Abstract

Protective footwear includes a metatarsal guard for providing protection of the metatarsal region of the wearer. The guard, which is internal of the footwear, of integral nonrigid assembly having mutually overlying multiple layers each extending both longitudinally and transversely in overlying relation to the metatarsal region of the wearer. Each layer is nonrigid and flexible. Different materials make up the different layers to within the footwear both energy absorbing and force dissipating capability for absorbing and dissipating impact forces throughout the multiple layers in order to protect the metatarsal region of the wearer from impact forces and from being cut by sharp objects.
METATARSAL GUARD AND PROTECTIVE FOOTWEAR EMBODYING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon Provisional Patent Application, Ser. No. 60/180,324, entitled “Protective Footwear With Internal Metatarsal Guard”, filed Feb. 4, 2000, the contents of which are incorporated herein by reference in their entirety, continued preservation of which is requested.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to industrial footwear and particularly to such footwear providing metatarsal protection for the user, and still more particularly to an improved metatarsal guard and to footwear that incorporates such a guard to prevent against injury to the user from falling objects or sudden impacts. Specifically, the present invention relates to protective guards and footwear incorporated such a guard so that the guard is positioned over the metatarsal region of the wearer to protect the top of the foot of a wearer but carried internally of the footwear.

[0004] 2. Known Art

[0005] Known art metatarsal protective footwear typically incorporates a steel cap in the toe of the footwear and/or is provided with an external metatarsal guard. The external metatarsal guard of the generally known type which is typically formed of tough polymer and is thus essentially rigid. Thus, the known external guard is typically hinged about near the toe of the footwear so as to swing or pivot back over the toes, or other securing means, of the footwear and over the metatarsals. Moreover, the known external guard is typically lined or provided with a layer of foam material to enhance wearer protection. Unfortunately, the externally hinged guard presents a tripping hazard if the guard were to become dislodged from its position over the metatarsals. Additionally, the side edges of the guard often catch on objects which also results in what is now believed to be a tripping hazard with potential serious injury to the wearer.

[0006] Also, the external metatarsal guards, while well-intentioned, have in retrospect not been always fully protective. It is now believed, for example, that the external guards may have a problem that they may allow an impact force delivered to the metatarsal region to be transferred into the surrounding footwear, with the consequence that the impact force may injure the metatarsal region of the foot of the wearer, despite the intent that the external guard would itself absorb a damaging impact force. That is, the impact force can be transferred directly through the external metatarsal guard, rather than being dissipated by the guard, and may thus reach the foot of the wearer. Also, because the external type of metatarsal guard typically has been hinged or pivotally or bandedly fastened usually relatively securely at its proximal (toe-adjacent) end, a metatarsal impact force may cause the metatarsal guard to apply by lever action an injuring force against the foot of the wearer either at the hinge or pivoting point or else at the ankle-proximate distal portion of the guard To remote from the location of the impact force.

[0007] In net effect, the known external guards are now believed by the present inventors, on the basis of available data, not to have been fully protective.

[0008] Industry standards for protecting the foot of the wearer from impact forces are often used in the design and manufacture of known protective footwear. A known standard used to determine whether footwear of this type meets the minimum requirements for providing metatarsal protection is ANSI (American National Standards Institute) Z41, 1999, Section 2, titled “Metatarsal Footwear”. Testing involves inserting a foot-simulative form of wax into the footwear and subjecting the footwear to an impact force. Indentation of the foot-simulative form is then measured to determine if metatarsal forces would result in foot injury.

[0009] It is believed by the present inventors that a metatarsal footwear protective device is needed which is internal to the footwear, rather than external as with the known art, to eliminate the possibility of tripping hazards. Furthermore, a protective device is needed which is more flexible and lighter weight and therefore more comfortable for the wearer. The protective device should also be cost effective to fabricate and be capable of integration with a wide variety of footwear styles.

