ABSTRACT
An improved running shoe is disclosed that dissipates the impact forces of the heel step by utilizing a pressurized inner bladder designed for bi-directional collapse. The shoe comprises a rear portion for accommodating a heel, a forward portion for accommodating toes, a shoe sole; and a compressible bladder. The compressible bladder is preferably contained within said shoe sole and partially inflated. The inner bladder has a heel portion extending proximate to an outside end of the rear portion of the shoe but tapered inward at the impact point and a toe portion extending proximate to an outside end of the forward portion of the shoe. The inner bladder collapses at the heel upon the initial heel step, significantly reducing the heel step impact forces. The heel step section of the inner sole is then re-pressurized utilizing the natural forward motion of the toe step. Preferred embodiments of the shoe include accordion pleats around the heel and a rounded heel to further dissipate impact forces.
SOFT HEEL RUNNING SHOE
CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 61/987,001 ("the '001 application") filed May 1, 2014. The '001 application is hereby incorporated by reference in its entirety for all purposes, including but not limited to, all portions describing various aspects of the present invention, those portions describing shoe design in general as background and/or for use as specific embodiments of the present invention, and those portions describing other aspects of manufacturing and testing shoes that may relate to the present invention.

STATEMENTS REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable.

REFERENCE TO A MICROFICHE APPENDIX


BACKGROUND OF THE INVENTION

[0004] 1. Field of the Invention
[0005] The present invention relates to shoes. More particularly, the present invention relates to a shoe that dissipates the harmful impact forces of the heel step.
[0006] 2. Description of the Related Art
[0007] The continued popularity of running as an exercise has spawned numerous innovations in running shoes. Many of these innovations are sourced to the fact that the initial heel step impact is the cause of the most running related injuries. In general, these innovations have evolved primarily in varying forms of cushioning. In addition, this heel step impact problem has also spawned the use of various forms of air bladders in shoes.
[0008] Addressing cushioning, there is significant evidence that additional cushioning, in whatever form, does not significantly reduce the occurrence of injury due to impact and specifically the initial heel contact impact. Recent studies described in the relevant literature, such as “Cushioned Running Shoes Don’t Reduce Injuries” from the Mar. 13, 2014, issue of Runners World, “Shoe Cushioning: All or Nothing?” from the Jun. 2, 2011, issue of Competitor Magazine, and “Study: Shock Absorbing Running Shoes Don’t Reduce Injury Risk” from the Oct. 13, 2013, issue of Red Orbit, demonstrate the failure of the prior art cushioning to effectively reduce running related injury.
[0009] Addressing bladders, there have also been many different models of bladder arrangements used in shoes that were intended to dissipate the heel step shock. However, these bladder systems, whether air or other fluid, tend to be limited in coverage area and/or dependent upon valves, etc. Also, the prior art bladders tend to be mounted with the same prior art feature of a rigid outer heel perimeter which junctions vertically downward with the hard heel horizontal bottom to form a perpendicular hard juncture at the "corner." This perpendicular hard juncture is where the initial heel step makes contact with the ground and in actuality, serves as a reinforcement. In other words, the direct heel step impact point meets the ground at its stiffest angle. This hard juncture reinforcement significantly neutralizes any intended prior art bladder or cushion shock dissipation.

[0010] As shown in FIG. 22, the prior art shoes were generally fitted with a flat bottom heel of heavy resilient material with an outer horseshoe shape and a hard “vertical to horizontal” corner. This heel is commonly layered with a midsole which provides additional stiffness. As will be recognized by those of skill in the art, prior art shoes also utilized hard plastic heel counters internal liners such as are shown in FIG. 17. These prior art shoes had a hard heel column 56 erected by the combination of the outsole, midsole, and hard heel counter. An example of such prior art shoe is shown in FIG. 22 approximating the point of impact 65 against the hard heel juncture and heel counter stiff perpendicular train 66. This view is presented with a nominal impact angle 63 of 22 degrees. The summation of the conventional prior art design is a stiff perpendicular heel column with little or no collapsibility and thus little or no shock dissipation at the exact point where it is critically needed.

[0011] As can be seen, it would be advantageous to have a running shoe, or more specifically a shoe system, that could effectively reduce the impact shock on the wearer’s heel by absorbing the culpable heel step shock to reduce the occurrences of injury.

