United States Patent

Chen

[15] **3,694,939**

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[54] **METHOD OF COVERING SHOES**

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[52] **U.S. Cl.** .....**36/7.3,** 36/72 C, 12/142 R

[51] **Int. Cl.** **A43b 1/10,** A43d 9/00

[58] **Field of Search**.....12/1 A, 142 R; 36/9 R, 72 R, 36/72 C, 7.3

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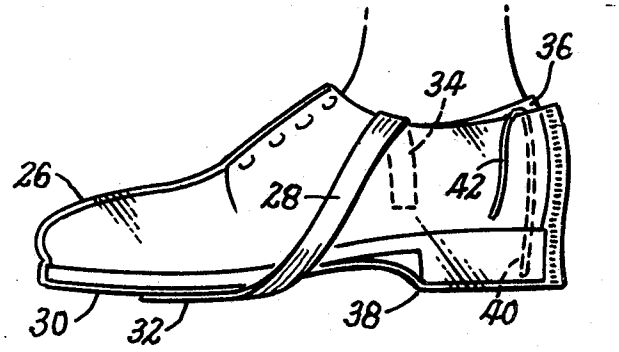
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[57] **ABSTRACT**

A method for covering shoes on the feet of a wearer with a protective sanitary shoe wrapper formed of heat-shrinkable material is disclosed, wherein individual shoe wrappers are positioned at a heat-shrink station in an open configuration to receive and enclose a shoe on the foot of a wearer; after the insertion of the shoe, heat is applied to the wrapper to heat-shrink it and conform it to the show.

