Oct. 3, 1944. J. T. RIDDELL 2,359,387

PROTECTIVE HELMET

Filed May 12, 1941 2 Sheets-Sheet 1

Fig. 1

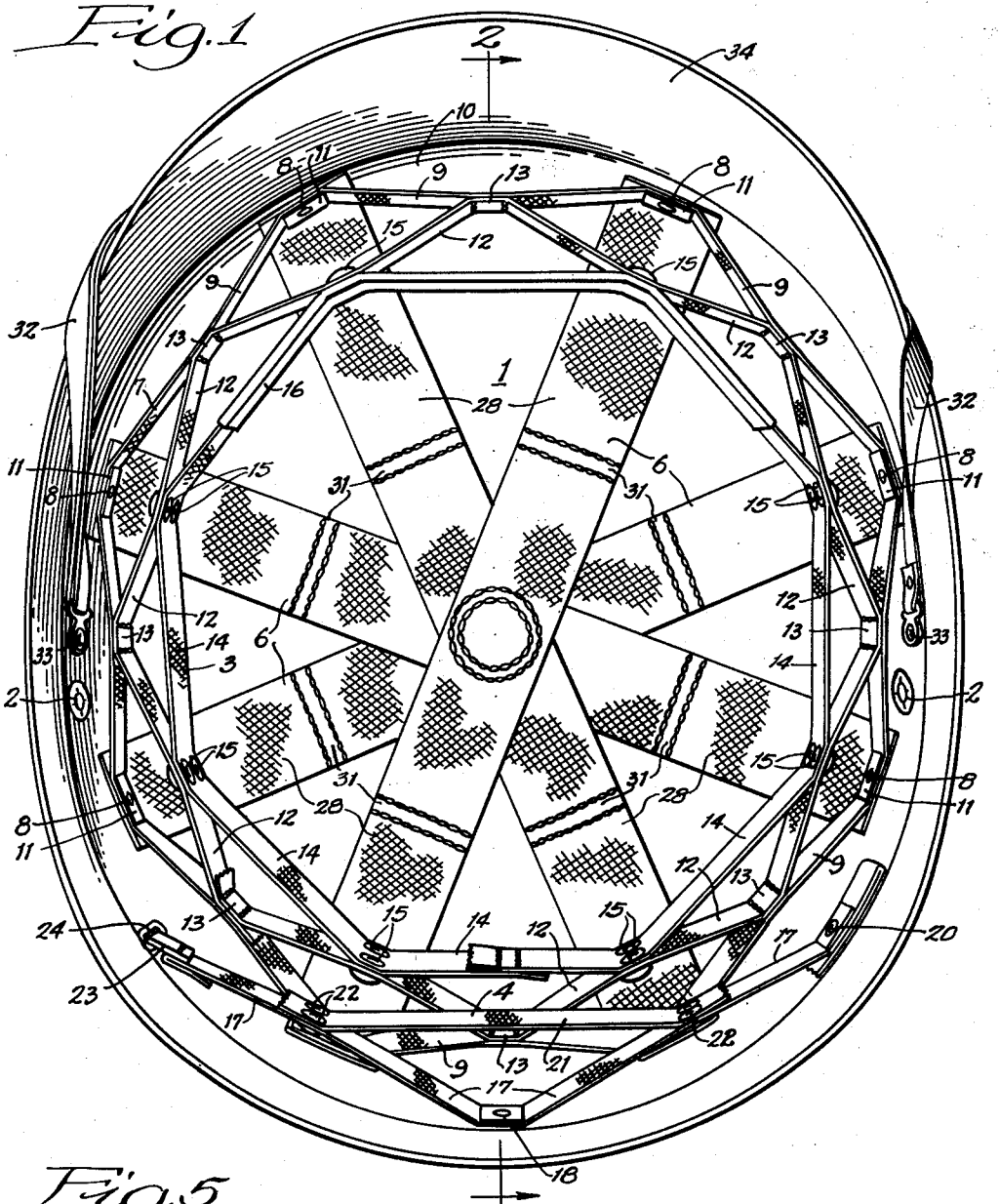


Fig. 5

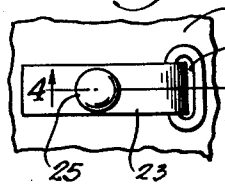
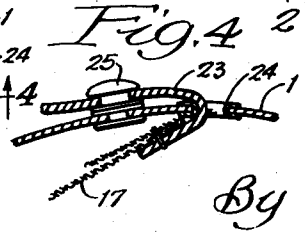


