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(54) Title: SOLE

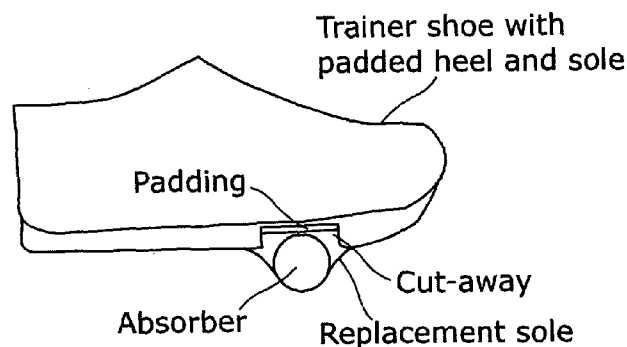


Figure 1

(57) Abstract: A sole for an item of footwear comprising: • a front portion; • a heel portion; and • an energy absorbing member positioned within the front portion, and having a first position in which the energy absorbing member protrudes from the sole, and a second position in which the energy absorbing member is substantially level with a surface of the sole.

SOLE

This invention relates to a sole for an item of footwear such as a boot or a shoe, and particularly, but not exclusively, to a sole for a running shoe. The invention also relates to
5 a shoe comprising such a sole.

Recent research has indicated that there is a fundamental requirement for mechanical energy to be absorbed during the first half of a runner's stance. This is why, whilst
10 landing with the foot in front of the body appears energetically wasteful as it slows the body down, it is essential in that it allows time after the foot has passed under the body in which to perform the positive work. Without this time element, the instantaneous power demanded from the muscle would be very high, requiring excess and metabolically wasteful activation of a large volume of muscle. The absorption of mechanical energy thus allows time for the positive work required to re-accelerate the body upwards during
15 the second half of the running stance.

The energy absorption is predominately provided by muscle in the runner. This energy is very different from the "impact" or "shock" energies of heel strike, which typically have high frequency components, and may be dissipated by fatty tissues such as those found
20 in a runner's heel pads or man-made trainer heels.

There are various different styles of running that different runners adopt. People who are used to running in shoes often use a "heel strike". This means that during running, it is the heel of the front foot that strikes the ground first.
25

On the other hand, people who habitually run barefoot tend to have a forefoot strike. In such a running style, a forward portion of the foot such as the ball of the foot tends to strike the ground first. It is not clear whether any particular style is better than another style. However, it can be challenging and/or painful as well as unappealing for a runner
30 to attempt to change his or her running style from a heel strike style to a forefoot strike style, for example.

It is thought that heel strike running is preferred by many runners due to the current design of running shoes such as trainers. These shoes tend to have good heel
35 protection. The resulting stance in which the heel strikes the ground first may be viewed as a running form of the normal walking heel-sole-toe stance.

Absorption of energy and opposition of force by muscle is metabolically costly, and can induce or exacerbate muscle soreness and injury including "shin splints".

According to the invention there is provided a sole for an item of footwear comprising:

- 5 a front portion;
 a heel portion; and
 an energy absorbing member positioned within the front portion, and having a first
position in which the energy absorbing member protrudes from the sole, and a second
10 position in which the energy absorbing member is substantially level with a surface of the
sole.

The energy absorbing member may be a mechanical energy absorbing member. The energy absorbing member is particularly suitable for absorbing mechanical energy during the first half of the runner's stance.

- 15
Embodiments of the invention thus comprise a passive mechanical device adapted to absorb a significant proportion of the energy to be absorbed and to reduce the forces on eccentrically loaded (dissipating) muscles such as the tibialis anterior which is associated with shin splints. Such a passive mechanical device can be lightweight.

- 20
Embodiments of the present invention reduce the demand for energy absorption by muscles of the runner, especially by reducing the loading on the shin muscles (including the tibialis anterior). In addition, by means of the present invention energy may be absorbed more rapidly. This may have potential benefits to the running style of a runner.

- 25
The heel portion of the sole will be that part of the sole that will support the heel of a person wearing a shoe into which the sole is incorporated. In use, the heel portion of the sole may be regarded as any portion of the sole behind the ankle when a wearer of the footwear item is in a standing position.

- 30
The front portion of the sole is any area other than the heel portion.

- The sole may define a substantially flat surface in which case there will be no definite division between the front portion and the heel portion of the sole which portions will
35 merge into one another.

