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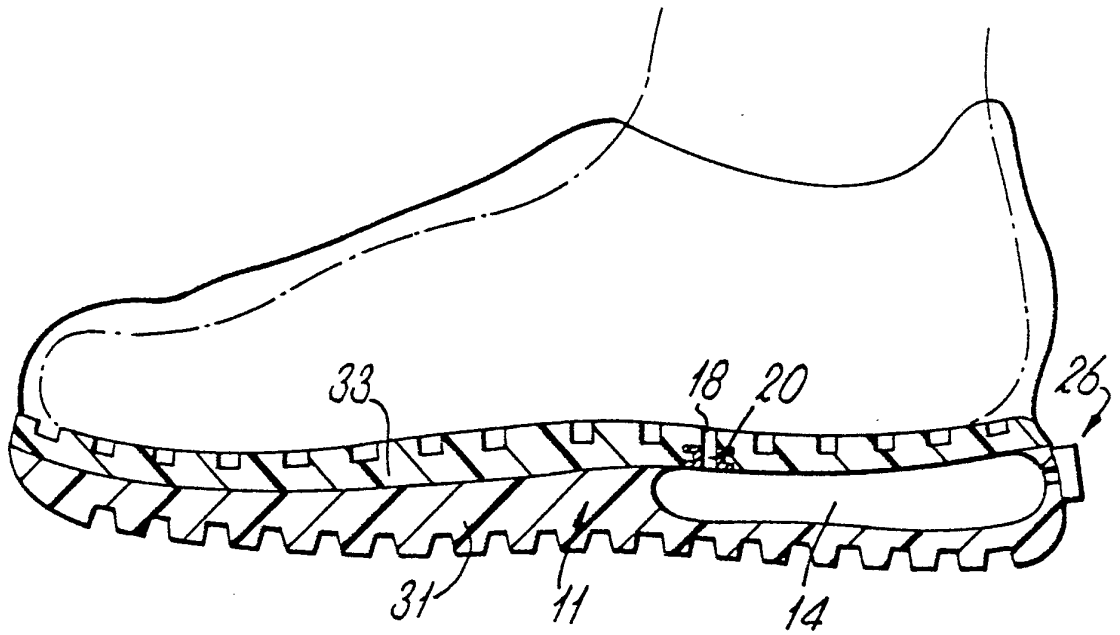
(54) Title: ARTICLE OF FOOTWEAR WITH VARIABLE CUSHIONING



(57) Abstract

Variable cushioning is provided by a sole of a shoe by incorporating in the heel a cavity (14) connected with the surrounding air by a throttle valve (26) which is adjustable by the user to provide a desired degree of cushioning. By connecting the cavity (14) via a check valve with openings exposed to the interior of the shoe, the pumping action of cavity (14) as the wearer of the shoe walks or runs, can be made to provide a circulation of ventilating air through the shoe around the wearer's foot.

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Title: "Article of Footwear with Variable Cushioning"

THIS INVENTION relates to an article of footwear, such as a running shoe, comprising a cushioned or resilient heel or sole and it is an object of the present invention to provide such an article of footwear in which the cushioning or resilience of the heel or sole is variable at will by the user.

According to the invention there is provided an article of footwear incorporating in the heel and/or sole thereof at least one cavity connected via a variable throttling valve with the surrounding air whereby said cavity can act as an air cushion, the resilience, and/or damping capacity of which may be adjusted by adjustment of said variable throttling valve.

Preferably, the article of footwear includes at least one inlet check valve connecting said cavity with the surrounding air, whereby air can be drawn into said cavity by the resilience of the material of the sole or heel when the latter is relieved of the weight of the wearer.

Embodiments of the invention are described below by way of example, with reference to the accompanying drawings in which:-

FIGURE 1 is a highly schematic sectional view of a running shoe embodying the invention;

FIGURE 2 is a view in vertical section showing a preferred embodiment;

FIGURE 3 is a horizontal section view, looking upwardly, of a lower sole part of the shoe of Figure 2;

FIGURE 4 is a rear view, with phantom sectioning, of the shoe of Figures 2 and 3, and

FIGURE 5 is a plan view of the inner layer of the sole of the shoe of Figures 2 to 4.

