

[72] Inventor **Melvin W. Dalebout**
 3661 Ceres Drive, Salt Lake City, Utah
 84117

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Continuation-in-part of application Ser. No.
 726,094, May 2, 1968, now Patent No.
 3,521,385.

[56] **References Cited**

UNITED STATES PATENTS

3,325,919	6/1967	Robinson	36/2.5
3,325,920	6/1967	Werner	36/2.5
3,377,721	4/1968	Johnson	36/2.5

Primary Examiner—Patrick D. Lawson
Attorneys—C. Harvey Gold, David V. Trask and William S. Britt

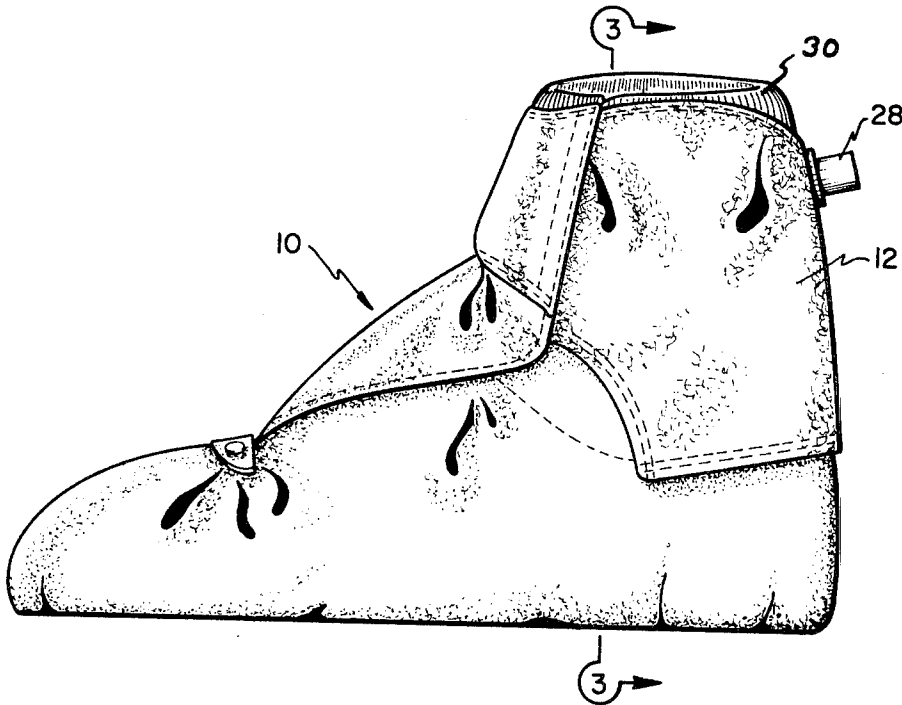
[54] **INNER BOOT AND METHOD FOR FORMING THE SAME**
 28 Claims, 4 Drawing Figs.

[52] U.S. Cl. 36/2.5AL

[51] Int. Cl. A43b 00/00

[50] Field of Search 36/2.5, 8.4,
 55, 2.5AL; 128/581

ABSTRACT: An inner boot which includes an outer liner, an inner liner connected to the outer liner and spaced apart therefrom to form a sealed compartment between the liners, and a resilient member positioned between the liners to mold the inner liner to the shape of an individual's foot and the outer liner to the interior shape of an outer boot shell. The resilient member is formed by injecting a liquid resin elastomer reaction mixture under pressure into the compartment between the liners when an individual's foot is positioned within the inner liner and when the inner boot is fitted in the outer boot shell and thereafter curing the resin elastomer reaction mixture.