In other embodiments of the invention, the heel portion may be distinct from the front portion.

5 In embodiments of the invention, the energy absorbing member may be positioned to be under the ball of the foot of a wearer of the item of footwear.

The energy absorbing member may protrude from the sole by between 10 and 40mm when in the first position.

10 In embodiments of the invention, when the energy absorbing member moves to the second position, it deflects by the same distance by which it protruded from the sole in the first position.

15 In embodiments of the invention, there may be no further deflection of the energy absorbing member after it has become substantially level with a surface of the sole.

In embodiments of the invention, the force required to achieve full deflection of the energy absorbing member may be in the range of 50% to 150% of the body weight of a wearer of an item of footwear incorporating the sole. In one embodiment of the
20 invention, the force required for full deflection is approximately 100% of the body weight of a person wearing the item of footwear. In other embodiments of the invention, the force required may be less than 50% or greater than 150% of the body weight of a wearer of the item of footwear.

25 In embodiments of the invention, the energy absorbing member is provided at least partially in a recess in the sole.

The recess may be shaped to receive the energy absorbing member, and to accommodate any change in shape of the absorbing member occurring between the first
30 position and the second position.

The recess may be formed by cutting into the sole.

The recess may comprise padding. The padding may be positioned over an inner
35 surface of the recess. The purpose of the padding is to spread the force exerted on a wearer of the item of footwear, thereby reducing the pressure applied between the absorbing member and the foot of the wearer.

In embodiments of the invention, the padding may maintain a plastic deformation, allowing the absorbing member to be consistently sited under the ball of the foot of a wearer. The plastic deformation may be slight.

5

The sole may comprise an outer layer extending over the energy absorbing member.

The outer layer is adapted to hold the energy absorbing member in place, and in embodiments of the invention comprising a recess in the sole, the outer layer is adapted to hold the absorbing member within the recess. In such embodiments, the outer layer is adapted to extend at least partially over the sole to thereby cover the recess.

10

The outer layer may be formed from an elastic or resilient material.

15

In such embodiments, the outer layer provides protection to the energy absorbing member, and prevents dirt and other foreign bodies from entering the recess. In addition, due to the elastic/resilient nature of the outer layer, the outer layer is adapted to hold the energy absorbing member in place whilst still allowing the energy absorbing member to move between the first and second positions.

20

The energy absorbing member may be elastic or resilient. The energy absorbing member may comprise a ball. The ball may be any suitable ball. In some embodiments, the ball may comprise a squash ball.

25

In other embodiments of the invention the energy absorbing member may be of a different shape, for example cylindrical, cubic, or donut shaped, for example.

In some embodiments of the invention, the energy absorbing member may be formed integrally with the sole. In such embodiments a region, or the entire sole may comprise the energy absorbing member.

30

In an embodiment of the invention, the energy absorbing member is made from rubber, or a rubber-like material. In other embodiments of the invention, the energy absorbing member may be made from a sponge-like material or a foam material.

35

In embodiments of the invention in which the energy absorbing member comprises a ball such as a squash ball, the recess will be shaped to allow for an increase in the cross-

sectional area of the squash ball when in the second position in which the ball is deflected to assume a position in which it is substantially level with the sole of the shoe. This means that the recess will have a greater cross-sectional area than the ball when the ball is in the first position in which it is undeflected.

5

In some embodiments of the invention the sole comprises a single energy absorbing member only. Such an arrangement is likely to be suitable for smaller sized footwear such as footwear for children or women.

10 In other embodiments of the invention the sole comprises a plurality, of energy absorbing members. In a specific embodiment, the sole comprises two energy absorbing members. Such an arrangement is particularly suitable for larger sized footwear such as footwear for use by men.

15 According to a second aspect of the present invention there is provided an item of footwear comprising a sole having:

a front portion;

a heel portion; and

20 a energy absorbing member positioned within the front portion, and having a first position in which the energy absorbing member protrudes from the sole, and a second position in which the energy absorbing member is substantially level with a surface of the sole.

The optional features set out above with respect to the first aspect of the invention also
25 apply to the second aspect of the invention too.

In an embodiment of the second aspect of the invention, the item of footwear may comprise a running shoe. The running shoe may have a substantially flat sole. In such an embodiment there will be no clear demarcation between the front portion and the heel
30 portion of the sole.

