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(54) CHANGEABLE JAW-PROTECTING HELMET

(57) The present invention pertains to the technical field of safety helmet, and more particularly relates to a safety helmet with changeable chin-guard structure, comprising a helmet body, a chin-guard with two holders, and two mounting plates symmetrically arranged on the two opposite sides of the helmet body, wherein the mounting plates and the helmet body are fixedly connected, or formed in one piece, the safety helmet is characterized in that each mounting plate is provided with two grooved tracks and cooperates with two movable nails, wherein one end of each moving nail is penetrated into the corresponding track of the mounting plate, and each holder is connected with two moving nails, driven by the china-guard via the holders, each moving nail is moveable along the corresponding guide-track groove; constrained by the moving nails and the grooved tracks, the position of the chin-guard is changeable. In comparison with the existing technology, the present invention no longer requires the sliding grooves arranged on the chin-guard, thus the bending strength of the chin-guard is enhanced so that the rupture strength of the holders is enhanced, in addition, abandoning the sliding grooves on the holders can effectively eliminate the hidden problems associated with stress concentration, the strength of the chin-guard is thus further enhanced.

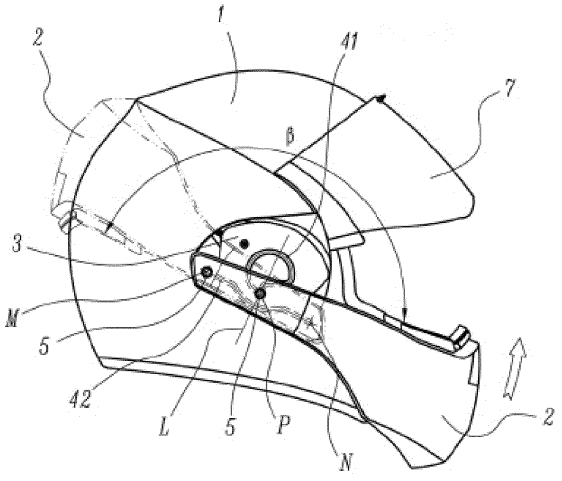

Figure 6

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Description

Technical Field

[0001] The present invention relates to a safety helmet for protecting head, particularly to a safety helmet for the drivers of motor vehicles, especially the motor bikes, and more particularly to a safety helmet with changeable chin-guard structure.

Background

[0002] The drivers of racing cars and motorbikes have to wear a safety helmet for protecting head, a typical safety helmet usually comprises a helmet body, and a goggle, facemask and chin-guard which are mounted on the helmet body, wherein the goggle is used to protect eyes from hurt by sun shine or other strong light, the facemask is used to prevent the dust or like harmful particles from entering the helmet, and the chin-guard is used to effectively protect the chin of the driver in case of collision. It is well known that a conventional safety helmet usually includes two types: full face and open face helmets, wherein the chin-guard and helmet body of a full-face helmet are usually firmly connected with each other or even formed in one piece, in other words the chin-guard is fixed with respect to the helmet body, putting it this way the structure of the helmet is certainly simple and safe enough, but rather inflexible, for example, even when allowed by the environment, the user has to take off the helmet before doing drinking, calling, or other like actions; in contrast, the chin-guard of an open face helmet is movable, but usually a movable chin-guard only can reach around the top of the helmet body, meanwhile the chin-guard is in an open state, namely the china-guard is not able to cling to the helmet body, this position of the chin-guard can satisfy the requirements of the driver on drinking, calling and like, but meanwhile the driver should not continue to drive, even in a safe condition.

[0003] As such, a Spain patent application ES2329494T3 discloses a helmet with structurally changeable chin-guard, comprising a helmet body, a chin-guard, two mounting plates, two moving pins and two fixed pins, wherein the mounting plates are symmetrically arranged on and firmly connected to the two sides of the helmet body as a whole, each mounting plate is provided with a grooved track formed by several grooved tracks connected, in addition the two holders of the chin-guard are respectively provided with grooved sliding rails, one end of each fixed pin is firmly fixed on the helmet body, the other end is penetrated into and moveably connected to the sliding rail on the corresponding holder of the chin-guard, one end of each moving pin is firmly fixed on the chin-guard, and the other end is penetrated into and moveably connected with the grooved track of the corresponding mounting plate, the most prominent feature of this technical scheme is that the position of its chin-guard can be flexibly changed according to need, namely the chin-guard can be raised from a full face position where the chin of the driver is protected to an open face position where the chin-guard is opened and moved up to behind the helmet body, in other words the safety helmet can be shifted between the modes of open face helmet and full face helmet, and in open face mode the chin-guard is stored and clings to the upper rear side of the helmet body. However the technology described above still has drawbacks, which mainly can be seen in that the perforated groove shaped sliding rails formed on the holders impair the strength of the chin-guard, as the perforated groove shaped sliding rails not only weaken the chin-guard in bending modulus, but also reinforce the tendency of stress concentration, the holders are thus easy to be broken in accident of collision; furthermore, the spacing of the fixed, and moving pins are various, when the chin-guard at the two travelling ends corresponding to the full face and open face helmet modes, as limited by the structure, the spacing of the fixed pins and moving pings must be small, the reliability and strength of the clinging of the chin-guard to the helmet body is quite weak.

Summary of the invention

[0004] The present invention provides a safety helmet with changeable chin-guard structure, with the purpose of allowing the chin-guard to change its position in relation to the helmet body, so as to achieve the structural shift between the full face and open face modes of the helmet, while effectively reinforcing the resistance to fracture of the holders of the chin-guard, and improving the reliability and strength of the clinging of the chin-guard to the helmet body.

[0005] The technical scheme of the present invention could be described as:

[0006] A safety helmet with changeable chin-guard structure, comprising a helmet body, a chin-guard with two holders, and two mounting plates arranged on the two opposite sides of the helmet body, the mounting plates and the helmet body being fixedly connected, or formed in one piece, characterized in that:

each mounting plate is provided with two grooved tracks, each which may be a single grooved track or a multi-segment grooved track formed by several grooved tracks connected; the helmet further comprise four moving nails,

wherein two moving nails, one holder and one mounting plate form a assembly and are arranged in a same side of the helmet body; in a same assembly the two moving nails are corresponding to the two tracks of the mounting plate respectively, one end of each moving nail is penetrated into the respective track while the other end is connected to the holder of the same assembly; driven by the chin-guard via the holders, the moving nails are movable along the corresponding tracks respectively, and

constrained by the moving nails and tracks, the position of the chin-guard is changeable.

[0007] The tracks on the two mounting plates are symmetrically arranged in relation to the median plane of the helmet body.

[0008] The spacing of the two moving nails in a same assembly is constant.

[0009] Each of the tracks has two ultimate positions, including a starting position and an ending position, and for each track, the track plane of the portion of the track to the starting position or/and end position is gradually inclined.

[0010] The ending position and starting position of one of the two tracks of each mounting plate are completely or partially overlapped.

[0011] The two sidewalls of at least one portion of the tracks forms a gradually shrinking or/and expanding track width.

[0012] The mounting plates are provided with shrinkable grooves.

[0013] Each of the moving nails has a stepped journal structure, and the shoulder of the stepped journal is movably connected to the track plane.

[0014] The safety helmet further comprises a separator disposed between each holder and the corresponding mounting plate; the separators are moveably connected with the track planes of the tracks.

[0015] The separators and the moving nails are fixedly connected, or formed in one piece.

[0016] The separators and the holders are formed in one piece.

[0017] The separators are provided with through holes for the moving nails 5 to go through.

[0018] The moving nails are provided with recesses, engaged with clamping plates. The safety helmet further comprises covers; the clamping plates are enclosed between the covers and holders.

[0019] One of the two tracks on the same mounting plate is configured in a closed loop annular track or an open loop arc track.

[0020] One of the two tracks on the same mounting plate is configured in a closed loop elliptical track or an open loop elliptical arc track.

[0021] One of the two tracks on the same mounting plate comprises a climbing, a crossing and a falling track.

[0022] The crossing track is an arc or an elliptical arc track.

[0023] The falling track is an arc or an elliptical arc track.

[0024] The climbing track is an arc or a straight line track.

[0025] The climbing track comprises a starting track.

[0026] The starting track is a straight or an arc track.

[0027] One of the two tracks on the same mounting plate comprises a reciprocating track.

[0028] The reciprocating track is a straight line track.

[0029] The track comprising the reciprocating track is a branched track.

[0030] The safety helmet further comprises road switching apparatuses arranged between the mounting plates and the helmet body, each of the road switching apparatuses comprises an elastic piece, comprising a sinking structure, a stopper and an elastic return structure.

[0031] The safety helmet with changeable chin-guard structure according to the present invention adopts a structural scheme of four moving nails cooperating with the tracks on the mounting plates, wherein the moving nails move with the chin-guard, through constraining the motion of the moving nails by the tacks formed on the mounting plates to define the motion trajectory of the chin-guard finally, so as to realize the function of changing the relative position of the chin-guard according to need, and to realize the structural shift between full face and open face helmet modes; and more importantly, in comparison with the prior art ES2329494T3, as in the present invention the grooved sliding rails are no longer required on the chin-guard, the bending modulus of the chin-guard is enhanced, and thus the rupture strength of the chin-guard is improved, in addition, abandoning the structure of grooved sliding rails for the holders can effectively eliminate the hidden problems associated with stress concentration, and thus to reinforce the strength of the holders as well, in addition again, between the two moving nails connected to the same holder a longer and constant relative distance is always maintained, thus the clinging of the chin-guard to the helmet body is more robust, and the motion of the chin-guard is more stable.

Brief Description of the Drawings

[0032] Further details and advantages of the present invention are explained using an embodiment, with reference to the attached drawings. In the drawings:

Fig. 1 is a trimetric view of a safety helmet with changeable chin-guard structure according to the present invention;

FIG. 2 is an exploded view of the safety helmet with changeable chin-guard structure in Fig. 1;

Fig. 3 is status view of the shifting process of the helmet in Fig. 1 from full face mode to open face mode;

Fig. 4 is a status view of the position change of the moving nails in the tracks while the helmet in Fig. 3 is shifted to full face mode from open face mode;

Fig.5 is a side view of a safety helmet with changeable chin-guard structure in full face mode according to the present invention;

Fig. 6 is a view showing the geometric relations of the helmet in its full face and open face modes in an embodiment of the present invention;

Fig. 7 is a trimetric view of a mounting plate in the present invention;

Fig. 8 is a front view of the mounting plate in Fig. 7;

Fig. 9 is the K-K sectional view of the mounting plate in Fig. 8.

Fig. 10 is a front view of a mounting plate having a closed loop annular track according to the present invention;

Fig. 11 is a sectional view of an assembly consisting of a moving nail, mounting plate and holder of the chin-guard in an embodiment of the present invention;

Fig. 12 is a sectional view of the assembly consisting of a moving nail, mounting plate and holder of the chin-guard in another embodiment of the present invention;

Fig. 13 is a sectional view of the assembly consisting of a moving nail, mounting plate and holder in the third embodiment of chin-guard of the present invention;

Fig. 14 is a sectional view of the assembly consisting of a moving nail, mounting plate and holder of the chin-guard in the fourth embodiment of the present invention;

Fig. 15 is a schematic view of the track with shrinking and expending width in an embodiment of the present invention;

Fig. 16 is a front view of a mounting plate with an open loop arc track according to the present invention;

Fig. 17 is a front view of a mounting plate with a closed loop elliptical track according to the present invention;

Fig. 18 is a front view of a mounting plate with an open loop elliptical arc track according to the present invention;

Fig. 19 is a front view of another mounting plate with an open loop elliptical arc track according to the present invention;

Fig. 20 is a front view of a mounting plate with a track divided into a climbing, a crossing and a falling track according to the present invention;

Fig. 21 is a front view of another mounting plate with a track divided into a climbing, a crossing and a falling track according to the present invention

Fig. 22 is a front view of a mounting plate with a straight line starting track according to the present invention;

Fig. 23 is a front view of a mounting plate with an arc starting track according to the present invention;

Fig. 24 is a front view of a mounting plate with a straight line reciprocating track according to the present invention;

Fig. 25 is a front view of a mounting plate with an arc reciprocating track according to the present invention;

Fig. 26 is a status view of the moving nails moving on the tracks while the helmet is shifted form full face mode to open face mode;

Fig. 27 is a front view of a mounting plate with a branched track according to the present invention;

Fig. 28 is a front view of another mounting plate with a branched track and a corresponding road switching apparatus according to the present invention;

Fig. 29 is a front view of another mounting plate with a branched track according to the present invention;

Fig. 30 is a structural and status view of the helmet with a road switching apparatus in an embodiment of the present invention;

Fig. 31 is a status view of the moving nails moving on the tracks of the mounting plate in Fig. 28 while the helmet is shifted from full face mode to open face mode.