BRIEF SUMMARY OF THE INVENTION

[0012] The present invention is an improved running shoe, or shoe system, that dissipates the impact forces of the heel step. Preferably, dissipation of impact forces occurs through utilization of a pressurized inner bladder designed for bi-directional (up and down) collapse. Another aspect of dissipating impact forces involves the use of accordion pleats at the outer shoe heel. Yet another aspect of dissipating impact forces involves the use of a recessed, rounded heel.

[0013] In a particular embodiment, the inner pressurized bladder is located between a midsole of a shoe and an insole of the shoe, and extends from the rear heel area of the shoe to the forward toe area. The pressurized bladder, which is preferably inflated with air, collapses at the heel upon the initial heel step, significantly reducing the heel step impact forces. The heel step section of the bladder is then re-pressurized utilizing the natural forward motion and weight shift of the toe step which compresses the fluid backward into the heel section. The bladder may be of resilient elastomer construction or other material with similar properties.

[0014] In a particular embodiment, a series of accordion pleats are located on the midsole at the outer shoe sides. The accordion pleats collapse on initial heel step impact to dissipate impact forces during the heel step and rebound to the original shape during the toe step. The accordion pleats are preferably pressed formed into both sides of the midsole above the heel.

[0015] In a particular embodiment, a recessed rounded heel is utilized to dissipate impact forces of the heel step. This rounded heel is recessed away from the back of the heel and rounded to eliminate the hard heel juncture and therefore facilitate a smoother, softer impact point. In a particular embodiment, a semi-flexible heel counter is provided to bear the vertical load and shock at points away from the heel step impact point. Preferably, the semi-flexible heel counter includes flexible ribs along the side of the counter generally perpendicular to the impact direction of the heel step.

[0016] In a preferred embodiment, an inner bladder, in conjunction with a series of side accordion pleats and a recessed, rounded heel are utilized together to dissipate impact forces from the heel step. Capitalizing on the compressible nature of
the bladder; the heel section of the bladder and the accordion pleats will preferably be re-pressurized by the natural forward motion of the toe step, thus imparting pressure back to the heel section. A most preferred embodiment comprises this system design to dissipate the energy, all utilizing the same, auto-compression source.

Additional advantages of the invention are set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

A better understanding of the present invention can be obtained when the following detailed description of the disclosed embodiments is considered in conjunction with the following drawings in which:

FIG. 1 is a side view of an embodiment of a running shoe made in accord with the present invention;

FIG. 2 is side view of an embodiment of a pressurized bladder for a running shoe made in accord with the present invention;

FIG. 3 is a top view of an embodiment of a pressurized bladder for a running shoe made in accord with the present invention;

FIG. 4 is a side view of an embodiment of a running shoe made in accord with the present invention in a heel impact position;

FIG. 5 is a side view of an embodiment of a running shoe made in accord with the present invention in a toe compression position;

FIG. 6 is a graph comparing impact forces on a conventional running shoe as compared to the estimated forces on an embodiment of the present invention;

FIG. 7 is a perspective view of an embodiment of the bottom of the rounded heel with an apex at the maximum point of impact;

FIG. 8 is a side view of an embodiment of a recessed, rounded heel;

FIG. 9 is a perspective view showing an embodiment having accordion pleats, oriented to culminate to an apex point;

FIG. 10 is an embodiment of the accordion pleats in the pressurized, upright position;

FIG. 11 is an embodiment of the accordion pleats in collapse due to the heel step downward force and the ground force upward force;

FIG. 12 is an alternative embodiment of the pleat design utilizing sealed tubing;

FIG. 13 is a side view of a shoe embodiment with accordion pleats having a downward sweep to absorb ground forces at the point of impact and an impact patch;

FIG. 14 is another perspective of the embodiment of FIG. 13;

FIG. 15 is perspective view of an embodiment of an insertable bladder retainer tabs;

FIG. 16 is a cutaway view of a shoe system embodiment shown from the back presenting a midsole, a bladder, an insole above the bladder and accordion pleats;

FIG. 17 is a side view of a prior art hard plastic heel counter;

FIG. 18 is a side view of an embodiment of a softer heel counter with an open lower back and flexibility ribs to remove a layer of stiffness such as was inherent in the prior art;

FIG. 19 is a back view of the embodiment of FIG. 18;

FIG. 20 is a side view of an embodiment of a heel counter approximating some impact distortion at the flexibility ribs and at the open lower back.

