LOWER LEG PROTECTIVE ARMOR


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9 Claims

ABSTRACT OF THE DISCLOSURE

Lower leg protective armor comprising a shaped one-piece covering for the frontal aspect of the lower leg and knee formed of rigid armor material, an articulating support bracket for the armor which attaches to the heel portion of the wearer's shoe and quick release means for attaching the armor to the lower leg.

The invention described herein may be manufactured, used and licensed by or for the Government for governmental purposes without the payment of us or any royalty thereon.

This invention relates to protective armor for the lower portion of a human leg and more particularly to lower leg protective armor which is of sufficient weight and thickness to resist penetration by small arms projectiles.

The concept of using low speed aircraft operating at very low altitudes in close support of combat troops has become rather widely accepted. Helicopters, in particular, have been extensively used for many purposes in connection with land combat operations including the rapid delivery of men and supplies to relatively inaccessible places, the evacuation of wounded and the provision of close air support utilizing both rockets and more conventional weaponry. Frequently, these activities bring the aircraft into close contact with hostile forces with the result that they are exposed to small arms fire. The expression “small arms” used herein refers to weapons capable of firing ammunition up to and including .30 caliber ammunition.

The multi-functional purpose of such aircraft effectively precludes extensive use of armor materials on the aircraft itself because of the severe weight penalty which would be incurred thereby. Critical portions of the aircraft are provided with armor protection but it has not thus far been found consistent with operational requirements to provide significant armor protection for the crew of the aircraft. In helicopters, for example, externally mounted machine guns are operated by crew members standing in large open doorways which are provided for the rapid loading and unloading of the aircraft during combat operations. Such crewmen are highly exposed to small arms fire from the ground as the relatively slow moving aircraft moves at low altitudes within range of hostile forces.

Armor materials capable of defeating small arms projectiles are necessarily quite heavy and thick. However, since aircraft crewmen and other personnel who spend most of their time in vehicles are required to do only limited amounts of walking, running or jumping, it is feasible to provide some armor protection to their legs, particularly where some portion of the weight of the armor may be transferred to the floor of the aircraft or vehicle. It has been found, however, that in actual combat operations such crewmen are often required to engage in brief periods of extreme physical activity requiring a high degree of mobility. For example, when the aircraft lands in a combat area to deliver emergency supplies or evacuate wounded, crewmen must assist in such operation, frequently under continuing small arms fire while providing for the maximum degree of leg movement by the wearer.

It is, therefore, an object of this invention to provide lower leg armor which will protect the lower leg and knee of the wearer from small arms fire while providing for the maximum degree of leg movement by the wearer.

Another object of this invention is to provide lower leg protective armor offering protection against small arms fire to the thigh and groin area of the wearer in a seated or squatting position.

Another object of this invention is to provide lower leg protective armor of minimum weight for the degree of protection afforded.

These and other objects, advantages, features and capabilities of this invention will become apparent to those skilled in the art from the following description and the accompanying drawings in which:

FIGURE 1 is a front elevation of right and left lower leg protective armor in accordance with the present invention with portions of the wearer's leg and foot shown in phantom and with the instep straps omitted for purposes of clarity:

FIGURE 2 is a side elevation of right leg protective armor in accordance with the present invention;

FIGURE 3 is a transverse section taken along line 3—3 of FIGURE 1 with the wearer's leg shown in phantom;

FIGURE 4 is a central vertical section taken along line 4—4 of FIGURE 1;

FIGURE 5 is a central vertical section taken along the line 5—5 of FIGURE 4;

FIGURE 6 is a rear view of the lower portion of the right leg protective armor showing articulation of the armor in relation to the heel of the wearer's shoe; and

FIGURE 7 is a central vertical section taken along the line 7—7 of FIGURE 6.

Referring now to the drawings wherein a preferred embodiment of this invention is shown for purposes of illustration, the lower leg protective armor of this invention comprises right leg armor 10 and left leg armor 11. As is apparent in FIGURE 1, the right leg armor and left leg armor are not intended to be interchangeable for reasons more fully set forth below. However, since the same concepts are embodied in the armor for each leg, unless otherwise indicated, references to leg armor in the following description shall refer to armor for one leg only with the understanding that the scope of the invention contemplates complementary armor for both legs.

As best shown in FIGURES 1 and 2, the lower leg protective armor of this invention comprises a generally anatomically shaped body member 12 formed of rigid armor material capable of preventing penetration by small arms projectiles and a foot bracket 13 depending from the body member 12 and capable of engaging the wearer's foot in a manner to be described. The body member 12 provides the protective capability while the foot bracket 13 effectively transfers a major portion of the weight of the body member 12 to the surface on which the wearer's heel is resting, i.e., the floor of an aircraft or the ground.

