An athletic shoe (20) having an inflatable air bladder (52) integrated into the design and construction of the shoe, and apparatus (50) for inflating the air bladder, as well as apparatus (82) for sensing and indicating the pressure in the bladder, all incorporated into the design of the shoe.
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Shoe Having An Air Bladder Pressure Indicator

BACKGROUND OF THE INVENTION

This invention generally relates to the field of footwear, and more particularly to athletic footwear. Specifically, the present invention relates to athletic footwear which incorporate at least one inflatable air bladder for adjusting the comfort and fit of the athletic footwear, and an apparatus for visually displaying the pressure within the inflatable air bladder.

In various types of athletic footwear, and in particular for footwear associated with particular types of athletic events, it is recognized that the comfort and fit of the footwear can affect the athletic performance. In order to increase both the comfort and fit of footwear, manufacturers have incorporated inflatable bladders of various designs into the construction of the footwear. The development, incorporation, and use of inflatable air bladders within athletic footwear was and is particularly appropriate for ski boots used for downhill skiing. Thus, a number of patents relate to the field of ski boots which incorporate inflatable air bladders, for example, German Patent No. 2,162,619, and more recently, U.S. Patent No. 4,662,087. While the original designs for ski boots having air bladders incorporated the use of an external pressurizing device such as a hand pump, more recent designs incorporate the design of the pump into the article of footwear, such as for example the ski boot of U.S. Patent No. 4,702,022.
The demands for comfort and snugness of fit in other athletic events has resulted in the use of the inflatable bladders originally developed for ski boots in various types of athletic footwear, including athletic shoes used for basketball and other sports. There are presently available athletic shoes incorporating an air pump, such as depicted within U.S. Patent No. 5,074,765, to inflate air bladders located within the sole of the shoe, or alternatively, bladders located in portions of the upper or the tongue of the athletic shoe. The advantages of these types of shoes is manifested primarily by their increased comfort and the secure positioning or fit of the foot within the shoe. Another benefit derived from the use of air bladders is the potential for reduction of forces transmitted through the shoe to the foot and ankle of the wearer during performance of the athletic endeavor. Thus, current athletic shoes having incorporated air bladders provide enhanced comfort and fit, while also reducing the occurrence of various types of injuries.

For the athletic shoes currently available which incorporate both the inflatable air bladders and a pump inflation means, the comfort and fit of the article of footwear is adjusted by inflating the air bladder by use of the pump after securing the footwear about the foot. The wearer simply inflates the air bladder until a particular pressure level, or fit, is felt by the foot. However, due to the rigors of various athletic events, and because the human foot tends to swell and contract with varying levels of activity, it is very difficult for the individual to obtain a consistent fit from one use to the next, or to recognize the difference in their performance, based upon a pressure
setting for the air bladders that is merely sensed by the foot.

This problem is primarily related to the fact that there is no currently available means for indicating the particular pressure to which the user has inflated the air bladder. Thus, it would be beneficial to have a means for indicating the pressure within the air bladder, thereby indicating the particular fit which is most advantageous for enhanced performance. A visual reference to which the user may refer when first affixing the shoe to the foot, prior to a particular athletic use, or alternatively, during use, when it may be desirable to vary or restore a given fit, is therefore desirable.

Accordingly, the present invention is directed to an article of athletic footwear which incorporates inflatable air bladders, and which also includes a pressure sensing means and means for displaying the sensed pressure in the air bladders.

SUMMARY OF THE INVENTION

The present invention provides an athletic shoe which incorporates an inflatable air bladder in the design and construction of the shoe, and means for inflating the air bladder, as well as means for sensing the pressure in the bladder and means for indicating the pressure sensed, all incorporated into the design of the shoe.

More specifically, the article of footwear of the present invention includes an air bladder and an associated pump for inflating the air bladder. In addition, the air bladder is integrally connected to a means for sensing the pressure within
the air bladder, and to a means for allowing a visual indication
of the pressure sensed therein.

In the preferred embodiment, the means for sensing the
pressure is an inflatable, arcurately expanding, bellows. The
bellows, which has a first end in open communication with the
bladder and a second, closed end, is contained in a partial
toroidal chamber, and is disposed beneath a clear plastic lens
or window. Inflation of the inflatable bladder using the pump
causes the bellows to expand, whereby the closed end of the
bellows forces an indicator means across the arcuate length of
the lens. The lens is disposed proximate to an indicia of
pressure, such as a graduated pressure indicating scale. The
scale preferably includes a plurality of markings, such as dashes
and dots, spaced about the arcuate length of the lens. By this
configuration, as the arcurately expanding bellows is inflated
simultaneously with the inflation of the inflatable air bladder,
the indicator traverses the scale between an unpressurized
position and a fully pressurized position. Thereby, the user may
simply affix the shoe to his or her foot, and then use the
incorporated pump to inflate the air bladder (and bellows) to a
particular pressure level as indicated by the location of the
indicator.

By the arrangement of the above assembly of elements, the
user of the athletic shoe can inflate the incorporated air
bladder(s) to a specifically identifiable pressure. Thereby, the
user will be able, through trial and error, to determine the most
appropriate pressure setting for any particular athletic
endeavor. Thereafter, the user will be able to rapidly inflate
or deflate the inflatable bladder to a specific pressure, accurately and repeatably, using the visual pressure indicating means as a pressure indicator, thereby optimizing his or her comfort and performance.

A better understanding of the invention, along with its features and advantages, may be had from a consideration of the detailed description of its preferred embodiments which follows hereinafter, particularly if this description is read in conjunction with the associated drawing figures, a brief description of which now follows.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 depicts an article of footwear incorporating the pressure indicating means of the present invention.

Fig. 2 depicts an enlarged frontal view of the pressure indicating means of the present invention.

Fig. 3 depicts a side view of the pressure indicating means of Fig. 2.

Fig. 4 depicts an exploded view of the air bladder, inflating means and pressure indicating means of the present invention.

Fig. 5 depicts a cross-sectional view along line 5-5 of Fig. 2, of the pressure indicating means of Figs. 1 through 3.

Fig. 6 depicts a partially schematic, partially cut-away view of the bellows and indicator means of the pressure indicating means of the present invention.

Fig. 7 depicts the bellows in an inflated state for the pressure indicating means of Fig. 6.
Fig. 8 depicts a frontal perspective view of the pressure indicating means.

Fig. 9 depicts a detailed view of the arcuately expanding bellows shown in a semi-inflated state.

Fig. 10 depicts a view similar to that shown in Fig. 8 of the arcuately expanding bellows, shown as fully expanded.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 schematically depicts a lace-up athletic shoe 20. The athletic shoe 20 includes an upper 22 and a sole 24. The upper 22 includes a tongue opening 26 which is defined by opposing facing sides, or flaps, 28 and 30. Disposed beneath the opening 26 is a tongue 32 of the upper 22. The tongue 32 generally overlays the instep of the wearer's foot and extends up to the level of the ankle, and in the exemplary embodiment of shoe illustrated, incorporates the pressurizing means 36 of the present invention, as detailed more fully below with respect to the following figures. As illustrated, the pressurizing means 36 of the present invention is preferably located at the top portion of the tongue 32, i.e., proximate the ankle opening of the athletic shoe 20.

Figs. 2 and 3 depict a frontal perspective view and a side perspective view, respectively, of the upper portion of the tongue 32. As illustrated in Figs. 2 and 3, the pressurizing means 36 is disposed behind a facing plate 38. The facing plate 38 includes a lens 40 of clear plastic material, which allows viewing of an indicator means 42 disposed beneath the lens 40. Preferably, the facing plate 38 is an article of flexible molded
rubber or polyurethane having the particular design features required for covering the various aspects of the pressurizing means 36, as will be defined in greater detail below.

Fig. 4 illustrates an exploded view of the pressurizing means 36 of the present invention. As illustrated in Fig. 4, all of the elements of the pressurizing means 36 may be incorporated into the design of the tongue 32 (Fig. 1) of the present invention. However, it should also be appreciated that various other configurations, including air bladders located at or within other portions of the shoe, may incorporate the design of the present invention.

In Fig. 4, the pressurizing means 36 includes a pump means 50 for inflating a bladder means 52. The pump means 50 may be a simple rubber bulb 54 having an associated one-way inlet valve 56 and a one-way outlet and pressure relief valve 58. Depressing the rubber bulb 54 directs air through valve 56 to a tee-joint 60 and conduit 62 leading to an inflation port 64 of the bladder means 52.

The bladder means 52 is preferably constructed from a pair of air-impenetrable elastomeric sheets, each having a desired precut form, which are bonded or heat-welded together at or near the peripheral edges to form a flexible, air-tight cushion or pillow. Thus, the bladder means 52 includes an upper member 66 and a lower member 68 bonded together at their peripheral edges 70. Additionally, assembly details, such as the fastener openings 71, as well as structural ribs 72 or connection points 74 can be incorporated into the construction of the bladder means 52, e.g., by "heat-stitching", to define other details, such as
pockets for inflation associated with particular areas or bone
structure of the foot, and/or other features lending structural
definition to the resulting cushion.

The pump means 50 and bladder means 52 are also integrally
attached pneumatically to a pressure sensing means 80 and means
for indicating the sensed pressure 82. The pressure sensing
means 80 and means for indicating the sensed pressure 82 combine
to provide a visual indication of the pneumatic pressure within
the bladder means 52.

In the preferred embodiment, the pressure sensing means 80
comprises a bellows 84 having a first end 84a in open
communication with the bladder means 52, and a closed, opposite
second end 84b. Preferably, the bellows 84 is configured to be
arcuately expanding, as will be described in greater detail
below. The bellows 84 is arranged to inflate concurrently with
inflation of the bladder means 52, in response to operation of
the pump means 50, because the bellows 84 is in continuous
pneumatic interconnection with the inflatable portion of the
bladder means 52 by way of the bellows' open end 84a.

The means for indicating the sensed pressure 82 preferably
comprises a plurality of elements constructed to work in
combination to visually display the pressure within the bladder
means 52 and bellows 84. In addition to the facing plate 38,
 lens 40, and indicator means 42, the means for indicating the
sensed pressure also includes a main housing 85 disposed behind
the bladder means 52 and a lens cover 86 disposed in front of it.
When assembled together, the main housing and lens cover combine
to define a partial toroidal chamber 88. The lens cover 86 has
an arcuate window or opening 89 in it to permit the indicator
means 42 to be seen therethrough. A resilient means 90 is
provided, preferably in the form of a coil spring 92, to force
the indicator means 42 to a retracted position, collapsing the
bellows 84, upon release of air from the bladder means 52 by
operation of the pressure relief valve 58.

In the preferred configuration illustrated, the main housing
85 and lens cover 86 are assembled together, e.g., by fastener
means 93, about the bellows 84 and indicator means 42 to define
a partial toroidal chamber 88 containing them. Thus, the bellows
84 can expand within the chamber 88, forcing the indicator means
42 to traverse the toroidal chamber beneath the window 89 and
overlying lens 40. An observer looking through the lens 40 will
see the indicator means 42 behind it traversing across the
arcuate length of the lens 40, and can utilize a number of
pressure indicating marks 94, for example, molded into the cover
of the facing plate 38, as references to determine the relative
pressure within the bellows 84 and bladder means 52.

In an alternative embodiment, the lens cover 86 can be
molded of a clear plastic material, in which case, the window 89
can be eliminated, and the lens 40 feature conveniently molded
integrally into the lens cover, thereby eliminating an extra
piece and some additional assembly.

In operation, depressing the bulb 54 of the pump means 50
causes air to flow through valve 58, tee-joint 60, and conduit
62, into the bladder means 52 and bellows 84, thereby inflating
the bladder means 52 and expanding bellows 84. Expansion of the
closed end 84b of bellows 84 against the indicator means 42
causes the latter to rotate about its pivot point 96 (see, Figs. 9 and 10) from a first position to a second position, depending upon the amount of pressure imparted to the bladder means 52 by repetitive depression of the pump means 50. Following any particular depression of the bulb 54, the bulb reinflates due to its inherent elastomeric characteristic while taking in air from ambient via the inlet valve 56.

The pressurized air within the bladder means 52, as well as the bellows 84, can be released by depressing a pressure relief button 98 of valve 58. When the pressure is released, the inherent elastomeric characteristic of the bladder means 52, as well as the pressure being exerted on it by the foot and other portions of the shoe, will cause it to deflate. Additionally, the force exerted by the resilient means 90 (or spring 92) on the indicator means 42 will cause the bellows 84 to deflate and contract, thereby causing the indicator means 42 to traverse from the second position back to the first position beneath the lens 40.

By the above configuration and operation, it may be appreciated that the combination of elements comprising the pressurizing means 36 of the present invention allows the user of the athletic shoe 20 to inflate the bladder means 52 to any particularly desired inflation pressure each time the user wears the athletic shoe 20. Additionally, since placing the shoe 20 on the user’s foot and tying the laces of the shoe will determine the initial comfort and fit of the shoe, the pressure indicating means of the present invention is designed to operate somewhat independently of the lacing mechanism. Thus, with the shoe laced
to a particular tightness, the inflation of the bladder means will be affected by the tightness of the lacing, and the inflation pressure for the bladder and bellows will reflect the pressure exerted by the lace. The device of the present invention thereby allows a visual indication of the pressure in the bladder means 52. The device also allows the user to visually observe and set the comfort and fit of the shoe 20, dependent only in part on the particular tightness of the lacing thereof.

Fig. 5 depicts a cross-sectional view through the top portion of the tongue 32 taken along the line 5-5 of Fig. 2. As illustrated, the facing plate 38 covers the bulb 54 of the pump means 50, which interconnects with the valve 58, as well as the pressure relief button 98 of valve 58. Also illustrated in greater cross-sectional detail are the lens 40 and an end face 102 of the indicator means 42, as well as the partially cylindrical portion 104 of the indicator means. The end face 102 of the indicator means 42 is partially cut away in the figure to depict the closed end 106 of the bellows 84. Also illustrated in the cross-sectional view are the main housing 85 and the portion of the lens cover 86 that combine to define the partial toroidal chamber 88. Finally, as illustrated, the indicator means 42 also includes an arm portion 110, which extends radially inward from a part-cylindrical portion 104 to define a cylindrical bore 112 about, and mounted to, a pin 114 about which the indicator means 42 is pivotable. In addition, concentrically mounted with the pin 114 is the spring 92, which is mounted about a post 116 and has a first end 118 secured to exert force against
the arm portion 110 of the indicator means 42. The opposite end 120 of the spring 92 is positioned to abut against a segment defined by the main housing 85.

Operation of the arcuately expandable bellows 84 is illustrated in Figs. 6 through 10. In Fig. 6, a partially cutaway, partially perspective view of the arcuately expanding bellows 84, lens 40, and indicator means 42, is illustrated. In this configuration, the bellows 84 is shown in the collapsed or deflated state wherein the arm portion 110 is shown being forced by the spring 92 to cause compaction of the bellows 84. Additionally, Fig. 6 illustrates the arrangement of the lens 40 within a bezel lens member 122, which includes a bezel element 124 (see Fig. 8) into which the lens 40 is affixed. The bezel element 124 provides a surface for affixing the lens 40 over the opening 89 in lens cover 87. Also illustrated is the spring 92, and the portion of the main housing 85 into which the spring 92, pin 114 and post 114 elements are located, relative to the arcuate bellows 84 and lens 40.

Fig. 7 depicts the arcuately expanding bellows 84 in an expanded state, corresponding to a pressurized state for the bladder means 52. In this configuration, the bellows 84 has expanded in an arcuate manner thereby forcing the indicator means 42 to pivot about the centerpoint 96 of pin 114. The indicator means 42 traverses across a portion of the partial toroidal chamber 88, and can be viewed through the lens 40 and opening 89. Thus, by observing where the front edge or wall of the indicator means is located relative to the indicator marks 94, the pressure within the bellows 84 and the bladder means 52 can be determined,
and for the relatively low pressure levels in the bladder means 
that are typically encountered in this type of application, the 
relationship between the position of the indicator means 42 and 
the pressure level within the bladder means is fairly linear, 
with little or no hysteresis in the position of the indicator 
means.