Embodiments

[0033] The present invention will be further explained in detail using embodiments, as shown by figures 1 - 31:

[0034] The safety helmet with changeable chin-guard structure disclosed herein, comprises: a helmet body 1, a chin-guard 2 and two mounted patters 3, wherein the chin-guard 2 has two holders 2a, and are arranged on the two opposite sides of the helmet body 1; the most prominent feature of the present invention lies in that on each mounting plate two grooved tracks 41, 42 are formed, each which may be formed by one single grooved track (namely the entire grooved track is formed according to a same rule), or a multi-segment grooved track (namely the grooved track is a combined track consisting of several tracks formed according to different rules), as shown by Fig. 10, the track 41 is such an single track, but track 42 is formed by five sections connected, consisting of linear grooved tracks 42c, 42g, transitional grooved tracks 42d, 42f, and an arc grooved track 42e , but in Fig. 21, the track 41 consists of several sections, while the track 42 has one single section only. In addition, the helmet further comprises four moving nails 5 movable in relation to the mounting plates 3, wherein two of the moving nails 5, one holder 2a, and one mounting plate3 form an assembly and are mounted on a same side of the helmet body 1, one end of each moving nail 5 is fixedly connected, and thus moves with the holder 2a of the same assembly, and the other ends are penetrated into and moveably connected with the tracks 41 and 42 on the mounting plates of the same group respectively; it should be noted that the mounting plates 3 can be firmly fixed on the helmet body 1, or can be part of the helmet body 1, in other words the mounting plates 3 and the helmet body 1 can be formed in one piece, furthermore the connection between these two parts can be achieved by screw, rivet, welding, buckle plug or other fixation means known in the art, in addition the mounting plates 3 can adopt an integral design or a split type design, while adopting a split type design, the mounting plates 3 comprises several parts, as shown by Fig. 2, the mounted patter 3 therein consists of an outer plate 3a, inner plate 3b and bottom plate 3c, wherein the track 41 is formed by the grooves respectively on the outer, and inner plates 3a, 3b; it should be further noted that, each of the tracks

41, 42 comprises two track sidewalls A, and the portions of the outer surface of the mounting pattern 3, which are close to and spreads along the tracks 41, 42, are called track plane B, as shown by Fig. 7 - 9, 11 and 12, the sections of the track plane B and two track sidewalls A are allowed to be connected through curve or radius transition, the best configuration of the two track sidewalls A of a track is that the two track sidewalls A are both perpendicular to the median plane S, and are the isometric surface of one another, of course, other arrangements for the track sidewalls A are possible as well, the median plane S described herein is such a plane: as shown by Fig. 1, it is a longitudinal section of the helmet, across the spine of the helmet, some distinguishing characteristic or essential positions on the two sides of the helmet, such as the hinging holes or lugs for connecting the goggle 6 and facemask 7, are symmetrically arranged in relation to the plane, general speaking, the median plane S is a symmetry plane of the helmet through the back and top of the head, the nose and the mouth of the driver; in addition, there exists two intersection lines L1 for the two track sidewalls A of the same track or the extension planes thereof, and the outer surface of the mounting plate 3 or the extension plane thereof, and there also exists a median line on the outer surface of the mounting plate or the extension plane thereof, corresponding to the two intersection lines, the media line is called trajectory C, as shown in Fig. 8 - 12, the intersection lines L1 and the trajectory C satisfy the following rules: through a point at the trajectory C only one sphere can be made tangent to the two intersection lines L1 simultaneously, and thus the distance between these two tangent points is the width of the track 41 or 42 at this point; the trajectory C represents the motion trajectory of the moving nails 5, or in other words the trajectory C represents the motion trajectory of the moving nails 5 constrained by the tracks 41, 42; at last, the moving nails 5 may be bolts, studs, pins or two-head rivets which have a variety of transverse sections, but the optimum transverse sections include circular, elliptical, rectangular or polygonal shapes, when the moving nails 5 with a rectangular or polygonal transverse section are adopted, the edges of these moving nails 5 are required to be chamfered; it should be noted that in the present invention the moving nails 5 may be fixedly or moveably connected with the chin-guard 2, but it had better to keep the relative positions of the axis 05 of the moving nails 5 constant to the chin-guard 2 (small changes due to manufacture error, assembly error, thermal deformation, or deformation under the action of force are allowed), this means that the relative position of the axes 05 of the two moving nails 5 connected with the same holder 2a is constant, general speaking, the spacing of the two moving nail 5 is constant; of course, when the holders 2a deform, the change of the relative position of the axes 05 of the two moving nails is allowed, in here, the so-called fixed connection means that the moving nails 5 and the chin-guard 2 have a stationary fit, or are formed in one piece simply, on the contrary, if a moveable fit is adopted that means the moving nails 5 and the chin-guard 2 have a clearance fit, namely the moving nails 5 can be moveable within a certain scope in relation to the chin-guard 2, i.e. rotating or sliding; obviously, the two moving nails 5 in the same assembly are respectively constrained by the two tracks 41, 42 on the same mounting plate 3, as these two moving nails 5 are also connected to the same holder 2a, noted that the mounting plate 3 and the helmet body 1 are firmly fixed with each other, or formed in one piece, in each assembly, when raising the chin-guard 2, the holder 2a drives the two moving nails 5 on it to move along the tracks 41, 42 on the corresponding mounting plate 3, conversely, when pulling down the chin-guard 2, the holder 2a drives the two moving nails 5 on it again to move back along the tracks 41, 42 on the corresponding mounting plate 3, it is not difficult to find that, the tracks 41, 42 on the mounting plates constrain the motion of the moving nails, and so as to constrain the motion trajectory of the chin-guard 2 ultimately, in other words the present invention realizes the function of changing the relative position of the chin-guard 2 to the helmet body 1 according to need, namely realizing the shift between full face and open face structures, as well as allowing the chin-guard 2 to be stored on and cling to the surface of the helmet body 1; there is no doubt that whatever raised or pulled down, the chin-guard 2 must pass through the goggle 6 and facemask 7, the chin-guard 2 has two ultimate positions as well: full face position and open face position, as shown in Fig, 6, when the chin-guard 2 is in its full face position the helmet is just similar to an existing full face helmet, effectively protecting the driver from injury in case of collision, and when the chin-guard 2 is in its open face position, the helmet is similar to an existing open face helmet, allowing the driver to drink or call; Fig. 3 gives a status view of the process of the helmet being shifted from full face mode to open face mode, Fig. 4 shows the position changes of the moving nails in the tracks 41, 42 for the chin-guard 2 shown in Fig .3, wherein Fig. 3 (a) and Fig. 4 (a) show the helmet in full face mode, wherein the chin-guard 2 is in a protective position, Fig. 3 (b) and Fig. 4 (b) show the helmet of which chin-guard 2 is just raised, wherein the chin-guard 2 is starting to climb, Fig. 3 (c), Fig. 4 (c), Fig. 3 (d), and Fig. 4 (d) show a crossing status, wherein the chin-guard 2 is crossing the goggle 6 and facemask 7, Fig. 3 (e) and Fig. 4 (e) show the helmet in open face mode, wherein the chin-guard 2 clings to the upper rear portion of helmet body 1.

[0035] The tracks 41, 42 on the two mounting plates 3 may be arranged symmetrically or asymmetrically, but the symmetrical arrangement may be better as the with this arrangement the structure of the helmet is simpler and the motion of the chin-guard is steadier; it should be noted that the symmetrical arrangement of the tracks 41, 42 of the two mounting plates 3 in relation to the median plane S could be described as: when perpendicularly projecting the trajectories C of the tracks 41, 42 of each mounting plate 3 onto the median plane S of the helmet

at the same time, the projections of the trajectories C of the corresponding tracks are completely overlapped or one trajectory C is contained by the other one, more particularly, the projections of the trajectories C of the tracks 41 of the two mounting plates 3 on the median plane S are fully overlapped, or one trajectory projection is fully contained by the other one, at the same time the projections of the tracks 42 of the mounting plates on the median S are fully overlapped as well, or one trajectory projection is fully contained by the other one, the so-called "contained" means the shorter trajectory projection is completely within the longer one; it should be noted that in the present invention the symmetrical arrangement of the tracks 41, 42 of the two mounting plates 3 in relation to the median plane S of the helmet body 1 is only with regards to the trajectories C of the tracks 41, 42, and does not require the tracks on the two mounting plates 3 to be equal or symmetrical in width and length, in order words the tracks 41 on the two mounting plates 3 are allowed to have different widths and lengths, in a similar way the tracks 42 on the mounting plates are also allowed to have different widths and lengths, in fact the tacks 41, 42 on the same mounting plate 3 are allowed to have different widths.

[0036] In the present invention, the tracks 41, 42 are configured to have two ultimate positions for each, including starting positions 41 a, 42a and ending positions 41b, 42b, a preferred embodiment can be: in the two moving nails connected with the same holder 2a, while the one cooperating with the track 41 is in the starting position 41 a, the other one cooperating with the track 42 should be in the starting position 42a as well, and while the one cooperating with the track 41 is in the ending position 41 b, the other one cooperating with the track 42 should be in the ending position 42b as well, vice versa; obviously, the position of the chin-guard 2 in full face mode can be determined correspondingly while the moving nails 5 are in the starting positions 41 a, 42a, and in like manner, the position of the chin-guard 2 in open face mode can be determined correspondingly while the moving nails 5 are in the ending positions 41b, 42b, in order to allow the chin-guard 2 in the two ultimate positions (the full face position and the open face position) to cling to the helmet body 1, some portions of the tracks 41, 42, leading to the starting positions 41 a, 42a and the ending positions 41b, 42b, can be configured to have a gradually inclined shape for the track plane B thereof, as shown by Fig. 7, 8, and 9, thus through the sinking track plane B , the holders 2a are pulled down by the moving nails to cling to the surfaces of the mounting plates 3, namely this structure is able to allow the chin-guard 2 to cling to the helmet body 1 more tightly, it should be noted that the starting positions 41 a, 42a may be overlapped or not, as shown by Fig. 8.

[0037] In the present invention, the starting position 41 a and ending position 41 b of the track 41 may be partially or fully overlapped, of course the ending position 41 b and starting position 41 a may not be overlapped at all, Fig. 10 shows an embodiment in which the starting and ending positions are fully overlapped, while Fig. 15 shows an embodiment in which the ending and starting positions are not overlapped at all; obviously, while the starting and ending positions are fully overlapped, the trajectory C of the track 41 is a closed loop track, and the trajectory C of the track 42 must be an open loop track, thus the trajectory C of the track 41 has a point of intersection p, a preferred point P can be determined as: as shown by Fig. 6, it is supposed that while the chin-guard 2 is in the full face position, the axis 05 of the moving nail 5 cooperating with the track 42 is at the point M, and while the chin-guard 2 is in the open face position, the axis 05 of the moving nail 5 cooperating with the track 42 is at the point N, and the angle rotated by the chin-guard 2 from the full face position to the open face position in relation to the helmet body 1 is β, thus the point of intersection of the line MN rotated by $90°-\beta/2$ degrees in the direction of the rising motion of the chin-guard 2 around the point M and the mid-perpendicular line L of the line MN is the point P, it should be pointed out that while the track 41 is configured in closed loop, if the moving nail cooperating with the track 42 is at the point M or point N, the point P at that time is the point through which the axis 05 of the moving nail 5 cooperating with the track 41 passes, in order words according to the position of the moving nail 5 cooperating with the track 42 on the holder 2a and the rotation angle of the chin-guard 2, the position of the moving nail 5 cooperation with the track 41 on the holder 2a is determined,; it should be noted that the points M and N should be in the trajectory C of the track 42, but point M and the starting position 42a of the track 42, the point N and the ending position 42b of the track 42, may be overlapped or not.

[0038] In the present invention, the two track sidewalls A forming a same track may be parallel or equidistant from each other, or not parallel or not equidistant, in fact while the moving nails 5 are moving along the tracks 41, 42, in order to enhance the motion stability of the moving nails 5, the track sidewalls A on some portions of the track 41, 42 may be configured in a tapered shape, namely the track sidewalls A of at least one portion of the tracks 41, 42 form a gradually shrinking or/and expanding track width, as when the two moving nails 5 move on the tracks 41, 42 of the same mounting plate 3 to a position in which the motion directions of the two moving nails are approximately opposite, for example, while the chin-guard 2 moves to the middle of the crossing track and the adjacent area, if the radiuses of curvature of the tracks 41, 42 at that point are close in design, impacted by the force of the chin-guard 2, the motion directions of the moving nails 5 at that point may be suddenly changed easily, namely the motion of the moving nails becomes unstable, in order to avoid this kind of circumstances from happening, a portion of the tracks 41, 42 formed by the two track sidewalls A can be configured in a structure with gradually shrinking and/or expanding width, as shown by Fig. 15, on the path from U42 to W42, the width of track 42 is

gradually increasing, on the path from W42 to V42 the width of the track 42 is gradually decreasing, on the path from U41 to W41, the width of track 41 is gradually increasing, and on the path from W41 to V41, the width of track 41 is gradually decreasing, there is no doubt that the track layout described above allows the moving nails 5 to quickly slide to the points W41 and W42, and pass through these points under the inertia effect, whatever the chin-guard 2 is shifted from the full face position to the open face position or shifted from the open face position to the full face position, the above effect can be achieved when the chin-guard 2 passes through the points W41 and W42, namely the chin-guard 2 of the present invention has greater stability; it should be noted that the shrinking width and expanding width may be applied on the track 41 or/and track 42, the shrinking width or expanding width may be a single formation, or consist of a variety of formations.

[0039] In the present invention, the mounting plates 3 are provided with shrinkable grooves 12, arranged on the both or single side thereof, and used to allow the moving nails 5 to travel more smoothly and stably, wherein the width of a portion of the tracks 41, 42 may be slightly smaller than the diameter of the portion of the journal of the moving nails 5 in the track, namely the moving nails 5 and the portion of the tracks 41, 42 have an interference fit, thus the moving nails 5 must prop open the two track sidewalls A of each of the tracks 41, 42 by force to pass through; it should be noted that the mounting plates 3 per se can be made of elastic materials, namely even without the structure of shrinkable groove, the tracks 41, 41 can also have an interference fit with the moving nails 5, of course the elasticity of the tracks 41, 42 can be greater with the structure of shrinkable groove, accordingly the greater interference can be used to improve the motion stability of the moving nails 5 for the tracks with a shrinking or/and expanding width structure.