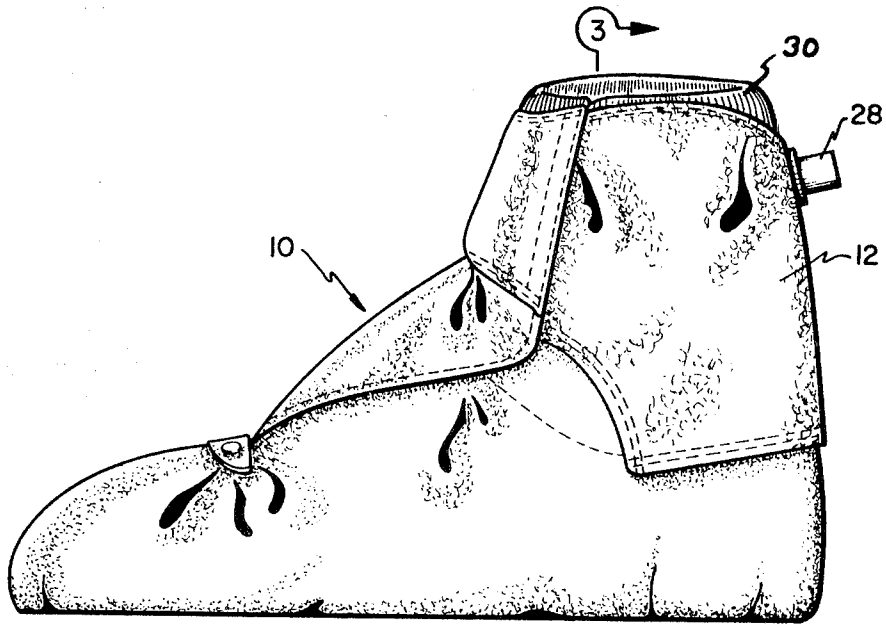


FIG. 1

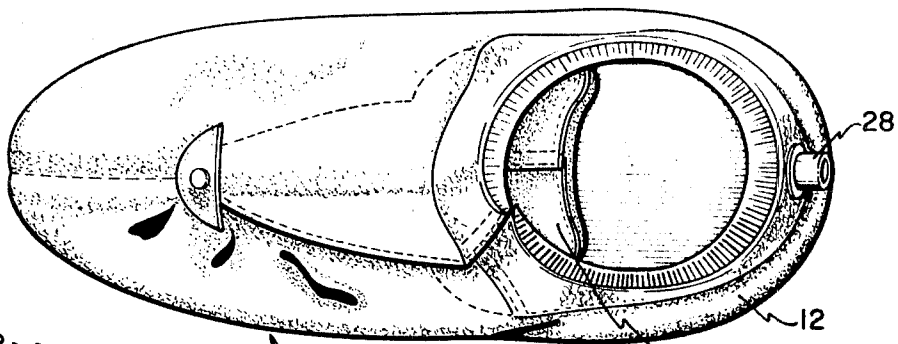


FIG. 2

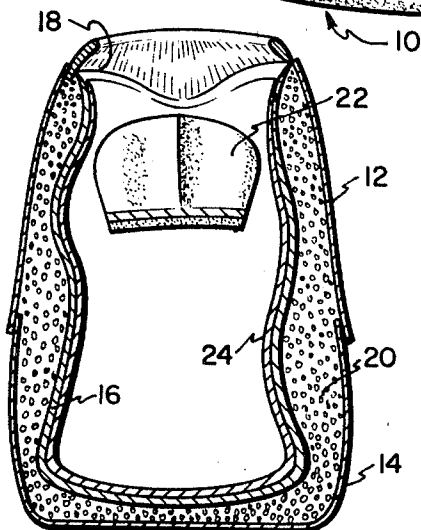


FIG. 3

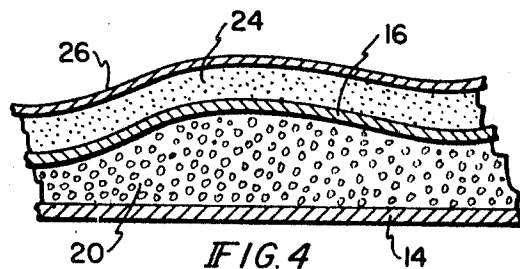


FIG. 4

INVENTOR.
Melvin W. Dalebout
BY
C. Hamerfeld
His Attorney

INNER BOOT AND METHOD FOR FORMING THE SAME

RELATED PATENT APPLICATION

This application is a continuation-in-part of my copending U.S. Pat. application Ser. No. 726,094, filed May 2, 1968, now U.S. Pat. No. 3,521,385.

BACKGROUND OF THE INVENTION

One of the most difficult problems that arises in connection with ski boots and the like is that of snugly fitting the boot to the foot of an individual without subjecting the foot and ankle to painful irritation because the boot fits too tightly. Attempts have been made to overcome this problem by using moldable pads in the boot such as described in U.S. Pat. No. 3,474,561, or by filling isolated compartments in the boot with small discrete particles or semiresins which flow to conform with the shape of the individual's foot such as described in U.S. Pat. No. 3,325,920 and 3,377,721. However, in all such previous attempts only a portion of the inner boot has been form fitted to the shape of the wearer's foot, i.e., generally, the portion of the boot that conforms with the sides of the foot and the lower ankle. Accordingly, the foot can still shift within the boot unless the boot is closed very tightly about the foot. This means that portions of the boot that do not conform to the shape of the individual's foot can exert substantial pressures on the foot thereby creating sources of pain.