Fig. 8 depicts an enlarged view of a portion of the facing 
plate 38 as well as the lens 40, and illustrates the position of 
the indicator means 42 when the bellows 84 is pressurized in a 
manner similar to the cutaway perspective view of Fig. 7. In 
Fig. 8, the pressure can be determined versus the indicator marks 
94, by the positioning of the indicator means 42. Thus, the 
pressure within the bellows 84 corresponds to approximately the 
fifth dash-mark on the indicator marks 94. Following placement 
of the athletic shoe 20 upon the foot of the wearer and tieing 
of the laces thereof, the pressurization of the bladder means 52 
and bellows 84 causes the indicator means 42 to traverse the 
partially toroidal chamber 88 behind the lens 40 and opening 89. 
Thus, by determining the appropriate fit for the shoe, the user 
can pump up the inflatable bladder and bellows 84 to a fixed 
level, as illustrated for example by the level shown in Fig. 8, 
in order to provide a consistent fit between subsequent uses of 
the athletic shoe 20.

Fig. 9 depicts in greater detail the operation of the 
arcuately expanding bellows 84. As may be appreciated from the 
illustration of Fig. 9, the arcuately expanding bellows 84 is 
specifically designed to include a smaller depth and pitch for 
the pleats along one side, i.e. at the radially internal
portions, than at the other side, i.e. the radially external portions. By this configuration, the arcuately expanding bellows 84 tends to expand and contract in a more nearly arcuate manner, as illustrated in Fig. 10, thereby reducing the amount of friction between the bellows and the walls defining the chamber in which it expands, as compared to using a linearly expanding type of bellows in an arcuate chamber.

The radially expanding bellows 84 of Figs. 9 and 10 is specifically designed to expand and contract in an arcuate manner. When deflated, bellows 84 has a generally cylindrical configuration, including a plurality of individual pleats defined by the pitch and depth thereof. As may be appreciated from the illustration of Fig. 10, the pitch (P) of the pleat at the radially inner portion of the bellows (Pi), is less than the pitch at the radially outer portion (Po). In addition, the depth (D) of the pleat at the radially inner portion (Di) is less than the depth of the pleat at the radially outer portion (Do). This combination of having a reduced pleat pitch and depth at one side as opposed to the opposite side causes the bellows to expand in the more nearly arcuate manner described above upon inflation. By this configuration, an arcuately expanding bellows can be used to display pressure using an arcuate, graded gauge. This particular configuration for a bellows pressure indicating means has not, heretofore, been available.

Having detailed the specific elements comprising the pressurizing means 36 of the athletic shoe 20 of the present invention, it may also be instructive to describe the operation of the pressurization means following placement of the athletic
shoe 20 on the foot of the wearer. Following insertion of the foot into the shoe 20, the laces of the shoe 20 will be securely tied to determine a first level of comfort or fit for the wearer. Following securing of the laces, the pump is utilized to inflate the bladder means 52 as well as to bias the pressure sensing means 80 measuring the pressure within the bladder means 52. The means for indicating the sensed pressure 82 is referred to by the wearer in order to allow the wearer to inflate the bladder to a desired pressure level, which corresponds to the desired fit for the particular type of athletic activity in which the user is to engage. The means for indicating the sensed pressure 82 provides the visual reference allowing the user to readily select the particular comfort level, as well as the snugness of fit of the athletic shoe 20, to which the user has become accustomed for a particular athletic event. By this arrangement, following an initial trial and error period to determine the appropriate snugness and fit for the athletic shoe 20, the user will be able to rapidly place the shoe 20 on his or her foot and adjust the fit and snugness to the desired level.

The pressure sensing means 80 preferably entails inflating the arcuately expanding bellows 84, which, in turn, causes the indicator means 42 to traverse an arcuate path beneath a reference indicia, such as indicator marks 94, and the visually transparent lens, which allows the user to determine the pressure setting based on the positioning of the indicator as against the indicia. In the case where the indicia has some type of numeric display associated with various markings on the indicia, a numeric representation of the pressure and comfort or snugness
can be obtained. Thus, the user could refer to the pressure
indicating means to determine a numeric value for the pressure
of the air bladder contained within the shoe.