30 Claims, 11 Drawing Figures



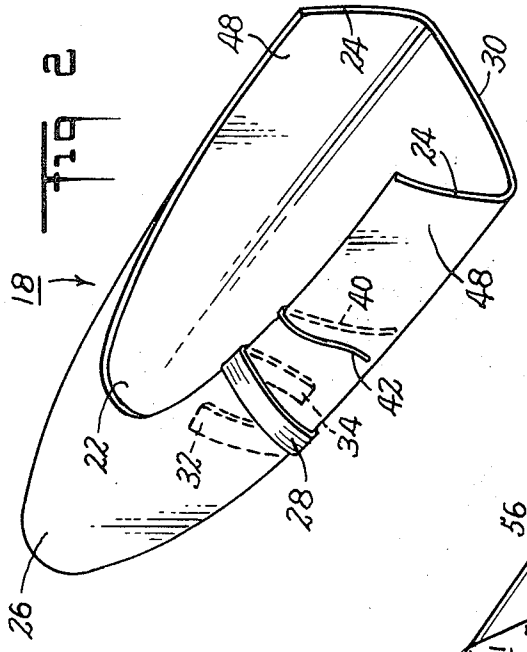


Fig 2

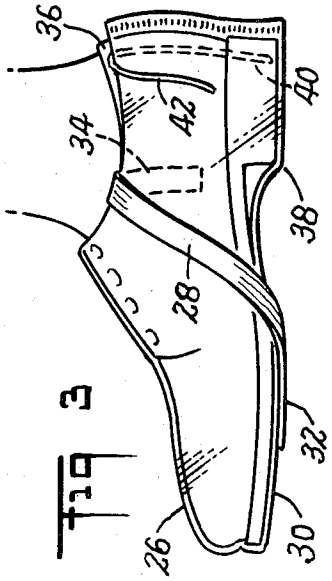


Fig 3

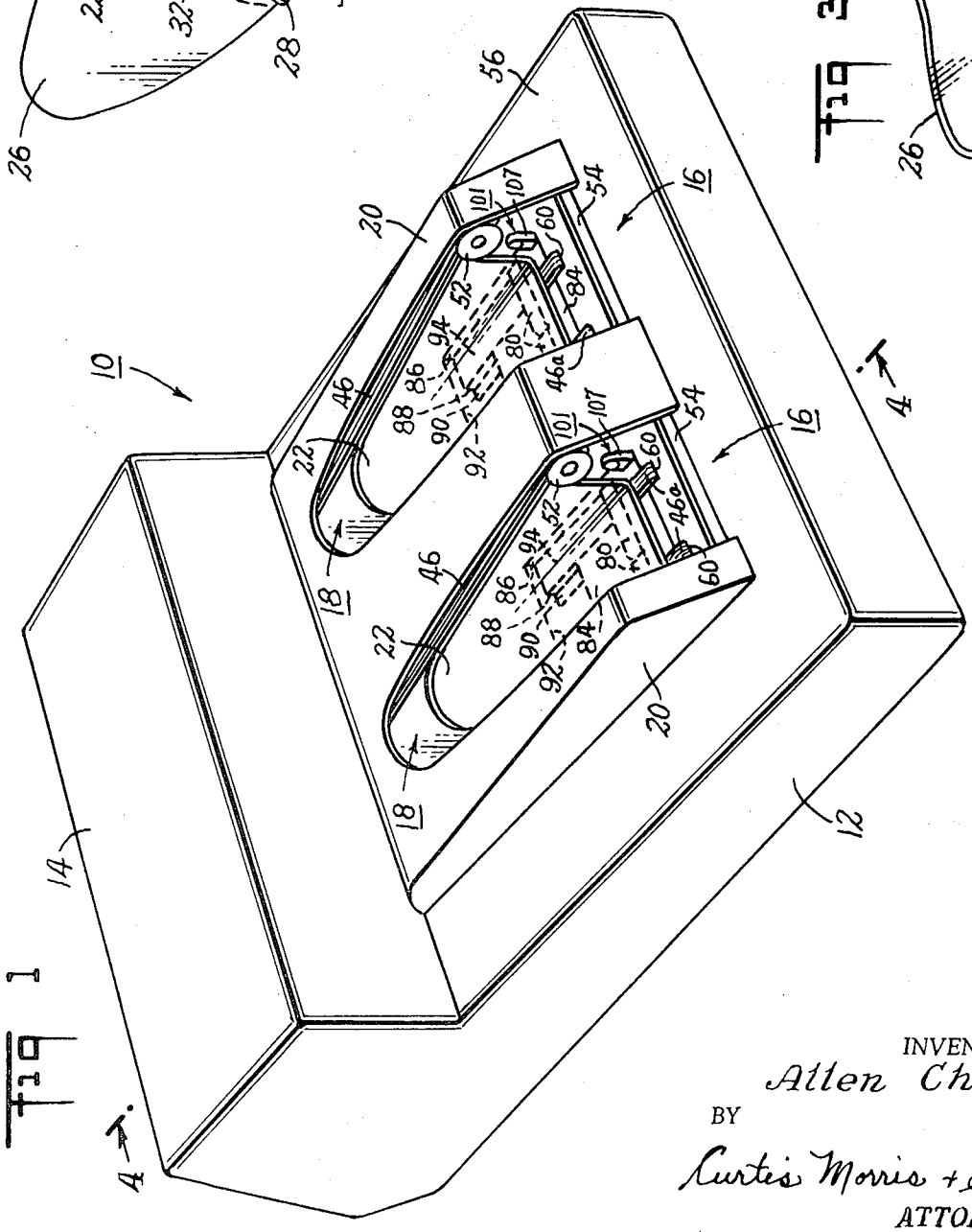


Fig 1

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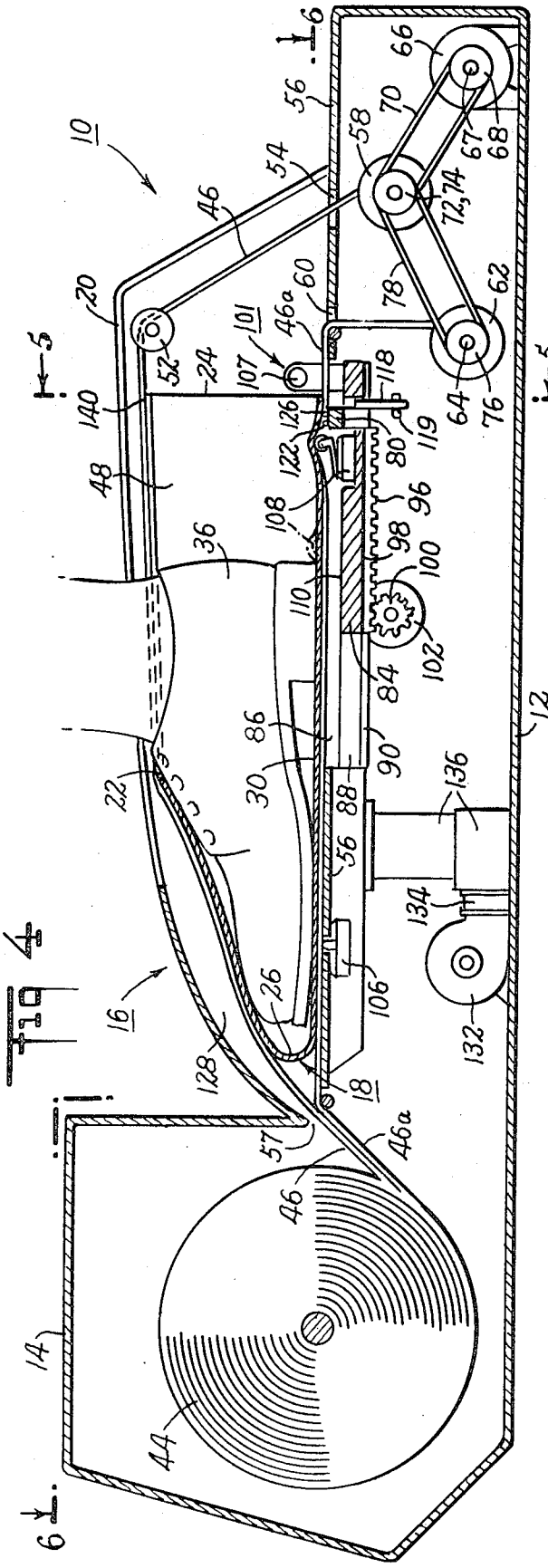