Accordingly, it is the principal object of this invention to provide an inner boot for substantially rigid boot shells, such as ski boot shells, having an interior liner which is custom fitted to the shape of an individual's foot and an exterior liner shaped to conform with the interior shape of the boot shell.

Another object of the invention relates to a method for forming the inner boot.

BRIEF DESCRIPTION OF THE INVENTION

In its broadest form the invention relates to the inner boot, sized to be received within an outer support shell, which includes a flexible inner liner sized to receive the foot and lower ankle of an individual; a flexible outer liner secured about said inner liner forming a substantially closed compartment between said inner liner and said outer liner; and a resilient member positioned between said inner liner and said outer liner which is formed to position said inner liner in a configuration which substantially conforms with the shape of an individual's foot positioned in said inner liner and which positions said outer liner in a configuration which substantially conforms with the interior shape of said outer support shell.

In another embodiment of the invention, the resilient material is a resin elastomer.

In yet another embodiment of the invention, the resin elastomer is formed by injecting the elastomer as an uncured liquid reaction mixture into the compartment between the inner liner and the outer liner when the individual's foot is positioned within the inner liner and the inner boot is positioned within the outer boot shell, and thereafter, curing the resin elastomer reaction mixture.

In still another embodiment of the invention, the inner liner of the inner boot is a closed cell foam pad with a stretch fabric material secured to the pad's surface.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the invention will be more readily understood and carried into effect reference is made to the accompanying drawings, which are offered by way of example only and are not to be taken as limiting the invention, the scope of which is defined by the appended claims which are intended to embrace equivalent structures and processes.

FIG. 1 is a side view of the inner boot of the invention with an umbilical cord attached thereto for injecting a liquid resin elastomer reaction mixture into the compartment between the boot's liners.

FIG. 2 is a top view of the inner boot of the invention.

FIG. 3 is a sectional view taken in the plane of line 3-3 of FIG. 1 looking in the direction of the arrows.

FIG. 4 is a partial sectional view of a segment of the inner boot's wall showing the construction of the wall.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, inner boot 10 of this invention is shown in FIGS. 1 and 2. As illustrated, the inner boot is a high top one sized to receive the entire foot and lower ankle of an individual. The ankle cuff portion 12 of the boot 10 is preferably sized to extend beyond the top edge of the outer boot shell in which the inner boot is used to protect the ankle from contacting any portion of the outer boot shell. While the inner boot 10 can be used with any outer boot shell, it is preferred to use a substantially rigid shell such as described in my U.S. Pat. No. 3,521,385.

Inner boot 10 includes an outer liner 14 and an inner liner 16 which are connected together proximate the top edge 18 of the boot's ankle cuff 12 to form a compartment 20 between the liners 14 and 16. Compartment 20 which extends substantially about the entire foot and lower ankle when an individual's foot is placed within the inner boot. Inner liner 16 and, preferably, outer liner 14 are constructed from a flexible material such as a suitable plastic, leather, fabric, or the like, so that the liners can be urged to a predetermined shape when compartment 20 is pressure filled with a resin elastomer of the type hereinafter described. As shown in FIG. 3, inner liner 16 is somewhat smaller than outer liner 14 so that the outer liner can be urged snugly against the interior of the outer boot shell while inner liner 16 is urged to conform with the shape of a foot or mandrel positioned within the inner boot 10. The ankle cuff portion 12 of inner boot 10 is split so that an individual can easily place his foot into the lower portion of the boot. A conventional tongue 22 can also be provided within the boot beneath said split in the ankle cuff for sealing purposes.

To minimize friction on the foot of the user of the inner boot 10 of this invention, a layer of protective material such as described in U.S. Letters Pat. No. 3,449,844 is positioned over the interior face of inner liner 16, or optionally, said protective layer is used as the inner liner 16. Protective layers of the type described in said U.S. Pat. No. 3,449,844 include a closed cell foam base 24 preferably having a two-way stretch fabric 26 bonded to the base's interior face, i.e., the face of the base 24 which is positioned adjacent to an individual's foot positioned in the inner boot. Base 24 is an elastic closed cell foam such as neoprene, closed cell rubber, poly vinyl chloride, rubber latex, vinyl foam, and the like. Stretch fabric 26 provides a slick surface between the protective pad and the foot of a person using the boot. Any fabric and/or weave can be used having a coefficient of friction lower than that of foam base 24 which is capable of two-way yield or stretch so that motion is imparted through the fabric to the foam base. The best example of a fabric of this type which does not impede base movement is a stretch nylon, also known as elastic nylon. Fabric 26 is bonded to foam base 24 with a rubbery adhesive so that the elastic characteristics of the fabric or the foam are not destroyed when the fabric is bonded to base 24.