The body member 12 is a unitary structure having a lower or shin portion 14 and an upper or knee portion 15. The lower portion 14, which extends from slightly above the ankle area to a point just below the knee area is generally parabolic in cross section and is curved longitudinally or bowed as best shown in FIGURE 1 to conform...
generally with the normal longitudinal curvature of the tibia bone of the human leg. As shown in FIGURE 3, the lower portion 14 of the lower cut of lower portion 14 thereof is not only in conjunction with the longitudinal curvature thereof also permits the rigid lower portion 14 to rest on the fleshly portions of the leg on either side of the shin bone rather than on the bone itself. With proper sizing, these features assure a snug, comfortable and durable fit. The impact loads over a greater area in the event of a hit. The frontal aspect of the lower edge 16 of the lower portion 14 is flared outwardly to provide clearance for the wearer's instep during leg movement.

The upper or knee portion 15 of body member 12 is formed integrally with the lower portion 14 thereof upwardly from the top of the lower portion 14 to a point above the knee area as shown in FIGURES 1 and 2. The upper portion 15 is flared outwardly of the lower portion 14 to form an inverted bell shape which is slightly off-set inwardly of the curved longitudinal center line of the lower portion 14. This slight off-set together with the generally inverted bell shape of the upper portion 15 accomplish two main functions, namely, to maintain the knee portion 15 of the armor out of direct contact with the bony portions of the knee in most leg positions and to provide armor coverage of the knee area of the thigh and groin and other areas of the body when the wearer is in a seated or squatting position.

The lower portion 14 of body member 12 is provided with a wide band 17 of textile material which has one end thereof fixed to the front of the lower portion and a free end 19 capable of encircling the wearer's leg and overlapping the fixed end of the band. The outer surface of the fixed end 18 and the inner surface of the free end 19 of band 17 are provided with complementary portions of nylon hook and pile fastening material 20 whereby the band may be used to firmly attach the body member 12 to the wearer's leg. While the nylon hook and pile fastening material provides a range of adjustment, firm holding and rapid, simple attachment and release characteristics and is thus particularly suitable for this application, it will be apparent that other fastening means could be employed for this purpose.

The foot bracket 13 depends from the lower edge of the body member 12 and is mounted thereto by means of studs 21 which extend downwardly from opposite sides of the lower edge of body member 12. The free ends of studs 21 are preferably threaded for a purpose to be described. Except as otherwise specified, the studs 21 and the various components of the foot bracket 13 to be hereinafter described may be formed of metal such as steel or aluminum or any other rigid material of suitable strength.

As best shown in FIGURES 6 and 7, the foot bracket 13 includes a heel cup 22 capable of receiving the heel portion of the wearer's shoe and extending over a substantial portion of the sides, rear and bottom of the heel portion of the shoe. The bottom surface of the heel cup 22 is preferably provided with a non-skid covering 23 of rubber or the like. The heel cup 22 includes tabs 24 extending forwardly and upwardly on each side of the front portion of the heel cup and having slots 25 therein. A strap 26 of flexible webbing material is looped through slots 25 and provided with buckle 27 to enable the strap 26 to be slipped over the instep of the wearer's foot to thereby secure the heel cup 22 in position on the heel of the wearer's shoe. The buckle 27 may be of any conventional type providing easy adjustability, secure holding and quick release capability. The Buckle, Single Bar, with Lip, described as Type IV in Military Specification MIL-B-5435E dated Apr. 26, 1965 has been found suitable for this purpose. A pad 28 of foam rubber or the like is attached to the strap 26 to provide cushion between the webbing and the instep of the wearer's foot. As shown in FIGURE 7, a pivot pin 29 is welded to the rear of the heel cup 22 on the longitudinal center line of the heel cup 22. The outer end of pivot pin 29 is drilled and tapped for a purpose to be described.

A U-shaped support bracket 30 conforming generally to the shape of the sides of heel cup 22 and provided with a centrally located opening 31 through the closed or rear end thereof is pivotally mounted on the heel cup 22 by inserting pivot pin 29 into opening 31 in support bracket. The support bracket 30 is retained in this position by washer 32 and flat headed machine screw 33 which engages in the drilled and tapped outer end of pivot pin 29. The forward edges of support bracket 30 carry parallel offset upstanding arms 34 which extend upwardly to points on either side of the angle joint terminating in a slightly beveled end to transfer the force to the ankle joint. As shown in FIGURE 1, arms 34 are offset outwardly of the sides of the support bracket 30 to provide for easy passage of the front of a shoe or boot therethrough during donning and doffing of the armor. The upper ends of arms 34 are aligned with studs 21 on the lower edge of body member 12 and are threaded for a purpose to be described.