SUMMARY OF THE INVENTION

[0010] Accordingly, among the several objects, features and advantages of the invention may be noted the provision of improved devices, namely a new metatarsal guard construction and protective footwear construction employing such a metatarsal guard internally of the for protection of the wearer from damage or from being struck by objects having forceful impacts; which constructions can provide protection of the metatarsal region of a wearer of industrial footwear; which include a unique combination of layers providing an energy absorbing and force dissipating capability; which can absorb and dissipates impact forces throughout the unique combination of layers; which provide protection of the metatarsal region of the wearer from impact forces; which offer protection of the metatarsal region of the wearer from being cut by sharp objects; which repeatedly, predictably and reliably can deliver a safe level of metatarsal protection; which provide a show construction in which the metatarsal guard is internal to the footwear, thereby eliminating the need for external devices that in part become tripping hazards; which allow utilization of components and materials used in the manufacture of a wide variety of footwear styles; which allow the use of distinctive principles for both construction and operation thereby providing a protective arrangement and metatarsal device or apparatus capable of being adapted to a wide variety of applications.

[0011] The protective properties are provided by a series of constructive layers in the metatarsal region that include a cut resistant material, a rebound layer of material, an energy absorbing and dissipating layer of material, a foam stabilizing layer of material, and a final layer of material for controlled recovery and cushioning. Additionally, a thick extension of foam material can be incorporated in the ankle-proximate region to provide additional softness under the tongue of the footwear. The series of layers, which may be either singular or a plurality for each characteristic layer, are encased in a material that is typically representative of
the tongue of footwear, i.e. leather outer and a soft cloth inner. The encased layers and outer materials are then attached to the footwear to serve the purpose of both the tongue of the footwear and for protection against impact forces. The encased layers can then be utilized in a wide variety of footwear styles and protective applications.

[0012] Additional protective properties can be provided below the foot of the wearer, in the midsole region, with at least one layer of rebound material. Furthermore, additional protective properties can be provided behind the heel of the wearer with at least one layer of controlled recovery and cushioning material.

[0013] The combination of protective layers are furthermore flexible to conform to the convex shape of the metatarsal region of the wearer. The flexible layers provide additional comfort to the wearer while also providing the required metatarsal protection. The convex shape furthermore enhances the stiffness and resistance to impact forces, so as to provide additional protection.

[0014] The construction of the layers and the location of the layers within the footwear is such that the apparatus repeatedly delivers the required metatarsal protection. As will become apparent in the forthcoming detailed description, the distinct and unique construction employed to achieve metatarsal protection can be incorporated into a multitude of devices in applications which require protection from impact forces.

[0015] Other objects and features will be apparent or are pointed out more particular herein below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The above mentioned and other features and objects of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

[0017] FIG. 1 is a cut-away perspective view of an example style of protective footwear in accordance with and embodying the present invention.

[0018] FIG. 2 is an exploded side view of the protective footwear layers illustrating each of the layers in accordance with a known embodiment.

[0019] Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of the present invention, the drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the present invention.

DESCRIPTION OF PRACTICAL EMBODIMENT

[0020] The present description for the industrial footwear protection application is merely representative of using the invention in many possible footwear styles for application of the present invention. The footwear embodiment of the present invention is not exclusive of other applications which require protection from impact forces. The distinct and unique characteristics of the present invention can be utilized in combination for a multitude of applications requiring protection against impact forces.

[0021] As shown in FIG. 1, the present invention comprises several layers of protective material that are encased into tongue element 12 of footwear 10, thereby providing protection for the metatarsal region of the wearer. Referring now to FIG. 2, the layers of protective material encased in tongue element 12 comprise cut resistant material 20, rebound material 22, layers of energy absorbing and dissipating material 24, stabilizing foam material 26, and controlled recovery and cushioning material 28. At least one layer of each material can be used for the present invention, although a known preferred embodiment with varying numbers of layers is described in the following.

[0022] Cut resistant material 20 provides protection against sharp objects penetrating footwear 10. Cut resistant material 20 is generally a fine wire mesh material embedded in a cloth fabric and is therefore flexible for subsequent joining to adjacent layers and for conforming to the general shape of the foot of the wearer.