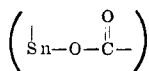
The filling material of this invention is a resin elastomer suitable for forming a resilient form, i.e., one that is capable of being bent and compressed and then return to substantially its original shape. Polyurethane elastomers are particularly useful filling materials. Such elastomers are formed by curing liquid reaction mixtures of organic polyisocyanates and organic polyols in the presence of a catalyst, and optionally, a filler. When a suitable catalyst is used the curing reaction occurs at ambient temperature and pressure conditions.

Suitable organic polyols for preparing the polyurethane elastomers include simple polyols such as ethylene glycol, or glycerol, as well as, polymeric polyols such as polyester polyols and polyalkylene ether polyols. Preferably, the organic polyols is a polyalkylene ether polyol such as described in U.S. Pat. No. 3,249,855 and 3,201,136.

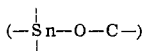
Typical suitable organic polyisocyanates for preparing polyurethane elastomers include aliphatic polyisocyanates such as hexamethylene diisocyanate, pentamethylene diisocyanate, etc.; cycloaliphatic polyisocyanates such as cyclohexyl 2, 4 diisocyanate, 4, 4'-methylene-bis (cyclohexyl isocyanate), etc., and; aromatic polyisocyanates such as 2, 4-toluene diisocyanate, 2, 6-toluene diisocyanate, 4, 4-methylene bis (phenylisocyanate), 1, 5-naphthalene diisocyanate, 4, 4',4''-triphenylmethane triisocyanate, polyalkylene polyaryl polyisocyanates disclosed in U.S. Pat. No. 2,683,730, etc.

The proportions of organic polyisocyanate and organic polyol employed in the polyurethane forming reaction can be varied somewhat depending on the particular characteristics of the polyurethane product desired. In preparing urethane elastomers according to the preferred embodiment of the invention, an amount corresponding to a NCO:OH ratio of about 0.9:1-1.4:1 is used.

Useful compounds which function as cold curing catalysts are, for example, certain organotin compounds of tetravalent tin, which may be defined as the organotin compounds having at least one tin to chalcogen valence bond. Representative groups of these tin catalysts are the organotin oxides, hydroxides, carboxylates



alcoholates



or combinations thereof. Representative examples of effective tin catalysts of this group are dibutyl tin diacetate, dibutyl tin di-2-ethyl hexoate, dibutyl tin oxide, dibutyl tin monomethoxy methyl maleate, dibutyl tin sulfide, tributyl tin 2-ethyl hexoate, monobutyl tin tri-2-ethyl hexoate, triphenyl tin hydroxide, bis-(tributyl tin) oxide, bis-(tributyl tin) tetrapropenyl succinate, bis-(tributyl tin) n-nonyl succinate, and bis-(tributyl tin) malonate.

Another group of cold curing catalysts for liquid hardenable polyurethane reaction systems of the type herein described are represented by the soluble organic acid salts of lead, bismuth, antimony, mercury, tin, and particularly their fatty acid salts. Representative of these metal salts are those of the fatty acids which are soluble in the glycol and urethane reaction mixture. A preferred group of catalysts are the lead salts such as lead octoate (lead di-2-ethyl hexoate), lead naphthenate and similar lead drying salts.

As indicated, a filler can be added to the urethane forming reaction mixture to alter the properties of the elastomer. For example even very small amounts of finely divided inert fillers will increase the load bearing characteristic of the elastomer. Any suitable finely pulverized organic or inorganic material or combination of materials which are inert to reaction with the elastomer forming reactants, may be incorporated into the polymer. Typical example of suitable fillers include expanded mica, cork, perlite, attapulgite, calcium silicate, kaolin, magnesium trisilicate, talc, zinc sulfide, red lead oxide, barium sulfate, bentonite, calcium flouride, halloysite, titanium dioxide, aluminum silicate, amorphous silica, etc.