[0040] In the present invention the moving nails can have a stepped journal structure, the so-called stepped journal structure is to have different transverse sections with jump changes in size at different positions along the axis 05 of the moving nails 5, for example, if the main body of the moving nail 5 is a cylinder, the moving nail 5 has at least two different shaft sections in diameter with a stepped journal structure, obviously, the adoption of the stepped journal structure can separate the chin-guard 2 and the holders 2a from the mounting plates 3 and the helmet body 1 by an appropriate distance, this could prevent the interference between the chin-guard 2 and the helmet body 1 (and the mounting plates 3) from happening while the chin-guard 2 travels in relation to the helmet body 1, as well as reduce the contact area between the chin-guard 2 and the mounting plates 3, so as to reduce drag, Fig. 11 shows the moving nails 5 with stepped journal, obviously shaft shoulder of the moving nails 5 may have a sliding fit with the track plane B, and the holders 2a is separated by the moving nails 5 from the helmet body 1 and the mounting plates to a certain distance $\delta 1$; it should be noted that the moving nails 5 may slide and/or rotate in relation to the track sidewalls A, and the shaft shoulder of the moving nails 5 may have a sliding fit (the moving nails 5 do not rotate around its axis 05) or/and rotating fit (the moving nails 5 rotate around its axis 05) with the track plane B.

[0041] In the present invention separators 2b may be arranged between the holders 2a of the chin-guard 2 and the mounting plates 3, the separators 2b are moveably connected to the track planes B of the tracks 41, 42 (including sliding and rotating manners); obviously, as the occurrence of the separators 2b, the main bodies of the holders 2a are separated from the mounting plates 3 and the helmet body 1 by a certain distance $\delta 2$, thus this structure could prevent the interference between the chin-guard 2 and the helmet body 1 (and the mounting plates 3) from happening while the chin-guard 2 travels in relation to the helmet body 1, as well as reduce the contact area between the chin-guard 2 and the mounting plates 3, so as to reduce drag; it should be noted that in the present invention the structure of arranging the separators 2b between the holders 2a and the mounting plates 3 includes two types: the first one is to form the separators 2b as part of the holders 2a, namely they are molded in one piece, as shown by Fig. 12; in the second type the separators 2b are independent parts, configured in a annular shape, and arranged between the holders 2a and the mounting plates 3, as shown by Fig. 13, in this case the separators 2b may be fixedly or moveably connected to the holders 2a; In particular, the separators 2b may be penetrated into the tracks 41, 42 and have a sliding or/and rotating fit with the track sidewalls A, as shown by Fig. 14; it should be noted that the separators 2b may be fixedly connected with the moving nails, or they can be simple formed in one piece. The separators 2b in the present invention are provided with through holes, through which the moving nails 5 are penetrated into the tracks 41, 42; the moving nails 5 are provided with recesses 5a, accordingly the helmet further comprises clamping plates with recesses 8a, the recesses 5a of the moving nails 5 are engaged with the recesses 8a of the clamping plates, as shown by Fig. 2, 11, 12, 13 and 14, to prevent the moving nails 5 from loosening; the present invention further comprises covers 9, which are fixedly connected to the holders by way of snap-in, or like ways, in addition, the clamping plates 8 are enclosed between the covers 9 and holders 2a.

[0042] The tracks 41, 42 of the present invention may have a variety of configurations, described as follows:

1) The track 41 is configured in a closed loop annular shape, as shown by Fig. 10, or in an open loop arc track, as shown by Fig. 16, wherein the so-called annular track refers to the track 41 on the mounting patter 3, when being projected onto the median plane S of the helmet body 1, the projection of the trajectory S thereof on the median S is a ring; the so-called arc track refers to the track 41 on the mounting pattern

3, when being protected onto the median S of the helmet body 1, the projection of the trajectory S thereof on the median S is an arc; obviously, the annular track pertains to the closed loop tracks, while the arc track pertains to the open loop track; it should be noted that, in order to shift the helmet from the full face mode to the open face mode, the track42 should be configured in an open track, namely a non-closed track, in this case the track 42 may be an single grooved track (not shown in the drawings), or formed by several grooved tracks connected, as shown by Fig. 10 and 16.

2) The track 41 is configured in a closed loop elliptical track, as shown by Fig .17, or an open loop elliptical arc track, as shown by Fig. 18, wherein the so-called elliptical track refers to the track 41 on the mounting pattern 3, when being projected onto the median plane S of the helmet body 1, the projection of the trajectory S thereof on the median S is a ellipse; the so-called elliptical arc track refers to the track 41 on the mounting pattern 3, when being protected onto the median S of the helmet body 1, the projection of the trajectory S thereof on the median S is an elliptical arc; it should be noted that, besides the ellipse and elliptical arc described above, in a broad sense, the track 41 can be configured in a variety of ellipse-like shapes, which refer to the ellipse-like curves, of which trajectory C has a ellipse-like curve projection or even a multiple-segment ellipse-like curve, satisfying the harmonic curve equation or spline function equation, on the median S of the helmet body 1, obviously, the elliptical track pertains to the closed loop track, while the elliptical arc pertains to the open loop track; as aforementioned, in order to assure that the chin-guard 2 can be shifted from the full face mode to the open face mode, the track42 should be configured in an open track, namely a non-closed track, in this case the track 42 may be an single grooved track as shown in Fig. 19, or a multiple-segment grooved track consisting of several grooved tracks connected, as shown by Fig. 17 and 18.

3) The track 41 may be divided into three portions, including a climbing, a crossing and a falling track, corresponding to the climbing, crossing and falling motion of the chin-guard 2, it should be noted that, even the track 41 is a single track, such as the annular track shown in Fig. 10, the arc track shown in Fig. 16, the elliptical track shown in Fig. 17 and the elliptical arc track shown in Fig. 18, the division still applies; corresponding to the different statuses of the chin-guard 2 moving from the full face position to the open face position: the climbing refers to the process of the chin-guard 2 leaving from the position at which the chin 2c of the chin-guard 2 clings to the helmet body 1 to rise, meanwhile the portion of the track 41 through which the moving nails 5 passes is the climbing track, in a similar way, the crossing refers to the process of the chin-guard 2 passing through the goggle 6 and facemask 7 (at that time the facemask 7 is fully or partially opened), meanwhile the portion of the track 41 through which the moving nails 5 passes is the crossing track, in a similar way again, the falling refers to the process of the chin 2c of the chin-guard 2 moving to the storage position and cling to the helmet body 1, meanwhile the portion of the track 41 through which the moving nails 5 passes is the falling track; obviously while the chin-guard 2 is shifted from open face mode to full face mode, the processes described above are inverse; it should be particularly noted that the climbing, crossing and falling tracks of the track 41 can be formed by different grooved tracks, for example the climbing track may include the straight line or arc tracks, while the crossing track and falling track may include the arc or elliptical arc tracks, Fig. 20 and 21 shows the track 41 formed by three main grooved tracks A41, B41, and C41 and several transitional grooved tracks D41, wherein the tracks A41, B41 and C41 are corresponding to the climbing, crossing and falling tracks respectively, meanwhile the track 41 may be a closed loop or an open loop track, as shown by Fig. 20 and 21 respectively, in particular, while the crossing and falling tracks are the arc or elliptical arc tracks, they can be formed in a track with single formation (a single track),such as the embodiment shown in Fig. 20 and 21, in which the crossing falling tracks are part of a single track.

4) The climbing track comprises a starting track 41 c, which is the portion of the track 41 through which the moving nails 5 travel from the full face position, the starting track 41 c is used to cooperate with the exit action of the chin-guard 2, including the process to allow the goggle 6 and facemask 7 to have sufficient time to complete the actions from unlocking, bouncing, and topping, or in other words to allow the goggle 6 and facemask 7 to be fully opened from closed, while the moving nails 5 cooperating with the track 41 are moving on the starting track 41 c, the moving nails 5 cooperating with the track 42 stays in the point M, almost not move or just slightly move; it should be noted that the staring track 41 c can be separate or part of the climbing track, it can be a single track or formed by several tracks connected; in particular, the starting track 41 c can be made in a straight line or arc shape, providing convenience for the layout, the starting track 41 c shown in Fig. 22 is a straight line track, while the starting track 41 c shown in Fig. 22 is an arc track, preferably, the center of the arc should be placed in the point M of the track 42, and the radius of the arc should equal to the axle distance of the two moving nails 5 of the same holder 2a.

5) The track 41 comprises a reciprocating track 41 d, which is a portion or all of the track 41 in which the cooperating moving nails 5 move back and forth while the chin-guard 2 is shifted from full face mode to open face mode in a nonstop way, similarly, while the chin-guard 2 is shifted from open face mode back to full face mode in a nonstop way, there exists reciprocating motion for the moving nails 5 in a portion or all of the track 41; the reciprocating track 41 d may be straight line track, its trajectory C is a straight line, as shown by Fig. 25, the reciprocating track 41 d may be a curved track, or its trajectory C is a curve, as shown by Fig. 25; in particular, while the track 41 is divided into a climbing, a crossing and a falling track, the tracks may be combined as a reciprocating track 41 d, namely the track 41 is used as a pure reciprocating track 41 d, meanwhile the starting position 41 a and the ending position 41 b may be overlapped (as shown by Fig. 24 and 25) or not (not shown), Fig. 26 provides a status view of the moving nails in different positions, while the chin-guard 2 is raised from the full face position to the open face position, wherein the track 41 is a reciprocating track 41 d of the straight line type, the Fig. 26(a) shows the chin-guard 2 in full face mode, the Fig. 26(b) shows the chin-guard 2 in the climbing state, the Fig. 26(c) shows the chin-guard 2 in the crossing state, the Fig. 26(d) shows the chin-guard 2 in the falling state, the Fig. 26(e) shows the chin-guard 2 in open face mode, it is not difficult to find that there exists reciprocating motion for the moving nails 5 in the track 41; of course, the track 41 comprising a reciprocating track 41 d may be configured in a branched structure, namely the climbing, crossing and falling tracks are arranged in a branched shape, Fig. 27, 28, and 29 provide the schematic views of three typical branched structures, wherein the climbing track and falling track shown in Fig. 27 are mainly the straight line tracks, the climbing track and falling track shown in Fig. 28 are mainly the arc tracks, and the climbing track shown in Fig. 29 has a small length of the starting track 41 d, it should be noted that the branched track may has a variety of other configurations, which are listed herein.

[0043] For the branched track comprising the reciprocating track 41 d, a road switching apparatus can be used to prevent the moving nails 5 from performing incorrect operation on a fork in the track, the road switching apparatus is arranged between the mounting pattern 3 and the helmet body 1, comprising an elastic piece 13, which is made from metal, plastic or composite materials; the elastic piece 13 comprises a sinking structure 13a, a stopper 13b, and an elastic return structure 13c, as shown in Fig. 29, for the two moving nails 5 of an assembly, when the moving nail 5, which is away from the chin 2c, passes through the elastic return structure 13c, as shown in Fig. 30b, pushed by the moving nail 5, the elastic piece 13 drives the stopper 13b to sink, by a certain extent sufficient to let the moving nail 5, which is close to the chin 2c, go through, and when the moving nail away from the chin 2c moves to the sinking structure 13a, as shown in Fig. 30a, the stopper 13b bounces depending on its own elasticity or a spring, to prevent the moving nail 5 close to the chin 2c from passing through; it should be noted that screws, rivets or like fasteners can be used to firmly fix the road switching apparatus on the helmet body 1 or mounting patterns 3, but the best way should be to fix the switching apparatus onto the helmet body 1 by way of snap-in; Fig. 31a - 31 e are the schematic views of the moving nails 5 in the different positions corresponding to the different states of the chin-guard 2 while moving from the full face position to the open face position, wherein Fig.31 a shows the chin-guard 2 in the full face position, and Fig. 31 b shows the chin-guard 2 in the climbing position, Fig. 31 c shows the chin-guard 2 in the crossing position, Fig. 31 d shows the chin-guard 2 in the falling position, Fig. 31 d shows the chin-guard 2 in the open face position, from above, it is found that there exists reciprocating motion for the moving nails in the track 41.

[0044] It should be noted that the roles of the tracks 41, 42 are interchangeable, in other words the object of the present invention can also be achieved while the tracks 41, 42 are interchanged in terms of position, function, shape and formation, under the premise of that the tracks 41, 42 respectively formed on the mounting patterns 3 mounted on the two opposite sides of the helmet body 1 must be interchanged completely.

[0045] The present invention discloses a safety helmet with changeable chin-guard structure, which adopts a structure scheme of using four moving nails 5 cooperating with the tracks 41, 42 on the mounting patterns 5, wherein while the moving nails 5 moves with the chin-guard 2, the tracks 41, 42 constrains the motion trajectory of the moving nails 5, so as to realize the function of changing the position of the chin-guard 2 in relation to the helmet body 1 according to need, i.e. shift between full face and open face modes, as well as to assure that the chin-guard 2 clings to the helmet body 1 while in open face mode; more importantly, in comparison with the existing art ES2329494T3, the present invention at least has the following improvements: 1)there no sliding groove structure exists on the chin-guard 2, the bending modulus of the holders 2a is thus enhanced, and consequently the rupture strength of the holders 2a is enhanced effectively; 2) the potential problems associated with the stress concentration are eliminated effectively by abandoning the sliding groove structure, and thus the strength of the chin-guard 2 is enhanced as well; 3) the spacing of two moving nails on a same holder 2a is constant, thus the chin-guard 2 clings to the helmet body more firmly, and moves more stably, in both full face or open face modes.

[0046] While the invention has been described in terms of what are presently considered to be the most practical and preferred embodiments, it is to be understood that

the invention need not be limited to the disclosed embodiments. On the contrary, it is intended to cover various modifications and similar arrangements included within the spirit and scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structure.

Claims

1. A safety helmet with changeable chin-guard structure, comprising a helmet body, a chin-guard with two holders, and two mounting plates arranged on the two opposite sides of the helmet body, the mounting plates and the helmet body being fixedly connected, or formed in one piece, **characterized in that**: each mounting plate is provided with two grooved tracks, each which may be a single grooved track or a multi-segment grooved track formed by several grooved tracks connected; the helmet further comprise four moving nails, wherein two moving nails, one holder and one mounting plate form a assembly and are arranged in a same side of the helmet body; in a same assembly the two moving nails are corresponding to the two tracks of the mounting plate respectively, one end of each moving nail is penetrated into the respective track while the other end is connected to the holder of the same assembly; driven by the chin-guard via the holders, the moving nails are movable along the corresponding tracks respectively, and constrained by the moving nails and tracks, the position of the chin-guard is changeable.

2. The safety helmet with changeable chin-guard structure according to claim 1, **characterized in that**: the tracks on the two mounting plates are symmetrically arranged in relation to the median plane of the helmet body.

3. The safety helmet with changeable chin-guard structure according to claim 1, **characterized in that**: the spacing of the two moving nails in a same assembly is constant.

4. The safety helmet with changeable chin-guard structure according to claim 1, **characterized in that**: each of the tracks has two ultimate positions, including a starting position and an ending position, and for each track, the track plane of the portion of the track to the starting position or/and end position is gradually inclined.

5. The safety helmet with changeable chin-guard structure according to claim 4, **characterized in that**: the ending position and starting position of one of the two tracks of each mounting plate are completely or partially overlapped.

6. The safety helmet with changeable chin-guard structure according to any one of claims 1 - 5, **characterized in that**: the two sidewalls of at least one portion of the tracks forms a gradually shrinking or/and expanding track width.

7. The safety helmet with changeable chin-guard structure according to any one of claims 1 - 5, **characterized in that**: the mounting plates are provided with shrinkable grooves.

8. The safety helmet with changeable chin-guard structure according to any one of claims 1 - 5, **characterized in that**: each of the moving nails has a stepped journal structure, and the shoulder of the stepped journal is movably connected to the track plane.

9. The safety helmet with changeable chin-guard structure according to any one of claims 1 - 5, **characterized in that**: the safety helmet further comprises a separator disposed between each holder and the corresponding mounting plate; the separators are moveably connected with the track planes of the tracks.

10. The safety helmet with changeable chin-guard structure according to claim 9, **characterized in that**: the separators and the moving nails are fixedly connected, or formed in one piece.

11. The safety helmet with changeable chin-guard structure according to claim 9, **characterized in that**: the separators and the holders are formed in one piece.

12. The safety helmet with changeable chin-guard structure according to claim 11, **characterized in that**: the separators are provided with through holes for the moving nails 5 to go through.

13. The safety helmet with changeable chin-guard structure according to claim 12, **characterized in that**: the moving nails are provided with recesses, engaged with clamping plates.

14. The safety helmet with changeable chin-guard structure according to claim 13, **characterized in that**: the safety helmet further comprises covers; the clamping plates are enclosed between the covers and holders.

15. The safety helmet with changeable chin-guard structure according to any one of claims 1 - 5, **characterized in that**: one of the two tracks on the same mounting plate is configured in a closed loop annular track or an open loop arc track.

16. The safety helmet with changeable chin-guard struc-

ture according to any one of claims 1 - 5, **characterized in that**: one of the two tracks on the same mounting plate is configured in a closed loop elliptical track or an open loop elliptical arc track.

17. The safety helmet with changeable chin-guard structure according to any one of claims 1 - 5, **characterized in that**: one of the two tracks on the same mounting plate comprises a climbing, a crossing and a falling track.

18. The safety helmet with changeable chin-guard structure according to claims 17, **characterized in that**: the crossing track is an arc or an elliptical arc track.

19. The safety helmet with changeable chin-guard structure according to claims 17, **characterized in that**: the falling track is an arc or an elliptical arc track.

20. The safety helmet with changeable chin-guard structure according to claims 17, **characterized in that**: the climbing track is an arc or a straight line track.

21. The safety helmet with changeable chin-guard structure according to claims 17, **characterized in that**: the climbing track comprises a starting track.

22. The safety helmet with changeable chin-guard structure according to claims 17, **characterized in that**: the starting track is a straight or an arc track.

23. The safety helmet with changeable chin-guard structure according to any one of claims 1 - 5, **characterized in that**: one of the two tracks on the same mounting plate comprises a reciprocating track.

24. The safety helmet with changeable chin-guard structure according to claims 23, **characterized in that**: the reciprocating track is a straight line track.

25. The safety helmet with changeable chin-guard structure according to claims 23, **characterized in that**: the track comprising the reciprocating track is a branched track.

26. The safety helmet with changeable chin-guard structure according to claims 25, **characterized in that**: the safety helmet further comprises road switching apparatuses arranged between the mounting plates and the helmet body, each of the road switching apparatuses comprises an elastic piece, comprising a sinking structure, a stopper and an elastic return structure.

