear in areas where any hardware and/or helmet

brim may protrude (as in the case of the current standard PASGT and ACH).

Wherein the helmet add-on (as in claim 1) has a two-point suspension subsystem that is to hold the helmet add-on (as in claim 1) in place without falling or rocking when the wearer is moving.

Wherein the two-point suspension system (as in claim 1) has a built-in "weak link" if the suspension system needs to break off for safety reasons.

Helmet add-on is to be fully compatible with the existing necessary attachments.

8. The multifunctional helmet (as in claim 1), wherein the helmet production process forms the multifunctional helmet.

The configuration of half sphere truncated exactly at the great circle and extended cylindrical stem forms a new shape, where the inventors have designed a preforms that shall form the prepared material into the helmet.

The preforms will be hand or laser cut.

Preforms are loaded into the Vacuum Mold designed by inventors wherein a green (uncured) helmet is to be formed.

The preforms is to be loaded into the mold under a given temperature of the heating fluid, as determined by the inventors, for molding the green helmet in a (vertical) press.

The green helmet is passed through an electronic beam to cure.

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