Fig. 4



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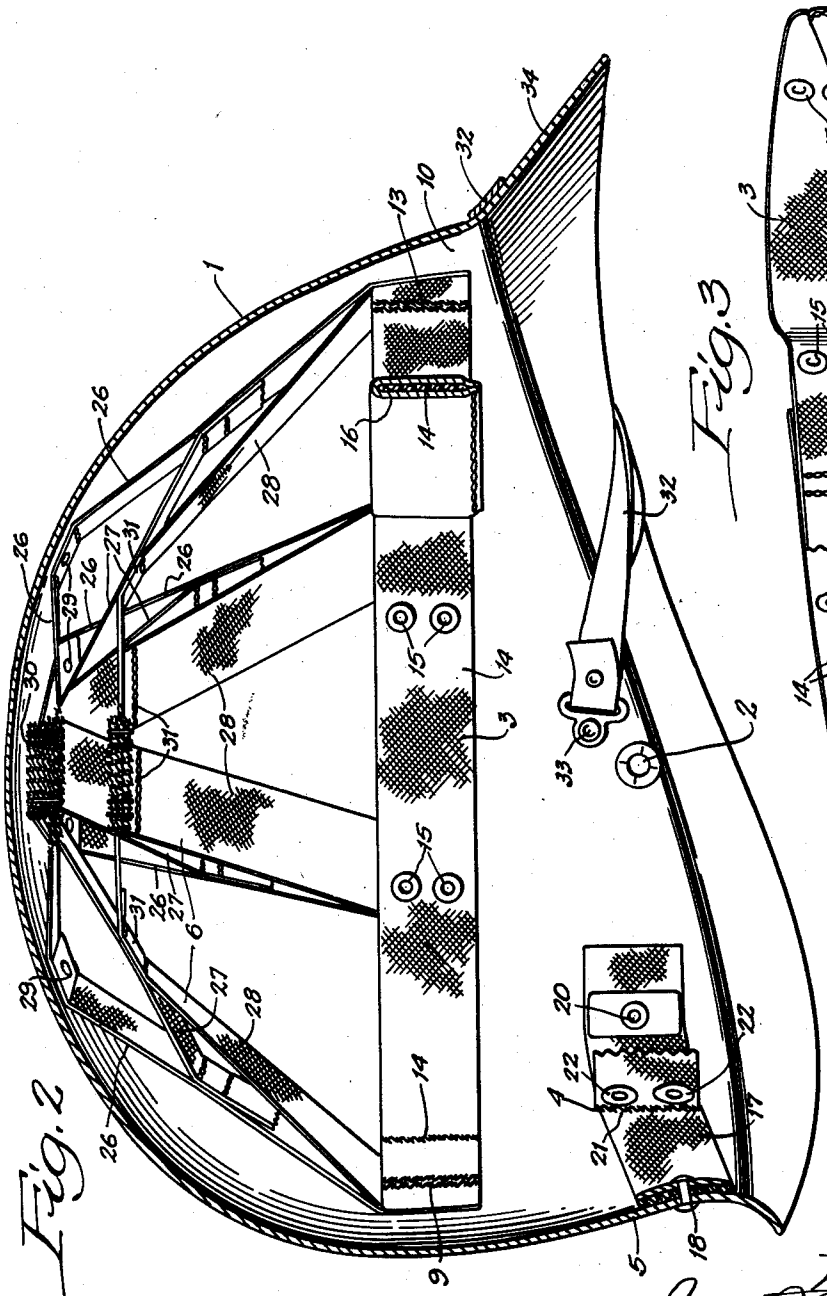


Fig. 2

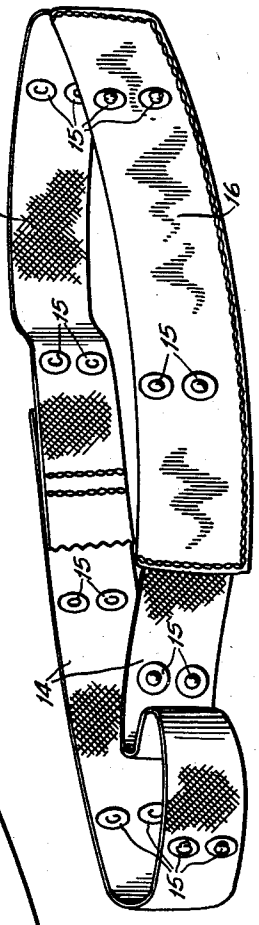


Fig. 3

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UNITED STATES PATENT OFFICE

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PROTECTIVE HELMET

John T. Riddell, Chicago, Ill.