Having detailed above the exemplary preferred embodiment for
the configuration of the present invention, it will be
appreciated that alternative embodiments and configurations will
be readily apparent to those skilled in the art. Accordingly,
it is expected that the proper scope of the present invention
will not be measured against the specification and drawings, but
only by the proper interpretation of the appended claims.
WHAT IS CLAIMED IS:

1. An athletic shoe having a sole, an upper, and a tongue, wherein the athletic shoe comprises:
   bladder means for inflating and altering the fit of the athletic shoe, said bladder means being incorporated into the construction of the athletic shoe;
   pump means for inflating said bladder means;
   pressure sensing means for sensing the pressure within said bladder means; and
   indicator means for indicating the pressure sensed by said pressure sensing means.

2. The athletic shoe Claim 1, wherein said pressure sensing means and said bladder means are in continuous open pneumatic interconnection.

3. The athletic shoe of Claim 1, wherein said pressure sensing means comprises an arcuately expanding bellows.

4. The athletic shoe of Claim 1, wherein said pump means comprises a bulb pump having a one way air inlet valve and a one way air outlet valve and an associated pressure relief valve in pneumatic communication with said bellows and said air bladder means.
5. The athletic shoe of Claim 4, wherein said bladder means further comprises first and second elements configured from an air-impenetrable elastomeric material, said first and second elements being cut to a desired pattern and affixed to one another at about their peripheral edges.

6. The athletic shoe of Claim 5, wherein said bladder means, said pump means, said pressure sensing means, and said means for indicating sensed pressure are all disposed within said tongue of the athletic shoe.

7. The athletic shoe of Claim 3, wherein said means for indicating the pressure sensed by the pressure sensing means comprises:
   an indicator means for displaying the sensed pressure, said indicator means being associated with, and moveable in response to, inflation of said bellows;
   encasing means for encasing said bellows and said indicator means; and
   a lens incorporated in said encasing means, said lens allowing the relative position of said indicator means to be visually observed.

8. The athletic shoe according to Claim 3, further comprising:
   resilient biasing means for causing deflation of said bellows upon release of pressurized air from said bladder means.
9. The athletic shoe according to Claim 8, wherein said resilient biasing means comprises a spring affixed to the athletic shoe so as to exert a biasing force against said indicator means.

10. The athletic shoe according to Claim 1, wherein said pump means, said pressure sensing means, and said means for indicating sensed pressure are all disposed beneath and encased by a cover of molded elastomeric material.

11. The athletic shoe according to Claim 7, wherein said encasing means comprises a main housing element defining a lower portion of a toroidal chamber and a cover element defining an upper portion of said toroidal chamber, whereby said main housing element and said cover element are assembled to define therebetween a partial toroidal chamber enclosing said bellows and said indicator means.

12. The athletic shoe according to Claim 3, wherein said arcuately expanding bellows further comprises:

a pleated element of flexible material having a plurality of radial pleats, each of said pleats being defined by a pleat pitch and pleat depth, and wherein said pleat pitch and said pleat depth varies circumferentially from a first pitch and pleat depth along one edge of said bellows to a larger pitch and pleat depth at an opposite circumferential edge of said bellows, whereby said bellows tends to expand in an arcuate manner upon application of a pressurizing force to the internal portion of said bellows.
13. The athletic shoe according to Claim 10, wherein said cover further comprises a graduated indicia associated with and proximate to said lens, whereby the position of said indicator means is referenced against said indicia to determine the inflation pressure of said bladder and said bellows.

14. The athletic shoe according to Claim 12, wherein said bladder means, said pressure sensing means, said pump means, and said means for indicating said sensed pressure are located proximate an upper portion of the tongue of the athletic shoe.

15. An improved athletic shoe of the type that includes an inflatable bladder disposed between an outer wall or sole of the shoe and the wearer's foot to provide enhanced fit and comfort of the shoe, wherein the improvement comprises: means disposed on said shoe for indicating the inflation pressure within the bladder.

16. The improved athletic shoe of Claim 15, wherein said means for indicating the inflation pressure in the bladder comprises:

pressure sensing means for sensing the pressure within the bladder and for producing an output proportional to said sensed pressure; and

indicator means for indicating the pressure sensed by said pressure sensing means.
17. The improved athletic shoe of Claim 16, wherein said pressure sensing means comprises an arcuately expanding bellows.

18. The improved athletic shoe of Claim 16, wherein said means for indicating the pressure sensed by said pressure sensing means comprises:

   an indicator means for displaying the sensed pressure, said indicator means being displaceable in response to said proportional output of said pressure sensing means;

   encasing means for encasing said pressure sensing means and said indicator means; and

   a lens incorporated in said encasing means, said lens allowing the relative position of said indicator means to be visually observed.

