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(54) **NOISE REDUCING FOOTWEAR**

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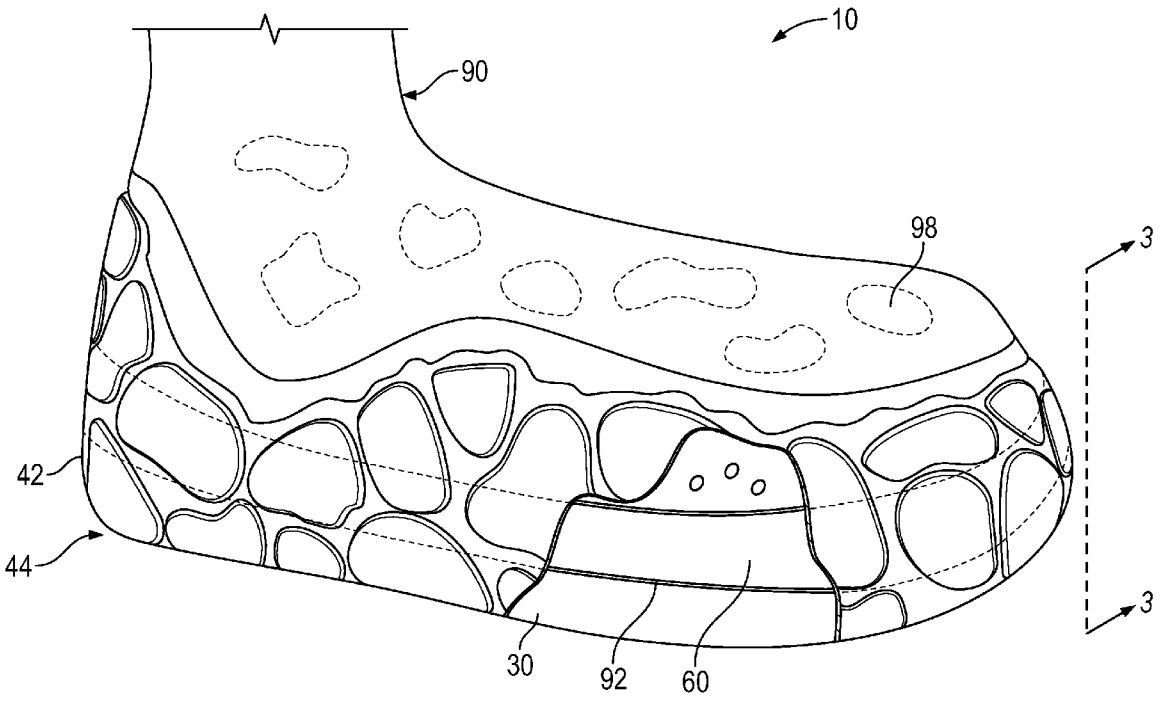
USPC **36/103**

(57) **ABSTRACT**

The present invention is drawn generally to footwear, and more specifically, to footwear having reduced noise and impact characteristics. According to the invention noise generated by the impact of the footfall when in contact with hard floors is reduced by an outer sole with certain hardness and a sound reducing insole which comprising a material of high indentation forced deflection (IFD) weight having a minimum thickness of ¼ to a maximum ¾ inch, and an optimal thickness of about ½ inch. Also, the footwear comprises an upper portion attached to the outer sole to provide comfort and foot protection.