Application May 12, 1941, Serial No. 393,090

7 Claims. (Cl. 2—3)

This invention relates to helmets of various types such as are used for the protection of a person's head from injury in dangerous occupations and games and has particular reference to the improvement of means for internally bracing the shell wall of the helmet and for mounting it on the head of the wearer.

The main object of this invention is to improve and carry forward the application of the principles of helmet and shield construction broadly described and claimed in my copending application Serial No. 352,215 filed August 12, 1940, Patent No. 2,250,275, July 22, 1941.

Other objects of this invention are to provide improved cushioning means in the interior of shields and particularly of helmets for increasing the safety of the wearer and for facilitating the adaptability of the device to differences of shapes and dimensions of different wearers' heads and bodies with a minimum of alteration of the cushioning structure.

A further object is to provide an improved form of helmet bracing and cushioning structure of this general type wherein the helmet and the greater part of its internal equipment may be made of standardized shape and fixed dimensions for all sizes of heads and may be adapted to any individual wearer by the appropriate selection of an interchangeable part or parts, such as a headband, of appropriate size.

A specific embodiment of this invention is shown in the accompanying drawings in which:

Figure 1 is a bottom view of a helmet with its internal bracing and head-cushioning means as it appears when viewed from the bottom.

Fig. 2 is a longitudinal section taken on the line 2—2 of Fig. 1.

Fig. 3 is a perspective view of the removable headband.

Fig. 4 is a sectional detail of the attaching means for one end of the neck sling whereby this member can be relaxed for facilitating application of the helmet to the wearer's head and restored to its cushioning position while the helmet is in place.

Fig. 5 is a fragmentary outside view of the same.

The design selected for illustration in the drawings is adapted for military use. The shell 1 may be of any appropriate stiff material that is rigid enough to withstand the shocks to which it is exposed or subjected and the internal bracing and cushioning members are mainly made of stout flexible straps of appropriate material, such as non-stretchable fabric tape or appropriate substitutes therefor.

For military use the shell may be of steel but it is preferred to make the shell 1 of a strong but comparatively light material, such as a synthetic resin like cellulose nitrate, cellulose acetate, vinyl resin, and the like, for general use, and this is covered by a close-fitting shell of steel (not shown) that is slipped over the shell 1 at times of danger and fastened thereto by appropriate means as for example, straps that pass around the edges of the double helmet and engage snap fastener sockets 2 on opposite sides of the shell 1.

In accordance with the present invention, the helmet shell 1 is shaped to conform generally with the portion of the wearer's head that it is designed to shield but is considerably larger than the head so as to be spaced therefrom a substantial distance on all sides.

The internal bracing and cushioning devices are so arranged that the shock of any blow on the helmet is distributed over the stiff material of the shell and is resisted by the wearer's head by means that serve as slings that spread the pressure over large areas of the wearer's head and prevent direct contact between the head and the shell, thus cushioning and reducing to a minimum the injury to the wearer from such shocks.

In the illustrative form shown there are three sets of flexible strap systems that bear slingwise against the wearer's head, namely, a headband 3 which fits about the head in a horizontal plane like the sweatband of a hat, a neck sling 4 which spaces the depending neck shield 5 from the nape of the neck and a plurality of crown sling straps 6 which extend over the top of the head to space it from the top of the helmet 1 and resist shocks from above.

The headband 3, the neck strap 4 and the crown straps 6 are each parts of networks of straps, each located generally in the plane of the respective sling and connecting the sling with that regional area of the helmet shell that is subtended by the sling. Thus each sling, together with its network of straps and the adjacent regional portion of the shell, acts as a truss that prevents distortion of the shell and insures that any shocks which reach the wearer's head are transmitted to and over the surface of the head as pulls on flexible tension members coming from parts of the shell remote from the point of impact of the blow on the shell.

The supporting strap system or network for the headband 3 includes an outer belt 7 anchored

at intervals to the shell 1 as by rivets 8 and stretched taut between these rivets so that it forms a series of chordal strap elements 9, each subtending and bracing an arcuate region 10 of the shell. The individual chordal strap elements 9 thus are connected end-to-end and stand at an angle to each other. Appropriate washer plates 11 held by the rivets 8 secure the strap elements 9 across their entire width.