FIG. 21 is a side view of the an embodiment illustrating the heel step at impact angle and the respective positions of the rounded, recessed heel, the impact patch, and the accordion pleats to absorb the impact forces;

FIG. 22 is a side view of a common prior art type shoe illustrating the point of impact against the hard heel juncture and heel counter stiff perpendicular train;

FIG. 23 is another shoe embodiment with a smaller, thinner bladder and smaller impact angle suitable for walking or power walking;

FIG. 24 is another shoe embodiment cross section showing a bladder with a support bias to one side suitable for supporting pronation (medial side) or supination (lateral side) symptoms;

FIG. 25 is another shoe embodiment cross section with a wider foot print and side channels for added stability;

FIG. 26 is another shoe embodiment cross section showing a vertically elongated bladder heel for compensating for a short leg or other possible gait afflictions.

FIG. 27 is another shoe embodiment with a slimmer profile bladder and more relaxed impact angle suitable for standard, lace-up walking shoes.

FIG. 28 is another shoe embodiment with a slimmer profile for hiking boot applications.

DETAILED DESCRIPTION OF THE INVENTION

The natural motion of running, whether male or female, can be divided into two distinct segments; the heel step followed by the toe step. The heel step is more time concentrated and therefore provides a significant instantaneous impact. The subsequent toe step is a time-linear, weight shift rolling motion, which is devoid of any significant impact forces. The present invention comprises a shoe and/or a shoe system that counters the initial and harmful heel step impact.

As shown in FIGS. 1, 2 and 3, in particular shoe embodiments, a compressible air bladder 12, comprises a rear containment portion 10, preferably extending from the rear heel of the shoe, and a forward containment section 13 extending into the toe portion of the shoe, which acts to significantly dissipate the energy of the heel step impact. The maximum impact point on the bladder 12 is shown as impact point 11. Another embodiment of the bladder is shown in FIG. 15. In preferred embodiments, bladder 12 extends from a point proximate to the rearmost portion of the heel of the shoe to a point proximate to the forward most portion of the shoe.

A bi-directional dissipation of the heel impact occurs with the compression of the heel into the top of the bladder 12 and simultaneous absorption of the ground force upward into the bottom of the bladder 12. This bi-directional
compression forces the bladder fluid from the heel section 10 of bladder 12, and thus the pressure, to the front toe section 13 of the bladder 12. The natural motion of the toe step then transfers this pressure energy back to the heel section 10 of the bladder 12, thus re-pressurizing the inner air bladder heel section 10. This, in effect, is a reciprocating motion that transfers pressure from the heel section to the toe section with the heel step and then back to the heel section with the toe step.

[0050] FIG. 1 depicts a side view of one embodiment of a running shoe with an inlay of a pressurized bladder. FIGS. 4 and 5 demonstrate the flow of pressure of the embodiment of FIG. 1. FIG. 4 is a side view of the heel step with the point of impact, with downward force 15, and upward force 16, and the direction of the pressure flow 17 inside the inner bladder 12. The heel section 10 of the pressurized inner bladder 12 preferably has a larger air cavity than the toe section 13 and this larger volume dissipates the heel step forces. FIG. 5 is a side view of the toe step (weight roll), with downward force 18, and upward force 19, and the opposite direction of the pressure flow 20 inside the bladder 12.

[0051] FIG. 6 compares a conventional shoe impact chart with an overlay of an estimated soft heel impact of an embodiment of the present invention. This conventional shoe test chart shows the impact peak (Impact Transient) 21 and also a larger slower peak 22; sometimes called the “Active Peak,”” both in standard Force vs. Time units. However, the so-called “Active Peak” does not create the concentrated force like the Impact Peak as the Active Peak is more of a rolling, weight motion. The present invention centers on dissipation of the heel step Impact Peak, as this is the primary cause of injuries. While this chart shows an estimated 40% reduction in impact forces 23, it is expected that actual testing of preferred embodiments may show an even greater reduction of the impact forces. As will be recognized by those of skill in the art, this chart can be refined by a properly configured, momentum based, test based on particular embodiments.

[0052] The bladder 12 is preferably formed from rubber or a resilient elastomer with similar properties. In particular embodiments, the bladder 12 can be formed from an inner layer and an outer layer to form a double ply bladder. Two layers of the bladder preferably can be cemented and stitched or even double stitched for durability. Preferably, the bladder 12 can withstand and hold a pressure of at least about 20 psig (plus or minus ten percent).

[0053] Preferably, pressurized bladder 12 is sized to the entire length of the foot. By way of example, using a size 10 male foot as a model, the heel section 10 of an embodiment of the bladder 12 calculates to a volume of about 10 in³ where the toe section 13 is about 8 in³. While the toe section 13 is preferably longer and wider, the heel section 10 of this embodiment is deeper creating a larger volume. This depth facilitates the dissipation of the heel step energy. Sizing the toe section 13 to the entire length and width of the foot facilitates the capture of the entire toe step energy to re-compress the heel section 10. This particular embodiment design has a natural self-corrective factor in that the toe step, while not as voluminous, is actually three to four times longer in execution time than the heel step. In other words, the toe step has more time to re-pressurize the heel step section 10 of the bladder 12, prior to the next cycle.

[0054] Utilizing an average standing foot print area and an average weight, the estimated working pressure of a preferred embodiment of the bladder is about a nominal 20 psig. The working fluid is preferably air, but other inert compressible gases such as nitrogen and the like can also be utilized. In addition, different air pressure values are preferably not required for different weight classes. There is a natural correction factor in that lower weight classes will normally have smaller foot prints and thus smaller bladders. This is a self-correction to a standardized inner pressure. As will be recognized by persons of skill in the art, the working pressure target can all be verified and refined utilizing properly configured, momentum based, testing for particular embodiments.

[0055] As shown in FIGS. 13 and 14, another aspect of the invention is the utilization of accordion pleats 41 to dissipate the energy of the heel step impact. Accordian pleats 41 may be a stand-alone impact reduction device or, preferably, serve as an enhancement of the aforementioned bi-directional compression of the bladder 12. Accordian pleats 41 comprise a series of folds of medium soft elastomer which are pressed into both sides of the heel portion of the shoe above the impact point. In preferred embodiments, accordion pleats 41 comprised three to four folds, but in others may comprise as few as two or more than four. Accordian pleats 41 act as a bellows on impact to facilitate maximum impact absorption. The accordion pleats 41 are preferably formed with a downward sweep to coincide with the maximum ground force impact point as shown.

[0056] As shown in FIGS. 10 and 11, accordion pleats 33 (or 41 in FIG. 13) will collapse with the force of the heel step and will be stretched back to the upright position, preferably with the bladder 12 back pressure from the toe step (FIGS. 10, 11). FIG. 10 depicts an embodiment of accordion pleats 33 adjacent, but not fused, to the bladder 12. Under normal internal heel pressure, the pleats 33 are expanded as bladder 12 is expanded to a normal height 34. FIG. 11 shows the embodiment of the pleats 33 compressed due to the heel step action. When the bladder 12 is again pressurized by the toe step action, the top of the bladder again expands with the pressure and “stretches” the accordion pleats 33 back to the upright, pressurized position.

[0057] To further enhance the collapse, the accordion pleats 33 may be graduated such that the bottom and thus the first contact pleat is greater in height than the second pleat and so on. This would enhance shock dissipation by allowing for a more natural decay of the impact. The accordion pleats 33, in effect, spread the impact contact time and thus decrease the peak impact force. One natural decay rate is a 0.6 power so that with a first (bottom) pleat height of “P,” the next pleat height would be 0.6P and the third pleat height would thus be 0.36P. Once again, this can be verified and refined by testing on a properly configured, momentum based, test stand for particular embodiments.

[0058] An alternative embodiment of accordion pleats is shown in FIG. 12 utilizing sealed tubing 37 to absorb the initial impact and then expand upon the re-compression of the bladder. Tubing 37 may be rubber or other material with similar properties. As will be recognized by those of skill in the art, the sealed tubing, preferably rubber, can be a more efficient manufacturing option, depending upon circumstance available to the manufacturer.