The amount of filler used is generally not critical and can be varied over a broad range and, as indicated, depends to a considerable extent upon the particular properties and characteristics desired in the final elastomer product. Generally, the filler is added in amounts of between about 10 percent and 60 percent by weight of the total reaction mixture.

Specific examples of the method of producing polyurethane elastomers suitable for use in this invention are disclosed in U.S. Letters Pat. Nos. 3,429,855 and 3,201,136, which patents are incorporated herein by reference in their entirety.

The inner boot 10 of this invention is custom fit to the foot of an individual by placing the boot in an outer support shell and thereafter closing the shell about the inner boot with the individual's foot positioned therein. Optionally, a mandrel

corresponding to the shape of the foot and lower ankle of an individual can be positioned within the boot. A liquid resin elastomer reaction mixture of the type herein described is then injected under pressure into compartment 20 until the compartment is substantially filled. When this occurs, inner liner 16 is snugly urged to a position adjacent to the individual's foot and lower ankle, or mandrel, and outer liner 14 is urged against the interior surface of the outer support shell. To expedite filling an umbilical tube 28 is secured to liner 14 in communication with compartment 20. Preferably, the umbilical opening in liner 14 is positioned proximate the upper portion of the inner boot's ankle cuff 12 above the top of the upper surface of the outer support shell. However, an opening can be provided in the outer support shell at any appropriate position therein through which the umbilical tube passes.

When fitting the inner boot 10 it often is desirable to provide an enlarged area for the individual's toes so that they can freely move within the boot. When this is desired an appropriately sized covering can be positioned over the toes before the individual's foot is placed within the boot. Accordingly, after the filling material has been injected into the inner boot's compartment 20, the toe covering can be removed and there results an enlarged compartment for the toes. This step can, of course, be omitted when an appropriately sized mandrel is used for fitting purposes.

It is to be noted that unless means are provided for air to escape from compartment 20 when it is filled with the liquid resin elastomer reaction mixture the liquid mixture will not completely fill compartment 20. Accordingly, it is preferred to connect liners 14 and 16 of inner boot 10 by, for example, sewing them together in a fashion which allows air to escape between the stitching but which is sufficiently tight to prevent the liquid mixture from passing therethrough. When air pockets are formed within compartment 20 the air can be withdrawn with a conventional hypodermic needle.

The individual components of the elastomer reaction mixture can be prepackaged so that they can easily mixed together in a proper reaction mixture. For example, a three package system can be used for polyurethane elastomers wherein a predetermined quantity of a polyisocyanate, a polyol and a curing catalyst are packaged in separate containers. When an inner boot 10 is to be pressure filled with an elastomer, the separate packages containing the reaction components are emptied into a container and mixed into a substantially homogeneous reaction mixture. Preferably the reaction mixture is whipped as it is mixed to entrain air bubbles therein which reduce the weight of the elastomer when it cure hardens and also increases its insulating property.

After compartment 20 has been filled to the desired extent the resin elastomer is allowed to cure harden. This can be done at ambient conditions or, optionally, the curing rate can be accelerated by elevating the temperature of the inner boot's environment. Preferably, the boot 10 is filled with a resin elastomer that will substantially cure harden in less than 60 minutes and most preferably, in about 10 to 45 minutes from the time the resin reactants are mixed together. After the reaction mixture has cured umbilical tube 28 is severed proximate its point of connection to outer wall 14. A patch can then be secured to the outer wall over the severed umbilical tube for appearance purposes.

It is to be noted that when inner boot 10 is to be used in combination with a ski boot outer shell it is particularly desirable to affix a closing cuff 30 to the top edge 18 of the inner boot's ankle cuff 12 which snugly encloses the cuff around the ankle of the individual using the inner boot to prevent snow and water from passing into the ankle cuff. The closing cuff can be formed from any soft elastic material such as stretch nylon or the like.

I claim:

1. An article of footwear which comprises an outer shell and an inner boot positioned within said outer shell, said inner boot having an inner liner sized to receive an individual's foot; an outer liner positioned about said inner liner forming a compartment between said inner liner and said outer liner, and a

resilient form member positioned in said compartment between said inner liner and said outer liner to position said inner liner substantially adjacent to and about said individual's foot and to position said outer liner substantially adjacent to the inner sidewalls of said outer shell.

2. The article of footwear of claim 1 wherein said resilient form member is formed from a resin elastomer material.

3. The article of footwear of claim 1 wherein said inner liner is sized to receive the foot and lower ankle of said individual.