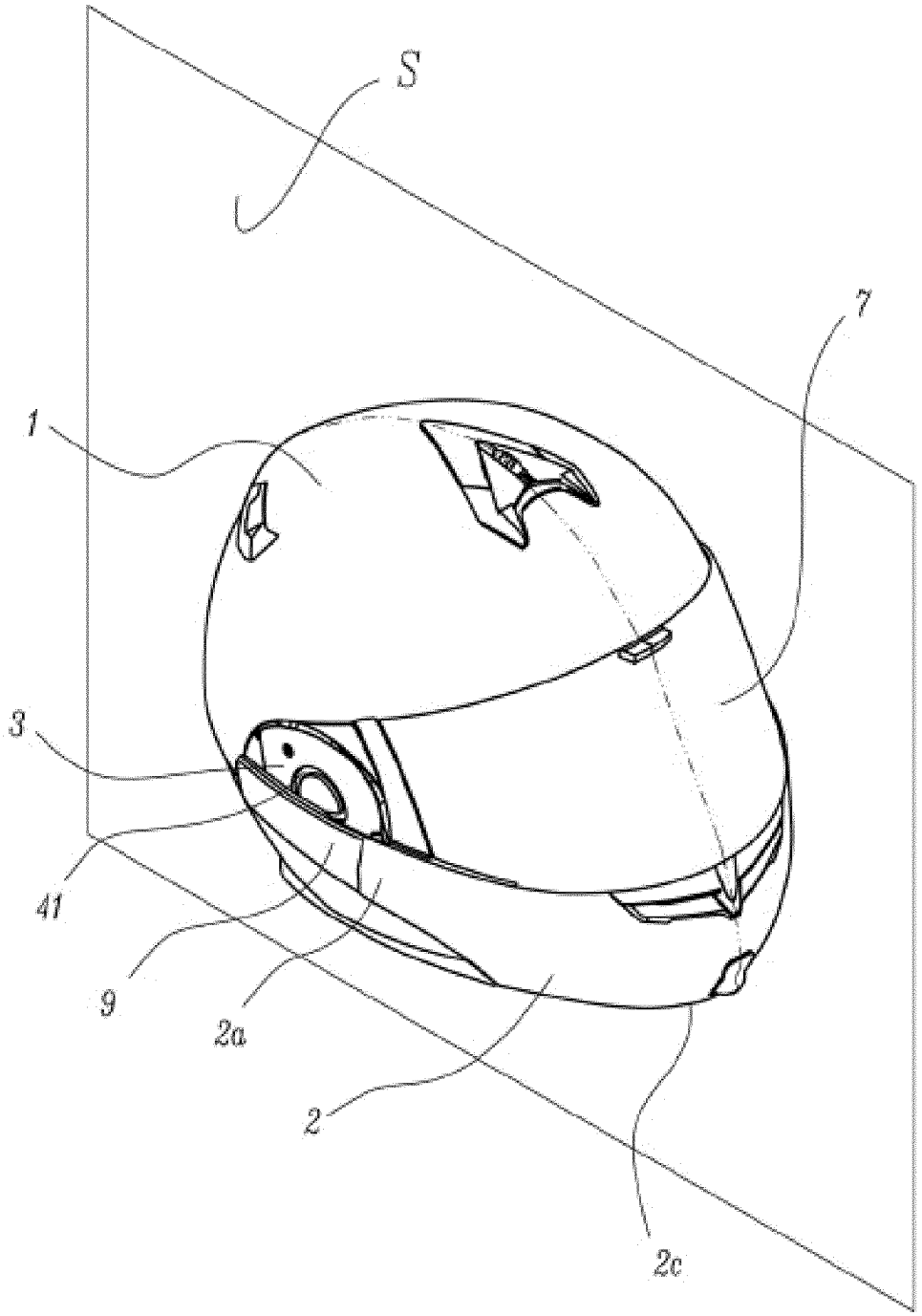


Figure 1

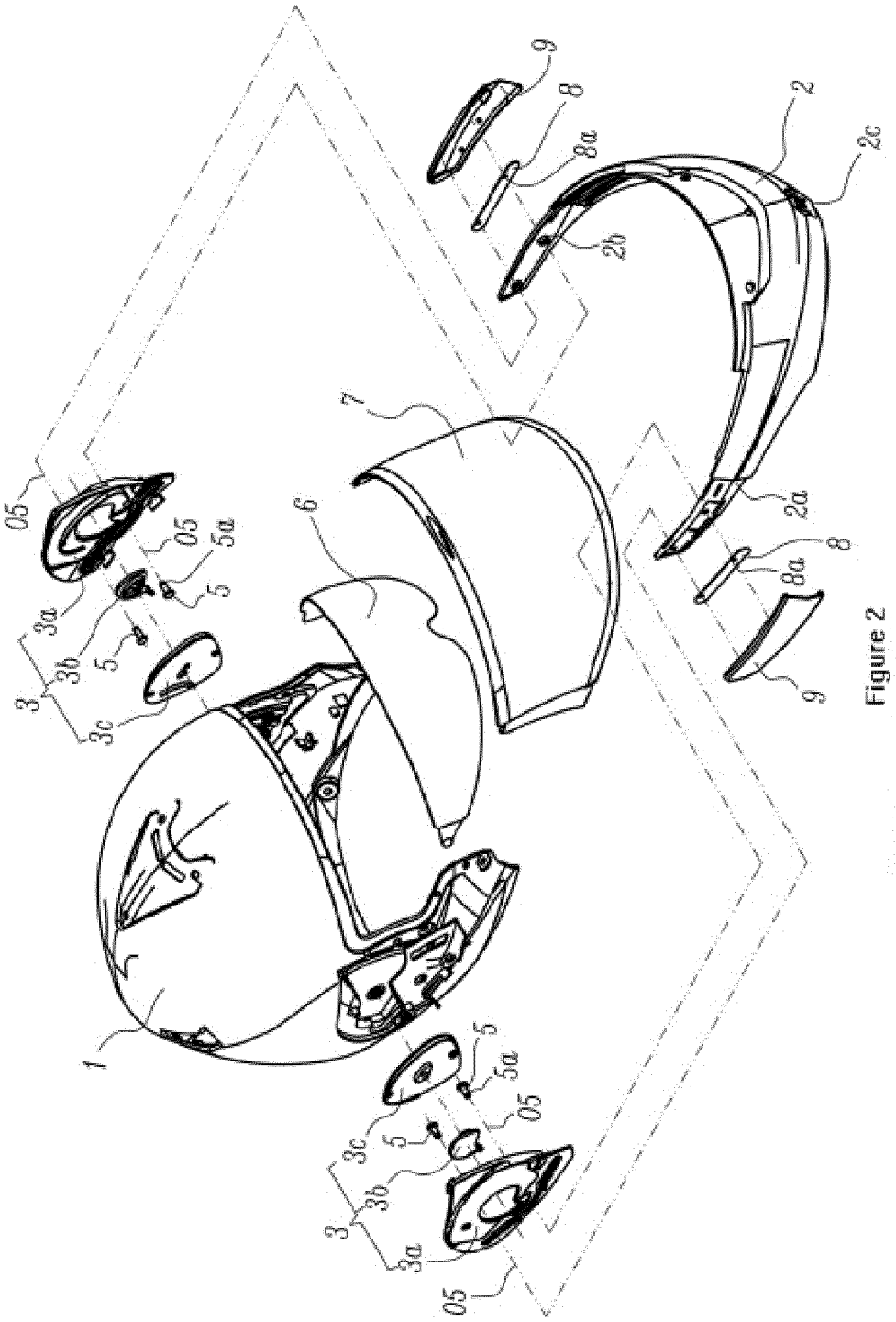


Figure 2

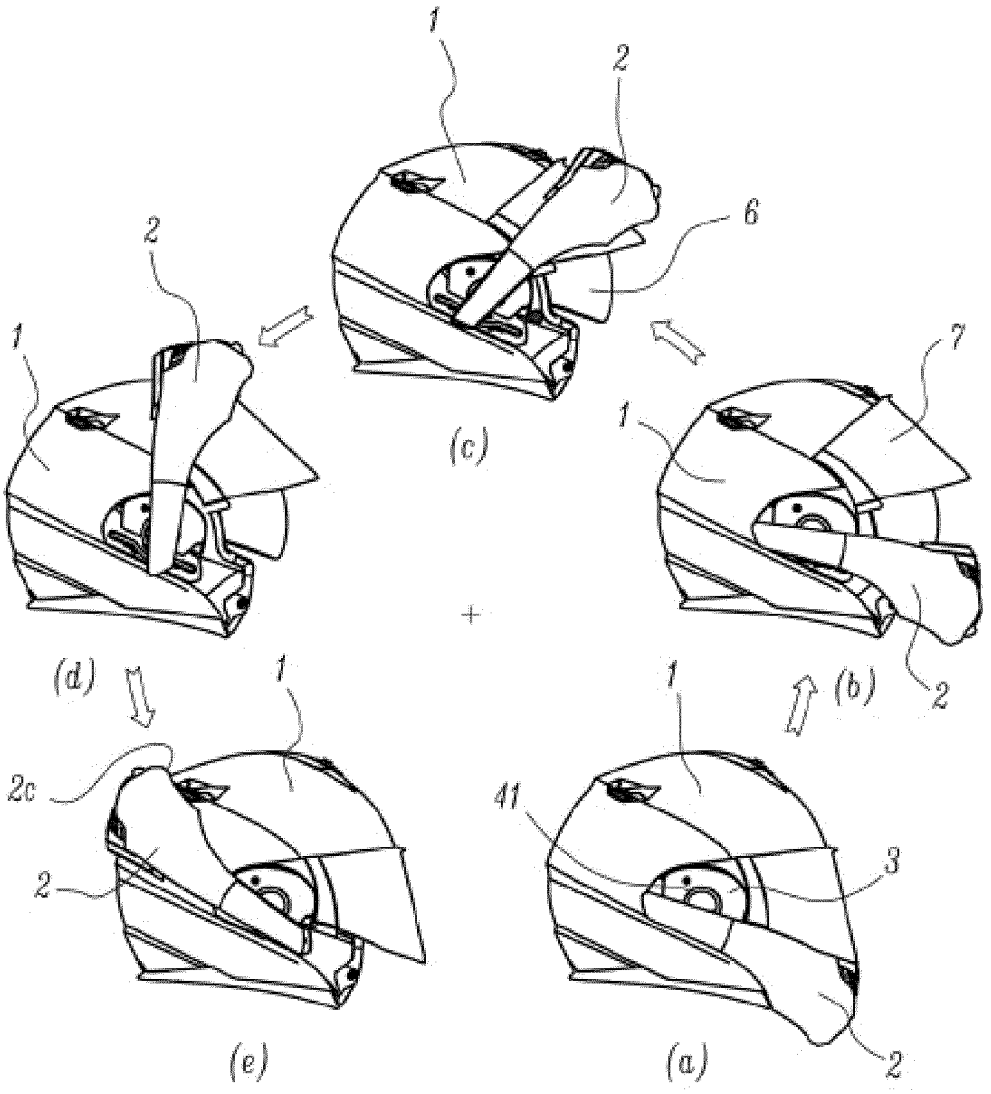


Figure 3

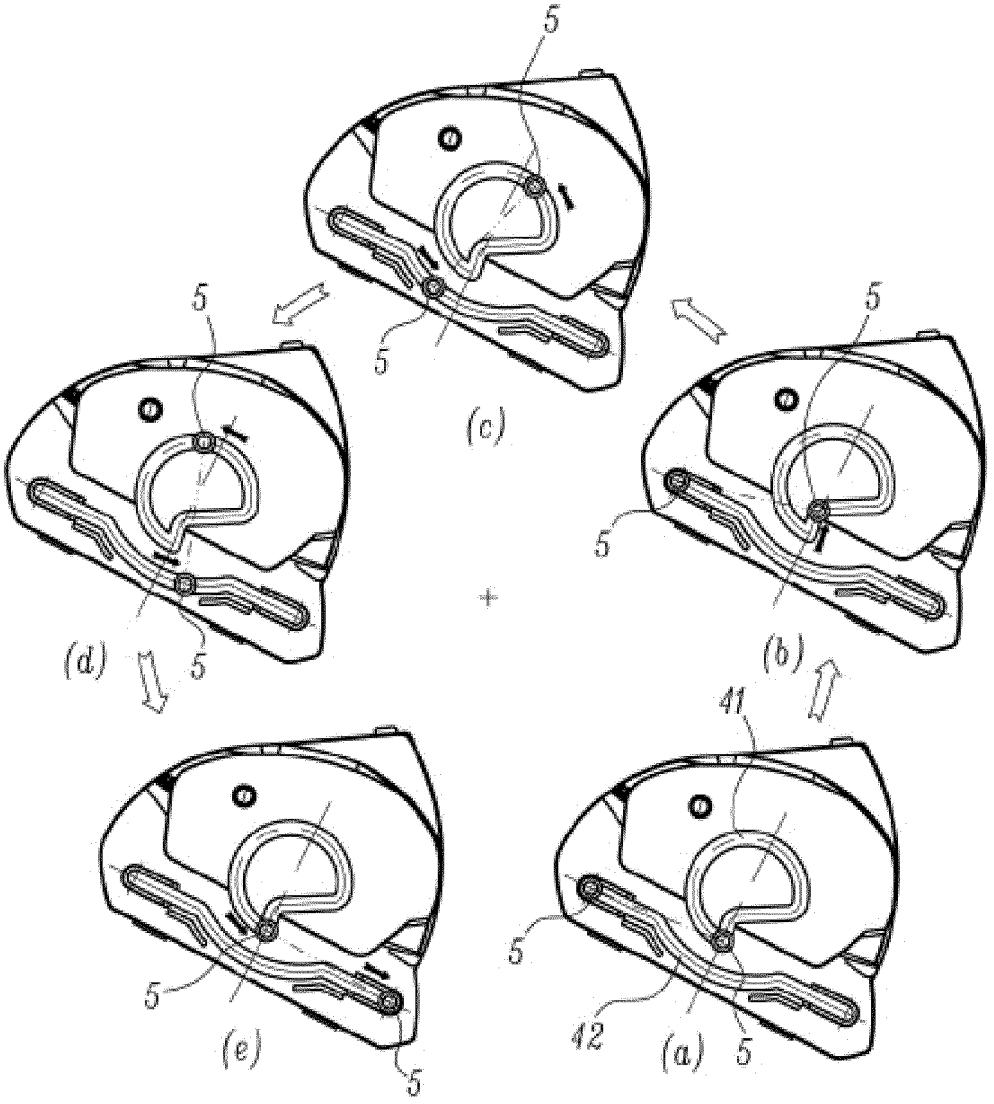


Figure 4

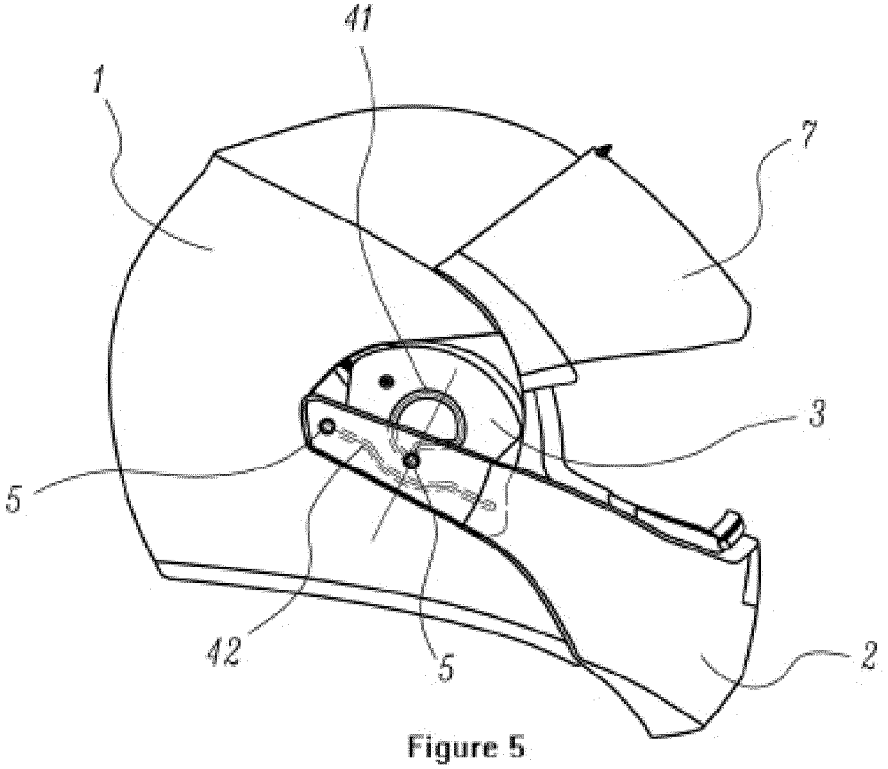


Figure 5

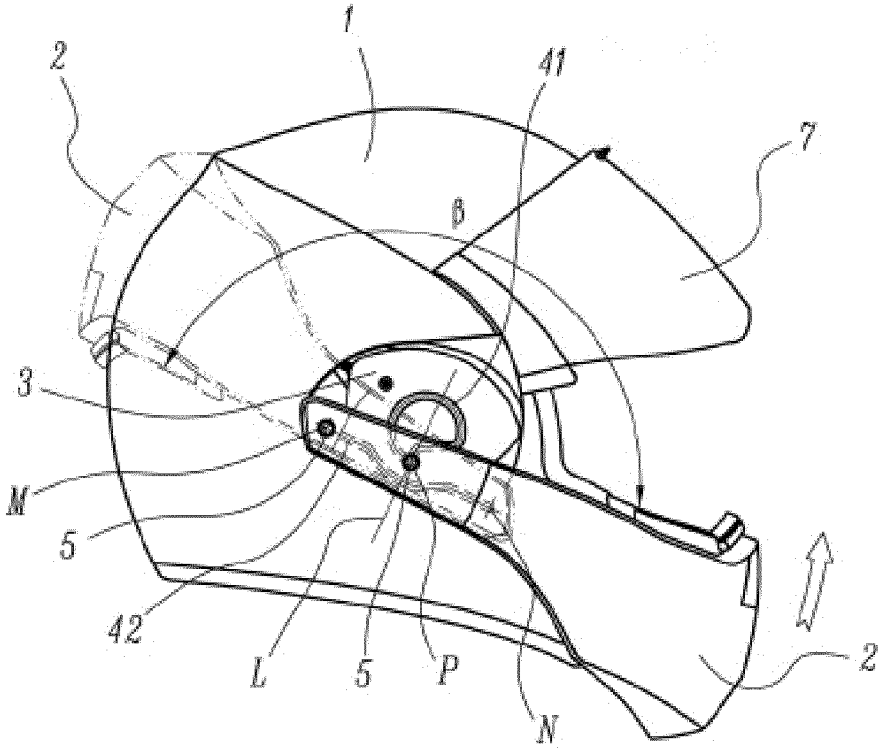


Figure 6

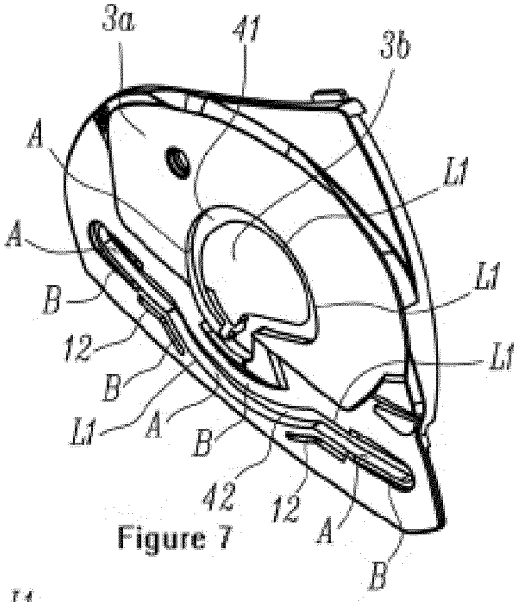


Figure 7

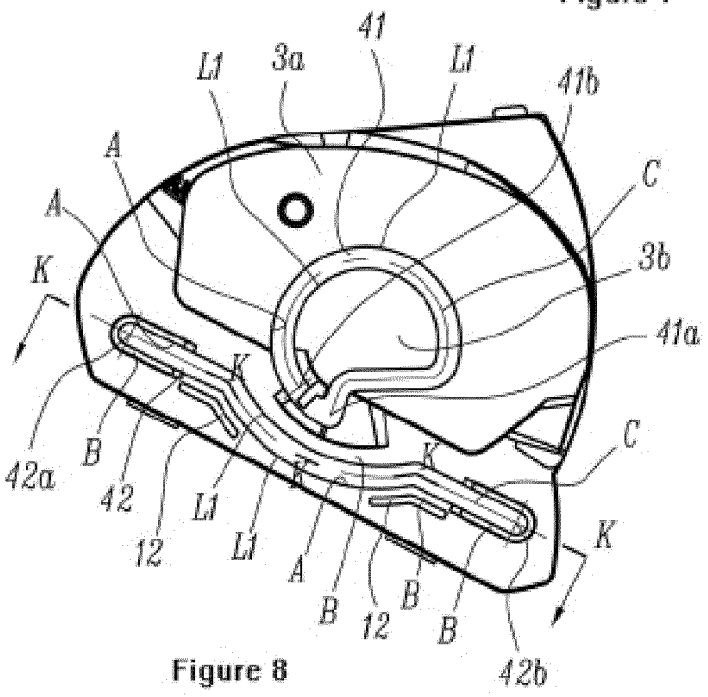


Figure 8

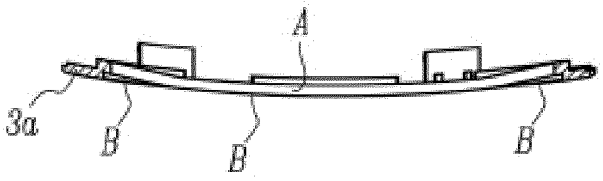


Figure 9