[0059] Another aspect of the invention is an impact patch 40. As shown in FIG. 13, an impact patch 40 can be combined with a downward sweep of the accordion pleats 41 for increased absorption of the impact. FIG. 14 depicts impact patch 40 and the downward sweep of the accordion pleats 41 from another view point. As will be recognized by those of
skill in the art, the normal impact point between the shoe and the ground is between the back heel center line and the outer edge of the lateral side of the heel. Impact patch 40, which preferably comprises a harder rubber or similar material, is located at the normal impact point on the shoe.

Another aspect of the invention is the development of a recessed, rounded heel to significantly dissipate the energy of the heel step impact as shown in FIG. 21. In this embodiment, the heel is rounded, from the back of the heel to the bottom of the heel, essentially eliminating the hard heel juncture or "corner." The rounded, recessed heel design can be a significant contributor to the dissipation of impact forces. The rounded heel section also eliminates the prior art "hard juncture" contact point and serves to accommodate the accordion pleats at the requisite strategic impact angle. In the preferred embodiments, the rounded heel has a minimum radius of curvature equivalent to about 0.5 inches. The rounded heel is generally rounded across the entire back of the shoe and may continue somewhat toward the sides.

FIG. 8 shows the offset of the rounded heel. This rounded heel point is preferably recessed away from the back of the shoe 29 to concentrate the impact dissipation designs to the maximum angle of impact 28. Again, this rounded heel eliminates the common heel outer band hard juncture which has no capacity for collapse and therefore no capacity to dissipate energy. Eliminating the stiff heel hard juncture of prior art shoes by utilizing the rounded heel significantly enhances the compression characteristics of the shoe.

Another aspect of the invention is a semi-flexible heel counter. As shown in FIGS. 18 and 19, particular embodiments of the invention utilize an embodiment of a heel counter 70 that it bears the vertical load and shock at points away from the heel step impact point. The heel counter is preferably manufactured from a thin, semi-firm rubber or material having similar properties. Preferably, the heel counter 70 has an open portion 57 along the bottom and flexibility ribs 58. Preferably, flexibility ribs 58 along the sides of the heel counter 70 are pressed in a direction perpendicular to the impact direction for additional enhanced shock absorption. Flexibility ribs 58 preferably comprise thin indentations or channels in the heel counter 70 that break the continuity of the counter and therefore create small zones of additional flexibility. FIG. 21 illustrates the heel step at the impact angle and the respective positions of the impact patch 61 and the downward sweep of the pleats 64 to absorb the impact force 62. This view is presented with a nominal impact angle 63 of about 22 degrees. As will be recognized by those of skill in the art, the embodiments utilizing the semi-flexible heel counter 70 eliminate the prior art stiffness column at the hard heel juncture (as shown in FIGS. 17 and 22).

Particular shoe embodiments utilize a midsole, preferably formed of a soft elastomer in a single piece. The midsole 52 can be shaped to form an internal shell for the bladder 53 (bladder 12 from earlier FIG’s) such as can be seen in FIG. 16. That is, the midsole 52 can be formed as an outer air bladder contour or support surface. Additionally, particular embodiments of the midsole 52 can have the accordion pleats 51 form pressed into the inner and outer walls above the heel. In such embodiments, midsole 52 thickness can be reduced significantly as compared to the prior art due to the removal of material to accommodate the heel section of the bladder 53. This has the added advantage of replacing solid weight material with virtually weightless air. In preferred embodiments, bladder 53 is placed between the midsole 52 and an insole 50 and is formed to fit snugly on top of the midsole. The midsole 52 is preferably contoured to the larger heel section to match the bladder heel section. This particular midsole embodiment arrangement, which includes the accordion pleats 51 has the added advantage of being press formed in one unitized piece. The midsole bottom is preferably formed to accommodate the larger heel section. The midsole 52, including the accordion pleats 51, can thus be pressed in one piece and joined to the insole 50 with Velcro. This insole joint 49 assists to raise the accordion pleats 51 on the next step compression and thus prepare the accordion pleats 51 for the next heel step impact.