Fig. 4

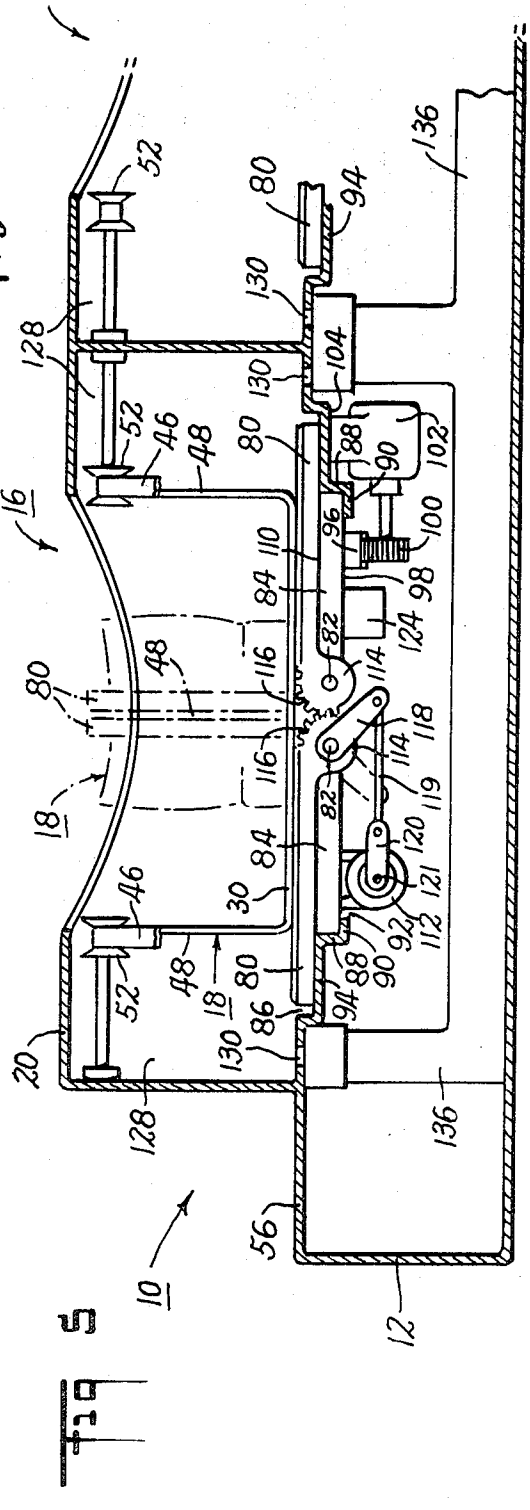


Fig. 5

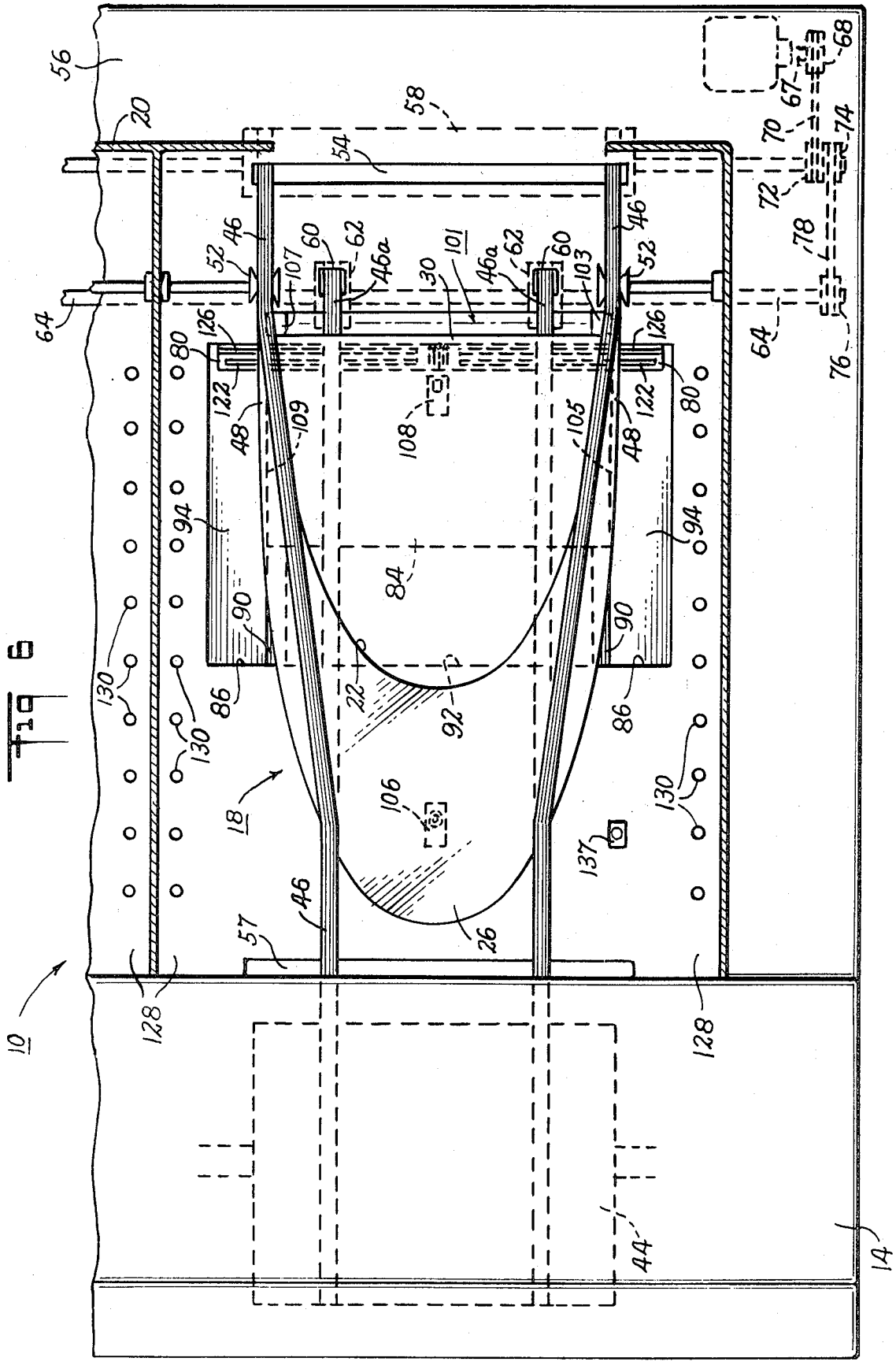

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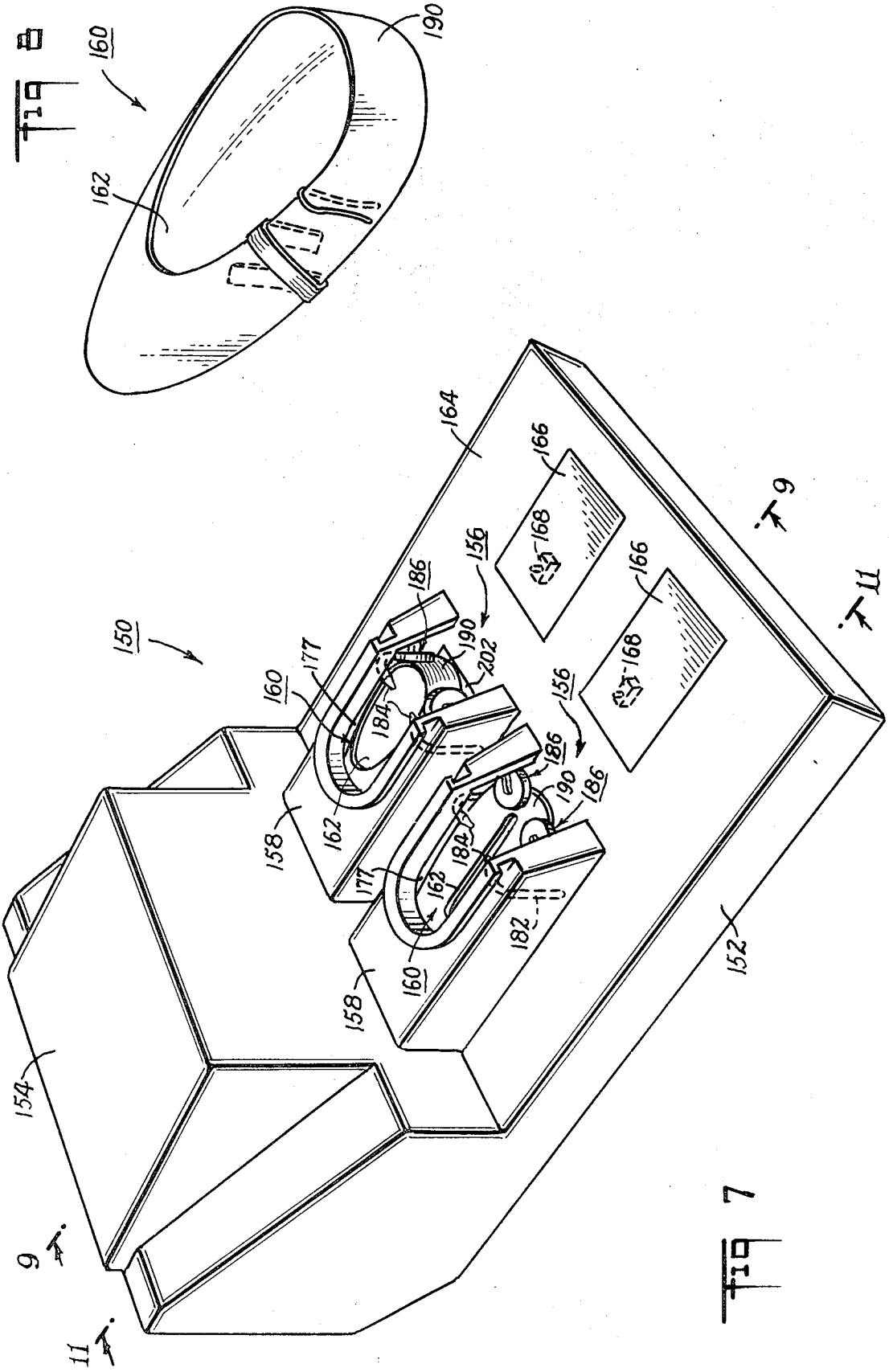


Fig. 7

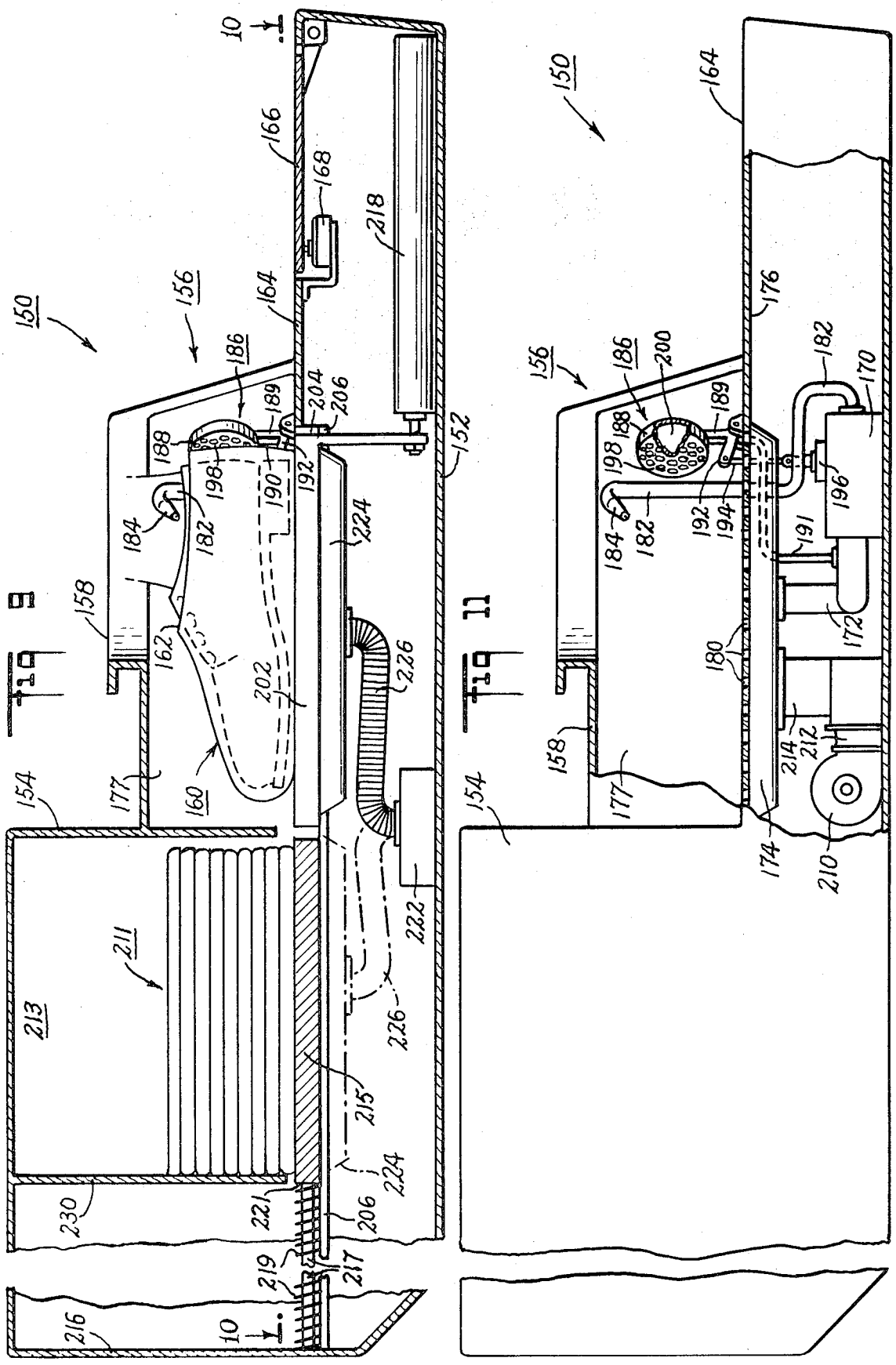

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Fig. 9

Fig. 11

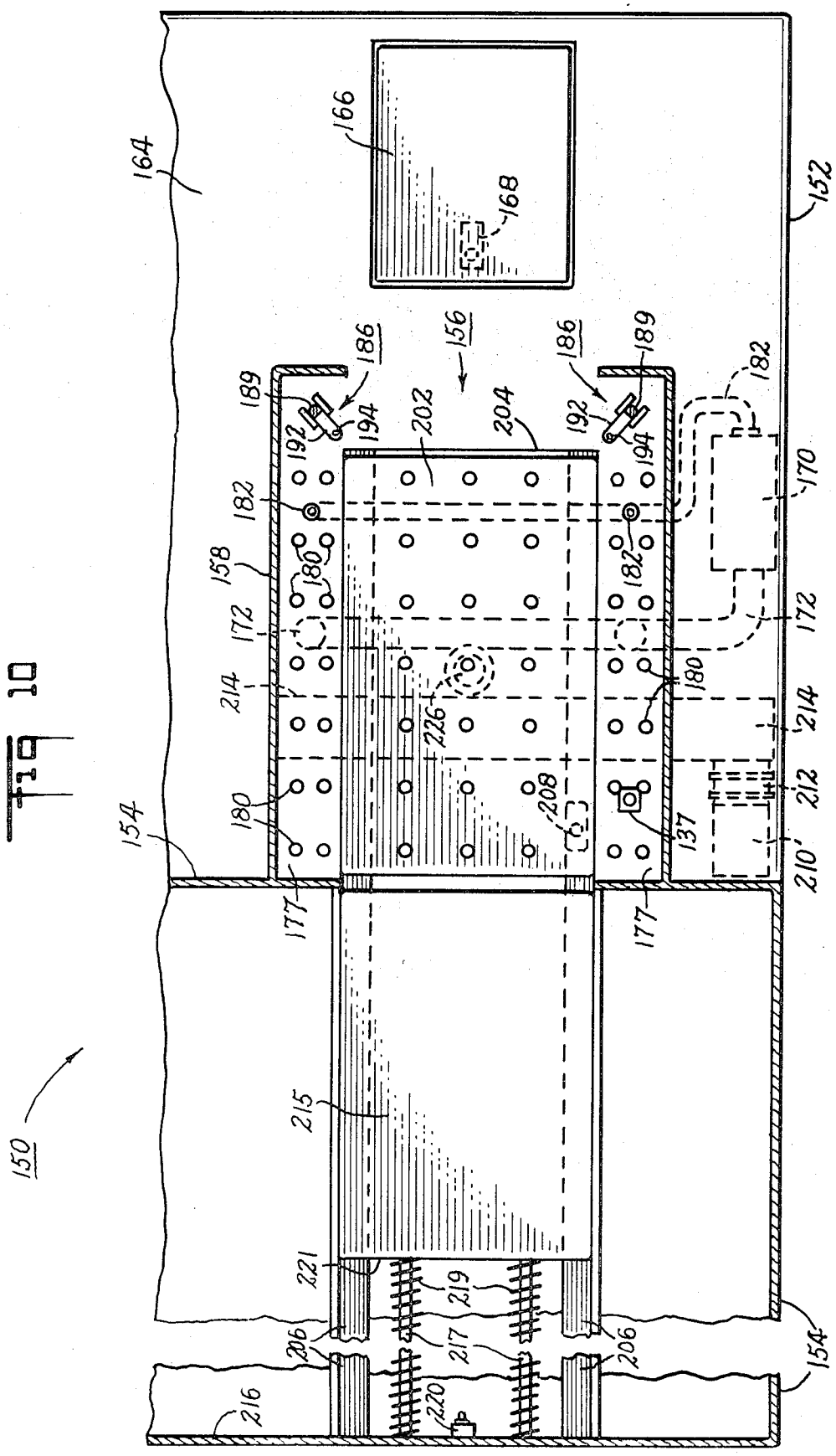

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Fig 10

METHOD OF COVERING SHOES

This invention relates generally to heat-shrinkable overshoes and to a method of applying heat-shrinkable overshoes to shoes while the shoes are being worn.

Disposable overshoes have been proposed in the past for use in various facilities in which sterile conditions must be maintained, e.g., for covering the shoes of physicians or other personnel working in operating or clean room facilities. Such overshoes are often utilized in hospital operating rooms where it is necessary to prevent contamination of the atmosphere and floor from bacteria carried on street shoes, thereby to avoid infection of the patient. Further, it is frequently necessary to maintain extremely clean conditions in industrial and commercial installations during production processes. This is particularly necessary in the aerospace and electronics industries, where delicate electronic components must often be protected from chemical and physical contaminants, minute particles of dirt, fine metal particles, etc.

The sanitary overshoes which have previously been proposed for use in these areas have been generally formed from a variety of materials, including paper, natural synthetic fibers, and plastic films. These overshoes have also been formed in a variety of manners, as by gluing, sewing, or heat-sealing the various parts to form completed shoe coverings. These coverings are generally provided with elastic tops, tie-strings, snap fasteners, and the like to secure them to the shoe and to facilitate later removal thereof.

While these prior art boots have been helpful in maintaining sanitary conditions in hospital operating rooms and other clean rooms, they have numerous disadvantages. Thus, they are generally cumbersome in appearance and are difficult to apply and remove. Moreover, the prior art boots are relatively expensive to produce and do not offer complete sanitary protection for hospital use. They are not fully sealed to the shoe, but rather are generally loose-fitting with numerous folds and openings through which bacteria and contaminants may escape to the atmosphere or floor of the operating room. Due to their expense, many of these boots must be reused, thereby requiring time consuming and costly sterilization procedures which, it is noted, are generally not fully satisfactory. Finally, due to their cumbersome size and bag-like character, the prior art boots are not only uncomfortable and untidy but they are also difficult to walk in. Thus, for example, such boots may hinder the mobility of the physician in the operating room.

Also, there is a need for cheap disposable protective foot coverings to protect the shoes in unexpected inclement weather. Such coverings could conveniently be dispensed from coin-operated machines in public places such as airports, railroad stations, and the like, for example.

Accordingly, it is an object of the present invention to provide a method and apparatus for protecting the shoes, particularly those of clean room and operating room personnel, with a shoe wrapper which is disposable after a single use.

Another object of the invention is to provide a relatively simple and inexpensive method of covering a shoe with a sanitary wrapper.

A still further object of the invention is to provide a method and apparatus for protecting a shoe with a sanitary wrapper by automatic application of the wrapper tightly to the shoe to maintain a good appearance conforming to the shoe, thereby to facilitate walking.

Yet another object of the invention is to provide a method of covering either the left or the right shoe of the wearer with a single undifferentiated wrapping.

In accordance with an aspect of this invention, a method and apparatus for protecting a shoe with a sanitary shoe wrapper are disclosed wherein a supply of wrappers, formed of heat-shrinkable material, is provided and each individual wrapper is positioned in a partially open configuration to receive and enclose a shoe on the wearer's foot. After insertion of the foot within the wrapper, a supply of heat such as a current of warm air, is directed over the wrapper to shrink the material on the shoe so that the wrapper conforms to the shoe and fully encloses the same.

For use in operating rooms or other places where explosive atmospheres may be encountered, each of the shoe wrappers may be provided with a conductive strip secured to the sole of the wrapper and adapted to contact the leg of the wearer at its other end, thereby to prevent discharges of static electricity between the foot of the wearer and the floor.

The above, and other objects, features and advantages of this invention will be apparent in the following detailed description of illustrative embodiments of the invention which are to be read in connection with the accompanying drawings wherein:

FIG. **1** is a perspective view of a device, according to an embodiment of the present invention, adapted to heat-shrink a plastic overshoe or boot onto the shoe of a wearer;

FIG. **2** is a perspective view of a plastic overshoe or boot formed in accordance with the present invention;

FIG. **3** is a perspective view of the boot shown in FIG. **2**, sealed on the foot of a wearer after the heat-shrink operation;

FIG. **4** is a side view, in section, of the device of FIG. **1**, taken along line **4—4** of FIG. **1**;

FIG. **5** is a partial front view, in section, taken along line **5—5** of FIG. **4** showing the left half of the device of FIG. **1**;

FIG. **6** is a plan view of a portion of the device taken along line **6—6** of FIG. **5**, with the leg shields removed;

FIG. **7** is a perspective view of another embodiment of the present invention;

FIG. **8** is a perspective view of an overshoe formed for use in the embodiment of the invention shown in FIG. **7**;

FIG. **9** is a side view, in section, taken along line **9—9** of FIG. **7**;

FIG. **10** is a plan view of a portion of the embodiment of the invention shown in FIG. **7**, taken along line **10—10** of FIG. **9**; and

FIG. **11** is a side view, in section, taken along line **11—11** of FIG. **9**.

Referring to the drawings in detail, FIG. **1** shows device **10**, of a type adapted to carry out the method of the present invention, generally comprising housing **12** having a storage section **14** and plurality **16** of heat-shrink stations where shoe wrappers **18** are presented beneath leg shields **20** for heat-shrinking about shoes on the feet of a wearer.

The wrappers placed on the foot of a wearer in this embodiment of the invention are shown in FIG. 2 and are formed of a sheet of material, e.g., a film of a plastic such as polyethylene or a vinyl copolymer, which is adapted to be heat-shrunk at relatively low temperatures. The wrapper is pre-formed as an oversized boot or overshoe having upper access opening 22 and plurality 24 of rear edges which, as more fully described hereinafter, are held in an open configuration at the heat-shrink station to permit insertion of a shoe on the foot of a wearer prior to the heat-shrink operation. Wrapper 18 is shaped generally with rounded front end or toe portion 26 to conform generally to the shape of a shoe, conveniently by heat-sealing the edges thereof, so that on shrinking the wrapper will more readily conform to the general configuration of a shoe.

Strip 28 of conductive plastic material, such as a polyethylene impregnated with carbon black or metallic particles, is heat-sealed to sole 30 of the wrapper at end 32 thereof, and is looped about the exterior of the wrapper with second end 34 positioned within access opening 22. After application of the overshoe, end 34 of strip 28 is inserted in shoe 36 to touch the ankle of the wearer and provide a ground connection between the body and the floor, thus to prevent discharges of static electricity therebetween. It is contemplated that strip 28 be tucked into the arch section of the foot outside the sock so that strip 28 may not touch the ankle but will provide an electrical connection to the body. Alternatively, it is contemplated that wrapper 18 itself may be completely formed of a conductive plastic material, in lieu of the use of strip 28.

After the heat-shrinking operation, as performed by the device 10 and described hereinafter, wrapper 18 conforms to shoe 36 on the foot of a wearer, as seen in FIG. 3, to provide a pleasant appearing, comfortable and compact shoe covering which is sealed tightly to the shoe to prevent escape of bacteria and other contaminants from the shoe to the ambient atmosphere, e.g., to a hospital operating room or a clean room environment in which the wearer is working.

While the material used to form the shoe coverings in the preferred embodiments of this invention is impervious to air so as to prevent escape of bacteria, etc., from the shoes, it is contemplated that the shoe covering may also be used in environments and in applications wherein such a high degree of sterility is not required. For example, overshoes of the character described could be used by window dressers or could also be used as foul weather overshoes. In these situations the wrapper material could be made air permeable by extremely small perforations in the material to permit ventilation of the foot and shoe. These perforations would however be positioned or dimensioned so as to prevent water from penetrating the wrapper and entering the shoe.

If a material which shrinks anisotropically is employed as the heat-shrinkable film in forming boot 18, the material is "aligned" in the longitudinal direction of the boot, so that the boot will shrink during the heat-shrink operation more in the direction of the length of the foot than in the direction of its width. By this construction the material is not tightened to a substantial extent adjacent edge 38 of the heel on shoe 36 so as to fracture or tear the material during walking. It is contemplated also that the material may be provided with a reinforcing strip of material at those portions on sole 30 thereof adjacent the heel to strengthen the material and avoid tearing during use.

To facilitate removal of the overshoe, tear strip or string 40 is embedded in the material forming wrapper 18 and is provided with loose end 42. Upon completion of use of the heat shrunk overshoe, end 42 of strip 40 is grasped by the wearer, and pulled downwardly to tear the material. The overshoe is thereafter readily peeled from the shoe. It is also contemplated, that where a conductive strip 28 is utilized, this strip may be heat sealed along a major portion thereof to the surface of wrapper 18 so that end 34 thereof may be grasped, upon completion of use of the overshoe, to tear the material and permit its removal.

Wrappers 18 are formed as individual members and are wound on roll 44 rotatably mounted in housing section 14. The wrappers are interconnected by pairs of strings or plastic strips 46, 46*a*, secured to the wrappers by a heat-sensitive adhesive (e.g., glue or wax) to form an integral roll of boots. As seen in FIGS. 5 and 6, the pair of strips 46 are secured to upper surface or sides 48 of wrapper 18, and pair of strips 46*a* are secured to sole 30 of the wrapper. While in the preferred embodiment, wrappers 18 are individually formed, and separately secured to strips 46, 46*a*, it is contemplated that the wrappers also can be provided as an integral roll wherein the front and rear edges of adjacent wrappers are connected by a perforated strip which is readily torn on completion of the heat shrink operation by a slight foot movement.

The ends of strips 46 are respectively guided over rollers 52 mounted in leg shield 20 as shown in FIGS. 1 and 5. From rollers 52 strips 46 extend through elongated aperture 54 in support surface or platform 56 and are secured to roll 58. Strips 46*a* extend along the surface of platform 56 through apertures 60 therein and are respectively secured to take-up pulleys 62. The latter are fixed to common shaft 64 adapted to be simultaneously rotated with roll 58 by motor 66 mounted below platform 56 in housing 12. Motor 66 has drive shaft 67 extending therefrom on which drive pulley 68 is secured. Pulley 68 is connected by belt 70 to pulley 72 mounted at one end of roll 58. Second pulley 74 mounted on roll 58 drives pulley 76 on shaft 64 through belt 78, so that while motor 66 is operating roll 58 and pulleys 62 are simultaneously rotated to draw wrappers 18 from roll 44 through aperture 57 in platform 56 to heat shrink station 16.

Initially, overshoe heat shrink device 10 is prepared for operation by securing strips 46 and 46*a* to roll 58 and pulleys 62, as described above, with the first wrapper 18 on roll 44 in position at heat shrink station 16. As seen in FIGS. 1 and 4, wrapper 18 is held at station 16 by pulleys 52 and 62 with access opening 22 and edges 24 in an open configuration permitting insertion of the wearer's foot and shoe within the wrapper prior to the heat shrink operation.

In order to close the opened rear end of boot 18 after the wearer has inserted his foot therein, a pair of jaws 80 are provided which are adapted to heat-seal sides 48 of wrapper 18 together adjacent the heel of shoe 36. Jaws 80 are formed as individual bars pivotally mounted by pins 82 on a transport plate 84 slidably mounted in recess 86 of platform 56. Recess 86 is

formed by pair **88** of longitudinally extending parallel stepped ledges having first stepped portions **90** which receive the longitudinal edges of plate **84** and define aperture **92** therebetween. Jaws **80** extend along the upper surface of plate **84** and into second stepped portions **94** of ledges **88** whereby bars **80** and plate **84** are located below the upper surface of platform **56** so that no obstruction is formed on the platform.

In order to provide a more pleasing appearance of the wrapper after heat shrinking, it is desirable to heat-seal sides **48** together adjacent the heel of shoe **36** prior to the heat shrinking operation since wrappers **18** are supplied in a uniform size being somewhat larger than a standard size **13** shoe. Thus, plate **84** is mounted for sliding movement longitudinally on ledges **90** to provide an adjustment for the position of heat-sealing jaws **80** thereby to closely secure wrappers **18** to various sized shoes so that the overshoe, when shrunk, conforms tightly to the shoe itself. To move plate **84** and, thus, bars **80** to a position adjacent the heel of shoe **36**, rack **96** is provided on lower surface **98** of plate **84** and engaged by spur gear **100**. The latter is driven by motor **102** mounted on lower surface **104** of platform **56**.

When the wearer inserts his foot within wrapper **18**, he engages pressure switch **106** mounted on platform **56** adjacent the ball of his foot, which switch activates motor **102** to drive gear **100** and thereby move rack **96** and plate **84** towards the heel of his foot.

Contact or microswitch **108** is provided immediately in front of bars **80** on the upper surface **110** of plate **84** to engage the heel of the shoe **36** as plate **84** is moved beneath the shoe. Accordingly, when plate **84** is moved towards shoe **36**, i.e., towards the left in FIG. **4**, a sufficient distance to engage switch **108** with the heel of the foot, switch **108** deactivates motor **102** to stop movement of plate **84** and simultaneously activates motor **112**. Motor **112** pivots bars **80** about pins **82** to move the bars to a vertical clamping position as seen in FIG. **5**. It is noted that while only one of the heat shrinking stations **16** is illustrated in FIGS. **5** and **6**, the other station is similarly constructed and operates in the same manner as the described station.

Referring again to FIG. **5**, it is seen that inner ends **114** of bars **80**, adjacent pivots **82** are formed with interengaging quadrant gears **116**. One of these gears is provided with an integral crank arm **118** which is pivotally connected, by link **119** to crank **120** fixed to drive shaft **121** of motor **112**. As motor **112** is operated, crank arm **120**, and thus crank arm **118**, is moved downwardly, thereby to pivot the bars **80** to the vertical position shown in phantom. As bars **80** move to the vertical position, they engage sides **48** of wrapper **18** and moves the sides towards each other and ultimately into contact with each other when the bars are in their fully extended vertical position.

A safety control device **101** is provided on plate **84** to prevent bars **80** from being raised in the event that the bars are blocked as for example by the heel of the foot. Control device **101** includes a photoelectric cell pickup **103** mounted adjacent one edge **105** of plate **84** and a light source **107** mounted adjacent opposite edge **109** which light source directs a beam of light towards pickup **103**. Pickup **103** is connected to a control circuit (not shown) which is operative to prevent activation of motor **112** should the light from source **107** be blocked. That is, if the heel of the foot is over bars **80**, thereby obstructing passage of light from source **103** to pickup **107**, the bars will not be pivoted by motor **112**. In this manner, damage to the bars and gears **116** is avoided, as is any possibility of injury to the foot.

Each bar **80** has mounted thereon resistance wire **122** which is connected to impulse heating unit **124** for heating wires **122**. After bars **80** are moved to their vertical position, unit **124** is automatically and sequentially operated to heat wires **122** and seal sides **48** together. After the heat sealing operation is completed, which operation generally takes less than 5 seconds, motor **112** is sequentially operated in reverse to permit bars **80** to return to their horizontal position. Thereafter, heat, such as a draft of warm air is supplied to heat shrink stations **16** to shrink the plastic wrappers about the shoes.

Bars **80** are each provided with a second resistance wire **126** connected to an independent impulse heating unit (not shown) for simultaneous heating with wires **122**. Wires **126** are located on bars **80** rearwardly of wires **126** and may have either sharpened edges or be positioned so that they lie in overlapped relation when bars **80** are raised. In this manner, wires **126** act as a cutter during the heat sealing operation to cut any excess material rearwardly of the heat seal. This excess material is thus separated from the main body of the wrapper and is discharged from the device in a manner more fully described hereinafter.

Shield **20**, of housing **12**, defines an air plenum chamber **128** adjacent each of the wrappers **18** at heat shrink stations **16**. Warm air is supplied to the plenum chambers through apertures **130** formed in platform **56** adjacent recess **86**. Air is provided from an electrically driven blower **132** which flows air over electrically powered heating elements **134**. The air, thus warmed, is thence discharged through duct **136** to plenum chambers **128** formed above platform **56**, as shown in FIG. **4**. The air thus supplied is discharged through apertures **130** into plenum chambers **128** and flows about wrappers **18**. The heat supplied by the elements **134** is sufficient to warm the air to a high enough temperature to permit shrinking of the copolymer material of which the wrapper is formed. Shield **20**, limits discharge of warm air upwardly from the plenum chambers to protect the trousers and the leg from the warm air. However, it is noted that the temperature of this air is sufficiently low so that sealing of the wrapper on the foot of the wearer is performed with complete safety and the entire operation is performed at relatively comfortable temperatures for the short period of time which the shrinking process takes. Blower **132** and heating elements **134** are controlled by a conventional timing circuit and after these elements have been in operation for a period of time adequate to shrink the wrapper to the configuration shown in FIG. **3**, they are automatically shut off and the foot may be removed from the device. A temperature sensitive switch **137** is provided in the circuit controlling blower **132** and heating elements **134**, and this switch is located on platform **56**, adjacent wrappers **18**. Switch **137** is adapted to shut off blower **132** and heating elements **134** in the event that there is a malfunction in the device which causes them to continue in operation beyond the predetermined period. Thus, should the temperature within

plenum chambers **128** rise above a predetermined level, the hot air will be immediately shut off. Further, in the preferred embodiment, heating elements **134** and blower **132** shut off sequentially, with elements **134** shutting off first, so that a flow of relatively cool air is supplied to plenum chambers **128** to carry heat away from the heated wrappers and "set" the plastic material. Alternatively, a separate and independent blower may be provided for this purpose.

During the heat shrinking operation, the remaining wrappers on roll **44** are protected from the warm air by housing section **14**. The volume of air entering this section through supply slot **57** in platform **56** is inadequate to damage these wrappers. Moreover, while the heat shrinking operation has been described using a supply of warm air, it is contemplated that other known heat shrinking methods may be utilized. In particular, it is foreseen that sources of infrared radiation may be provided to shrink wrappers **18**.

As mentioned above, strips **46** and **46a** are secured to wrappers **18** by heat-sensitive adhesive. Thus these strips are released from the wrappers during the heat-shrinking operation, since the adhesive releases or separates under the influence of the warm air supplied from blower **132** and heater **134**. The strips are formed of non-heat-shrinkable material and are in no way damaged by the heat-shrinking process. However, strips **46** are secured to wrappers **18** adjacent rear edges **24**, as for example at points **140** which are sufficiently remote from shoe **36** and apertures **130** so that that connection of the wrapper with the strips at this point is not released. Thus, on completion of the heat shrinking operation, when the wearer removes his foot from the device, strips **46** remain secured to the excess material removed from the boot by heat sealing bars **80** and their cutting edges **126**.

Release of pressure on switch **106**, by removal of the wearer's foot, activates motor **66**, after a suitable time delay, to rotate roll **58** and pulley **62**. In this manner strips **46***a* are wound on pulleys **62** and strips **46**, along with the excess or waste portion of the prior boot are drawn through aperture **54** in platform **56** onto roll **58**. Motor **66** is controlled by a conventional timing circuit and continues in operation for a predetermined period of time adequate to properly position the next wrapper **18** on roll **44** at heat shrink station **16**. Thereafter the cycle is restarted by subsequent activation of switch **106**. It is noted that the specific electronic circuitry utilized in overshoe heat shrink device **10** to control the various components thereof forms no part of the present invention, and is not described in detail. The sequential steps of the present invention may be controlled in numerous manners, as will be evident to those skilled in the art.

After the use of the overshoe is completed, wrapper **18** is conveniently removed from the foot of the wearer by tear strip **40**. Free end **42** of string **40** is grasped and pulled downwardly to tear the relatively thin plastic material and free wrapper **18** from shoe **36**. It is noted that while the material is sufficiently thin to be torn by narrow string **40**, the material is also sufficiently strong and durable to withstand normal usage and will not tear of its own accord. As mentioned above, it is contemplated that conductive strip **28** may be heat-sealed along a thin line to the sides **48** of wrapper **18** so that it also may be used as a tear strip.

Referring now to FIG. **7**, there is illustrated in embodiment of the present invention which is adapted to heat shrink preformed overshoes on a shoe on the foot of a wearer. As seen therein, overshoe heat shrink device **150** includes housing **152** having storage section **154** and pair **156** of heat shrink stations. Leg shields **158** are provided at stations **156**, and correspond substantially to shields **20** of the previously described embodiment. In this embodiment, fully formed oversized wrappers **160** are provided, as seen in FIG. **8**. Wrappers **160** have enlarged access opening **162** at the upper surface thereof through which the foot of the wearer is inserted.

Initially, wrappers **160** are in position at heat shrink stations **156** and the wrappers are opened to a limited extent, from their prior folded configuration, because of their own natural resiliency. When the wearer desires to place the wrappers upon his feet, he steps onto the forward portion of platform **164**, including pads **166**, and thereby activates pressure switches **168** mounted below the pads. Switches **168** control a blower or source of suction **170** which is connected by a pair of ducts **172** to plenum chambers **174**. Chambers **174** are mounted on the lower surface **176** of platform **164** at opposite sides of heat shrink stations **156** and communicate with plenum chamber **177** formed by shield **158** about station **156** through apertures **180** in platform **164**. Suction source **170** creates a low pressure atmosphere in plenum chambers **177** by drawing air from the chamber through chamber **174** and ducts **172**. Simultaneously, source **170** supplies this air to jets **182** having nozzles **184** directed into access opening **162** to partially inflate the overshoe. Thus, the combination of the low pressure within plenum chamber **177** and the force of the jets of air discharged from source **170** to jet nozzles **184** into access opening **162** of wrappers **160** opens the wrappers to facilitate insertion of the shoe therein.

To further facilitate insertion of shoe **36** within wrappers **160** and to enlarge the access opening presented to the shoe for insertion, hold-down mechanism **186** is provided for the heel of the wrapper. Hold-down mechanism **186** includes a pair of plenum chambers or suction cups **188**, each of which is pivotally mounted by arms **189** on platform **164** adjacent opposite sides of heel **190** of wrapper **160**. Arms **189** each include a rigid lever **192** which levers are pivotally connected respectively, by links **194** to solenoids **196** for operative control of the position of cups **188**. Suction cups **188** include a perforated face **198** which encloses a chamber **200** connected by flexible conduit **191** to source of suction **170**. Activation of pressure switch **168** simultaneously activates source of suction **170** and solenoids **196** so that arm **189** is first pivoted downwardly to engage face **198** of cup **188** with heel **190** of wrapper **160**. Since plenem chamber **200** is connected to source of suction **170**, a low pressure area is produced in chamber **200** which causes heel **190** to be secured to face **198**. After cups **188** reach their lowermost position solenoid **196** is operated in reverse to raise the cups and the heel **190** in conjunction therewith to enlarge the access opening in the wrapper. In FIG. **7**, suction cups **188** in each heat-shrink station **156** are respectively shown in their raised and lowered positions for clarity in understanding this operation.

After the physician's feet are inserted in wrappers **160**, they are supported at heat-shrink stations **156** by wrapper transport plates **202** whose principal function is described more fully hereinafter. Plates **202** are mounted for sliding movement in recesses **204** on longitudinally extending ledges **206** adjacent the sides thereof. The pressure of the wearer's weight on plate **202** activates pressure-sensitive switch **208** positioned on ledge **206** which deactivates suction source **170**. Simultaneously, blower **210** and heating elements **212** are activated, which elements supply warm air to plenum chamber **174**. Blower **210** blows air over heating elements **212** and supplies the warmed air through duct **214** to plenum chamber **174** wherein the warm air is discharged through apertures **180** to plenum chamber **177**. The air is thereby flowed over the surface of heat-shrink wrapper **160** to shrink the material of which the wrapper is made and conform the wrapper to the shoe. As in the prior embodiment, blower **210** and heating element **212** are controlled by a conventional timing circuit so that after a period of time, adequate to shrink the material forming wrappers **160**, the blower and heating elements are sequentially shut off so that a flow of relatively cool air is supplied to set the molten plastic. When the blower shuts off, thermal shut off switch or control **137** may also be provided in the circuit for blower **210** and heater **212** to shut off the system in the event of malfunction which causes the temperature in plenum chambers **177** to rise above a predetermined level. As in the prior embodiment, the particular electronic circuitry utilized in conjunction with the present invention to perform the various operations thereof are within the skill of the ordinary artisan and illustration of specific circuits is omitted.

When the wearer's foot is removed from heat-shrink station **156**, pressure on switch **208** is released and after a suitable time delay, transport plate **202** is operated to move a wrapper **160** from storage station **213** within housing section **154**. Wrappers **160** are supplied to storage station **213** in stacks **211** seated on movable platforms **215**. Platforms **215** are slidably mounted on ledge **206** associated respectively with each of the heat-shrink stations **156**.