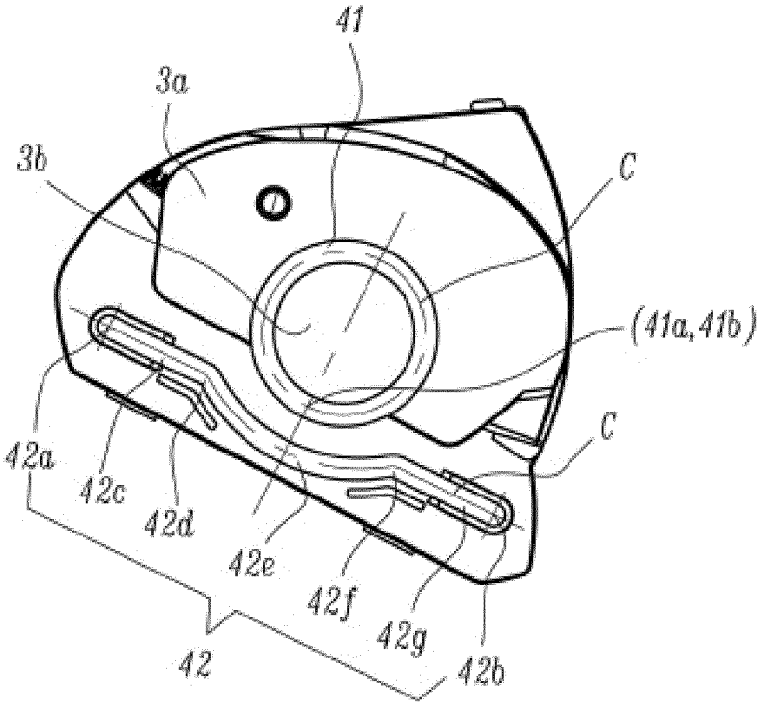


Figure 10

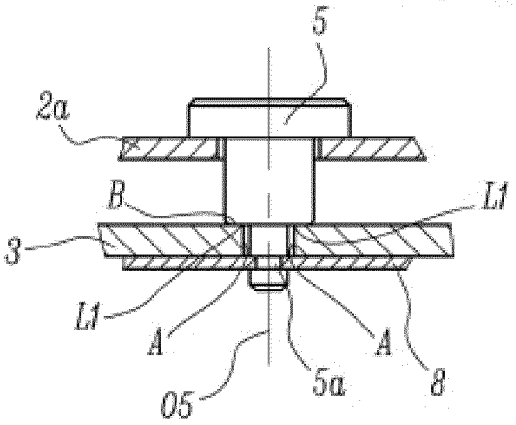


Figure 11

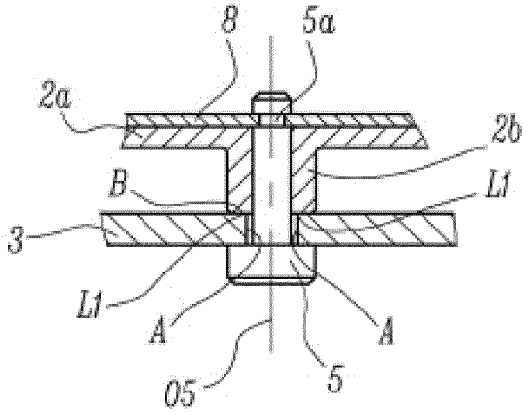


Figure 12

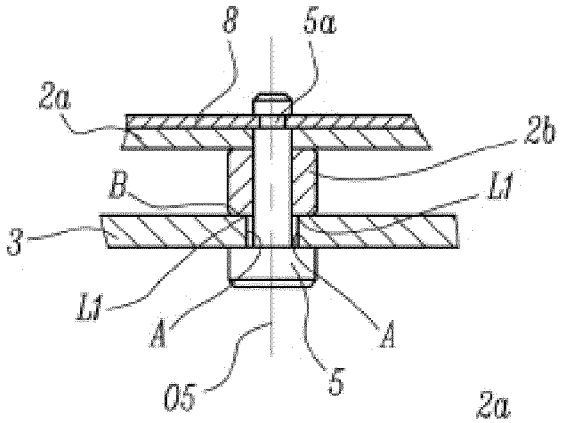


Figure 13

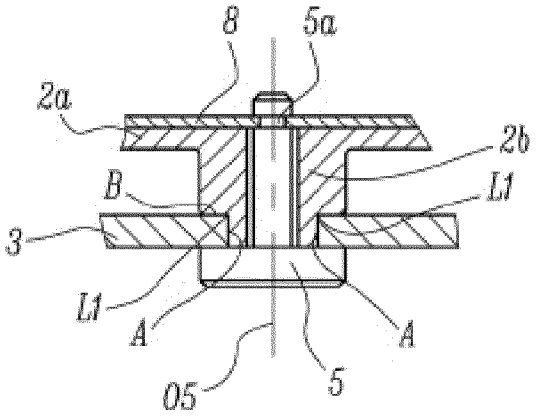


Figure 14

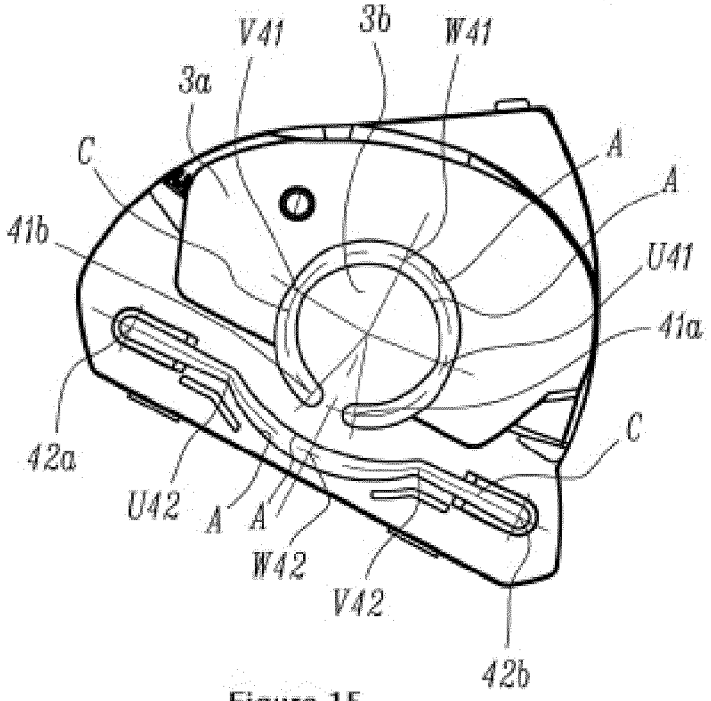


Figure 15

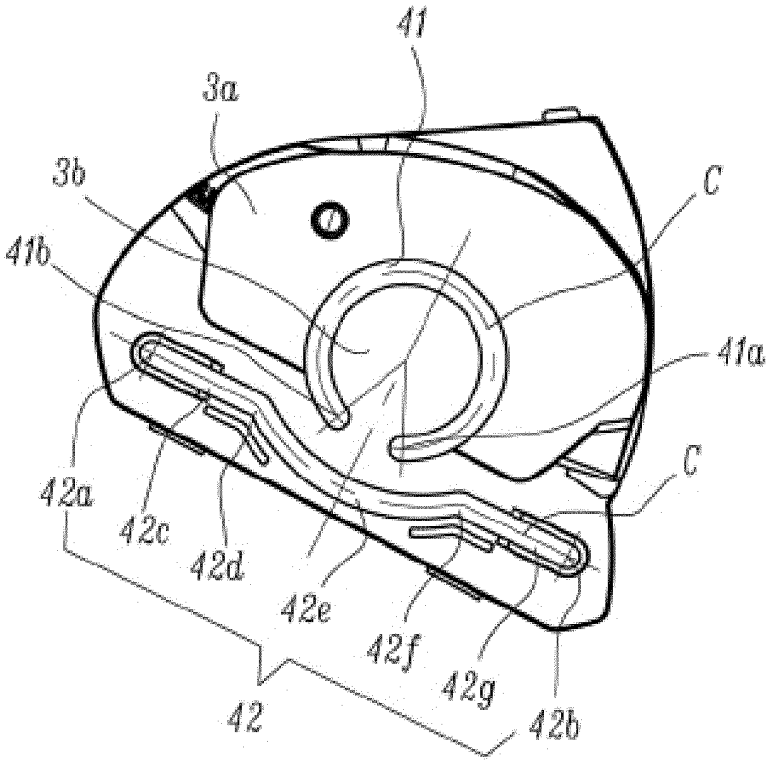


Figure 16

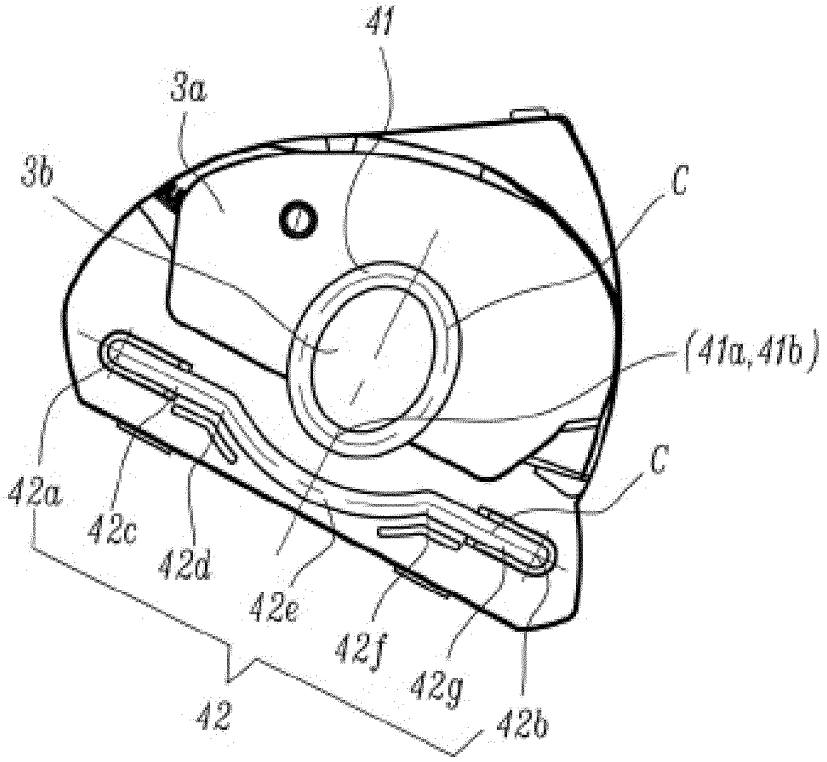


Figure 17

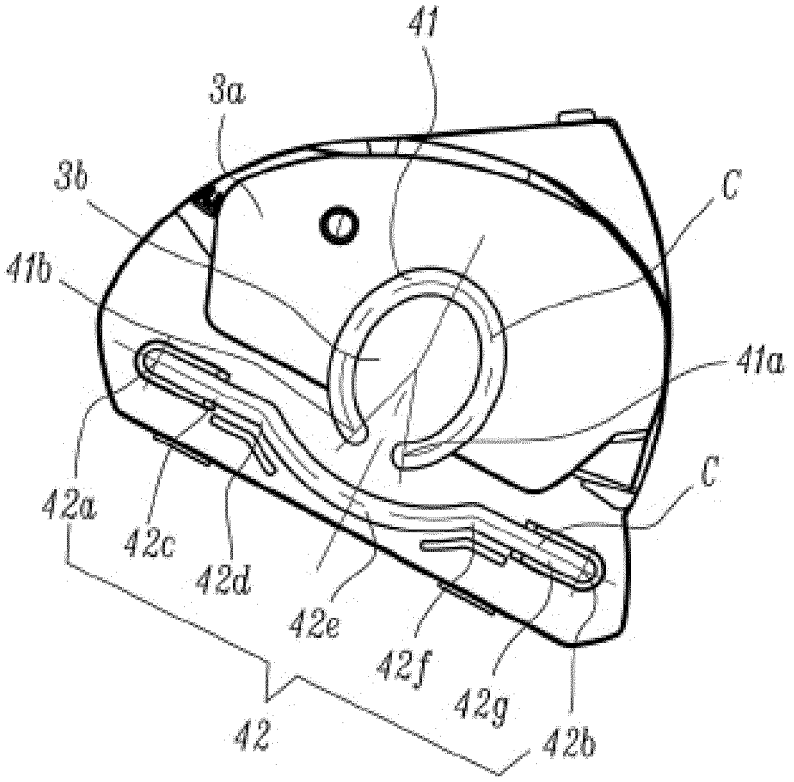


Figure 18