In this regard, FIG. 15 depicts a bladder embodiment 45 (53 in FIG. 16) formed to fit snugly on top of the midsole 52. An arc section 46 can be custom sized to address various arch problems. Preferably, bladder 45 is insertable into the midsole and can be secured to the midsole cavity utilizing Velcro tabs 47 above the bladder heel section 48. This bladder to midsole joint 49 need not be air tight but merely secure, as the pressure is within the bladder 45.

Various embodiments allow for bladder 45 to be inserted in various ways. In some embodiments, bladder 45 is inserted in permanent manner during on assembly and affixed between the midsole and insole. In other embodiments, bladder 45 can be inserted through a side zipper or through the upper opening. Due to the extra size of the bladder heel section, the most preferred embodiment allows insertion and removal of bladder 45 through an opening thereby making it readily replaceable.

Particular embodiments may utilize an outsole comprising a slightly more flexible grade of blown rubber than is conventionally utilized to remove another layer of the hard heel juncture column. However, the outer sole impact patch contact area preferably maintains the conventional carbon rubber as it must withstand the impact. The impact 40 patch will preferably be formed of carbon rubber or other durable material to withstand the heel impact.

Particular shoe embodiments and the various shoe features discussed herein may utilize materials of construction such as are readily known to those of skill in the art. Contemporary materials (rubber derivatives, leather, canvas, EVA, polyvinyl chloride, proprietary derivatives etc.) can be used in excess as were specifically described herein, for example as with the semi-flexible heel counter and outsole.

As an alternative, an apex may be utilized on the shoe heel bottom to withstand the contact at the impact point and reduce the common hard heel circumference outer band. This apex also collapses and provides more dissipation of the initial heel impact forces. The apex replaces the common hard heel outer band of the prior art shoes which is stiff and therefore has no capacity to dissipate impact energy. FIG. 7 shows an alternate embodiment of the bottom of the heel with a strategic apex point 26. The bottom of the shoe heel, near the convergence of the accordion pleats, forms an apex strategically located at the maximum impact point 26. Preferably, the apex is a triangle shaped hard rubber patch to provide a more resilient impact surface point for wear. It is noted that the apex design, along with the recessed heel, eliminates the common prior art, hard, outer heel perimeter (hard juncture), which has virtually no flexibility and therefore no dissipation characteristics. The compressible nature of accordion pleats 27 offers additional impact dissipation which converges near the apex point 26. Preferably, the apex is located between the heel center and the lateral edge to coincide with the impact point.
While each of the aspects described above can be utilized independently, in the most preferred embodiments the bladder, accordion pleats, and rounded heel combine to dissipate the heel impact by utilizing compression. That is, the bi-directional heel step dissipation, the accordion pleats, and the off-set rounded heel, combine to provide optimum heel step impact dissipation. In addition, the compressive nature of the inner bladder also serves to recharge (re-pressurize) the elements above at each running step.

As described, these embodiments of the present invention primarily address the sport of running and the accompanying running injuries. However, the present invention is applicable to footwear utilized in other fields including, but not limited to, walking, football and other running sports, therapeutic walking and other foot or leg therapies, hiking, and various military applications. In addition, the compressive nature of the inner bladder can be shaped in different configurations to address different problems, for example, to also relieve pronation problems, while at the same time dissipating the initial impact.

For example, three additional shoe style embodiments are shown in FIGS. 23, 27 and 28. In FIG. 23, a shoe embodiment is shown with a more shallow or thinner bladder and smaller impact angle suitable for walking or power walking. This embodiment preferably has fewer accordion pleats 67, for example two or three, and an impact angle of approximately 10 degrees as opposed to the running impact angle of a nominal 20 degrees. This smaller impact angle 68 is sufficient for a smooth step while at the same time offering the impact dissipation necessary for walking. In FIG. 27, a shoe embodiment is shown with a smaller, thinner bladder 79 and a more relaxed impact angle suitable for standard, lace-up walking shoes. To maintain the common shoe appearance, this embodiment can be implemented with or without accordion pleats and can be fitted with a dark rubber heel that gives the appearance of leather. As will be recognized by one of skill in the art, there is sufficient absorption in the bladder heel to absorb normal walking impact. In FIG. 28, another shoe embodiment is shown with a shallow profile bladder 80 that can be utilized for hiking boot applications. This embodiment is shown without accordion pleats but retains support for a soft leather heel. As will be recognized by those of skill in the art, there is sufficient absorption in the bladder heel to absorb normal hiking impact.