An inner belt of webbing is secured to each of the strap elements 9 at points approximately midway between the anchorages of the elements 9, thus providing a series of strap elements 12 anchored to the strap elements 9 at points 13 preferably by stitches extending crosswise over the width of the straps. Each of the strap elements 12 is stretched taut between anchorages 13 so that it subtends the angle between the adjacent portions of the straps 9 and forms a triangular clearance space.

There may be any number of such inner belts each made up of elements 12 stretched across and subtending the angles between the next adjacent outer belt, and the innermost belt constitutes the headband 3 which, in effect, comprises a series of strap elements 14 bridging or subtending the angles between the strap elements 12 in the same manner that these bridge the angles between the strap elements 9.

The headband is, however, anchored to the strap elements 12 by detachable fasteners 15 so that the headband may be readily attached and removed; thus permitting the wearer to select a headband of appropriate size for his head and apply it to the helmet. The headband, like the other belts or strap elements, is normally of polygonal form, as shown in Fig. 1, due to the tensile strain of these tautly drawn elements. When, however, the headband is in place on the wearer's head it fits the head snugly and conforms to the curvature of head throughout its circumferential length. This causes the individual strap elements 14 to curve about the wearer's head and to pull inwardly on the strap elements 12 and 9 so that normally all of the straps are under tension when the device is in position on the wearer's head.

Preferably that part of the headband which bears directly on the skin of the wearer is incased or coated with a layer of material 16 like leather or an appropriate substitute.

The distribution of the anchoring devices 15 about the circumference of the head band 3 is such as to distribute among the band elements 14 proportionate fractions of the total amount of the give-and-take arising from changes in circumferential headband size; and when the network is properly constructed it will accommodate all the normal headband sizes and still apply sufficient tension to all of the strap elements for snugness of fit and security of support for the helmet.

It will be seen from a consideration of Figure 1 that the network of straps divides the peripheral space between the wearer's head and the helmet into substantially triangular clearance units which overlap each other in such manner as to provide adequate clearance between the helmet and the wearer's head. The network of tension members anchored to the helmet and to each other affords substantial resistance to distortion of the shape of the helmet, so that the force of a blow thereon at any point tends to displace the helmet as an entirety and the shock of such force is absorbed by the resilience of the shell, the pull of the entire system of straps upon the headband and the lateral pressure of the headband upon the head of the wearer. Thus wherever a blow is struck, the force thereof is distributed over at least one-half of the surface of the wearer's head that is encompassed by the head band.

For the neck sling it has been found sufficient to employ an outer belt made up of two primary chordal strap elements 17 anchored to the shell by a rivet and washer plate at the mid point 18 at the back of the helmet and by side anchorages 25 and 20 with a single secondary strap 21 subtending the angle between elements 17 and anchored at 22 at appropriate points between the anchorages of elements 17. Snap fasteners or other detachable anchorages are used at the ends 22 of the strap 21, so that the individual wearer may select a strap of appropriate length to properly adapt the sling 4 to his neck according to the vertical contour of the back of his head, and so as to fit snugly and comfortably when the headband is in its normal position on the head.

In order to permit the tension of the neck sling to be relaxed while the helmet is being placed on the wearer's head and then be put under secure tension while the helmet is in place, the anchorage 25 is made releasable and accessible, as shown in Figs. 4 and 5. As there shown the adjacent end of the strap 17 is connected to a tongue 23 of tough flexible material which extends through a slot 24 in the shell and has a snap fastener anchorage 25 on the outside of the shell in such position that when this fastener is engaged the strap 17 will be drawn taut.

The crown slings 6 are each composed of an outer belt of chordal straps 26 lying in the same radial or diametrical plane and inner belts of angle-subtending elements 27 and 28 anchored to the shell by the rivets 8 and 29 and to each other by fastenings 30 and 31 in much the same manner as are the chordal straps and inner straps of headband network.

The crown slings preferably extend entirely across the helmet on a diameter and their corresponding horizontally disposed middle elements 6 and 26 cross each other at the vertical axis of the helmet and are sewn or otherwise fastened together at this point to interconnect the several networks.

In the drawings a chin strap 32 is shown swingably attached at 33 at opposite sides of the helmet. This is adjustable as to length in the customary fashion and is normally swung out of the way over the visor 34 as shown. When swung downwardly about the chin of the wearer, it cooperates with the neck sling 4 to give additional security against possible loss of the helment in combat.

