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(54) **SHOCK RESISTANT SHOE**

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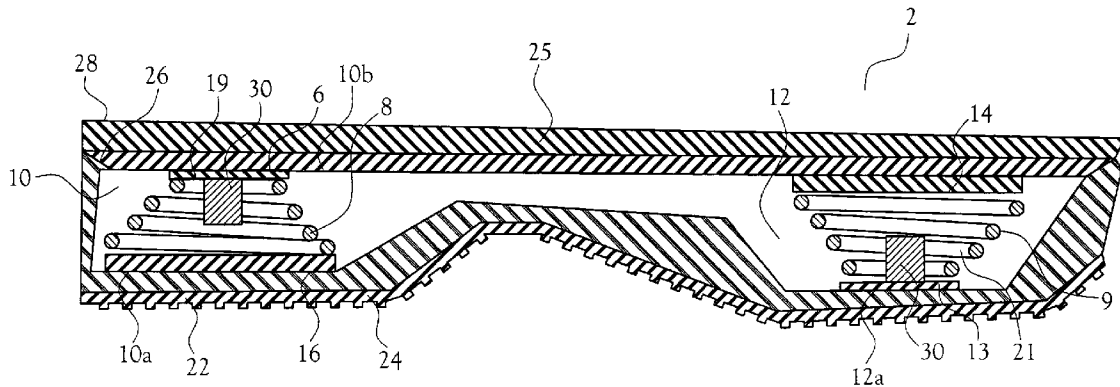
(57) **ABSTRACT**

(73) Assignee: **Shoe Spring, Inc.**, Knoxville, TN (US)

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A sole assembly for a shock resistant shoe includes a sole having a heel region and a ball region. A first cone spring, disposed within the sole, includes a large diameter terminal end and an opposing small diameter terminal end. The large diameter terminal end is disposed above the small diameter terminal end.