Examples of shoe embodiments directed to therapeutic issues are shown in FIGS. 15, 24, 25, and 26. In FIG. 15, an arch section 46 is shown that can be reduced or enlarged to address different arch types and arch problems. In FIG. 24, a heel portion of a shoe embodiment is shown illustrating a bladder with a support bias to one side suitable for supporting pronation (medial side) or supination (lateral side) symptoms. Utilizing the enclosed compressed fluid, bladders can be formed to off-set the effects of pronation or supination by compensating with the shape of the inner heel on the medial or lateral side. As will be recognized by those in the art, this example demonstrates but one of the possibilities for biomechanical applications. In FIG. 25, a heel portion of another shoe embodiment is shown with a wider foot print and side channels 73 for added stability. Side channels 73 are channels protruding more to the medial and lateral sides of the heel. This extra volume and breadth provides more stability if needed. Because bladder 74 is filled with a compressed fluid, the bladder 74 will form into the proper spaces within the midsole 73. As noted previously, the insole can be secured with Velcro strips. In FIG. 26, a heel portion of another shoe embodiment is shown with a vertically elongated bladder heel section 78 for compensating for a short leg or other possible gait afflictions. As will be recognized by those of skill in the art, this concept can be expanded to bladders that can minimize limps by reverse-engineering the limp and forming a bladder that will adequately compensate. Preferably for such embodiments, midsole 77 is formed in one piece and includes the accordion pleats 69. These are but a few examples of the utility of enclosed, expandable, compressed air bladders to relieve and alleviate a wide range of bio-mechanical problems.

While the terms used herein are believed to be well-understood by one of ordinary skill in the art, definitions are set forth to facilitate explanation of certain of the presently disclosed subject matter.

Following long-standing patent law convention, the terms "a", "an", and "the" refer to one or more when used in this application, including the claims. Thus, for example, reference to "a pleat" includes a plurality of such pleats, and so forth.

Unless otherwise indicated, all numbers expressing quantities of ingredients, properties such as reaction conditions, and so forth used in the specification and claims are to be understood as being modified in all instances by the term "about". Accordingly, unless indicated to the contrary, the numerical parameters set forth in this specification and claims are approximations that can vary depending upon the desired properties sought to be obtained by the presently disclosed subject matter.

As used herein, the term "about," when referring to a value or to an amount of a dimension, mass, weight, time, volume, percentage, etc., is meant to encompass variations of in some embodiments plus or minus 20%, in some embodiments plus or minus 15%, in some embodiments plus or minus 10%, in some embodiments plus or minus 5%, in some embodiments plus or minus 1%, in some embodiments plus or minus 0.5%, and in some embodiments plus or minus 0.1% from the specified amount, as such variations are appropriate to perform the disclosed methods or employ the disclosed compositions.

The term "comprising", which is synonymous with "including" "containing" or "characterized by" is inclusive or open-ended and does not exclude additional, unreferenced elements or method steps. "Comprising" is a term of art used in claim language which means that the named elements are essential, but other elements can be added and still form a construct within the scope of the claim.

As used herein, the phrase "consisting of" excludes any element, step, or ingredient not specified in the claim. When the phrase "consists of" appears in a clause of the body of a claim, rather than immediately following the preamble, it limits only the element set forth in that clause; other elements are not excluded from the claim as a whole.

As used herein, the phrase "consisting essentially of" limits the scope of a claim to the specified materials or steps, plus those that do not materially affect the basic and novel characteristic(s) of the claimed subject matter. With respect to the terms "comprising", "consisting of", and "consisting essentially of", where one of these three terms is used herein, the presently disclosed and claimed subject matter can include the use of either of the other two terms.

As used herein, the term "and/or" when used in the context of a listing of entities, refers to the entities being present singly or in combination. Thus, for example, the
phrase “A, S, C, and/or O” includes A, S, C, and O individually, but also includes any and all combinations and subcombinations of A, S, C, and O.

