An article of footwear has a shock absorbing insert placed between the insole and the outsole thereof, for example at the heel. The insert includes a spring carrier having upper and lower portions, each having a plurality seats for receiving a respective ends of respective coil springs. Each of the springs extends between said upper and lower portions and is captured therebetween. A magnetic spring supplements the mechanical springs. The springs and carrier are protected from environmental elements and abrasive particles by a debris shield.
QUICK CHANGE SHOCK MITIGATION OUTSOLE INSERT WITH DEBRIS SHIELD


BACKGROUND OF THE INVENTION

[0002] This invention relates to shock absorbing footwear.
[0003] Numerous footwear inventions have been proposed for absorbing shock and adding lift, particularly in the athletic shoe field. For example, U.S. Pat. No. 4,817,304 describes footwear with a cushioning sole structure in which a sealed internal member in the sole is inflated with gas to form a resilient insert in the heel region of the shoe. Various shoe structures have also been proposed in which springs are embedded in the shoe sole in the heel region or over the entire sole. See, for example, U.S. Pat. No. 5,502,901, No. 5,338,776, No. 4,566,206, and No. 4,592,153. Some of these structures are bulky and heavy, or cannot effectively be manufactured. My own patents (U.S. Pat. Nos. 5,502,901 and 7,213,350) describe improvements over those prior patents.
[0004] One problem with prior shock absorbing footwear, including my own, is that the characteristics of the shock absorber, particularly including the load capacity, cannot be easily adjusted.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide new and improved items of footwear which have improved shock absorbing properties and which also add lift and propulsion to the foot of a wearer when walking or running.
[0006] In this invention, two strong permanent magnets are placed in a cavity in the heel in magnetic opposition so that they are repelled from one another and tend to hold the cavity open. This magnetic spring acts in conjunction with mechanical (coil) springs to dissipate shock and further add lift and propulsion to the wearer's foot in motion.
[0007] The coil springs and magnetic spring together are designed to support an air-flux gap within the sole member at all times. This permits continuous and more effective shock dissipation than when the gap is closed, solid or absent under load.
[0008] The coil springs and magnets work in conjunction to absorb and dissipate load or shock as the foot hits the ground. Subsequently, as the load shifts from the heel to the ball of the foot, both the coil springs and the magnets bias the opposing walls of the cavity apart, giving lift or propulsion to the wearer.
[0009] The shock absorbing insert of this invention may be used in any type of footwear, such as sports/athletic shoes, boots, casual shoes, work shoes, children's shoes, orthopedic shoes, sandals and the like. It significantly reduces shock to the body while walking, running or in other types of foot motion, and adds lift and propulsion, thereby reducing fatigue.
[0010] An object of the invention is to provide an article of footwear having an improved, easily replaceable, spring insert in the heel.
[0011] These and other objects are attained by a shock absorbing footwear as described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] In the accompanying drawings,
[0013] FIG. 1 is an exploded perspective view of a first embodiment of shock absorbing footwear embodying the invention;
[0014] FIG. 2 is a similar view of a second embodiment of the invention;
[0015] FIG. 3 is an unexplained sectional view of the second embodiment, taken on a vertical longitudinal plane;
[0016] FIG. 4 is a view of a spring insert assembly shown in FIGS. 1 and 2;
[0017] FIG. 5 is an enlargement of the portion of FIG. 4 indicated by a circle;
[0018] FIG. 6 is a top plan view of the insert assembly;
[0019] FIG. 7 is a sectional view taken on the vertical center plane 7-7 in FIG. 6;
[0020] FIGS. 8, 9 and 10 are enlargements of the portions indicated in FIG. 7 by respective circles;
[0021] FIG. 11 is a perspective view of a portion of a debris shield shown in FIGS. 1 and 2; and
[0022] FIG. 12 is an enlargement of the portion of FIG. 11 indicated by a circle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0023] As shown in FIGS. 1 and 2, which depict two embodiments of the invention, shock absorbing footwear embodying the invention includes an outsole 10, an insole 20, and an insert assembly 30.
[0024] The outsole 10 is preferably made of rubber, EVA, composite or polyurethane. It has an open heel cavity or a similar cavity beneath the ball of the foot, approximately as wide as the heel or ball, 2.5" for example. FIG. 2 shows the heel cavity only, as an example. The reader will understand that the principles illustrated can easily be adapted to an insert placed beneath the ball of the foot (as suggested in FIG. 1) rather than—or in addition to—at the heel location.
[0025] The heel cavity has an opening on one side, e.g., toward the arch or heel, approximately 3.0" wide, for receiving the insert assembly.
[0026] The outsole has a perimeter bead made of rubber, eva, composite or polyurethane. Alternatively, it may have multiple beads (upper and lower) to allow the insert to be manually pressed in the cavity while also allowing for easy removal and replacement.
[0027] The footwear preferably also includes, between the insole and outsole, a midsole or footbed 25 made of modified cardboard or other suitable stiff material. The insole (FIG. 1) or the footbed (FIG. 2) has a hinged or flexible portion 27 which can be peeled back to allow access to the insert for removal or replacement.
[0028] The insert assembly 30 includes a spring assembly 40 contained within a protective debris shield 60. The spring assembly, best seen in FIGS. 4 and 7, includes a plate which has upper and lower portions 42, 44 joined along one edge by a living hinge 46; that is, the upper and lower plates are a continuous piece of material. The living hinge provides a preferred line of flexure between the upper and lower portions and allows the insert to be closed around the coil springs and magnets described below. The hinge and the upper and lower plates are preferably a single piece U-shaped molded part made of nylon or other suitable polymer.
[0029] Each of the upper and lower plate portions 42, 44 is provided with a plurality of (preferably five or more) cup-shaped seats 48, each designed to receive one end of a respective compression coil spring 50. Each seat on the upper por-
tion is aligned with a counterpart seat on the lower portion, along a longitudinal axis of the spring. Each seat has spaced walls 52, 54 defining an annular volume for securely holding the end of one of the springs.