The upstanding arms 34 of support bracket 30 are joined to studs 21 extending from the lower portion of body member 12 by elastomeric couplings 35 which include threaded bushings 36 capable of receiving the threaded end portions of arms 34 and studs 21 respectively. Set screws 37 are provided in couplings 35 to lock arms 34 and studs 21 in position therein.

As thus comprised, the foot bracket 13 provides for articulation between the body member 12 and the heel portion of the wearer's shoe closely approximating the articulation which occurs about the ankle joint during normal leg movement. Pivoting of the support bracket 30 on pivot pin 29 provides articulation approximating the side to side movement of the leg or the ankle joint, i.e., pronation, while the flexure of the elastomeric couplings 35 provide articulation approximating the fore and aft movement of the leg about the transverse axis of the ankle joint. It should be noted that both types of articulation occur to some extent in normal walking. Thus, the selection of an elastomeric material of suitable durometer for the couplings 35 and the location of these couplings on the approximate transverse axis of the ankle joint together with the pivoting of the support bracket 30 on pivot pin 29 will permit substantially normal leg movement while at the same time providing for the transfer of the weight of the armor to the surface on which the wearer's heel is resting.

As noted above, the essentially anatomical shape of the body member 12 requires a separate and non-interchangeable armor for each leg, but the present invention provides for maximum protective covering with a minimum amount of armor material and thus a minimum weight penalty. At the same time, this shape offers minimal interference to normal leg movements. The longitudinal and cross sectional configuration of the lower portion 14 of body member 12 permits the armor to be used without the addition of padding material which would add further to the weight problem. It is apparent, however, that padding material may be used if desired without departing from the scope of the present invention.

From the foregoing description, it will be apparent to those skilled in the art that the present invention provides novel lower leg armor which may be of sufficient weight and thickness to provide protection against small arms projectiles not only to the lower leg but also to the thighs and groin when the wearer is in a seated or squatting position. The invention further provides for support means to transfer a major portion of the weight of the armor to a surface, and has been found suitable in all respects for the wearer's feet are placed while permitting substantially normal leg movements through articulation of the support bracket about the pivot pin on the heel cup and articulation of the elastomeric couplings.
We claim:

1. Lower leg protective armor comprising, for each leg,
   a unitary body member formed of rigid armor material capable of shielding the frontal aspect of the lower leg from the ankle to a point above the knee joint, said body member having a lower portion adapted to extend from the ankle to a point below the knee joint and an upper portion adapted to extend over the knee joint,
   said lower portion being curved longitudinally thereof to conform generally to the longitudinal curvature of the tibia bone of the leg and having a cross sectional shape which is curved to extend from one side of the leg, across the front thereof, to the other side of the leg,
   said upper portion having an outwardly flared inverted bell shape,

2. Lower leg protective armor as in claim 1 wherein said heel cup means comprises a rigid cup member conformed to receive the heel of the shoe of the wearer, flexible fastening means for releasably engaging the instep of the wearer's foot to retain said rigid cup member in engagement with said heel and said support means comprise a support bracket pivotally mounted on the rear of said cup member for rockering movement about the longitudinal center line of said cup member, said support bracket having upstanding arms connected to the lower end of said body member.

3. Lower leg protective armor as in claim 6 wherein said upstanding arms are offset from the sides of said heel cup means whereby the wearer's shoe may readily pass between said support means in donning and doffing said lower leg protective armor.

4. Lower leg protective armor as in claim 1 wherein said flexible means for releasably retaining said heel cup means in engagement with said heel portion comprises a textile web strap adapted to extend over the instep of the wearer's foot, an adjustable quick-release buckle for said strap, and a pad carried by said strap for engagement between said strap and the instep of the wearer's foot.

5. Lower leg protective armor as in claim 1 wherein said flexible means for releasably fastening said body portion to the wearer's leg comprise a wide band of textile material having one end thereof fixed to the front surface of said lower portion of said body member and a free end capable of encircling the wearer's leg and overlapping said fixed end, the exterior surface of said fixed end and the interior surface of said free end carrying complementary portions of nylon hook and pile fastening material whereby said body member may be securely fastened to the wearer's leg by said band of textile material.

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