[0023] Rebound material 22 in the preferred embodiment is a PORON® material that provides primarily a layer of shock absorption. Rebound material 22 also provides flexibility for conforming to the general shape of the foot of the wearer.

[0024] Energy absorbing and dissipating material 24 in the preferred embodiment is two layers of METATEC material. The METATEC material is comprised of layers of polymer provided along the width and length of the surface with an array of bubbles which are gas-filled. The bubbles are such that they are in columns and rows and interlock with corresponding bubbles of an adjacent layer. The bubble-type character of energy absorbing and dissipating material 24 greatly assists in absorbing dissipating energy from an impact force.

[0025] Stabilizing foam material 26 is used to stabilize the layers of protective materials for subsequent joining and operation.

[0026] Controlled recovery and cushioning material 28 in the preferred embodiment is also a PORON® material that provides additional shock protection and flexible cushioning.

[0027] As shown in FIG. 1, protective layers can also include foam extension cushion 30 which provides additional softness under tongue element 12 of footwear 10, but is not intended specifically to provide any additional metatarsal protection.

[0028] Each layer of material is generally adhesively bonded to adjacent layers, and cut resistant material 20 is also sewn around its periphery to all adjacent layers. The layers of protective materials generally extend forward along the footwear and overlap a conventional steel toe by approximately 1/4". The layers of protective material in tongue element 12 are flexible and therefore take on a curvature corresponding to the convex curvature of the foot of a wearer in the region of the metatarsals. In addition to comfort, the curved shape furthermore enhances the stiffness and resistance to impact forces, so as to provide additional protection.

[0029] Another known embodiment of the present invention comprises, in addition to the metatarsal protective layers as described above, several layers of protective mate-
rial located in the midsole of the footwear. As shown in FIG. 1, midsole region 14 of footwear 10 includes two layers of rebounding material 22. When used in conjunction with the protective layers in the metatarsal region of footwear 10, midsole rebounding material 22 provides additional protection against impact forces. Midsole region 14 of footwear 10 can also include other conventional layers such as a sock liner, an insole board, a steel shank for stabilization, an EVA (ethyl vinyl acetate) bottom filler, and an outer sole.

Another known embodiment of the present invention comprises, in addition to the metatarsal protective layers as described above, several layers of protective material located at the heel of footwear 10. As shown in FIG. 1, heel region 16 of footwear 10 includes a layer of controlled recovery and cushioning material 28. When used in conjunction with the protective layers in the metatarsal region of footwear 10, or in combination with the protective layers in the metatarsal region and midsole region of footwear 10, controlled recovery and cushioning material 28 provides additional protection against impact forces.

Although the new metatarsal guard arrangement has been illustrated for use within an article of footwear, it should be appreciated that the new guard features herein described and illustrated can be used to construct a metatarsal guard which is applied externally to an article of footwear for providing improved protection, flexibility and comfort to footwear compared to existing external metatarsal guards known in the art.

As incorporated in footwear, there is thus seen to be provided an article of protective footwear including an outsole, an insole, an upper extending over the forefoot of the wearer and extending toward the metatarsal region of the wearer, and a metatarsal guard carried by the upper internally of the footwear for providing protection of the metatarsal region of a wearer of the footwear, the metatarsal guard comprising at least

- a layer of cut resistant material,
- a layer of rebound-absorbing material, and
- a layer of an energy absorbing and dissipating material,

the footwear further comprising

- a layer of foam stabilizing material, and
- a layer of controlled recovery and cushioning material.

wherein all of said layers (a) through (e) are completely internally of the footwear, for together providing within the footwear both energy absorbing and force dissipating capability for absorbing and dissipating impact forces throughout said multiple layers in order to protect the metatarsal region of foot of the wearer from impact forces received by the footwear article over the metatarsal region of the wearer and to protect the metatarsal region of the wearer from being cut by sharp objects.

In view of the foregoing description of the present invention and practical embodiments it will be seen that the several objects of the invention are achieved and other advantages are attained.

As various modifications could be made in the constructions and methods herein described and illustrated without departing from the scope of the invention, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative rather than limiting.

The breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with claims of the application and their equivalents.

What is claimed is:

1. For use with an article of protective footwear, a metatarsal guard for providing protection of the metatarsal region of a wearer of the footwear, comprising an integral nonrigid assembly formed of a combination of mutually overlying multiple layers each extending both longitudinally and transversely in overlying relation to the metatarsal region of the wearer, each of said multiple layers being nonrigid, said multiple layers being constituted by respective multiple different materials so that said multiple layers together provide within the footwear both energy absorbing and force dissipating capability for absorbing and dissipating impact forces throughout said multiple layers in order to protect the metatarsal region of foot of the wearer from impact forces received by the footwear article over the metatarsal region of the wearer and to protect the metatarsal region of the wearer from being cut by sharp objects, the integral nonrigid assembly being substantially entirely internal to the footwear article.

2. A metatarsal guard as set forth in claim 1 wherein the multiple layers are mutually adhesively secured together over at least portions of their respective areas.

3. A metatarsal guard as set forth in claim 1 wherein the multiple layers are carried beneath a tongue of the footwear.

4. A metatarsal guard as set forth in claim 1 wherein said multiple layers respectively provide respective distinctly characteristic protective functions, which functions together synergistically provide said protection of the metatarsal region of the wearer, and wherein each of said multiple layers is formed of either a single layer or a plurality of layers.

5. A metatarsal guard as set forth in claim 4 wherein said multiple layers include at least

- a layer of cut resistant material,
- a layer of an energy absorbing and dissipating material, and
- a layer of foam stabilizing material.

6. A metatarsal guard as set forth in claim 5 wherein said multiple layers further include an extension layer of foam material extending to an ankle-proximate region of the foot of the wearer for provide additional softness under the tongue, the extension layer extending in the direction of the ankle of the wearer beyond at least some of layers (a) through (c).

7. A metatarsal guard as set forth in claim 5 wherein the layer of an energy absorbing and dissipating material is constituted by interlocked adjacent overlying layers of bubble-surfaced polymer each provided along its width and length an array of gas-filled bubbles that interlock with corresponding bubbles of the adjacent layer of bubble-surfaced polymer.
8. A metatarsal guard as set forth in claim 5 wherein said multiple layers are encased in an encasement defining a tongue of the footwear, whereby the metatarsal guard constitutes also the tongue of the footwear.

9. A metatarsal guard as set forth in claim 8 wherein said multiple layers and encasement together define a metatarsal subassembly capable of securement to the footwear by attachment of only the encasement to an upper of the footwear.

10. A metatarsal guard as set forth in claim 6 wherein said encasement comprises an outer layer formed of the same material which forms an upper of the footwear article.

11. A metatarsal guard as set forth in claim 6 wherein the footwear includes an upper extending over the forefoot of the wearer and having a metatarsal-overlying margin extending at least over a portion of the metatarsal region of the wearer with generally foot-conforming profile, the encasement outer layer being secured to the metatarsal-overlying margin of the upper, and extending the outer profile of the upper toward the ankle of the wearer substantially without interrupting protrusion of the foot-conforming profile, and wherein all of layers (a) through (c) are located beneath the encasement outer layer and without portions laterally outwardly beyond the shoe upper.

12. A metatarsal guard as set forth in claim 9 wherein all of layers (a) through (c) are concealed beneath the encasement outer layer.

13. A metatarsal guard as set forth in claim 9 wherein the encasement comprises and an outer layer formed of the same material as an outer surface of the tongue.

14. A metatarsal guard as set forth in claim 9 wherein the encasement comprises a leather outer layer and a soft cloth inner layer.