4. The article of footwear of claim 2 wherein said resin elastomer material is a polyurethane resin.

5. The article of footwear of claim 1 wherein said inner liner of said inner boot comprises a closed cell foam sheet having a two-way stretch fabric bonded to the face of said sheet positioned adjacent said foot of said individual.

6. The article of footwear of said claim 3 wherein said inner liner and said outer liner of said inner boot surrounds the entire foot and lower ankle of said individual.

7. A method for custom fitting an article of footwear to the foot of an individual which comprises providing an outer shell with an inner boot within said outer shell, said inner boot including an inner liner sized to receive the foot of said individual and an outer liner positioned about said inner liner forming a substantially closed compartment between said inner liner and said outer liner; injecting a liquid resin reaction mixture into said compartment when a form the shape of an individual's foot is positioned within said inner liner of said inner boot until sufficient resin is present, when cured, to urge said inner liner substantially adjacent to and about said form of said individual's foot and to urge said outer liner substantially against the interior sidewalls of said outer boot shell; and curing said resin reaction mixture while said form of said individual's foot is positioned within said inner liner.

8. The method of claim 24 wherein the form the shape of said individual's foot is said individual's foot.

9. The method of claim 24 wherein said resin reaction mixture is aerated prior to injecting said reaction mixture into said compartment.

10. The method of claim 24 wherein said resin reaction mixture is a polyurethane resin reaction mixture.

11. The method of claim 25 wherein said resin reaction mixture is injected into said compartment through an elongated tube in communication with said compartment.

12. The method of claim 27 wherein said polyurethane resin reaction mixture contains a filler material.

13. The method of claim 25 wherein a toe covering is positioned over the toes of said individual's foot when said foot is positioned within said inner liner of said inner boot to provide an enlarged area for the toes of said individual's foot in said inner boot.

14. The method of claim 27 wherein said polyurethane resin reaction mixture is prepared prior to injecting said mixture

into said compartment by mixing together separately packaged quantities of a polyisocyanate, a polyol and a curing catalyst.

15. The method of claim 31 wherein a filling material is mixed with said polyurethane resin reaction mixture prior to injecting said polyurethane resin reaction mixture into said compartment.

16. In combination with an outer shell, an inner boot adapted to be custom fit to the foot of an individual positioned within said outer shell, said inner boot comprising a flexible inner liner sized to receive the foot of said individual; an outer liner positioned about said inner liner and forming a substantially closed compartment between said inner liner and said outer liner; and filling means in communication with said compartment for injecting filling material into said compartment.

17. The combination of claim 16 wherein said inner liner and said outer liner are secured together.

18. The combination of claim 16 wherein said inner boot is sized to enclose the foot and lower ankle of said individual.

19. The combination of claim 17 wherein said filling means comprises an elongated tube.

20. The combination of claim 19 wherein said elongated tube is secured to the ankle cuff portion of said outer liner at a position above the top edge of the ankle cuff of the outer boot shell.

21. The combination of claim 18 wherein said inner liner and said outer liner of said inner boot surround the entire foot and lower ankle of said individual.

22. The combination of claim 16 wherein said inner liner of said inner boot comprises a closed cell foam sheet having a two-way stretch fabric bonded to the face of said sheet positioned adjacent said foot of said individual.

23. An inner boot for use within an outer shell and adapted to be custom fit to the foot of an individual which comprises a flexible inner liner sized to receive said foot of said individual; an outer liner positioned about said inner liner and forming a substantially closed compartment between said inner liner and said outer liner; and filling means in communication with said compartment for injecting filling material into said compartment.

24. The inner boot of claim 23 wherein said inner liner and said outer liner are secured together.

25. The inner boot of claim 23 wherein said inner boot is sized to enclose the foot and lower ankle of said individual.

26. The inner boot of claim 24 wherein said filling means comprises an elongated tube.

27. The inner boot of claim 23 wherein said inner liner of said inner boot comprises a closed cell foam sheet having a two-way stretch fabric bonded to the face of said sheet positioned adjacent said foot of said individual.

28. The inner boot of claim 25 wherein said inner liner and said outer liner of said inner boot surround the entire foot and lower ankle of said individual.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3, 581, 412 Dated June 1, 1971

Inventor(s) Melvin W. Dalebout

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the specification, column 1, line 16, the number "3,474,561" should be--3,374,561--.

Signed and sealed this 28th day of December 1971.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents