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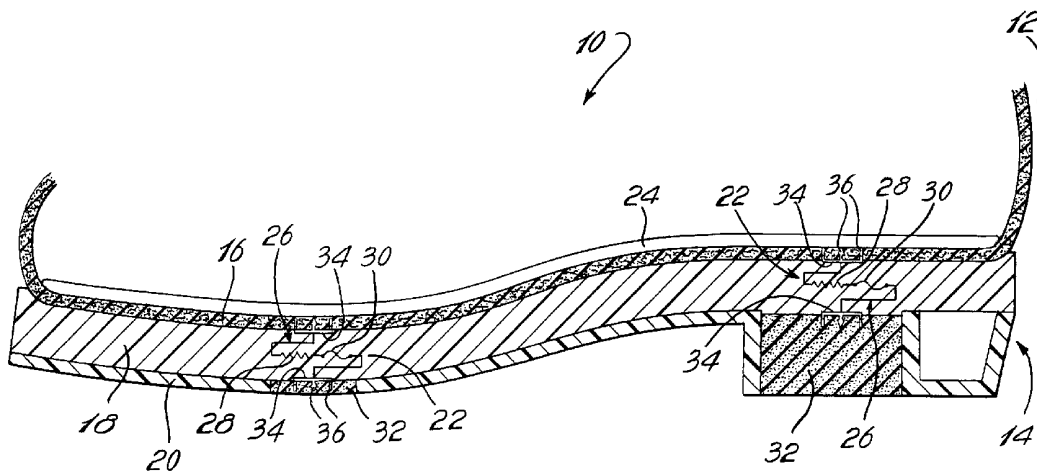
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(54) Title: SAFETY FOOTWEAR



(57) Abstract: An electrostatic dissipative footwear (10) comprises a conductive insole (16) and a conductive outsole (20) spaced by a non-conductive mid sole (18). An electronic device (22) is embedded in the insulating mid sole (18) for connecting the insole (16) and the outsole (20) in electrically conductive relationship. The electronic device (22) includes a resistor (28) for precisely controlling current flow between the insole (16) and the outsole (20), and an active electrical device, such as a fuse (30), for protecting the wearer against electrical shocks.



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SAFETY FOOTWEAR

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates to footwear and, more particularly, to a safety footwear which is adapted to dissipate electrostatic charges while at the same time protecting the wearer against electric shocks.

10 2. Description of the Prior Art

 It is known to wear static dissipative shoes, for instance, to prevent electrostatic charges build up upon the body and clothing from being discharged to an electrostatic sensitive device being
15 handled. Such static dissipative shoes are widely used in the electronic and computer industries to prevent damaging of electronic components, such as integrated circuits, by electrical discharges..

 United States Patents Nos. 4,366,630 and
20 4,785,371 respectively issued on January 4, 1983 and November 15, 1988 to Bloom and Edwards both disclose an electrostatically dissipating shoe having a composite sole including a conductive insole and a conductive outsole of rubber or plastic materials
25 doped with an electrically conductive substance and connected together in electrically conductive relationship. United States Patent No. 4,785,371 also teaches that the overall resistance across the composite sole should be in a range of about 10^6 to 10^8
30 ohms to not expose the wearer to the undue risk of injury from electrical contact, as would conventional conductive footwear exhibiting an overall resistance from zero to about 10^4 ohms. While plastic soles doped with electrically conductive substances are generally
35 effective, they are generally not suitable for use in cold weather applications.

 United States Patent No. 2,712,099 issued on February 23, 1952 to Legge discloses a footwear having

metallic grounding members for conducting electrostatic charges from the body of the wearer to the ground. Resistors are provided in a free space defined in the sole to act as a safety device to prevent the passage of a current of high amperage from the grounding members to the wearer's body. This arrangement is particularly adapted for use in dry weather or when wearer is not engaged in a wet or soggy ground condition which might render the shoe conductive.

Although the electrostatically dissipating shoes described in the above mentioned patents are effective, it has been found that there is a need for a new electrostatically dissipating footwear having a relatively low electrical resistance between the wearer's foot and ground, while still providing protection against electrical shocks. There is also a need for a new electrostatically dissipating footwear that can be used in a wide variety of environments irrespective of the ground condition and the surrounding temperature.

SUMMARY OF THE INVENTION

It is therefore an aim of the present invention to provide a composite sole for a safety footwear which is adapted to dissipate electrostatic charges while at the same time protecting the wearer against potential electric shocks.

It is also an aim of the present invention to provide an electrostatically dissipating sole that can be used in a wide variety of weather conditions.

It is also an aim of the present invention to provide a safety footwear which is comfortable to wear.

It is a further aim of the present invention to provide an electrostatically dissipating sole having a relatively low electric resistance.

It is still a further aim of the present invention to provide a new method of manufacturing an electrostatically dissipating sole for a safety footwear.

5 Therefore, in accordance with the present invention, there is provided a composite sole for use in an electrostatic dissipative footwear, comprising an insole and an outsole spaced by a mid sole, said insole and said outsole being at least partly made of
10 electrically-conducting material, whereas said mid sole is made of a substantially non-conductive material, and an electronic device electrically connected to said insole and said outsole for controlling current flow therebetween, said electronic
15 device being embedded in said mid sole which acts therefor as an insulator.

In accordance with a further general aspect of the present invention there is provided a method of manufacturing an electrostatically dissipating sole for a safety footwear, comprising the steps of:
20 providing a conductive insole and a conductive outsole, providing an electronic device in a free space between said insole and said outsole for controlling current flow therebetween, connecting said
25 insole and said outsole in electrically conductive relationship with said electronic device, and structurally joining said insole to said outsole by injecting a substantially non-conductive material in said free space to form a mid sole between said insole
30 and said outsole with said electronic device at least partly embedded in said mid sole.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus generally described the nature of the invention, reference will now be made to the
35 accompanying drawing, showing by way of illustration a preferred embodiment thereof, and in which:

Fig. 1 is a longitudinal cross-sectional view of a safety footwear in accordance with a first embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 Now referring to Fig. 1, a safety footwear embodying the elements of the present invention and generally designated by numeral 10 will be described.

10 More particularly, the safety footwear 10 includes an upper 12 secured to a composite sole 14. The composite sole 14 includes an electrically conductive insole 16, an electrically insulating mid sole 18, an electrically conductive outsole 20, and an electronic device 22 embedded in the mid sole 18 for dynamically controlling the electric flow between the
15 insole sole 16 and the outsole 20.

20 Provided within the safety footwear 10 and overlying the insole 16 is a removable foot bead 24 made of a conductive material, such as a woven material with conductive fibers. The removable foot bead 24 has a resistance of about 10^5 ohms or less.

The inner sole 16 forms the bottom portion of the upper 12 and is typically made of a conducting fiberboard material having a resistance of about 10^5 ohms or less.

25 According to the illustrated embodiment, the electronic device 22 defines with the insole 16 and the outsole 20 a pair of electrically conductive paths 26 for dissipating electrostatic charges from the feet of the wearer to the ground. The resistance of each
30 path 26 is precisely set by a resistor 28 forming part of the device 22. Each resistor 28 has a precise resistance selected in a range of about 0 to 10^6 ohms. It is understood that the resistance of the removable foot bead 24, the insole 16 and the outsole 20 must be
35 less than that of the resistors 28 to ensure that the overall resistance of the electrically conductive paths 26 be limited by the resistors 28 and, thus, set

thereby. As opposed to conventional conductive soles solely constructed of doped rubber or plastic materials, the resistors 28 advantageously allows to precisely set the effective resistance of the footwear between the wearer's feet and the ground.

A microfuse 30 is preferably inserted in each electrically conductive path 26 to prevent the passage of a current of high amperage from the outsole 20 to the insole 16 in order to protect the wearer against electrical shocks. The provision of such microfuse 30 advantageously allows reducing the effective resistance of the safety footwear 10 between the wearer feet and the ground, thereby increasing the overall dissipating capacity of the safety footwear 10 and that without exposing the wearer to the undue risk of electrical shocks.

According to Canadian Standards (CSA), a person should not be exposed to a current exceeding 1 mA for a voltage of 18 kV. Commonly available safety fuses do not meet these standards for a circuit having a resistance of about 10^6 ohms or less. Applicant has found that an appropriate microfuse could be made for this particular application by using the techniques developed for manufacturing integrated circuits. For instance, thermal evaporation, e-beam or sputtering techniques could be used to obtain a length of fusible wire having the required dimensions to ensure melting thereof in the event that the current passing through the wire increases beyond 1 mA. According to a preferred embodiment of the present invention, each microfuse 30 could consist of aluminum or lead wire having a maximum cross-sectional area of about 1×10^{-11} m².

Each microfuse 30 is connected to a ground engaging plug 32 forming part of the outsole 20. One plug 32 could be provided at the heel region of the outsole 20 and the other one at the forepart region

thereof. The ground engaging plugs 32 are made of a conductive material having a resistance of 10^4 to 10^6 ohms. For instance, the plugs 32 could be made of a rubber material containing an electrically conductive substance. The outsole 20 is preferably molded from high-density polyurethane having a resistance in a range of about 10^7 to 10^{11} ohms.

Conductive washers 34 having sharp teeth 36 protruding at right angles from one side thereof can be used to anchor the resistors 28 and the microfuses 30 into the insole 16 and the ground engaging plugs 32. Alternatively, a conductive adhesive could be used.

The insole 16 and the outsole 20 are structurally joined by the mid sole 18 which is formed by injecting low density polyurethane in the free space between the prefabricated insole 16 and outsole 20 after the electronic device 22 has been operatively connected therebetween. A conductive adhesive is used to secure the insole 16 to the mid sole 18. The mid sole has a resistance in a range of about 10^8 to 10^{11} ohms and, thus, acts as an insulating cartridge for the electronic device 22 which is completely embedded therein. The mid sole 18 is impermeable and, thus, protects the electronic device 22 from the elements.

The use of a two density injection molding process to form the mid sole 18 and the outsole 20 allows to obtain a composite sole which is flexible and of a relatively lightweight construction.

During the manufacturing process of the safety footwear 10, the outsole 20 is first molded and the insole 16 fabricated with the upper 12 using known techniques. Then, the electric circuits formed by the resistors 28 and the microfuses 30 are inserted between the insole 16 and the outsole 20 and connected thereto in electrically conductive relationship. Thereafter, the insole 16 and the outsole 20 are

maintained in relatively close proximity in a mold and low density polyurethane is then injected in the free space between the insole 16 and the outsole 20 for forming the mid sole 18 in which the resistors 28 and the microfuses 30 are embedded and, thus, sealed from the atmosphere.

It is noted that according to a further embodiment of the present invention the outsole could be solely molded from a rubber material containing electrically conductive substance. This would provide a continuous grounding surface of conductive material but would increase the weight of the safety shoe 10.

According to further embodiments of the present invention which are not illustrated, the fuse could consist of a reversed biased diode or, alternatively, of an assembly of transistors.

According to another embodiment of the present invention, the plugs 32 could be electrically connected together with a single resistor and a single fuse completing the electric circuit between the insole and the outsole.

CLAIMS:

1. A composite sole for use in an electrostatic dissipative footwear, comprising an insole and an outsole spaced by a mid sole, said insole and said outsole being at least partly made of electrically-conducting material, whereas said mid sole is made of a substantially non-conductive material, and an electronic device electrically connected to said insole and said outsole for controlling current flow therebetween, said electronic device being embedded in said mid sole which acts therefor as an insulator.

2. A composite sole as defined in claim 1, wherein said mid sole is molded about said electronic device.

3. A composite sole as defined in claim 1, wherein said electronic device includes a resistor for setting the electrical resistance of an electrically conductive path defined by said insole, said electronic device and said outsole.

4. A composite sole as defined in claim 3, wherein said electronic device further includes a microfuse for protecting the wearer against electrical shocks.

5. A composite sole as defined in claim 4, wherein said microfuse includes a fusible wire having a maximum cross-sectional area of about $1 \times 10^{-11} \text{ m}^2$, said fusible wire being adapted to melt at a predetermined amperage to break said electrically conductive path.

6. A composite sole as defined in claim 5, wherein said fusible wire is made of aluminum.

7. A composite sole as defined in claim 1, wherein said mid sole is made of a material having a resistance which is higher than that of said insole, said outsole and said electronic device.

8. A composite sole as defined in claim 3, wherein said electronic device is anchored at a first end thereof in said insole and at a second end thereof in said outsole, said insole and said outsole having a resistance which is smaller than that of said resistor.

9. A composite sole as defined in claim 1, wherein said outsole is provided with at least one conductive grounding engaging plug connected in electrically conductive relationship with said electronic device for discharging static charges from the wearer to the ground.

10. A composite sole as defined in claim 1, wherein said mid sole and said outsole are respectively molded from low density and high-density polyurethane materials.

11. A method of manufacturing an electrostatically dissipating sole for a safety footwear, comprising the steps of: providing a conductive insole and a conductive outsole, providing an electronic device in a free space between said insole and said outsole for controlling current flow therebetween, connecting said insole and said outsole in electrically conductive relationship with said electronic device, and structurally joining said insole to said outsole by injecting a substantially

non-conductive material in said free space to form a mid sole between said insole and said outsole with said electronic device at least partly embedded in said mid sole.

12. A method as defined in claim 11, wherein the step of structurally joining said insole to said outsole includes the steps of placing said insole and said outsole in a mold with said electronic device extending between said insole and said outsole, and then injecting said substantially non-conductive material in said mold between said insole and said outsole.