In embodiments of the invention where the item of footwear comprises a larger shoe having two energy absorbing members, the shoe may be adapted for use by an 80kg man. In such an embodiment each of the energy absorbing members may comprise a
35 ball, such as a squash ball. Each squash ball is adapted to deflect 15 to 20mm into the second position under a load of 1000N, absorbing approximately 4 Joules and returning approximately 0.4J (that is 10% elasticity, or 90% hysteresis dissipation).

Embodiments of the invention comprise a sole for an item of footwear, or an item of footwear incorporating a sole, the sole comprising an energy absorbing member positioned such that in use the energy absorbing member is positioned under the ball of the foot of a wearer. The energy absorbing member is adapted to deflect from between 10 to 40mm when the item of footwear hits the ground during a running movement of the wearer. The force for full deflection may be approximately 100% of the body weight of the wearer of the item of footwear. No further deflection of the energy absorbing member occurs after it has become substantially level with a surface of the sole of the item of footwear.

The invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic representation of an item of footwear according to an embodiment of the invention;

Figures 2 to 4 are schematic representations showing the energy absorbing member of Figure 1 moving from a first position to a second position and back to the first position;

Figure 5 is a schematic representation of a second embodiment of the invention showing two recesses adapted each to hold a energy absorbing member;

Figure 6 is a schematic representation of a third embodiment of the invention having a single recess adapted to hold a single energy absorbing member; and

Figures 7 and 8 are representations of further embodiments of the invention showing footwear comprising an outer layer extending partially over the sole in order to cover the energy absorbing member;

Referring first to Figure 1, an item of footwear according to an embodiment of the invention is designated generally by the reference numeral 2. The item of footwear is in this example a running shoe and comprises a sole 4 according to an embodiment of the first aspect of the invention. The sole 4 in this example has a substantially flat surface, although in other embodiments, there may be a recess. In this embodiment the sole comprises a heel portion 6 and a front portion 8 which are not distinct from one another.

In embodiments of the invention where the sole comprises a recess, the recess may serve to separate the heel portion 6 from the front portion 8.

5 The shoe 2 further comprises a energy absorbing member 10 which in this embodiment comprises a ball 12. The ball comprises a squash ball, although other balls may also be suitable.

The sole 4 comprises a recess 14 shaped to receive the ball 12. The recess is formed by cutting into the sole but leaving the inner sole 16 of the shoe intact.

10

The recess comprises a layer of padding 18 positioned between the ball 12 and the inner sole 16. The padding provides cushioning and cushions the force exerted on the shoe by the ball 12. The ball has a first position as shown in Figure 1 in which it protrudes beyond the sole 4. The presence of the ball 12 serves to absorb energy and to oppose
15 forces created during running. The invention thus reduces the demand for energy absorption by muscles, especially by reducing the load on the shin muscles (including tibialis anterior).

20 The ball 12, in use, acts under the ball of a foot of a wearer of the shoe 2. In this embodiment the ball will protrude 15 to 30mm beyond the sole 4 and will therefore deflect by this amount when the foot of a runner wearing the shoe strikes the ground.

Referring now to Figures 2 to 4, the deflection of the energy absorber 10 is shown in more detail.

25

In Figure 2 a user of the shoe 2 is using a heel strike stance, and the heel portion 6 of the shoe 2 has hit the ground. At this point, the absorber 10 is in the first position and protrudes from the sole 4 and is in an undeflected state.

30 As the runner continues with his running stance, the runner puts his whole foot down onto the ground and the absorber assumes the second position in which the absorber has been deflected and compressed so that it does not now protrude beyond the sole.

In this position, the ball will have a greater cross-sectional area than when it is in the first
35 position due to the compression, and the recess 14 is shaped to accommodate this increase in cross-sectional area. Because of the resilient nature of the absorber, when the runner continues to begin to lift his foot off the ground, the absorber returns to its

original undeflected state and returns to the first position. In so doing, the ball 12 returns energy to the runner by applying force to the ground during unloading. This action protects biological tissues including shin muscles, during loading by moving the centre of pressure forwards. It also and has the ability to allow more rapid energy absorption than is favoured by muscles because the energy can be absorbed by the energy absorbing member over a short duration, i.e., with a high negative power. To achieve this high rate of energy absorption by muscle would require very large muscle forces. This is undesirable in terms of economy and potential damage.

Turning now to Figure 5 a second embodiment of the invention is shown. Corresponding parts have been given corresponding reference numbers for ease of understanding. In this embodiment, the sole 4 comprises two recesses 14 each of which is adapted to hold an energy absorber 10 in the form of a ball 12. This embodiment is particularly designed for larger shoe sizes 20.