[0081] As used herein, proximate means near, but not necessarily at a specific point. Thus for example on end of a bladder is proximate to the outside of the heel, if a portion of the bladder is located in the heel area and extends into the rearmost fifty percent of the heel, or more preferably into the rearmost 20% of the heel. Similarly, a portion of the bladder is proximate to the front of the toe portion if a portion of the bladder is located in the toe portion and extends into the forward most fifty percent of the toe section, or more preferably into the forward most twenty percent of the toe section.

[0082] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The foregoing disclosure and description are illustrative and exemplary thereof, and various changes in the details of the illustrated apparatus and construction and method of operation may be made without departing from the spirit or scope of the invention which is described by the following claims.

We claim:

1. A shoe comprising:
   a rear portion for accommodating a heel, a forward portion for accommodating toes, and a shoe sole; and
   a compressible bladder being contained at least partially within the shoe sole and being partially inflated with a compressible fluid, said inner bladder having a heel portion extending from the rear portion of the shoe, and a toe portion extending into the forward portion of the shoe; wherein said compressible fluid is transferred from the heel portion to the toe portion upon heel impact and returned from the toe portion to the heel portion as the shoe rolls forward toward the toe.

2. The shoe of claim 1, wherein said shoe sole comprises an insole, a midsole, and an outer sole, and said compressible bladder is positioned between the insole and the midsole.

3. The shoe of claim 2, wherein the midsole comprises a recessed portion into which said compressible inner bladder is housed.

4. The shoe of claim 1 further comprising a series of accordion pleats across the rear portion of the shoe sole.

5. The shoe of claim 4 wherein the accordion pleats comprises a series of pleats adjacent to the bladder.

6. The shoe of claim 4 wherein the accordion pleat comprises a series of sealed tubes against a firm backing.

7. The shoe of claim 4 wherein the height of each pleat decreases from one to the next going upward from the bottom pleat.

8. The shoe of claim 1 wherein the rear portion of the shoe comprises a recessed, rounded heel portion.

9. The shoe of claim 8 further comprising an impact patch on the rounded heel portion, said patch being located at a point between a centerline of the rear heel portion and a side of the heel.

10. The shoe of claim 9 wherein the impact patch comprises a material having a greater hardness that the remaining portions of the outer sole of the shoe.

11. The shoe of claim 8 further comprising accordion pleats integral to the rounded rear heel.

12. The shoe of claim 11 wherein the rounded heel and accordion pleats are formed into a midsole portion of the shoe sole.

13. The shoe of claim 1 wherein said bladder comprises two distinct containment areas, a rear containment area adjacent to the heel and a forward containment portion adjacent to the forward portion of the shoe; said containment areas being fluid communication such that force impact on one containment area forces compressed gas from that containment area into the next containment area.

14. The shoe of claim 1 wherein said fluid comprises air.

15. The shoe of claim 1 wherein the shoe is a running shoe.

16. A running shoe comprising:
   a rear portion for accommodating a heel,
   a forward portion for accommodating toes,
   a shoe sole comprising an insole, midsole and outer sole;
   a bladder partially inflated with a compressible gas, said bladder comprising two distinct containment areas, a rear containment area adjacent to the rear portion of the shoe and a forward containment portion adjacent to the forward portion of the shoe, said containment areas being fluid communication such that force impact on one containment area forces compressed gas from that containment area into the other containment area, said bladder being located between the inner sole and the midsole of the shoe;
   a series of accordion pleats formed integrally to the midsole around an outer surface of the midsole on the rear portion of the shoe; and
   a rounded heel on the rear portion of the shoe along the shoe sole, said rounded heel having a radius of curvature of at least about 0.5 inches.

17. The shoe of claim 16 further comprising an impact patch on the rounded heel portion, said patch being located at a point between a centerline of the rear heel portion and a side of the heel.

18. The shoe of claim 17 wherein the impact patch comprises a material having a greater hardness that the remaining portions of the outer sole of the shoe.

19. The shoe of claim 16, wherein the midsole comprises a recessed portion in which said compressible bladder is housed.

20. The shoe of claim 16 wherein the height of each pleat decreases from one to the next going upward from the bottom pleat.

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