13. A method as defined in claim 11, wherein the step of connecting said insole and said outsole in electrically conductive relationship with said electronic device is effected by anchoring a first end of said electronic device in said insole and a second opposed end thereof in said outsole.

14. A method as defined in claim 11, wherein the step of providing said outsole includes the steps of inserting at least one conductive ground engaging plug into a pre-molded outsole.

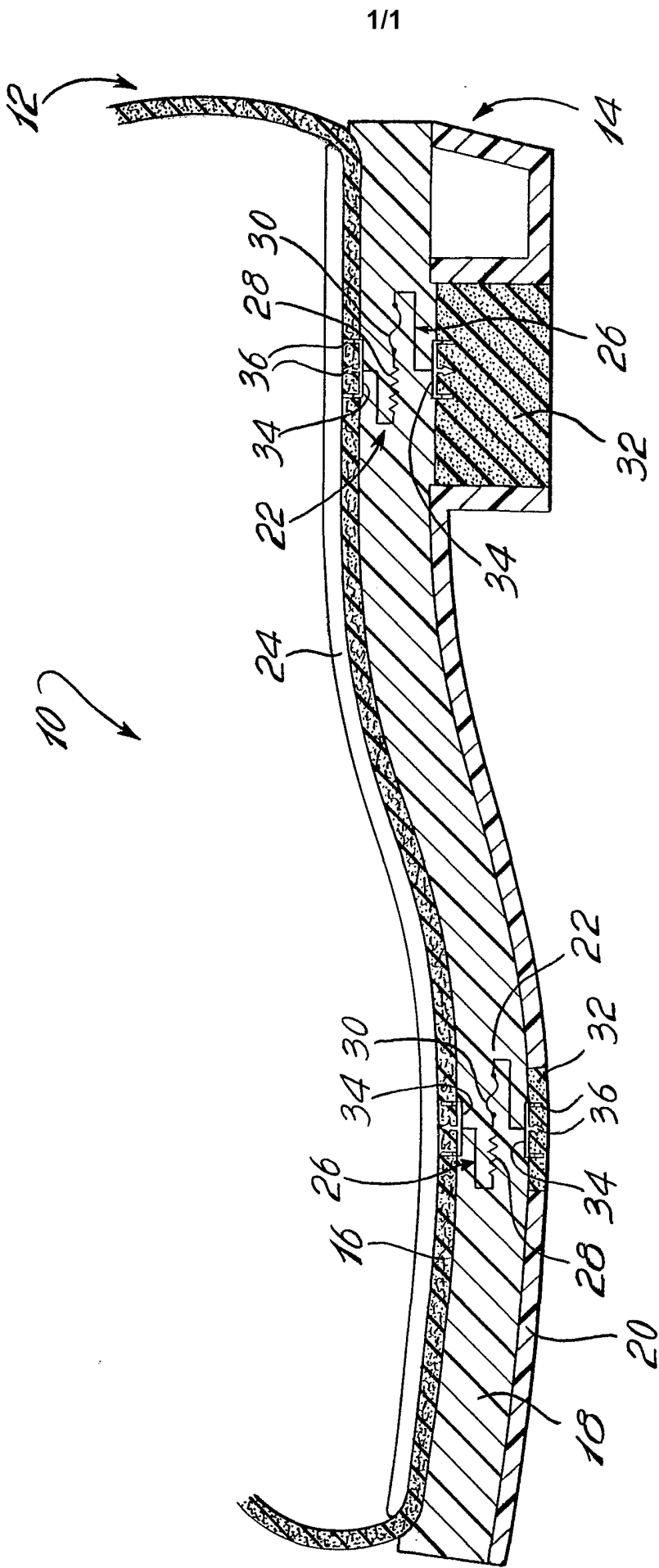


Fig. 1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 01/01299

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A43B7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A43B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	the whole document	11
X	DE 30 36 263 A (JOWA HOLZSCHUHE GMBH & CO KG F) 30 April 1981 (1981-04-30)	1
A	the whole document	11
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A	US 5 426 870 A (PURNELL ANDREW T ET AL) 27 June 1995 (1995-06-27) claims	1,10,11
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Further documents are listed in the continuation of box C. Patent family members are listed in annex.

° Special categories of cited documents :

<p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>*&* document member of the same patent family</p>
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Date of the actual completion of the international search 19 February 2002	Date of mailing of the international search report 26/02/2002
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Claudel, B
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INTERNATIONAL SEARCH REPORT

ational Application No
PCT/CA 01/01299

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 366 630 A (BLOOM LESLIE I) 4 January 1983 (1983-01-04) cited in the application the whole document -----	1,11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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