Each platform **215** is mounted on a pair of rods **217** secured to the rear wall **216** of housing **152**. Each of the rods **217** is provided with a compression spring **219** surrounding the rod, which springs urge platform **215** into position beneath the stack of wrappers.

Release of switch **208** activates air cylinder **218** which is adapted to reciprocate transport plate **202** from heat-shrink station **156**, along ledges **206**, to storage station **213**. As plate **202** is moved towards plate **215**, plate **202** engages plate **215** and moves the latter from beneath stack **211** and towards wall **216** while stack **211** is held stationary by baffle **230**. At the end of the stroke of piston **218**, the rearward end **221** of plate **215** is engaged with a switch **220**. Switch **220** activates a vacuum source **222** which decreases the pressure beneath plate **202** to secure an individual wrapper to the surface thereof. Plate **202** has plenum chamber **224** formed therebeneath and connected by flexible conduit **226** to source of suction **222**. Chamber **224** is thus moved with plate **202** from heat shrink station **156** to storage station **213**. Cylinder **218** is then operated in reverse to withdraw plate **202** and an individual wrapper **160**, which is secured thereto by the suction force produced by member **222** from station **213** back to the heat-shrink station **156**. At the same time, plate **215** is urged back to position beneath the stack **211** by springs **219** to maintain the remainder of the overshoes within the stack and in position for subsequent operations.

In this embodiment of the present invention it is seen that there is no waste, as a fully formed heat-shrink boot is provided and there is no excess cut off portions of the boot by heat sealing jaws as in the prior embodiment. The material of the boots in this embodiment of the invention is similarly aligned in the manner earlier described so that the material shrinks more in the direction of length than in width and thereby provides a relief area adjacent the forward edge of the heel so that the material is not damaged or torn by the heel during use.

For hospital use, each of the above-described embodiments of the present invention can be incorporated into a console unit (not shown) at which the physician may perform other procedures while having the sanitary overshoes automatically applied to his feet. For example, the console may contain a supply of surgical hats, surgical masks, and gowns which the physician may put on during the time in which the booting operation is taking place. It is also contemplated that such a console may contain a supply of heat shrinkable overshoes which may be manually applied to the physician's foot. The above-described apparatus may then be used to heat shrink the wrappers, or alternatively, the console may include a warm air blower which can be held manually and utilized to shrink the wrappers.

It is thus seen that a sample and relatively convenient sanitary shoe wrapping is provided which is readily placed on the foot of the wearer and which is neat and clean in appearance and comfortable in use. Further, the overshoes of the present invention are both for right and left feet, so that a single overwrapper will fit either foot and thus substantially reduce the cost of manufacturing the wrappers. Moreover, the wrappers are relatively inexpensive, thus disposable, and they are rapidly and conveniently applied to the shoes of the wearer by the methods of the present invention.

Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of this invention.

What is claimed is:

1. The method of covering a shoe on the foot of a wearer with a protective wrapper, comprising the steps of positioning said wrapper for insertion of said shoe and foot therein, inserting said shoe and foot in the wrapper, and, after insertion of said shoe, heat shrinking said wrapper about said shoe, whereby said wrapper conforms to said shoe.

2. The method as in claim 1 wherein said wrapper is preformed, said method including the step of holding said wrapper in an open configuration for insertion of said shoe and foot therein.

3. The method as in claim 2 wherein said holding step includes the step of blowing air into said wrapper.

4. The method as in claim 1 wherein said step of heat shrinking comprises the step of supplying a flow of warm air over said wrapper and said shoe to shrink said wrapper.

5. The method as in claim 1 wherein said positioning step includes the step of holding said wrapper in a partially open configuration with at least two of its sides in spaced relation to permit insertion of said shoe in said wrapper.

6. The method as in claim 5 including the step of sealing said open wrapper sides after insertion of said shoe.

7. The method as in claim 6 wherein said sealing step comprises the step of heat sealing said sides.

8. The method as in claim 1 wherein said step of heat shrinking comprises the step of directing infrared radiation at said shoe and said wrapper.

9. The method as in claim 5 including the steps of sensing the size of said shoe after insertion in said wrapper and sealing said wrapper sides adjacent said shoe to enclose said shoe prior to said heat shrinking step.

10. The method of claim 9 wherein said sealing step comprises the step of moving a pair of heat sealing jaws toward each other with said open sides therebetween.

11. The method of claim 10 wherein said sensing step includes the step of moving said jaws to a position adjacent the heel of said shoe prior to said heat sealing step.

12. The method of claim 10 including the step of cutting off excess portions of said sides.

13. The method of claim 1 including the step of forming said wrapper with an electrically conductive strip to provide a ground contact between the body of the wearer and the floor.

14. The method of claim 13 including the step of heat sealing a portion of said strip to said wrapper along a relatively narrow band, whereby said strip comprises a tear strip for opening said wrapper after use.

15. The method of claim 13 including the step of forming a tear strip in said wrapper for opening said wrapper after use.

16. The method of claim 1 including the step of forming said wrapper from a conductive heat shrinkable material.

17. The method of covering a shoe on the foot of a wearer with a protective wrapper, comprising the steps of holding an oversized protective shoe shaped wrapper formed of heat shrinkable material in an opened configuration for insertion of said shoe and foot therein, inserting said shoe and foot in the open wrapper, and heat shrinking said wrapper about said shoe to conform the wrapper to the shoe.

18. The method as in claim 17 wherein said step of heat shrinking comprises the step of supplying a flow of warm air over said wrapper and said shoe to heat shrink said wrapper.

19. The method of claim 17 including the step of forming said wrapper with an electrically conductive strip to provide a ground contact between the body of the wearer and the floor.

20. The method of claim 19 including the step of forming a tear strip in said wrapper for opening said wrapper after use.

21. A protective shoe covering comprising an oversized generally shoe-shaped wrapper having an access opening therein for insertion of a shoe while said shoe is on the foot of a wearer, said wrapper being formed of a heat-shrinkable material to be tightly drawn onto the shoe by an application of heat to the wrapper after the wrapper is placed on the shoe, thereby to define a sole and top portion surrounding this sole, heel and upper of said shoe.

22. A protective shoe covering as in claim 21 wherein said wrapper is a fully formed oversized overshoe and said access opening is in the top thereof.

23. A protective shoe covering as in claim 21 wherein said wrapper is formed with a toe portion, a sole portion, and spaced side portions rearwardly of said toe portion, said side portions defining said access opening in the heel and upper portion of said wrapper.

24. A protective shoe covering as in claim 21 wherein said material is electrically conductive.

25. A protective shoe covering as in claim 21 including an electrically conductive strip of material secured at one end to the sole of said wrapper, the other end of said strip being positioned adjacent said access opening and adapted to be placed in contact with the skin of the wearer for conducting electricity from the wearer's body to the floor.

26. A protective shoe covering as in claim 25 wherein said strip is heat sealed to said wrapper.

27. A protective shoe covering as in claim 25 wherein said strip is heat sealed to said wrapper along a relatively narrow portion thereof, whereby said strip forms a tear strip for ripping said wrapper upon completion of use to facilitate removal thereof from said shoe.

28. A protective shoe covering as in claim 21 including a tear strip secured to said wrapper for tearing said wrapper upon completion of use to facilitate removal thereof from said shoes.

29. A protective shoe covering as in claim 21 wherein said material is alinged to shrink to a substantially greater extent in length than in width.

30. A protective shoe covering as in claim 21 wherein said material is air permeable.

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