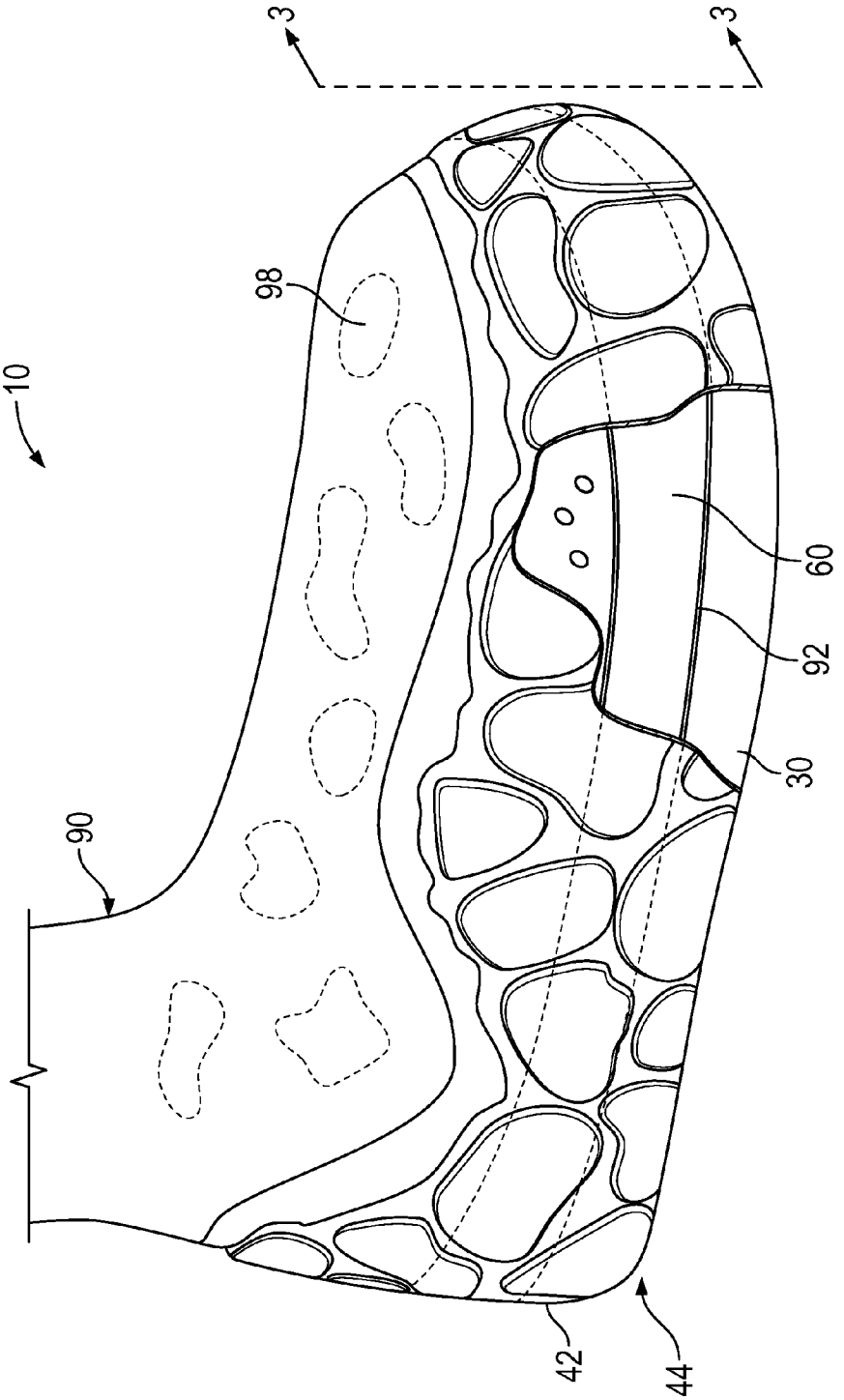


FIG. 1

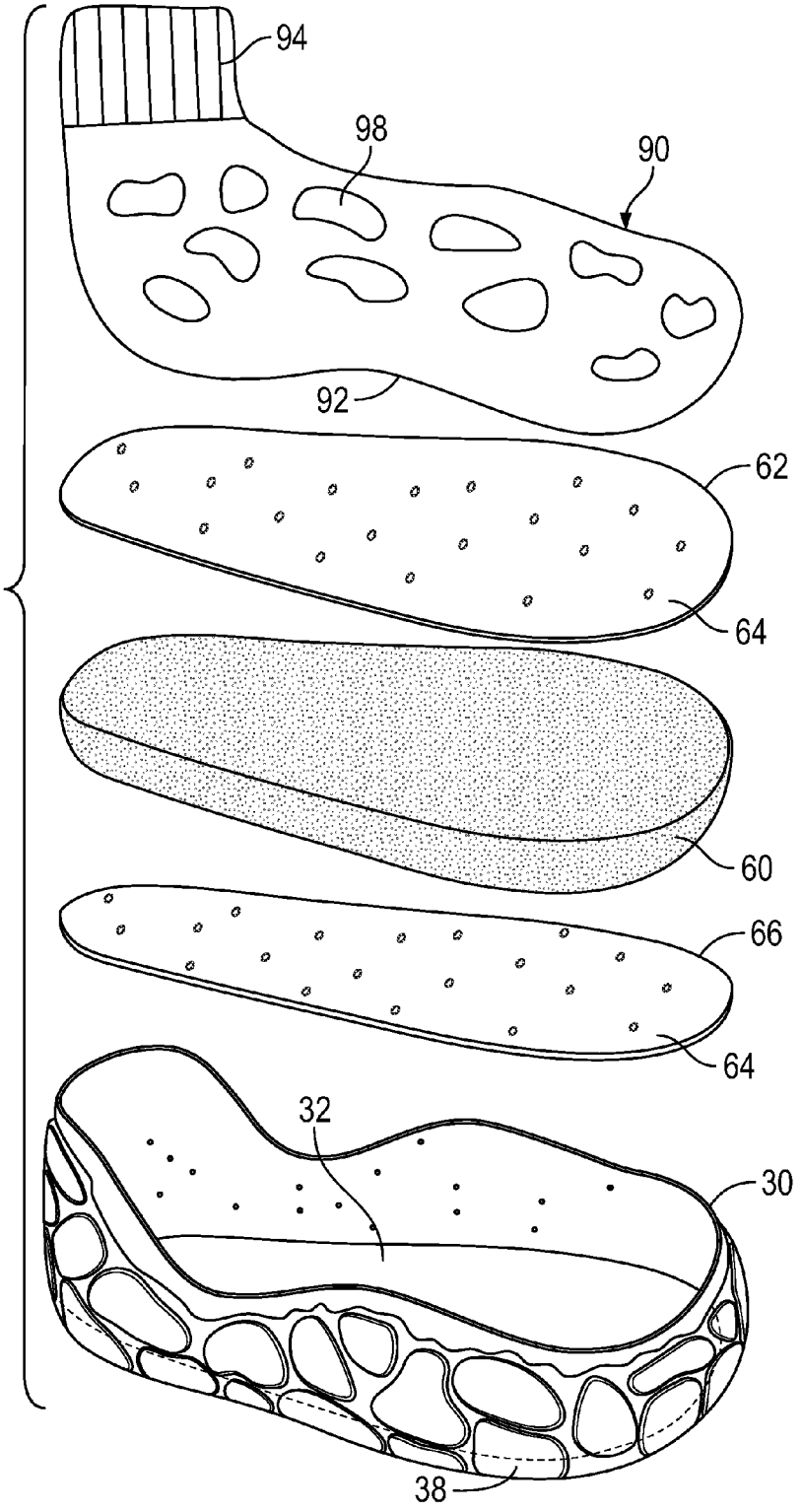


FIG. 2

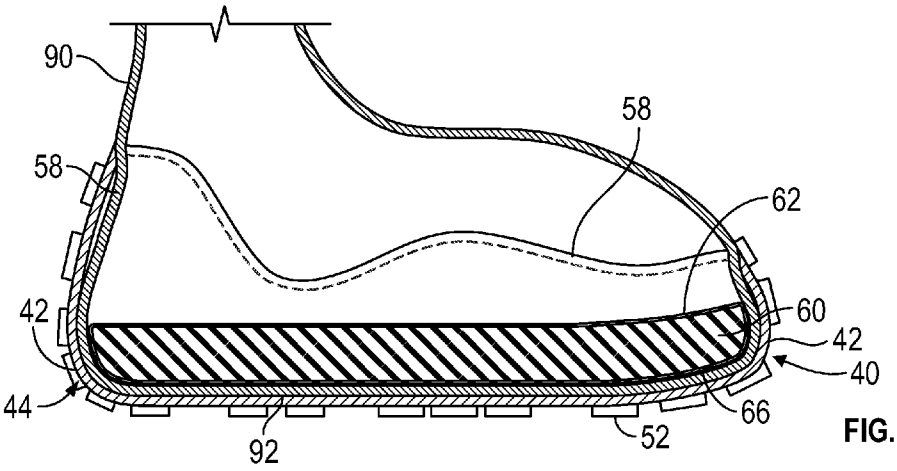


FIG. 3

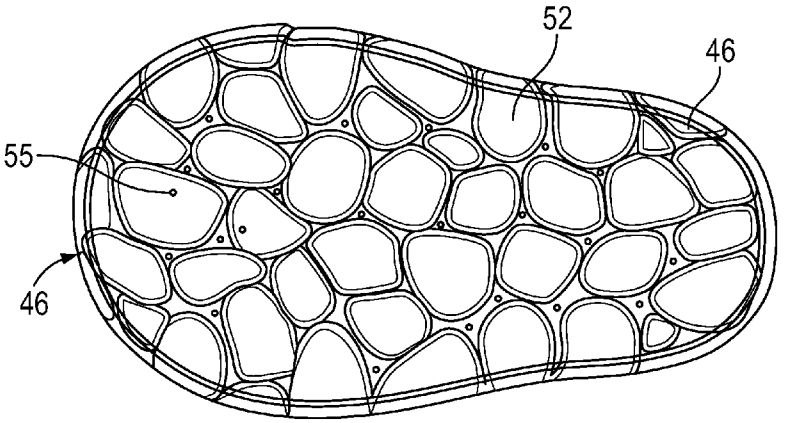


FIG. 4

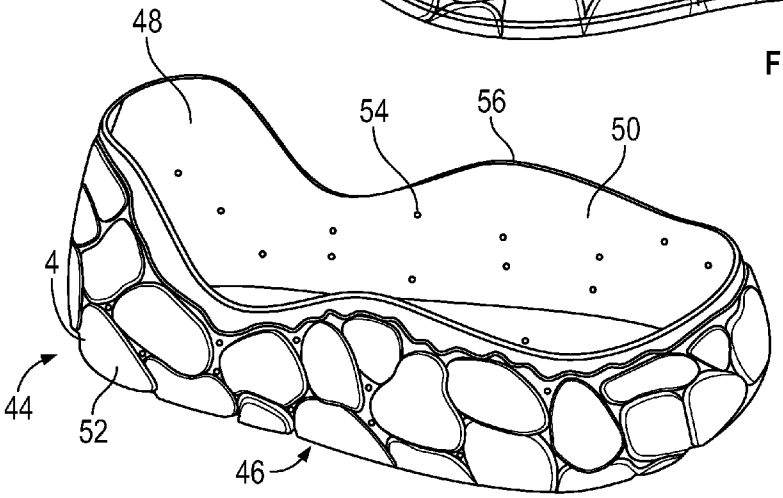


FIG. 5

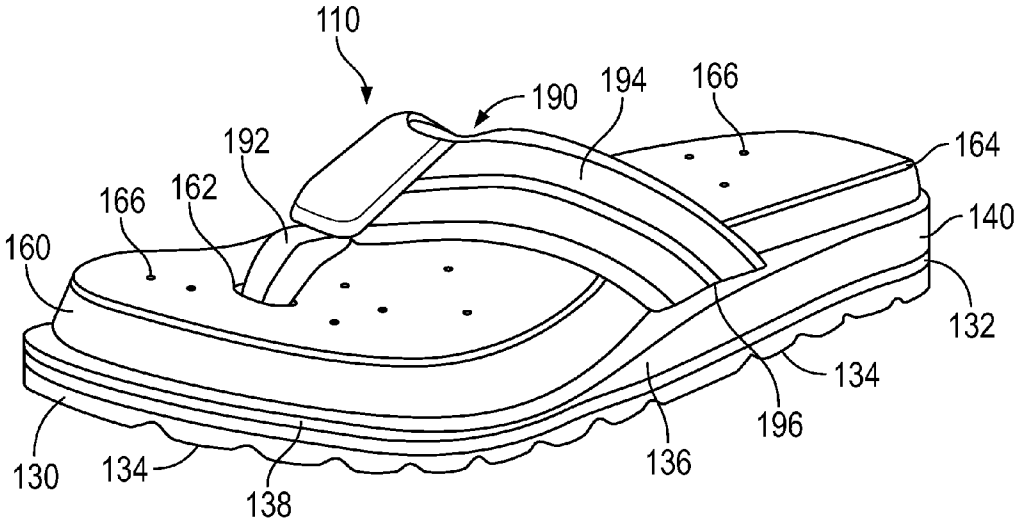

110
190
194
166
192
164
166
162
140
160
132
134
196
130
134
136
138

FIG. 6

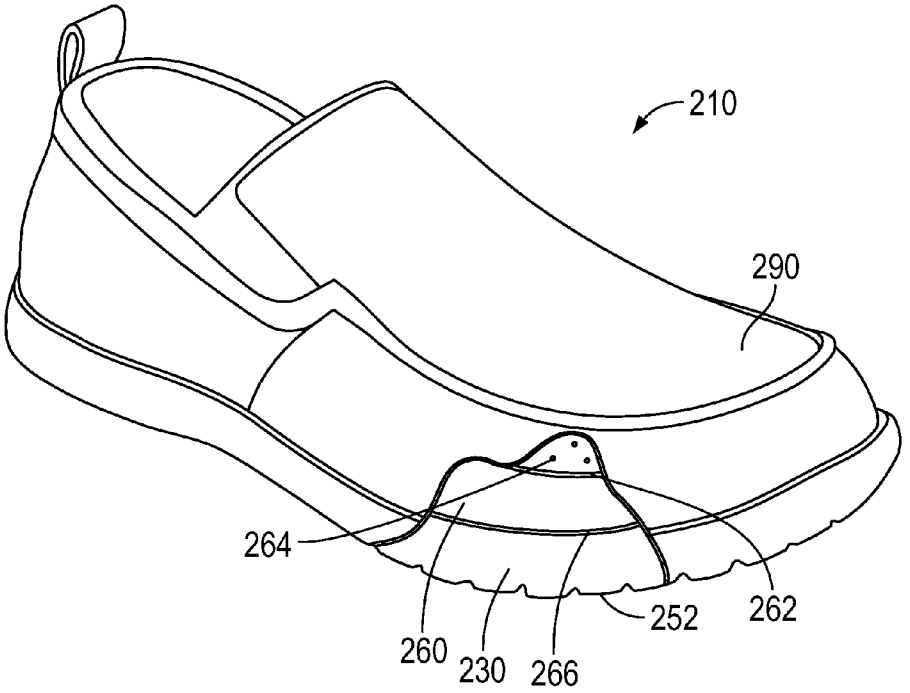

210
290
264
252
262
260
230
266

FIG. 7

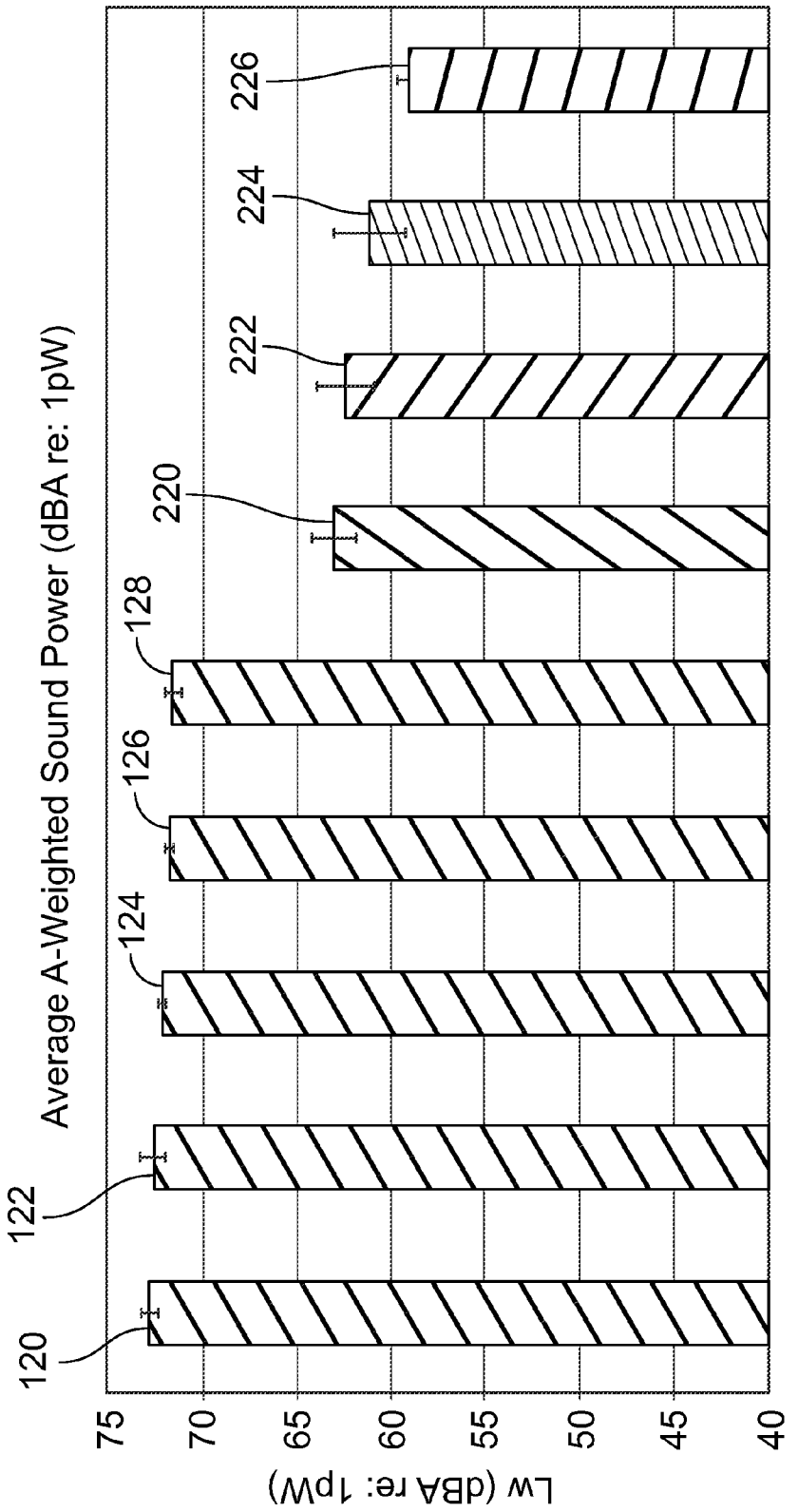

Average A-Weighted Sound Power (dBA re: 1pW)
Lw (dBA re: 1pW)
75
70
65
60
55
50
45
40
120
122
124
126
128
220
222
224
226

FIG. 8

NOISE REDUCING FOOTWEAR

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The disclosed invention claims the benefit under 35 U.S.C. §119 (e)(**1**) of provisional application Ser. No. 61/838,848, filed on Jun. 24, 2013, the entire specification of which is incorporated by reference as if fully set forth herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention is drawn generally to footwear, and more specifically, to footwear having reduced noise and impact characteristics when walking on hard floors.

[0004] 2. Background Art