In general, the ability of the structure to withstand shocks is a function of the strength of the shell to resist bending and compressive strains and of the tensile strength of the straps to brace the shell and to transmit the strains to the wearer's head. Thus for any particular shell material, the thickness and resulting stiffness of the shell wall determines the length or span of the individual strap units. A thinner shell would require more straps and shorter spans to approximate a given resistance to blows than would a thicker shell. The curvature of the shell is to a large extent fixed by the size of the human head, and if shorter strap spans are used, it may be

necessary to employ more belts of strap elements, one within another, to obtain a satisfactory spacing of the shell from the head.

Although but one specific embodiment of this invention is herein shown and described, as relating to a military helmet, it will be understood that numerous details of the device shown may be altered or omitted without departing from the spirit of the invention as defined by the following claims.

I claim:

1. A protective helmet, comprising a stiff shell, a headband enclosed by said shell and spaced inwardly therefrom, and a system of headband supporting straps arranged to space the headband from the shell and including a series of chordal straps stretched across successive arcuate regions of said shell in the plane of said headband and anchored to the shell in angular relation to each other, said headband having portions bridging spaces defined by said supporting straps and being detachably anchored thereto at points spaced from the anchorages of the chordal straps, the anchorages of said headband being relatively spaced so as to normally apply a tensional strain to all said supporting straps when the headband fits about a wearer's head.

2. A protective helmet, comprising a stiff shell, a removable headband enclosed by said shell and spaced inwardly therefrom, and a system of headband supporting straps including a series of chordal straps stretched across successive arcuate regions of said shell in the plane of said headband and anchored to the shell in angular relation to each other, said headband having portions respectively bridging angular spaces defined by pairs of adjacent supporting straps and detachably anchored to certain ones of said supporting straps at points spaced from the anchorages thereof, and said headband anchorages being spaced from one to another so as to subdivide and distribute among said headband portions any increase or decrease of the circumferential length of the headband as required to fit the wearer's head and to normally apply tensional strain to all said supporting straps.

3. A protective helment, comprising a stiff shell, a headband enclosed by said shell and spaced inwardly therefrom, and a system of stretched straps including chordal straps stretched across successive arcuate regions of said shell in the plane of said headband and anchored to the shell in angular relation to each other, said headband having portions bridging the angles between successive straps of said system and secured to such straps at points between their anchorages, and a neck sling structure at the back of said helmet comprising chordal straps subtending successive arcuate regions of said shell and anchored thereto in angular relation to each other in a plane below said headband and a secondary strap subtending an angle between adjacent chordal straps and secured to the chordal straps between their anchorages, said neck sling structure including means accessible from the outside of the shell to control the tension on said neck sling structure.

4. A shield for personal wear, comprising a stiff shell having a generally concavely curved cross-section for overlying a convex portion of the wearer's body, a plurality of flexible primary chordal straps stretched across successive arcuate regions of the shield and anchored thereto and arranged in angular relation to each other in substantially the same plane, and a secondary strap bridging the angle between the primary straps and secured to the primary straps between their anchorages, whereby all of said straps will cooperate under tension to space the shield from the wearer's body for resisting shocks on said shield, one of said straps having a tongue laced through an aperture in said shield and having its anchorage exterior to said shield and detachably connected thereto.

5. A protective helmet, comprising a stiff shell, vertically disposed and horizontally disposed bracing systems for spacing the helmet from the wearer's head; each said bracing system comprising a belt of chordal strap elements stretched across successively adjacent arcuate regions of said shell in approximately the same plane anchored to the shell in angular relation to each other, and an inner belt of strap elements each stretched across the respective angles between the chordal straps and anchored thereto between the anchorages of said chordal straps.

6. In a protective helmet, the combination of a stiff shell for enclosing in spaced relation the crown of a wearer's head, and a plurality of bracing systems respectively located in vertical planes intersecting each other at a central axis of the helmet, each such system comprising a belt of chordal strap elements stretched across successively adjacent arcuate regions of said shell in approximately the same plane and anchored to the shell in angular relation to each other, and an inner belt of strap elements each stretched across the respective angles between the chordal straps and anchored thereto between the anchorages of said chordal straps.

7. In a protective helmet, the combination of a stiff shell for enclosing in spaced relation the crown of a wearer's head, and a plurality of bracing systems respectively located in vertical planes intersecting each other at a central axis of the helmet, each such system comprising a belt of chordal strap elements stretched across successively adjacent arcuate regions of said shell in approximately the same plane and anchored to the shell in angular relation to each other, and an inner belt of strap elements each stretched across the respective angles between the chordal straps and anchored thereto between the anchorages of said chordal straps, each of said systems having a strap element crossing and secured to a corresponding strap element of another said system at their intersection.

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