19. The improved athletic shoe according to Claim 18, wherein said pressure sensing means comprises:

   an arcuately expanding bellows formed from a cylindrical pleated element of flexible material having a plurality of pleats, each of said pleats being defined by a pitch angle and pleat depth, and wherein said pitch angle and pleat depth varies from a first pitch and pleat depth along one edge of said bellows to a larger pitch and pleat depth at an opposite circumferential edge of said bellows, whereby said bellows tends to expand in an arcuate manner upon application of a pressurizing force to the internal portion of said bellows.
20. An athletic shoe having a sole, an upper, and a tongue, wherein the athletic shoe further comprises:

a bladder incorporated into the construction of the athletic shoe and configured to inflate and alter the fit of the athletic shoe;

a pump incorporated into the construction of the athletic shoe to inflate said bladder;

a pressure sensing inflatable bellows for sensing the pressure within said bladder, said bellows and said bladder being interconnected in continuous open pneumatic interconnection; and

a pressure indicator for displaying the inflation pressure of said bellows and said bladder, said pressure indicator including a member moveable in response to inflation of said bellows, a housing for encasing said bellows and said member, and a lens incorporated in said housing, said lens allowing the relative position of said member in said housing to be visually observed.
21. A pneumatic pressure indicator comprising:
   an inflatable pleated bellows of flexible material having
   a plurality of pleats, each of said pleats being defined by a
   pleat pitch and a pleat depth, and wherein said pleat pitch and
   said pleat depth varies circumferentially from a first pitch and
   pleat depth along one edge of said bellows to a larger pitch and
   pleat depth at an opposite circumferential edge of said bellows,
   whereby said bellows tends to expand in an arcuate manner upon
   application of a pressurizing force to the interior of said
   bellows;
   encasing means for encasing said bellows, said encasing
   means defining a partial toroidal chamber; and
   a graduated indicia of pressure associated with said
   encasing means, whereby the inflation of said bellows is compared
   to said indicia to determine the inflation pressure of said
   bellows.

22. The pneumatic pressure indicator of Claim 21, further
   comprising:
   an indicator pivotally disposed in contact with said bellows
   within said toroidal chamber and pinioned to move concentrically
   therein in response to an expansive urging by said bellows; and
   spring means disposed in said housing means for urging said
   indicator in a direction opposite to that urged by said expanding
   bellows.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : A43B 23/26
US CL : 36/54, 71, 29

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 36/28, 88, 3B, 93

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X,&amp;</td>
<td>WO, A, 9,118,527 (REEBOK) 12 December 1991, see page 28.</td>
<td>1,2,10,15,16</td>
</tr>
<tr>
<td>X</td>
<td>EP, A, 0,472,110 (CASIO) 14 August 1991.</td>
<td>1,2,10,15,16</td>
</tr>
<tr>
<td>X,&amp;,E</td>
<td>US, A, 5,113,599 (COHEN) 19 May 1992.</td>
<td>1,2,10,15,16</td>
</tr>
<tr>
<td>A</td>
<td>US, A, 5,074,765 (PEKAR) 24 December 1991.</td>
<td>1,2,10,15,16</td>
</tr>
<tr>
<td>A</td>
<td>DT, A, 2,845,824 (NORDICA) 03 May 1979.</td>
<td></td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

- "A": document defining the general state of the art which is not considered to be part of particular relevance
- "E": earlier document published on or after the international filing date
- "L": document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O": document referring to an oral disclosure, use, exhibition or other means
- "P": document published prior to the international filing date but later than the priority date claimed
- "S": later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X": document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y": document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "A": document member of the same patent family

Date of the actual completion of the international search: 06 AUGUST 1992

Date of mailing of the international search report: 28 SEP 1992

Authorized officer: ROBERT H. SPITZER

Telephone No.: (703) 308-3794

Form PCT/ISA/210 (second sheet)(July 1992)
### Box I Observations where certain claims were found unsearable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2.☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2.☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3.☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4.☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant’s protest.

☐ No protest accompanied the payment of additional search fees.