[0005] Noise reducing footwear has been proposed for some time and especially for use to reduce noise outdoors. There are several kinds of noise reduction footwear used for outdoorsmen. The general idea is to use sound absorbing materials as a bottom sole of the footwear, as shown in U.S. Pat. No. 5,799,418 and U.S. Pat. No. 5,1686,43. However, no such footwear has been proposed for use in an indoor casual or recreational environment having this function. The noise reducing footwear used for outdoor mostly focuses to reduce noise caused by walking over ground objects such as leaves and twigs, and not on the noise generated by the impact of the footfall when in contact with indoor, especially hardwood floors.

[0006] Also known are footwear intended for use in a casual or recreational environment, such as slipper socks described in U.S. Pat. No. 5,617,585, which discloses a combination of sock and a rubber sole, for providing comfort and foot protection, but not addressing the problem of noise reduction. In addition, U.S. Pat. No. 5,101,579 discloses a "Sound deadening ballet shoe" using foam pad to absorbs impact when the padded front end or padded bottom beneath the front of the shank of the ballet shoe are banged against the floor to reduce noise normally generated. But this ballet shoe is intended to be used in a specific environment, during ballet dancing. The main focus is on the transitory impact generated by the front of the ballet shoe, not the bottom of the shoe as a whole as would be found in a normal indoor environment.

[0007] Materials used for impact force reduction and incidental sound absorbing, U.S. Pat. No. 5,799,418 disclosed a bottom sole section comprising a synthetic fur material for absorbing sound and reducing walking related noise. U.S. Pat. No. 5,168,643 generally describes and illustrates sound absorbing members filled with a highly porous material, such as a felted mineral fiber or an open cell polymer having a high sound absorption coefficient to dampen out sound waves caused by the contact of the shoe with ground objects. These materials are disclosed as being used at the bottom of the footwear, underneath the outer sole, and not as an insole.

[0008] Another disclosure in U.S. Pat. No. 5,101,579, teaches "[p]referably, the material used for the pad is ethyl vinyl acetate. This is a fine cell, irradiation cross-linked, polyolefin, foam material", and "[t]he pad is a quite thin layer, on the order of 1/32 of an inch thick". The thickness requirement in this disclosure is limited by the special use of the material for use in a ballet shoe. None of above disclosures require the materials to be of high volumetric mass density and of high indentation forced deflection (IFD) weight or having a thickness of sufficient magnitude to enable it to absorb impacts and sound during walking indoors.

[0009] Presently known foam insoles are not made with quality made open cell IFD firmness and density and can be considered to be little more than plain sponge material. Most other high quality "memory foam" insoles are not made with impact noise reduction in mind but are made to promote good health and comfort for the feet. Those insoles are much thinner and may incorporate a hard arch for the instep but these products are designed for adult use anyway.

[0010] In addition, there is a review article, entitled "The Use of Viscoelastic Materials in Shoes and Insoles," which discloses in theory using viscoelastic materials in shoes and insoles for shock absorption and discloses that "[v]ery compliant foams tend to 'bottom out' at moderate loads, unless a considerable thickness is used, which is seldom practical". The focus of this article is using viscoelastic materials to reduce transient impact forces generated by the heelstrike for clinical treatment, not to reduce the noise generated by the impact of the footfall when in contact with the indoor floor. Theoretically, energy which transform to noise would also be considered as reducing energy, but this is not fully disclosed.

[0011] A continuing need exists for footwear having reduced noise and impact characteristics which can be used both in casual or recreational environment and outdoors, but more especially for children who would normally generate much more noise indoors than adults.