15. An article of protective footwear including an outsole, an insole, an upper extending over the forefoot of the wearer and extending toward the metatarsal region of the wearer, and a metatarsal guard carried by the upper internally thereof for providing protection of the metatarsal region of a wearer of the footwear, comprising an integral nonrigid assembly formed of a combination of mutually overlying multiple layers each extending both longitudinally and transversely in overlying relation to the metatarsal region of the wearer, each of said multiple layers being nonrigid, said multiple layers being constituted by respective multiple different materials so that said multiple layers together providing within the footwear both energy absorbing and force dissipating capability for absorbing and dissipating impact forces throughout said multiple layers in order to protect the metatarsal region of foot of the wearer from impact forces received by the footwear article over the metatarsal region of the wearer and to protect the metatarsal region of the wearer from being cut by sharp objects, said protection; the integral nonrigid assembly being substantially entirely internal to the footwear.

16. An article of footwear as set forth in claim 15 wherein the multiple layers are mutually secured together over at least portions of their respective areas and the multiple layers respectively provide distinctly characteristic protective functions, which functions together synergistically provide said protection of the metatarsal region of the wearer.

17. An article of footwear as set forth in claim 16 wherein said multiple layers include at least (a) a layer of cut resistant material,
(b) a layer of an energy absorbing and dissipating material, and
(c) a layer of foam stabilizing material.

18. An article of footwear as set forth in claim 17 wherein the layer of an energy absorbing and dissipating material is in turn constituted by interlocked adjacent layers of bubble-surfaced polymer each provided along its width and length an array of gas-filled bubbles that interlock with corresponding bubbles of the adjacent layer of bubble-surfaced polymer.

19. An article of footwear as set forth in claim 17 wherein said multiple layers further include an extension layer of foam material extending to an ankle-proximate region of the foot of the wearer for provide additional softness under the tongue, the extension layer extending in the direction of the ankle of the wearer beyond at least some of layers (a) through (c).

20. An article of footwear as set forth in claim 17 wherein said multiple layers together define a metatarsal subassembly, and the metatarsal subassembly comprises an outer layer joined to the upper and extending an outer generally foot-conforming profile of the upper toward the ankle of the wearer substantially without interrupting protrusion of the foot-conforming profile, and wherein all of layers (a) through (c) are located beneath the encasement outer layer and without portions laterally outwardly beyond the shoe upper, and wherein all of layers (a) through (c) are concealed beneath the encasement outer layer.

21. An article of footwear as set forth in claim 20 further comprising a further layer constituted of rebound material below the foot of the wearer, within the midsole region of the foot, for coacting with the metatarsal guard to provide additional foot protection by permitting rebound of the foot in response to external force delivered by the metatarsal guard.

22. An article of footwear as set forth in claim 21 further comprising a still further layer of material constituted by of controlled recovery and cushioning material and located behind the heel of the wearer, for coacting with the metatarsal guard to provide additional foot protection by permitting rearward movement of the foot in response to external force delivered by the metatarsal guard.

23. An article of footwear as set forth in claim 15 wherein the multiple layers are all sufficiently flexible as to conform to convex shape of the metatarsal region of the wearer and thereby to provide additional comfort to the wearer while also providing required metatarsal protection.

24. An article of footwear as set forth in claim 15 wherein the multiple layers as secured together have an outwardly convex, foot-conforming shape for corresponding outwardly convex, foot-conforming shape of the metatarsal guard, whereby to enhance the stiffness and resistance thereof to impact forces and so to provide additional protection.

25. An article of protective footwear including an outsole, an insole, an upper extending over the forefoot of the wearer and extending toward the metatarsal region of the wearer, and a metatarsal guard carried by the upper internally of the
footwear for providing protection of the metatarsal region of a wearer of the footwear, the metatarsal guard comprising at least

(a) a layer of cut resistant material,
(b) a layer of rebound-absorbing material, and
(c) a layer of an energy absorbing and dissipating material,

the footwear further comprising

(d) a layer of foam stabilizing material, and
(e) a layer of controlled recovery and cushioning material.

wherein all of said layers (a) through (e) are completely internally of the footwear, for together providing within the footwear both energy absorbing and force dissipating capability for absorbing and dissipating impact forces throughout said multiple layers in order to protect the metatarsal region of foot of the wearer from impact forces received by the footwear article over the metatarsal region of the wearer and to protect the metatarsal region of the wearer from being cut by sharp objects.

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