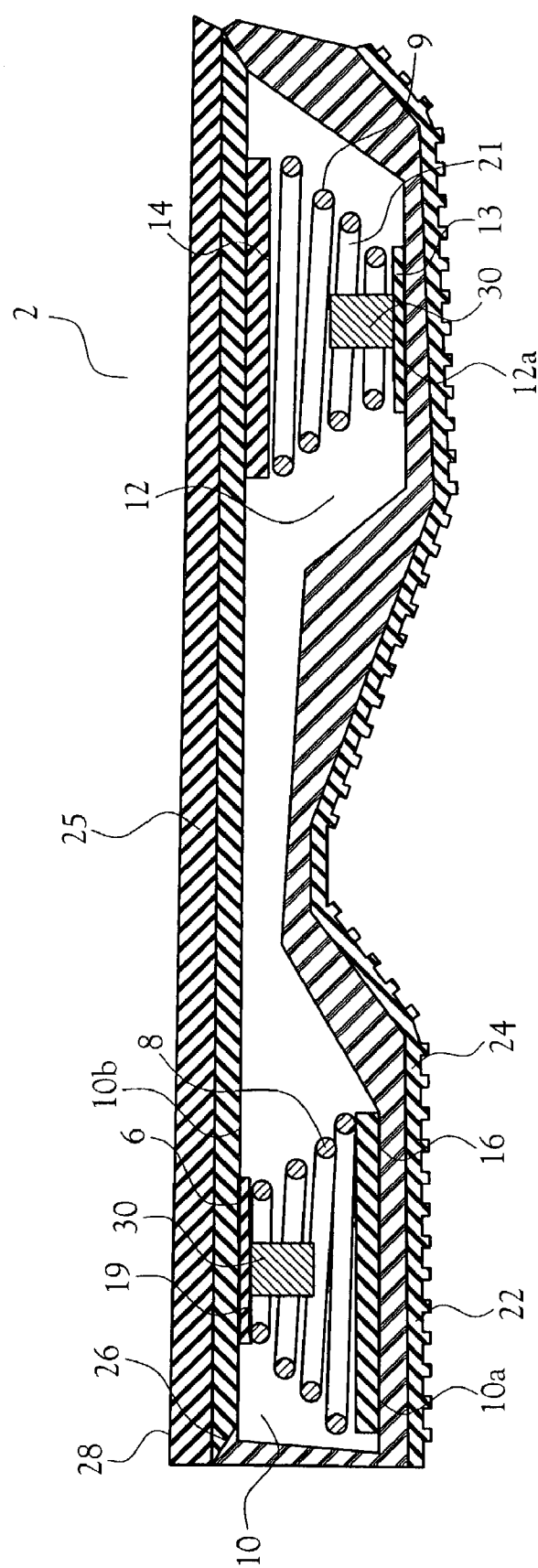


Fig.1

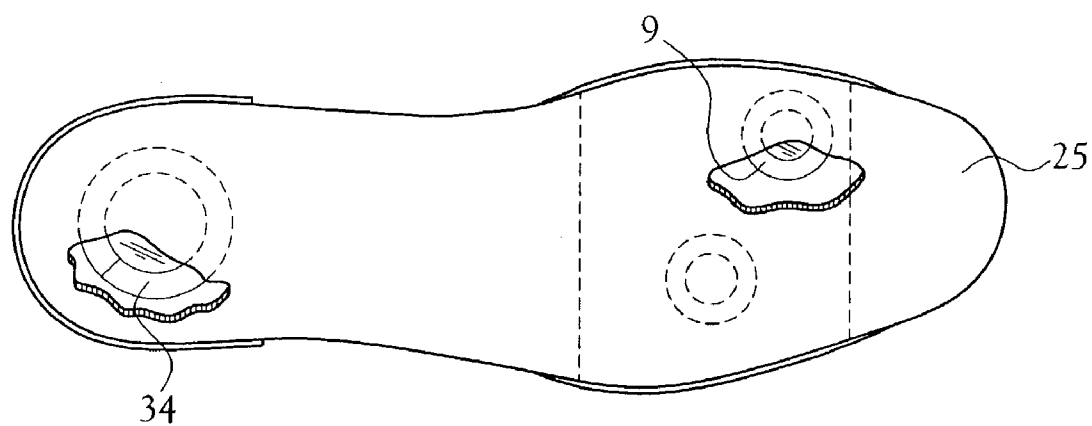


Fig.2

SHOCK RESISTANT SHOE**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] Pursuant to 35 USC Section 119, this application claims the benefit of priority from Provisional Application Serial No. 60/345,667 with a filing date of Jan. 4, 2002.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

[0003] 1. Field of Invention

[0004] In most running, walking, and jumping activities, the return force resulting from foot strikes causes great shock to the body. Repeated foot strikes place great stress on joints and bones, and can cause injuries to the lower back and the rotating joints of the legs. To minimize injury to the body resulting from repeated foot strikes, and also to improve athletic performance, shoe engineers have designed various spring-cushioned shoes. The springs in spring-cushioned shoes are designed to reduce shock to the body during a foot strike, and also to recover and return impact energy to the user.

[0005] One type of spring-cushioned shoe is described in U.S. Pat. No. 6,282,814 to Krafzur et al., which is incorporated herein by reference.

BRIEF SUMMARY OF THE INVENTION

[0006] In most running, walking, and jumping events, the foot follows a prescribed set of motions. The heel impacts the ground first, the weight then shifts forward onto the ball of the foot in a rolling manner, and the toe region provides the last contact with the ground. It is desirable to absorb as much of the impact energy from the both the heel and ball areas of the foot during a foot strike, while still providing a stable landing and not slowing down the user.

[0007] In one aspect, the present invention features a spring cushioned shoe with at least one cone spring disposed within the sole of the shoe. The cone spring includes a large diameter end and an opposing small diameter end. The cone spring is positioned in an "inverse orientation," wherein the large diameter end is disposed above the small diameter end. The small diameter end faces downward, toward the outer sole of the shoe, so that the spring returns energy to the user in a manner consistent with the rolling motion of the foot during a foot strike.