SUMMARY OF THE INVENTION

[0012] The present invention is drawn generally to footwear, and more specifically, to footwear having reduced noise and impact characteristics for wearing on a hard floor, for example, tile, wood, or other hard material. Noise generated by impact of the foot falling, striking or impacting onto a hard floor is reduced by an outsole with predetermined hardness and a sound reducing insole which ideally comprises a material having high indentation forced deflection (IFD) weight and a high volumetric mass density, with a minimum thickness of ¼ inch (6.3 mm), and in a range of between ¼ to ¾ inch (6.3 mm-19.1 mm). Footwear upper portion is attached to the outsole to provide comfort and foot protection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention will now be discussed in further detail below with reference to the accompanying figures in which:

[0014] FIG. **1** illustrates in a partially cutaway view, a first embodiment of the present invention in the form of a shoe sock;

[0015] FIG. **2** is an exploded view of the embodiment of FIG. **1**;

[0016] FIG. **3** is a side cross-sectional view the embodiment of FIG. **1**;

[0017] FIG. **4** is a bottom view of the embodiment of FIG. **1**;

[0018] FIG. **5** illustrates a preferred embodiment of the outsole of the present invention;

[0019] FIG. **6** illustrates a second embodiment of the present invention with a sandal like upper portion;

[0020] FIG. **7** illustrates a partially cutaway view of yet another embodiment of the present invention having a shoe like appearance, and

[0021] FIG. **8** is a diagram of the test results showing how different sound characteristics are generated by samples on a hard floor having different combinations of outsole and insole, and the improved sound reduction of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Referring now to the drawings, it should be appreciated that like numerals refer to like parts and to corresponding parts throughout the several views and parts having similar functions have similar numbers, but having the prefix of a different hundred series. A first embodiment of the present invention sock shoe **10** is shown in FIGS. **1** to **5**, which comprises an outsole **30**, an insert **60** and a shoe upper **90**. Generally, shoe upper **90** is attached to the outsole **30**, and insert **60** is placed within outsole **30** and retained within the outsole **30** by the upper **90**.

[0023] Outsole **30** may be made with materials traditional thermoplastic elastomers (TPE) as well as "green" polyethylene rubbers which are made from any natural resource that can be processed using biopolymer chemical engineering. Ideally, these have a pre-specified hardness, outsole **30** being hard enough to give protection to the foot and simultaneously to withstand normal wear and at the same time reducing the noise generated by footsteps. Preferably, outsole **30** may comprise a Shore 'A' anti-slip Thermo Plastic Rubber material outsole, preferably with vent throughholes **53** well distributed all around it to circulate air. The preferred method of making the material is by cast molding or alternately by injection molding.

[0024] The shape of outsole **30** may be a flat shape, or the outline may include rounded shape edges without a sharply defined heel, so as to avoid the additional impact noise generated by the heel portion, as would a normal shoe striking a hard surface. In addition, rounded edges **42** in both outsole front portion **40** and outsole back portion **44** provide a more impact friendly shape to increase the contact surface when these two portions of the footwear come into contact with floor, thus contributing to reducing the impact noise, and also giving comfort to the wearer while walking. To make the sock shoe **10** more attractive for children to wear, outsole **30** may be made with knobs **52** disposed on outsole surface **38**. Preferably, knobs **52** can be disposed on the outer surface of the outsole **30** to provide an aesthetic appearance and may look like, for example, chunks or bricks of chocolate fudge, or any other appropriate ornamental design such as would be attractive to a young child.

[0025] The insole **30** made for the indoor play slipper according to the present invention is purposely made thicker than most inserts to take advantage of the sound absorbing properties of this material. Higher side walls of the outsole **30** keep the wearer's foot and instep secure and in place and without slippage relative to the shoe. Of course, quality foam will provide the wearer with support and comfort to walk or run in.

[0026] Insert **60** ideally comprises a material having high indentation forced deflection (IFD) weight. Such particular materials are usually very dense and have a very high impact absorption rating to reduce impact sound transmission. As shown in FIG. **8**, the sound pressure L dBA (SPL), generated from an average indoor play slipper using a weighted machine (identified by ID Nos. **120-128**) provides a sound level that is equal to city traffic at between 71.8 to 72.9 dBA, while inserts using the material (identified by ID Nos. **220-226**) produce sound pressure values of between 59.0 to 63.1 dBA, which sound levels are in the range of a normal conversation between two subjects at one meter (three feet) apart.

[0027] The insole **60** preferably is in a thickness range from a minimum of ¼ to a maximum of ¾ inch. Preferably, the material may be an open-cell viscoelastic foam having **6** PCF (pounds per cubic foot) with an IFD weight of 68 lbs., a high density weight of 6 pounds or higher, and should have a depth dimension in a range of between ¼ inch to ¾ inch (6.3 mm to 19.1 mm), and optimally of can be about ½ inch (12.7 mm) thick. The combination of density and high indentation forced deflection weight ideally should provide a high impact sound absorption capability and be capable of significantly reducing the impact noise, ideally by as much as 20-30 decibels of sound power magnification. It has been determined that an insert **60** using the specified material and dimensions resulted in a reduction of impact noise by about 8.7 to 13.9 decibels compared to other known comparable indoor children's footwear (see FIG. **8**).

[0028] To provide comfort to the wearer and protection from excessive wear of, and accumulation of dirt on, insert **60**, the first embodiment of footwear **10** may further comprise one or more insert protective layers, such as insert upper protective layer **62** and insert lower protective layer **66**. These protective layers **62**, **66** cover and are attached by an appropriate method, such as gluing, stapling etc., and disposed on the upper and lower side of insert **60**. Alternatively, if desired to have a protective layer all around the insert **60**, it may be applied on all surfaces thereof, as is shown in FIG. **3**. The two protective layers **62**, **66** preferably comprise an ethylene-vinyl acetate copolymer (EVA) foam, which is a more durable material than that of the viscoelastic insert **60**. Since EVA foam is a closed cell material the two protective **62**, **66** layers may preferably include throughholes **64** for providing air circulation to keep the feet cool.