15

Turning now to Figure 6 third embodiment of the invention is shown comprising two smaller sized shoes 21, 22. In this embodiment the sole 4 comprises a single recess 14 adapted to accommodate a single absorber in the form of a ball 12.

Figure 6 also shows how the recess 14 may be formed. The recess is formed initially by cutting-out a portion of the sole by drilling into the sole, for example. The cut-out is formed in a front portion of the sole in the area that is adapted to support the ball of the foot during use. In this case the cut-out 24 is substantially circular in shape. The dimensions of the cut-out are such that when the absorber 10 is positioned in the recess, the recess is large enough to accommodate the change in shape of the absorber 10 when it is in its deflected/compressed state.

The cut out extends to the inner sole 26 of the shoe and leaves the inner sole 26 intact.

In the examples shown, the shoe has a diameter of approximately 5cm and a depth of approximately 15mm.

A layer of padding 18 may then be positioned within the recess covering the exposed portion of the inner sole. The padding 18 is shaped to fit snugly within the recess 14. The padding 18 is shown in position in the shoe 21 in Figure 6.

The padding may be formed from any suitable material, and in this embodiment the padding has been formed from rubber from a mouse mat and is a few millimetres thick. The padding should be sufficiently stiff to aid the inner sole in spreading the load applied by the energy absorbing member on the foot. It should also deflect a little plastically,
5 providing a seating for the energy absorbing member. High density foams including plastic foams may be appropriate.

Turning now to Figure 7, another embodiment of the invention is shown. In this embodiment the shoe 30 comprises an outer layer 32 adapted to extend at least partially
10 across the sole 4 in order to cover the absorber 10 and recess 14. The outer layer 32 is particularly useful for retaining the absorber in place and for preventing dirt etc. from entering the recess.

Turning now to Figure 8, two further shoes 40, 42 are shown, each comprising an outer
15 layer 32. The shoe 40 is a smaller size shoe and has a single recess 14 and a single absorber 10 only. Shoe 42 is a larger size shoe having two recesses 14 and two absorbers 10 respectively.

In the embodiments illustrated, the shoe comprises a conventional running shoe in the
20 form of a trainer having a padded heel and sole.

The absorbers shown in the illustrated embodiments comprise squash balls. Any type of squash ball may be used, but in the illustrated embodiments the squash balls are Dunlop Progress. These balls have a 42mm diameter in the spherical (uncompressed) state.
25 When compressed in position two as shown in Figure 3, most of the lateral deflection is accommodated within the recess which has a greater diameter than the diameter of the ball in its uncompressed state.

The outer layer is designed to cover the absorber/s and the recess/s and to hold the
30 absorbers in place and prevents the gap between the recess side and the uncompressed ball from being filled with mud/stones/dirt etc. The outer layer is also the major element retaining the absorbers in position. The outer layer should allow deflection and return of the absorbers. Any suitable material may be used, but in the embodiments shown the material is obtained from motorcycle inner tubes was cut to size in order that the outer
35 layer extends across the width of the sole.

The absorber may be adhesively attached to the padding which in turn may be adhesively attached to the inner sole of the shoe. Any suitable adhesive may be used such as carpet glue.

- 5 The energy absorbing member forming part of the sole according to the present invention acts under the ball of the foot of a runner during use.

CLAIMS

1. A sole for an item of footwear comprising:
a front portion;
5 a heel portion; and
a energy absorbing member positioned within the front portion, and having a first position in which the energy absorbing member protrudes from the sole, and a second position in which the energy absorbing member is substantially level with a surface of the sole.
10
2. A sole according to claim 1 wherein the surface of the sole defines a substantially flat surface.
3. A sole according to claim 1 or claim 2 wherein the energy absorbing member
15 protrudes between 10 and 40 mm from the sole in the first position.
4. A sole according to any one of the preceding claims wherein the force required for full deflection of the absorbing member is within the range 50% to 150% of the body weight of a person wearing the footwear.
20
5. A sole according to any one of the preceding claims wherein the energy absorbing member is provided at least partially in a recess in the sole.
6. A sole according to any one of the preceding claims wherein the recess
25 comprises padding.
7. A sole according to any one of the preceding claims further comprising an outer layer extending over the energy absorbing member.
- 30 8. A sole according to claim 7 wherein the outer layer extends at least partially over the sole.
9. A sole according to claim 7 or claim 8 wherein the cover is elastic or resilient.
- 35 10. A sole according to any one of the preceding claims wherein the energy absorbing member is elastic or resilient.