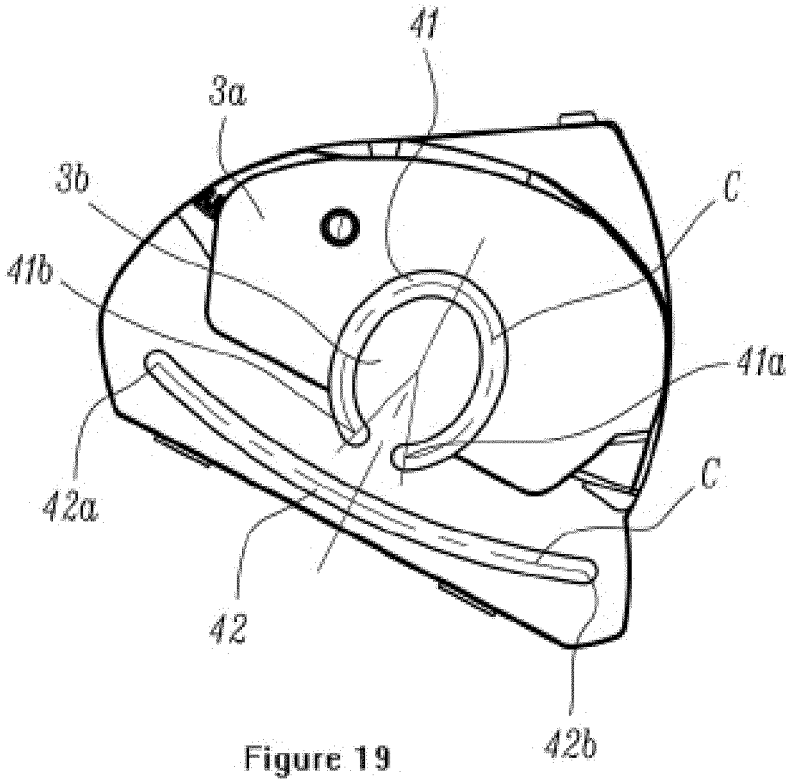


Figure 19

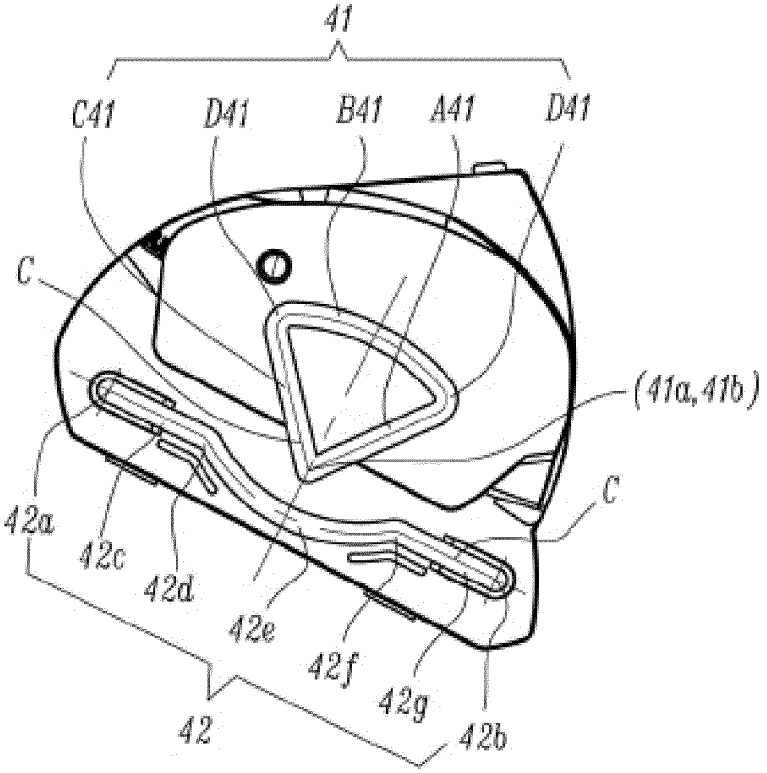


Figure 20

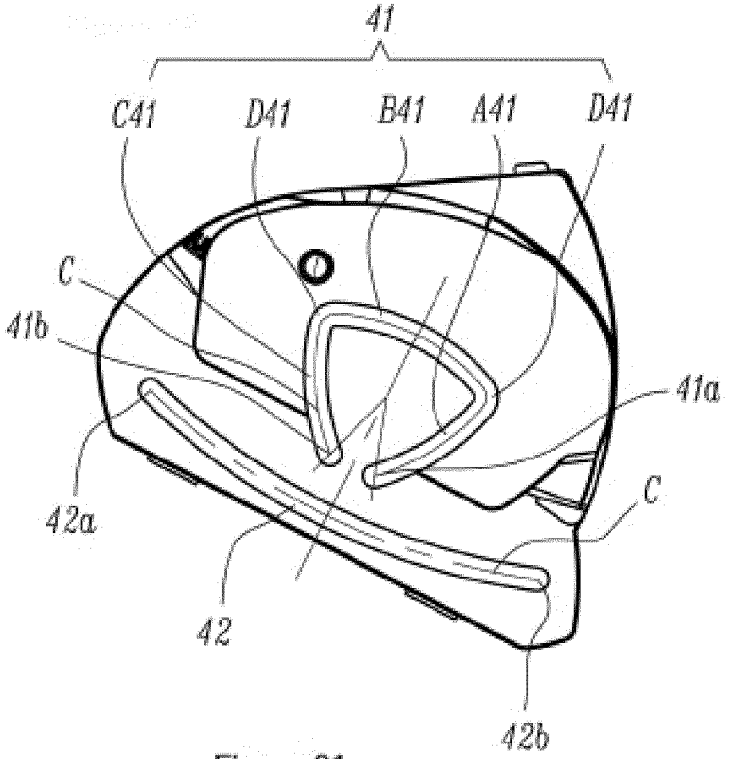


Figure 21

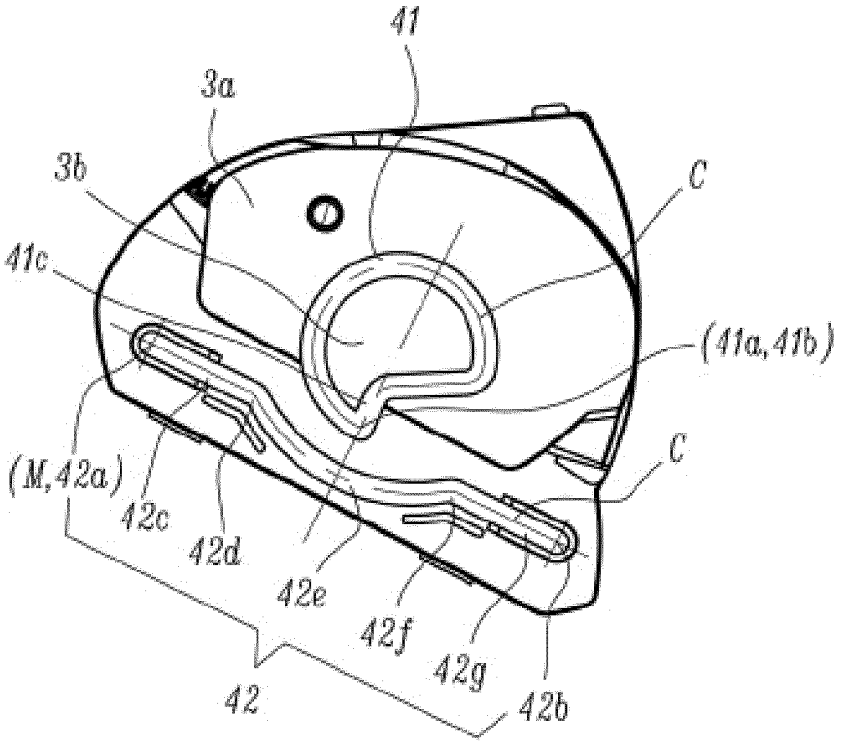


Figure 22

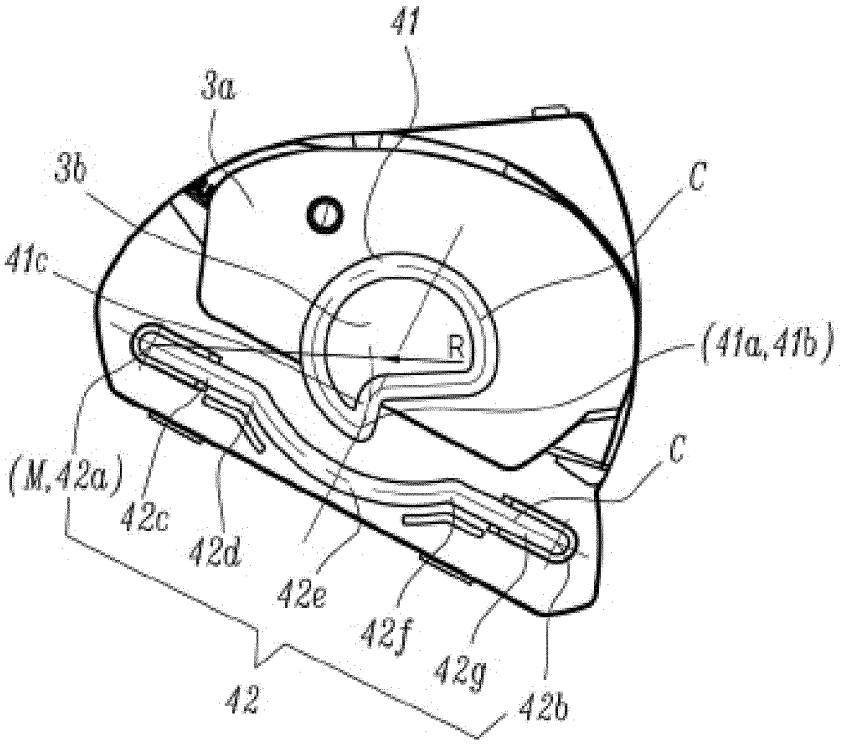
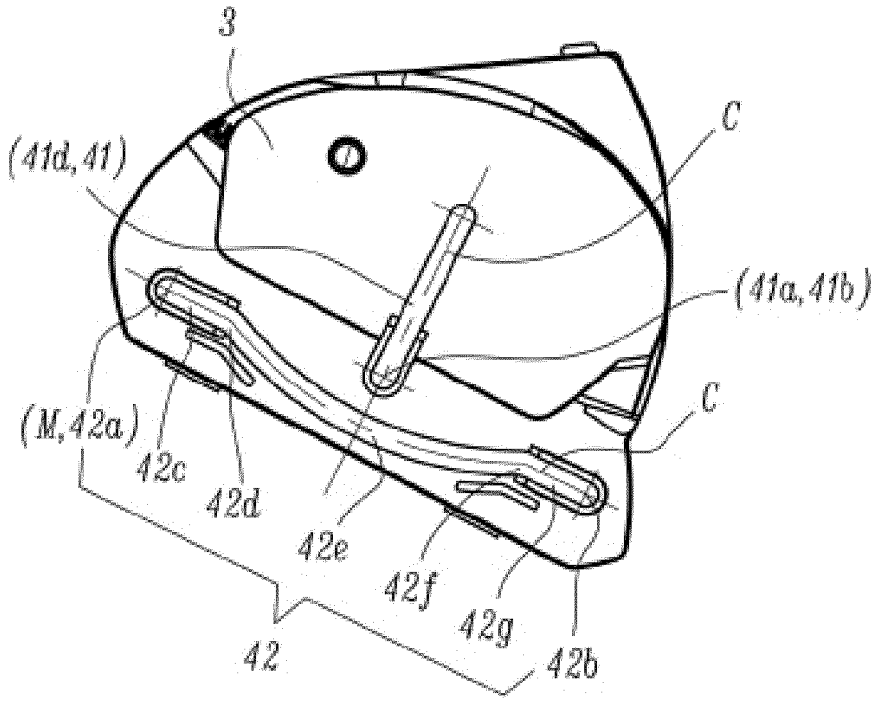


Figure 23



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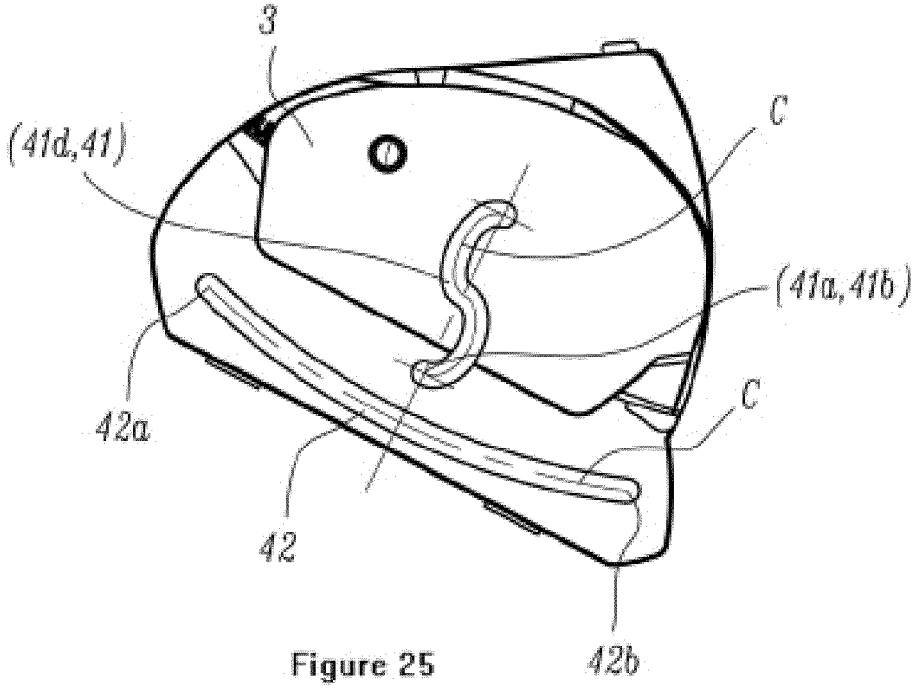

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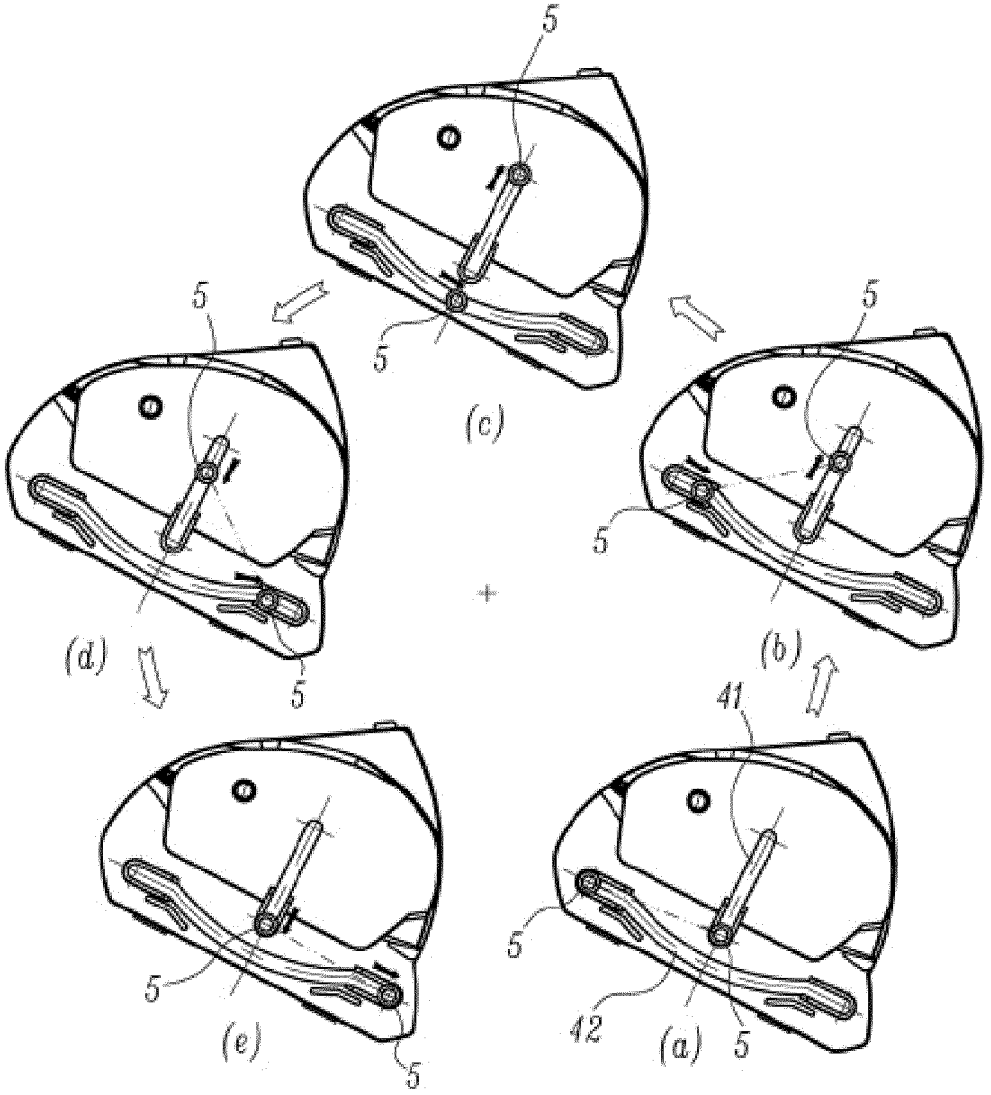