[0029] Shoe upper **90** may be an upper portion, such as an open sock, attached to an outsole edge **56** defined about the perimeter of the outsole **30**. It can be made attached to outsole edge **56** of outsole **60** by overmolding, sewing, gluing or by any other ways that would be appropriate to connect the sock portion to the outsole edge. Shoe upper **90** may also comprise sock top **94** gathering shoe upper **90** against the ankle or leg of the wearer, thereby preventing drafts from entering sock shoe **10**. Upper **90** may be made of cotton or a mixed fabric sock material or from neoprene.

[0030] To make the sock shoe **10** more attractive for children to wear, shoe upper **90** may further comprise design patterns **98** on the outside surface, which design may take the form of logos, patterns, cartoon characters, etc. In this case, insert **60** may be inserted into the cavity defined by the sock portion upper **90** and outsole **60** having an inner surface **38** to enable it to be easily inserted and removed from the cavity within sock shoe **10** through sock top **94**.

[0031] Shoe upper **90** also may take the form of a complete sock, that is, a sock having a bottom as well as the tube portion ending in sock top **94**, attached to outsole inner surface **32**. It may be made attached to the inside surface of outsole **30** within the boundary **58**, by overmolding, sewing, gluing or any appropriate method for connecting the two objects, preferably as close to edge **56** as possible. Shoe upper **90** may also comprise sock top **94** gathering upper **90** against the ankle or leg of the wearer, thereby preventing drafts from entering sock shoe **10**. To make the sock shoe **10** more attractive for

children to wear, shoe upper **90** may further comprise design patterns **98** on the outside surface of it. In this case, preferably, insert **60** may be housed inside shoe upper **90** and be removable from the cavity through sock top **94**.

[0032] Thus, to make said sock shoe **10**, first, outsole **30** is made with materials of certain hardness, preferably, Shore 'A' anti-slip Thermo Plastic Rubber, by calendaring molding, extrusion molding, compression molding, or any other ways that would be appropriate to make and shape said materials of outsole **30**. For upper portion type shoe upper **90** described above, outsole **30** should be made with outsole edge **56** at the top edge of it. Then shoe upper **90**, preferably with sock top **94** gathering shoe upper **90** against the ankle or leg of the wearer, is made attached to outsole edge **56** by overmolding, sewing, gluing or any other ways that would be proper to connect the two objects.

[0033] Aforementioned insert **60**, preferably with insert upper protective layer **62** and insert lower protective layer **66** covering and being attached, e.g., glued, respectively on the upper and lower side thereof, is inserted onto outsole inner surface **38** and is easily removed from cavity defined by the elements of sock shoe **10** through sock top **94**. For a complete sock type shoe upper **90** described above, preferably with sock top **94** gathering upper **90** against the ankle or leg of the wearer, shoe upper **90** is made attached to the inside surface of outsole **30** within the overmolded boundary **58**, by overmolding, sewing, gluing or any other ways that would be proper to connect the two objects. Then aforementioned insert **60**, preferably with insert upper protective layer **62** and insert lower protective layer **66** covering and being attached, e.g., glued, respectively on the upper and lower side of it, is housed inside shoe upper **90** and able to be removed from it through sock top **94**.

[0034] Aforesaid sock shoe **10** can be used both in casual or recreational environment and outdoors, especially for children, who would be expected to generate much more noise indoor than adults. When the footfall is in contact with the floor, most of the energy of the impact generated by it would be absorbed by said insert **60**, and at same time, enough protection and comfort would be given to the wearer's foot by said outsole **30** and shoe upper **90**. Additional sound reduction capability is introduced by the shape of the outsole **30**.

[0035] Referring now to FIG. **6**, wherein a second inventive embodiment sandal **110** is shown and generally comprises an outsole **130**, an insert **160**, and an upper portion **190**. Outsole **130** may be made with materials of certain hardness which are hard enough to give protection to the foot at the same time reducing the noise generated by the footsteps as explained above. Preferably, outsole **130** may be a shore 'A' anti-slip Thermo Plastic Rubber outsole, with ridges **134** on its lower surface to provide additional anti-slip capability. Sandal **110** may further comprise cushion **136** attached to the upper surface of outsole **130**, with flexible layer **132** placed therebetween. Cushion **136** may comprise a relatively thinner cushion forward **138** and a relatively thicker cushion rear **140**, to provide a somewhat raised heel, but the heel should not be raised so much as to create so much of a slope that the heel impact on the floor would be strike at an obtuse angle.

[0036] Insert **160** may comprises a material of high indentation forced deflection (IFD) weight which is in a thickness range from a minimum of ¼ to a maximum of ¾ inch. Preferably, the material may be an open-cell viscoelastic foam of 6 PCF (pounds per cubic) or higher with an IFD weight of 68 lbs, and have a depth dimension of ½ inch in thickness. To provide comfort to the wearer and protection to insert **160**, sandal **110** may be regarded as being further comprising insert upper protective layer **164** being attached, e.g., glued, to the upper side of insert **160**. Insert upper protective layer **164** may be made of ethylene-vinyl acetate copolymer (EVA) foam, and further may comprise throughholes **166** for air circulation to keep the feet cool. Preferably, the front part of insert **160** may be relatively thicker and the back part of insert **160** may be relatively thinner to fit with cushion **130**. Insert **160** may also comprise a perforate hole **162** in the front portion of it for purposes of insertion of the end of the upper portion **190**.

[0037] Upper portion **190** may comprises of a thong **192** and one or more cross-straps **194**, as in known sandal constructions. Thong **192** should be attached to cushion forward **138** through a perforate hole **162**, as shown. Cross-strap **194** may be attached to cushion rear **140** by cross-strap attachment **196** to the edges of the cushion rear **140** by adhesive, melt bonding or other appropriate means.