11. A sole according to any one of the preceding claims wherein the energy absorbing member comprises a ball.

12. A sole according to any one of the preceding claims comprising a plurality of
5 energy absorbing members.

13. An item of footwear comprising a sole according to any one of the preceding claims.

10 14. A sole substantially as hereinbefore described with reference to the accompanying drawings.

15. An item of footwear substantially as herein before described with reference to the accompanying drawings.

15

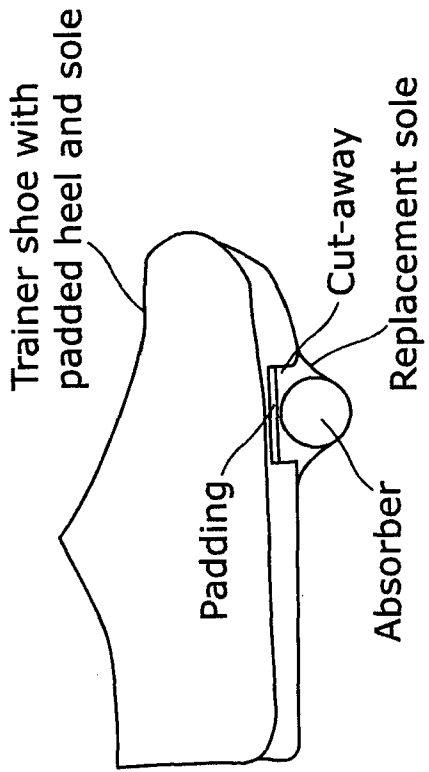


Figure 1

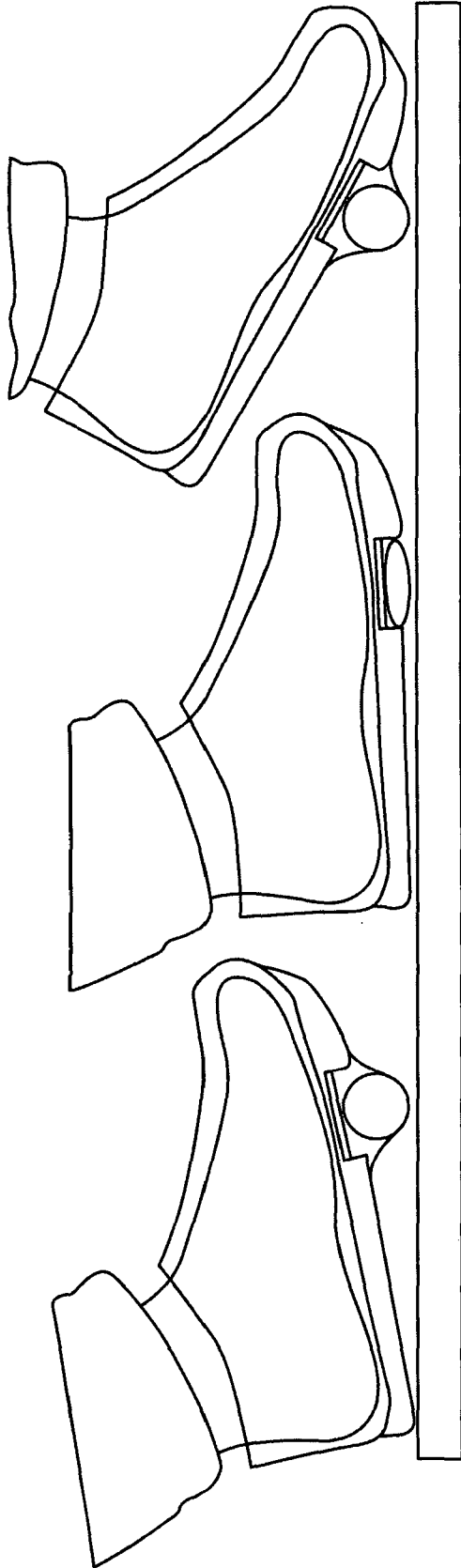


Figure 2

Figure 3

Figure 4

2/3

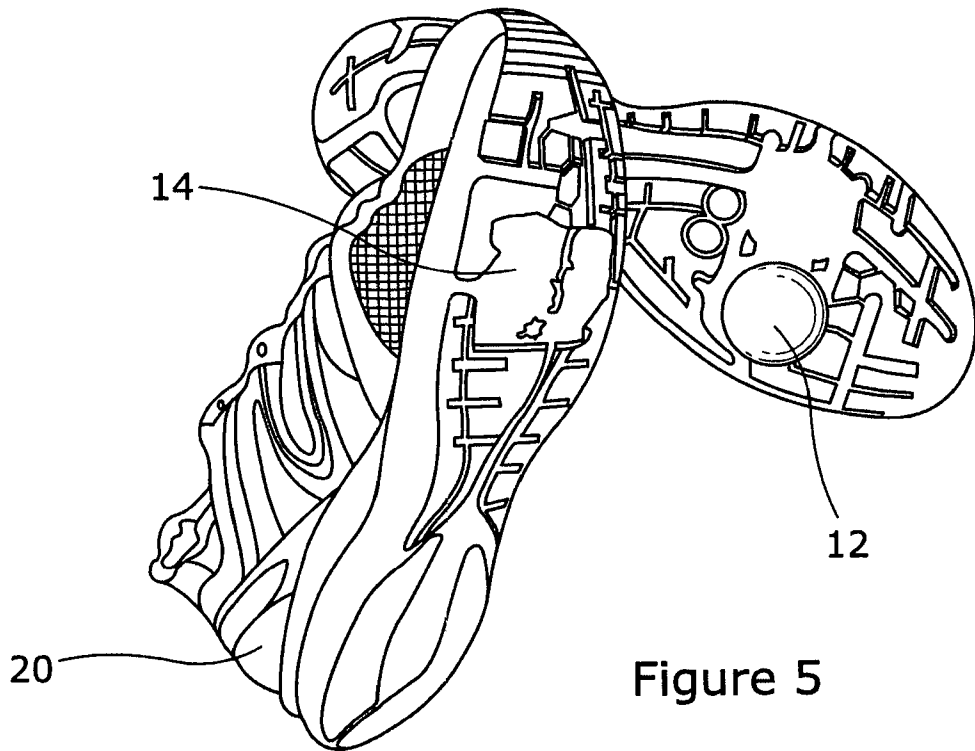


Figure 5

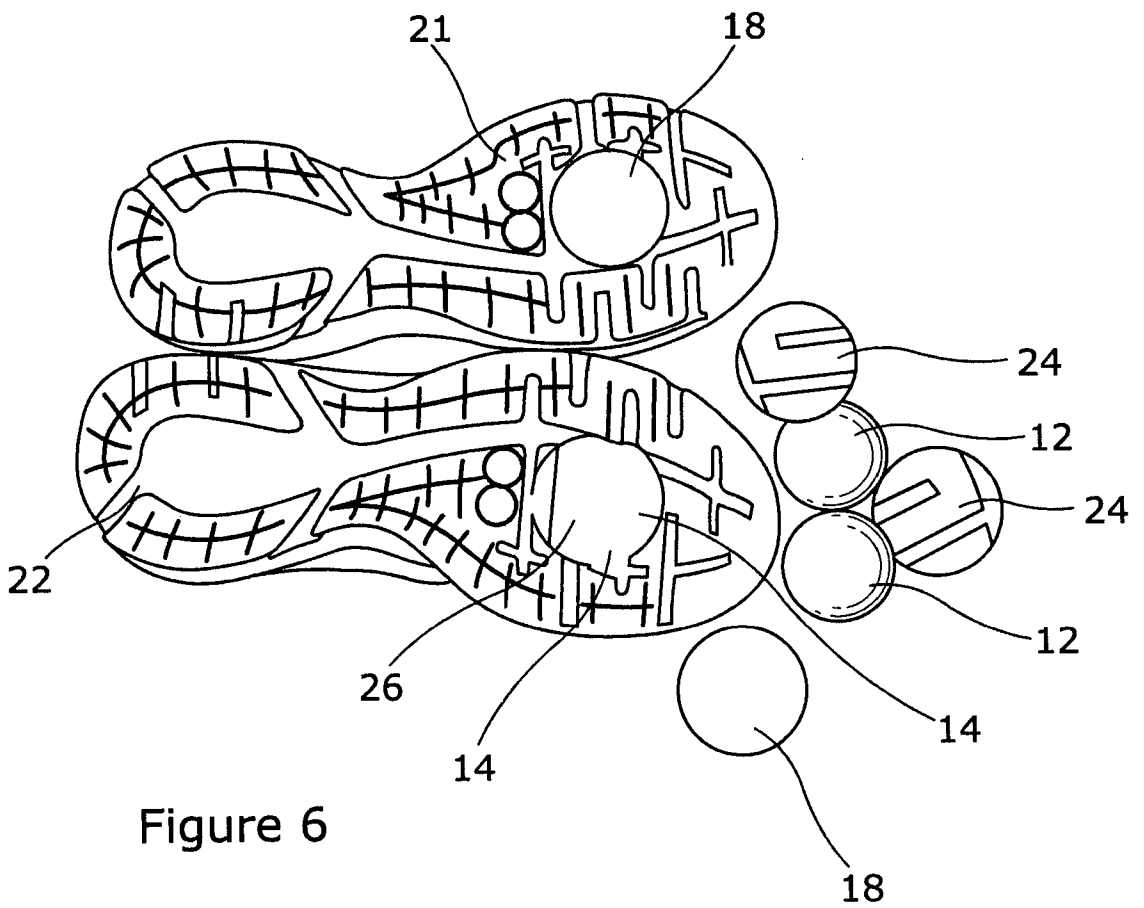


Figure 6

3/3

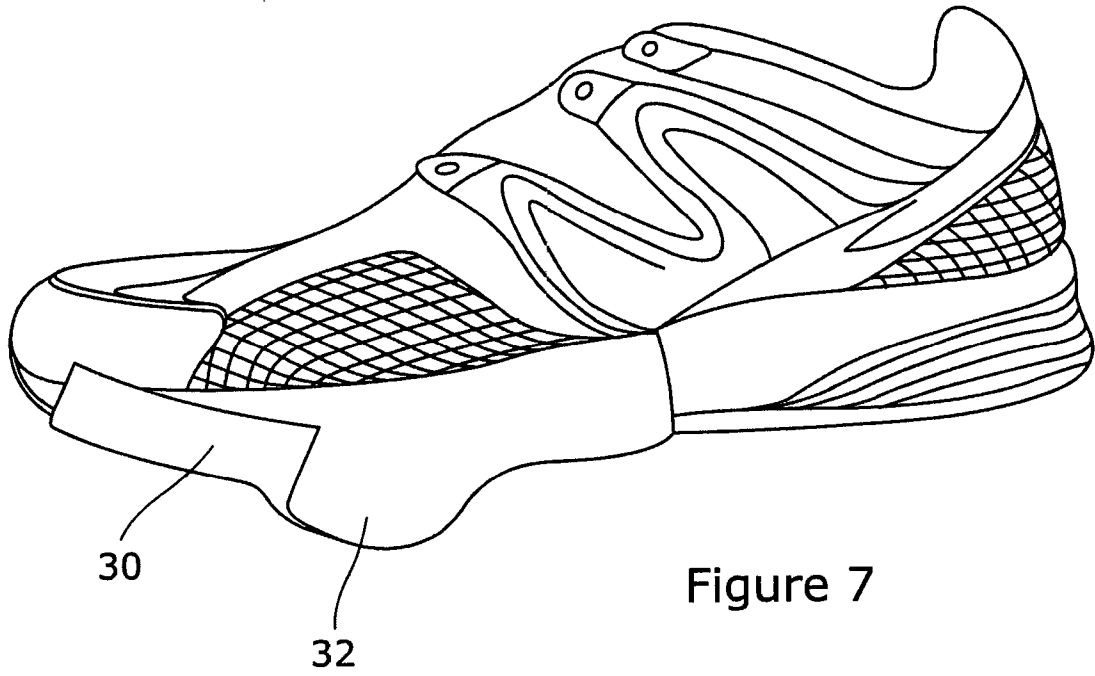


Figure 7