[0030] The spring seats 48 have beveled tops to prevent spring rub. The bottoms of the seats have protruding ribs that allow the spring to snap in, but hold the springs in place thereafter.

[0031] Exemplary dimensions for each coil spring are 1.25" length by 0.50" diameter. The springs are preferably made of stainless steel; however, it should be understood that the choice of materials and exact dimensions may be adjusted to suit a particular situation. Furthermore, other types of mechanical springs, such as wave springs or Belleville springs, might be used instead of coil springs. The claims below use the generic term “mechanical compression springs” to cover all such alternatives.

[0032] The seats 48 are preferably molded integrally with the plate portions 42, 44, but they could alternatively be made as separate pieces.

[0033] Upper and lower magnet casings 55 are also formed in the plate, amid the coil spring seats 48. The axis A-A (FIG. 7) of each canister lies on the vertical center plane 7-7 (FIG. 6) of the insert. The coil spring seats are arranged around the canisters, preferably at a uniform radial distance from the axis A-A. The insert preferably has snap-in feature to hold the magnet casings in place.

[0034] The preferred magnets 56 are two opposing thick nickel-coated rare earth permanent magnets of 35 mgo (megagnuss oersted) or greater. Exemplary dimensions of each magnet are 1.0" dia.x0.350".

[0035] It is preferred that the magnet spring and coil spring arrangement be able to support a load in the range of 100-600 pounds without binding.

[0036] Before being installed in the outsole, the spring insert is placed within a debris shield 60 (FIGS. 1-3) which provides some structural support and protects the springs and magnets from the elements (water, dirt, abrasive particles). The debris shield is a rubber or elastomeric polymer cover for the spring assembly; it is open on one end to receive the spring assembly.

[0037] The debris shield preferably has a pair of pull tabs 58 that the user can grasp when removing the spring insert from the envelope.

[0038] The insert assembly, normally securely seated in the recess in the outsole, can be quickly removed, for example when one desires to replace the insert with another having different spring characteristics, or to rebuild the insert by replacing the mechanical springs or the magnetic spring with parts having different spring rates of other characteristics. For example, the coil spring rates can be adjusted higher or lower around the perimeter of the insert. All the coil springs may have the same spring rate, or springs of different rates may be used to control pronation and supination for a particular wearer.

[0039] Since the invention is subject to modifications and variations, it is intended that the foregoing description and the accompanying drawings shall be interpreted as only illustrative of the invention defined by the following claims.

1 claim:
1. An article of footwear comprising
   an outsole,
   an inner sole, and
   a shock absorbing insert disposed between the outsole and the inner sole, said insert comprising
   a spring carrier having upper and lower portions, each of said portions having a plurality of seats for receiving a respective ends of respective mechanical compression springs,
   a like plurality of mechanical compression springs, each extending between said upper and lower portions and being captured therebetween,
   a magnetic spring disposed between the mechanical compression springs, said magnetic spring comprising a pair of permanent magnets of opposed polarity,
wherein said upper and lower portions of the spring carrier are interconnected by a hinge so that the spring carrier can be opened to permit servicing or replacement of the springs, whereby characteristics of the insert may be adjusted for different wearers or to control supination and/or pronation of a wearer’s foot.

16. The insert assembly of claim 15, wherein the hinge is a living hinge formed integrally with said upper and lower portions.

17. The insert assembly of claim 15, further comprising a debris shield for containing said spring carrier and said springs, to protect said mechanical and magnetic springs from environmental elements and abrasive particles, said debris shield comprising a flexible envelope having an opening at one side into which the spring assembly can be inserted, prior to installation of the spring assembly into the footwear.

18. The insert assembly of claim 17, wherein the flexible envelope is made of rubber or an elastomeric polymer.

19. The insert assembly of claim 17, wherein the debris shield has formed thereon at least one pull tab to facilitate installation and removal of the spring assembly.

20. The insert assembly of claim 15, wherein the mechanical and compression springs are selected to as to together support a load in the range of 100-600 pounds without binding.