[0038] Sandal **110** can be used both in casual or recreational environment and outdoors, especially in environment with high temperature and for children, maybe worn indoors, as they would be expected to generate much more noise indoor than adults. When the footfall is in contact with the floor, most of the energy of the impact generated by it would be absorbed by insert **160** and cushion **136**, but the wearer would be comfortable as a result of the air circulation provided to the wearer's foot by outsole **130** and upper portion **190**.

[0039] In yet another embodiment, a standard type shoe **210** is shown in FIG. **7**, which may comprise an outsole **230**, an insert **260**, and an upper portion **290**. Outsole **230** and shoe upper **290** may be similar with the same portions of a normal shoe. Outsole **230** may further comprise outsole pattern ridges **252** on the bottom thereof for providing anti-slip characteristics. Insert **260** may comprises a material of high indentation forced deflection (IFD) weight which is in a thickness range from a minimum of ¼ to a maximum of ¾ inch. Preferably, the material may be an open-cell viscoelastic foam of 6 P/CF (pounds per cubic foot) with an IFD weight of 68 lbs., at ½ inch in thickness. To provide comfort to the wearer and protection to insert **260**, shoe **210** may further comprise insert upper protective layer **262** and insert lower protective layer **266** being attached (e.g. glued) respectively to the upper side and lower side of insert **260**. The Insert protective layers may be made of ethylene-vinyl acetate copolymer (EVA) foam, and further comprises throughholes **264** for air circulation to keep the feet cool.

[0040] Aforesaid shoe **210** can be used both in casual or recreational environment and outdoors. When the footfall is in contact with the floor, most of the energy of the impact generated by it would be absorbed by insert **260**, and at same time, enough protection and comfort would be given to the wearer's foot by said outsole **230** and shoe upper **290** to enable long periods of wear.

[0041] Referring now to FIG. **8**, a graph illustration of the sound reducing capability of the present inventive is graphically illustrated. The testing producing the graphed results was performed under controlled conditions, with each type of shoe tested being done as carefully identical as possible. The shoes tested were those not using the inventive materials of predetermined dimensions, as described above, and then those which did use the materials as described. The bar graphs are indicative of decibel level tested when walking along a

hard floor, with each bar graph reflecting eh average A-weighted sound power. The types of shoes tested included: a skidder shoe bar graph **120**, normal slipper sock bar graph **122**, rubber outsole alone bar graph **124**, basketball booty bar graph **126**, rubber outsole with gel insole bar graph **128**, and combinations of preferred rubber outsoles and preferred inserts bar graph **220** to **226**, which had the inventive materials as described above in various combinations. Bar graphs **220-226** shoe the test results of shoe sock **10** (first embodiment), each having varying thicknesses of the insole **60**. It is considered that similar results would arise when testing the other embodiments.

[0042] As shown in FIG. **8**, the sound pressure L dBA (SPL), generated from an average indoor play slipper using a weighted machine (ID No. **120-128**) provides a sound decibel level that is about equal to city traffic at between 71.8 to 72.9 dBA, while inserts using the insole having the specified materials (identified by ID Nos. **220-226**) produce sound pressure value of between 59.0 to 63.1 dBA. This is significant reduction of the noise level, and reflect sound levels in the range of a normal conversation between two subjects at one meter (three feet) apart.

[0043] The invention herein has been described and illustrated with reference to the embodiments of FIGS. **1-8**, but it should be understood that the features and operation of the invention as described is susceptible to modification or alteration without departing significantly from the spirit of the invention as disclosed above. For example, the dimensions, size and shape of the various elements may be altered to fit specific applications and needs. The shape of other types of shoes, or boots, may reflect the style or fashion, but the elements are essentially identical in material and spacing. Accordingly, the specific embodiments illustrated and described herein are for illustrative purposes only and the invention is not limited except by the following claims.

What is claimed is:

1. Footwear for reducing noise of as footfall, comprising:
(a) an having an outer sole and walls extending essentially perpendicularly therefrom, defining an inner surface, said outer sole having a predetermined hardness;
(b) an upper portion attached to said outer sole;
(c) a sound reducing insole disposed within said outer sole, the sound reducing insole comprising a material having high indentation forced deflection (IFD) weight;
(d) said sound reducing insole having a thickness in a range between ¼ to ¾ inch.

2. The footwear according to claim **1**, said outer sole further comprises a shore 'A' rubber outsole.

3. The footwear according to claim **1**, said outsole including vent throughholes well distributed all around its outside surfaces.

4. The footwear according to claim **1**, said outer sole having protrusions disposed on the outside surface thereof, said protrusions being separated from each other by a gap of predetermined dimension.

5. The footwear according to claim **1**, said upper portion being of flexible material attached to said outsole.

6. The footwear according to claim **5**, said upper portion comprising a lower end opening attached to an upper edge of said outer sole.

7. The footwear according to clam **5**, said upper portion comprising a lower end enclosing a sock cavity and being attached to said inner surface of said outer sole.

8. The footwear according to claim **7**, said insole being disposed within said upper portion.

9. The footwear according to claim **1**, said material being of high density foam exceeding 6 lbs.

10. The footwear according to claim **9**, said material being at a minimum density of 6 pounds per cubic foot.

11. The footwear according to claim **1**, said material being with a minimum IFD weight of 68 lbs.

12. The footwear according to claim **1**, said material having a thickness of approximately ½ inch.

* * * * *