Figure 26

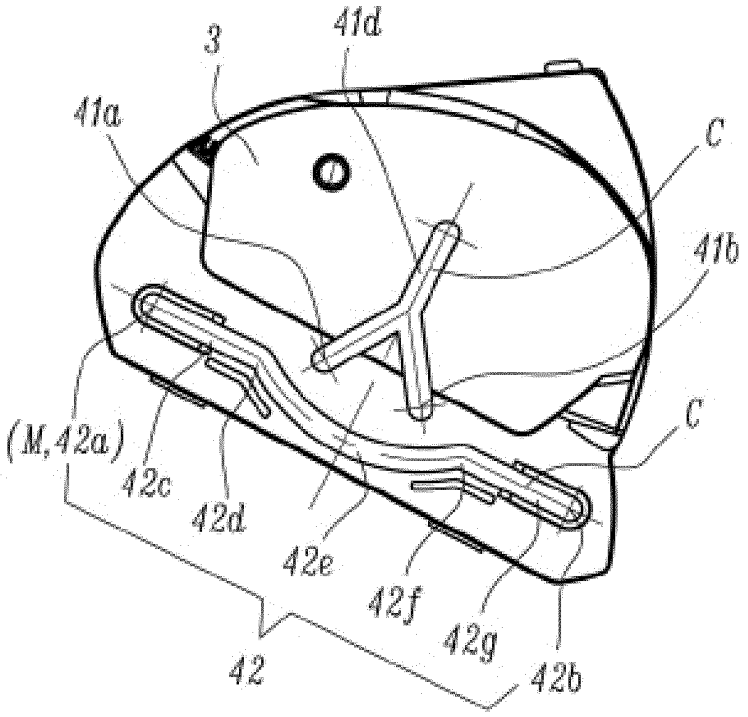

Figure 27

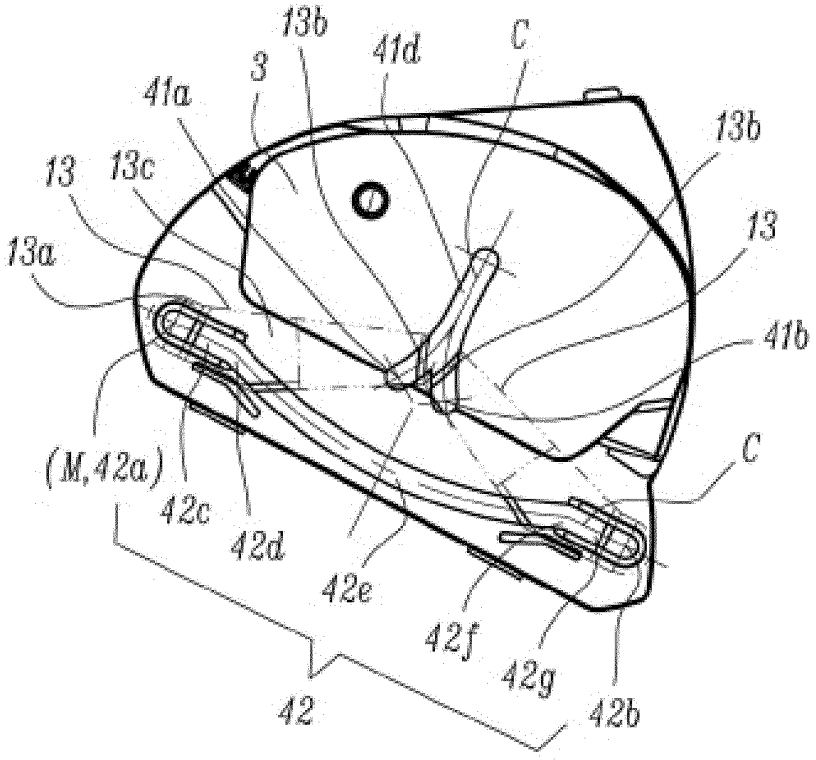

Figure 28

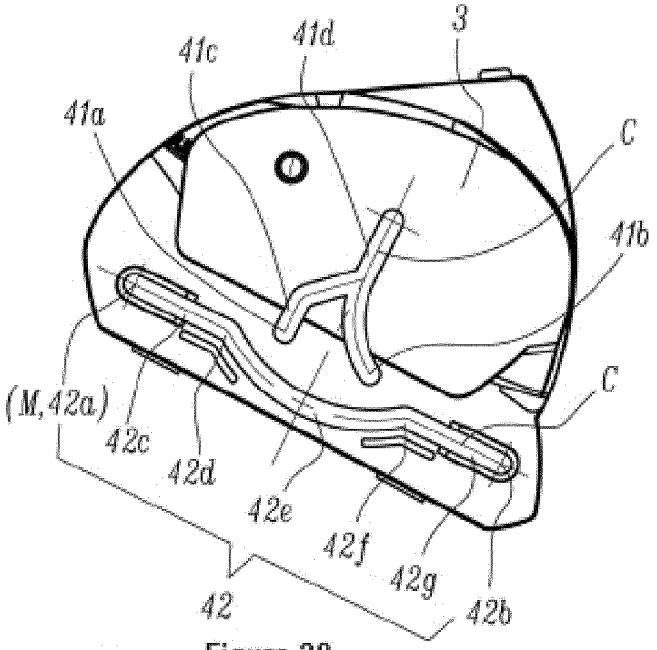

Figure 29

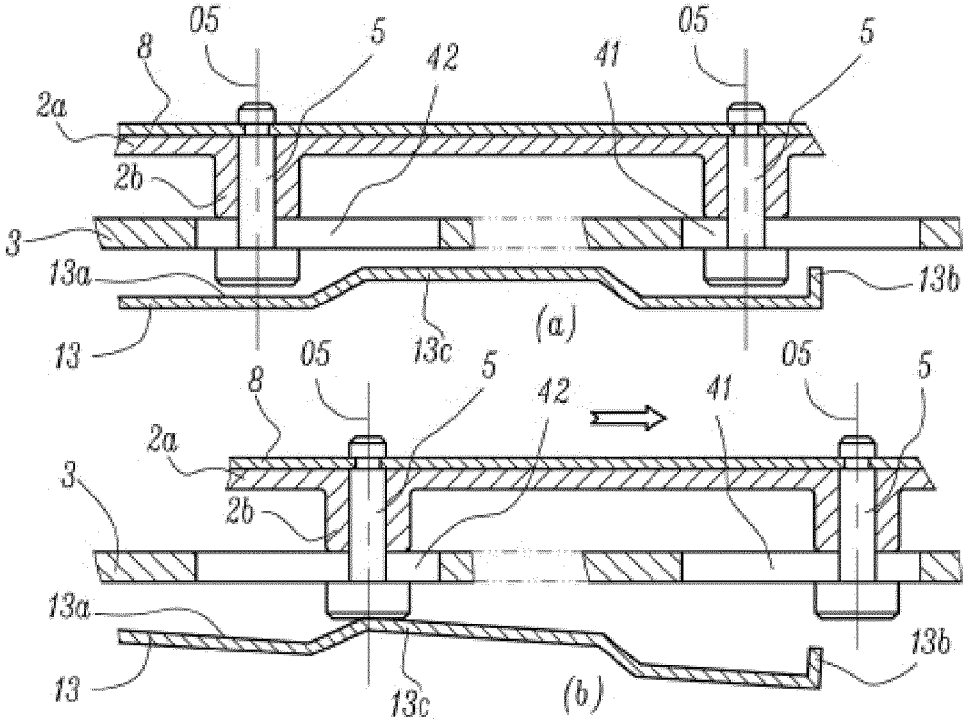

Figure 30

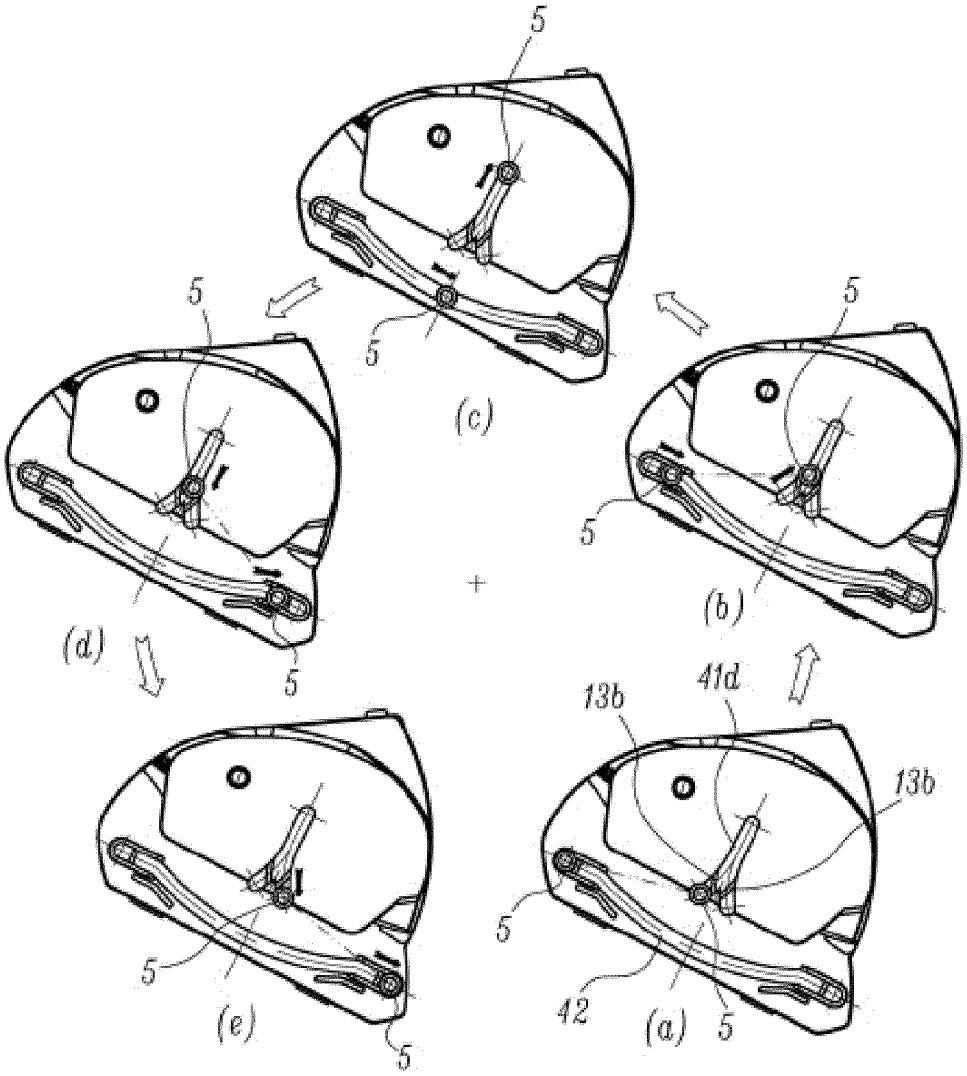

Figure 31

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/076064

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC：A42B3/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI,EPODOC,CNPAT,CNKI

guide or rail or slide or track

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	CN101991208A (JIANGMEN PENGCHENG HELMETS LTD.)30 Mar.2011(30.03.2011) claims 1-26	1-26
P,X	CN201854732U (JIANGMEN PENGCHENG HELMETS LTD.)08 Jun. 2011(08.06.2011) claims 1-26	1-26
A	WO2006045912A1 (SHARK SA) 04 May 2006(04.05.2006) The whole document	1-26
A	CN101212913A(CBM DISTRIB) 02 Jul.2008(02.07.2008) The whole document	1-26
A	EP0395845A1(AGV S.P.A) 07 Nov.1990(07.11.1990) The whole document	1-26
A	EP0797935A1(E. D. C. SA) 01 Oct.1997(01.10.1997) The whole document	1-26

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 Aug. 2011(24.08.2011)	**29 Sep. 2011 (29.09.2011)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer ZHAO, Xiaoyu Telephone No. (86-10)62084132

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/076064

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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CN201854732U	08.06.2011	None	
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/076064

According to International Patent Classification (IPC) or to both national classification and IPC

A42B3/04 (2006.01) i
A42B3/00 (2006.01) i

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REFERENCES CITED IN THE DESCRIPTION

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- ES 2329494 T3 **[0003] [0031] [0045]**