BRIEF DESCRIPTION OF THE DRAWING

[0008] The above-mentioned features of the invention will become more clearly understood from the following detailed description of the invention read together with the drawings in which:

[0009] **FIG. 1** is a cross sectional side view of a shoe midsole assembly having cone springs disposed within the heel and ball areas of the assembly.

[0010] **FIG. 2** is a plan view of an alternative embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0011] An embodiment of the present invention will be described below with reference to the accompanying figure.

[0012] Referring to **FIG. 1**, a midsole assembly **2** includes first and second surfaces **22** and **26**, respectively, positioned such that first surface **22** can be adhesively attached to an ordinary outer sole **24**. The second surface **26** is designed to attach adhesively to inner sole **25**. Inner sole **25** provides contact area **28** for an upper shoe portion (not shown) to be attached to midsole **2**.

[0013] Midsole **2** contains vacuities **10** and **12** positioned in the heel and ball areas of midsole **2**, respectively. Vacuities **10** and **12** communicate with each other by way of fluid flow pathway **18**, which allows the free flow of fluid there between, as described in the co-pending U.S. patent application assigned Ser. No. 09/982,520, which is incorporated herein by reference. Alternatively, the vacuities **10** and **12** and the pathway **18** may be filled, either partially or completely, with a low density, polymeric foam to encapsulate the spring mechanisms described more fully hereinafter.

[0014] A first cone spring **8** is positioned in the heel vacuity **10** of midsole **2**. Cone spring **8** has a large diameter terminal end **17**, and a small diameter terminal end **19**; the large diameter terminal end **17** faces downward, toward the outer sole **24**, and the small diameter terminal end **19** faces upward, towards inner sole **25**. Terminal end **17** is in mechanical contact with plate **16**, to resist lateral movement relative to the plate **16**, as by welding, adhesive, virtual interference, engagement in a slot defined in the plate **16** or physical attachment, for example. The small diameter terminal end **19** is firmly attached to a first surface plate **6**, to resist lateral movement relative to the plate **6**, as by welding, adhesive, virtual interference, engagement in a slot defined in the plate **6** or physical attachment, for example. A textured face of the plate **16** is held in adhesive contact with a lower surface **10a** of vacuity **10**. Plate **6** is in mechanical contact with the upper surface **10b** of the vacuity **10**. A spring compression limiter **30** is attached to the axial center of plate **6**, in a vertical orientation, to prevent the full compression of cone spring **8** during use.

[0015] Plates **6** and **16** are constructed of sheet metallic material, but could also be made from various other metal or non-metallic materials. The spring compression limiter **30** is made of, e.g., a polymeric material.

[0016] A second cone spring **9** is positioned in ball vacuity **12** of midsole **2**. Like cone spring **8**, cone spring **9** has a large diameter terminal end **23** and a small diameter terminal end **21**. Unlike spring **8**, spring **9** is positioned within the ball vacuity such that the large diameter end **23** faces upward, toward inner sole **25**, and the smaller diameter end **21** faces downward, toward outer sole **24**.

[0017] The second cone spring **9** is positioned between plates **13** and **14** in the ball vacuity **12**. A first face of plate **13** is adhesively attached to surface **12a** of vacuity **12**, and the second face of plate **13** is attached to the small diameter end **21** of spring **9** by a mechanical fixture, or, alternatively, by adhesion. Plate **14** is attached, at one face, to the large diameter end **23** of coil spring **9**, and is attached adhesively at its opposite face to inner sole **25**. The ball vacuity also

includes a compression limiter **30**, as described above in connection with heel vacuity **10**.