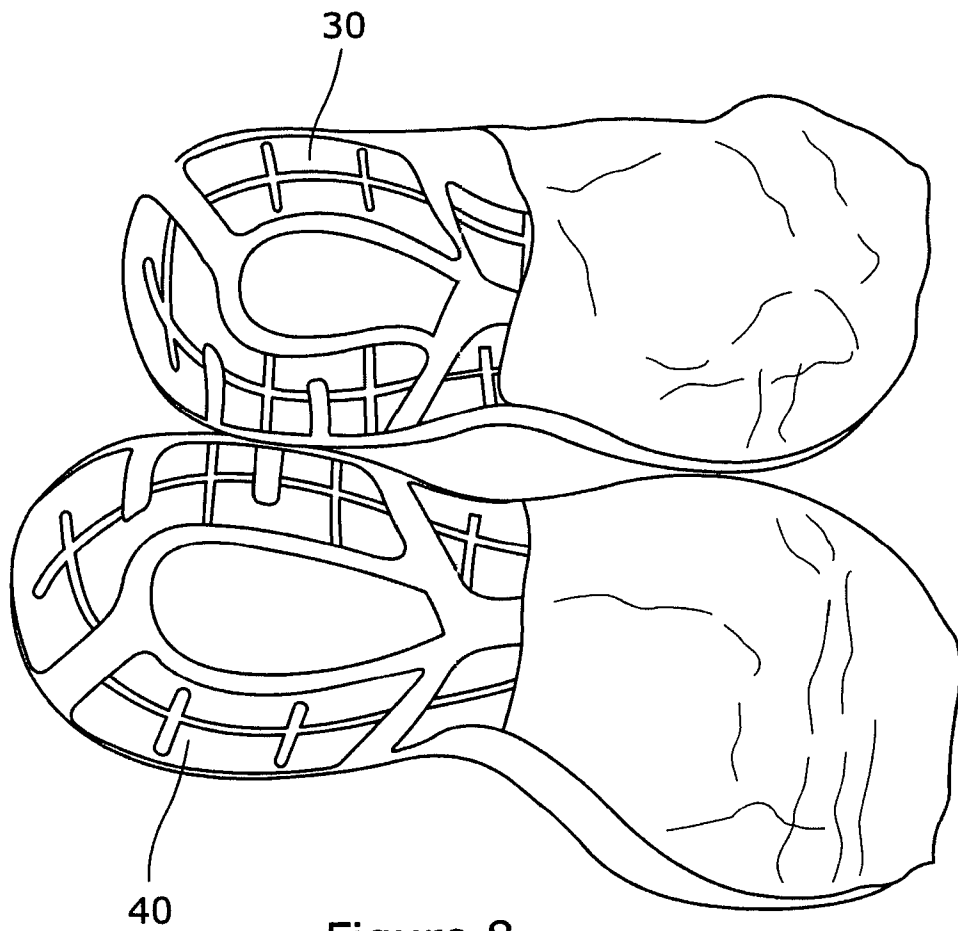


Figure 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2015/051462

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A43B13/18 A43B5/06
 ADD. A43B7/14

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)
 A43B A63B

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)
 EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/126422 A1 (VATTES ET AL.) 2 June 2011 (2011-06-02) the whole document	1-13
X	US 2007/277401 A1 (YOUNG-CHUL) 6 December 2007 (2007-12-06) paragraphs [0036] - [0052]; figures 3-9	1-10,12, 13
X	JP 2001 340104 A (FUJIOKA MITSURU) 11 December 2001 (2001-12-11) abstract; figures 1-4	1-6,10, 12,13
X	FR 873 618 A (LACOSTE) 15 July 1942 (1942-07-15) the whole document	1-5,10, 12,13
X	WO 2010/062039 A2 (OH) 3 June 2010 (2010-06-03) abstract; figures 1-8	1-5,10, 12,13

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 of particular relevance

"E" earlier application or patent but 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

"T" 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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 August 2015	24/08/2015

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Williams, Mark
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2015/051462

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search 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.: 14, 15
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:
see FURTHER INFORMATION sheet PCT/ISA/210

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 No. III Observations where unity of invention is lacking (Continuation of item 3 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 fees, this Authority did not invite payment of additional fees.

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 and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 14, 15

Rule 6.2(a) PCT

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/GB2015/051462

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011126422 A1	02-06-2011	US 2011126422 A1	02-06-2011
		WO 2011068782 A1	09-06-2011

US 2007277401 A1	06-12-2007	CN 1871965 A	06-12-2006
		DE 102006025990 A1	14-12-2006
		JP 4353959 B2	28-10-2009
		JP 2006334400 A	14-12-2006
		KR 20060125989 A	07-12-2006
		US 2007277401 A1	06-12-2007

JP 2001340104 A	11-12-2001	NONE	

FR 873618 A	15-07-1942	NONE	

WO 2010062039 A2	03-06-2010	KR 100904042 B1	22-06-2009
		WO 2010062039 A2	03-06-2010