[0018] Positioning the ball area cone spring **9** in this “inverse” orientation takes into account the rolling motion of the ball portion of the foot during a foot strike. This inverse orientation allows the outer sole, as it rolls over the ball of the foot, to pivot over a smaller surface of spring. As a result, the spring **9** returns force to the user over a greater portion of the ball strike, and therefore returns a greater percentage of the impact energy to the user.

[0019] The cone springs **8** and **9** are both multi-turn coil springs, having a large diameter terminal end and a small diameter terminal end, as described above and as shown in **FIG. 1**. The springs **8** and **9** taper evenly from the large diameter ends to the small diameter ends. The springs can be made from metal, or various non-metallic polymeric materials.

[0020] Other embodiments are also possible. For example, both the heel and ball area cone springs could be disposed in the “inverse orientation,” with the small diameter end facing downward, as shown above for cone spring **9**.

[0021] The cone springs **8** and **9** need not have a conical shape. So long as the springs have a small diameter end and an opposing large diameter end, the spring need not taper evenly from the large end to the small end. For example, the diameter might remain constant for a portion near the large diameter end, and then taper to the small diameter end. Alternatively, the spring may bulge in the middle section.

[0022] As depicted in **FIG. 2**, a wave spring **34** may be placed in the heel vacuity **10** instead of a cone spring. Such an embodiment includes a wave spring in the heel area, as described, e.g., in U.S. Pat. No. 6,282,814, and at least one inversely oriented cone spring **9** in the ball area, as described above.

[0023] Multiple springs may be included in each vacuity. For example, the heel vacuity **10** may include multiple wave springs, multiple cone springs, or a combination of wave springs and cone springs. Similarly, ball vacuity **12** may include multiple inversely oriented cone springs, or a combination of wave springs and inversely oriented cone springs. Alternatively, the multiple heel and ball springs may be disposed within multiple heel and ball vacuities.

[0024] The springs may be disposed within the heel and ball vacuities using, e.g., countersunk volumes and shim ends, as described in U.S. Pat. No. 6,282,814.

[0025] From the foregoing description, it will be recognized by those skilled in the art that an improved sole assembly has been provided.

[0026] While the present invention has been illustrated by description of several embodiments and while the illustrative embodiment has been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear

to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.

Having thus described the aforementioned invention, we claim:

1. A sole assembly for an article of footwear comprising:
a sole having a heel region and a ball region;
a first cone spring disposed within the sole, said first cone spring including a large diameter terminal end and an opposing small diameter terminal end, said large diameter terminal end being disposed above said small diameter terminal end.
2. A sole assembly in accordance with claim 1 wherein said cone spring is located in said ball region of said sole.
3. A sole assembly in accordance with claim 2 and further comprising a wave spring located in said heel region of said sole.
4. A sole assembly in accordance with claim 1 wherein said sole defines a first vacuity and said first cone spring is disposed within the first vacuity.
5. A sole assembly in accordance with claim 1 wherein said cone spring is at least partially encapsulated in low density foam.
6. A sole assembly in accordance with claim 1 wherein said first cone spring is located in said heel region of said sole.
7. A sole assembly in accordance with claim 1 wherein said first cone spring defines a cylindrical axis substantially perpendicular to said sole.
8. A sole assembly in accordance with claim 1 and further comprising a second cone spring disposed within the sole, said second cone spring including a large diameter terminal end and an opposing small diameter terminal end, said large diameter terminal end being disposed below said small diameter terminal end.
9. A sole assembly in accordance with claim 8 wherein said second cone spring is located in said heel region of said sole.
10. A sole assembly in accordance with claim 8 wherein said sole defines a second vacuity and said second cone spring is disposed within the second vacuity.
11. A sole assembly in accordance with claim 8 wherein said first cone spring defines a cylindrical axis substantially perpendicular to said sole.
12. A sole assembly for an article of footwear comprising:
a sole having a heel region and a ball region;
at least one cone spring disposed within the sole, said cone spring including a large diameter terminal end and an opposing small diameter terminal end, said large diameter terminal end being disposed above said small diameter terminal end.

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