Referring to the drawings, a running shoe incorporates a heel and sole assembly 10 of resilient impermeable material such as rubber or elastomeric plastics. The assembly 10 is provided internally with air cavities, indicated as a cavity 12 in the sole portion 11 located approximately below the ball of the foot of the wearer and a further cavity 14 in the heel of the shoe. The cavities 12 and 14 are connected by a conduit 16 within the heel and sole assembly whilst, in the arrangement shown, the cavity 12 is connected by way of a conduit 17 in the sole with an opening or openings 18 in the insole of the shoe. A one way valve (i.e. a check valve) 20 is disposed in the conduit 17 and is arranged to allow passage of air through the conduit 17 only towards the cavity 12. A conduit 22 connects the cavity 14 with an outlet or outlets 24, for example, formed on the exterior side or rear surface of the heel of the shoe. A variable restriction throttle valve 26 is disposed in the conduit 22 and a similar variable throttle valve 28 is disposed in the conduit 16. The valves 26 and 28 are adjustable as regards the restriction afforded thereby to the flow of air by means of manual control members (not shown) which may take the form, for example, of rotatable knobs on the side of the heel and sole assembly.

When the wearer of the shoe is walking or running, the cavities 12, 14 are alternately compressed (as the weight of the wearer is exerted thereon) and allowed to expand (as they are relieved of the weight of the wearer), and so the cavities 12, 14 operate as pumps. By virtue of the action of the one way valve 20, air cannot pass from the cavity 12 through conduit 17 when the sole of the shoe is compressed by the weight of the wearer, but can pass (depending upon the setting of the valve 28) through conduit 16 to the chamber 14. Depending upon the setting of the valve 26, air may pass from the chamber 14 through the conduit 22 to the outlet 24 when the cavity 12 and/or the cavity 14 is compressed. It will be appreciated that if the valves 26 and 28 are fully closed, the chambers 12 and 14 will act as resilient air springs with a relatively high spring rating, whereas if the

valves 26 and 28 are fully open, the chambers 12 and 14 will act as air springs of somewhat lower spring rating in conjunction with air dampers to provide a cushioning or shock-absorbing effect. At intermediate settings of the valves 26, 28, intermediate degrees of resilience and cushioning are obtained. If desired, the valve 28 may be omitted and the conduit 16 enlarged so that the chambers 12 and 14 and conduit 16 effectively form a single chamber extending throughout the heel and sole assembly.

On the other hand the cavities 12 and 14 may be completely sealed, apart from their interconnection via the conduit 16 and valve 28. In this arrangement, during normal walking the chambers 12 and 14 are compressed alternately and are relieved of pressure alternately so that with the valve 28 fully open, air from chamber 14 can pass relatively freely to the chamber 12 and conversely, providing, effectively, a low spring rate and a measure of damping, whereas with the valve 28 closed, the chambers 12 and 14 act effectively as independent air springs. At intermediate settings of the valve 28 corresponding intermediate values of effective spring rate and damping are achieved.

The conduit 22 may have a check valve (one-way valve) 30 therein, in series with the valve 26 and arranged to permit the flow of air only in the direction toward the outlet 24. Alternatively, the valve 30 may be in parallel with the valve 26. The cavity 14 may have associated therewith an independent inlet check valve 32 disposed in a conduit leading from an opening 34 (communicating with the surrounding air) to the cavity 14. When such an independent valve 32 is provided, the conduit 16 and valve 28 connecting the cavities 12 and 14 may be dispensed with so that the two cavities operate independently of one another. The opening 34 may be provided in the rear of the side surface of the heel of the shoe or may, alternatively, like the opening 18, be an opening provided in the insole of the shoe. Conversely, the opening(s) 18 to the conduit 17 may be provided, for example, on the underside of the sole or on the outer side surface of the edge of the sole rather than being provided in the insole.

It will be appreciated that where the one-way valves 20, 30 are provided there will in fact be, when the wearer of the shoe is walking or running, a continual net flow of air into the openings 18, through the

chamber 12, conduit 16, valve 28, chamber 14 and conduit 22 to the outlet(s) 24 whereby the interior of the shoe is continuously ventilated.

In practice, an adequate ventilation effect may be afforded using only the valve 20 associated with the inlet(s) and a restrictor valve 26 associated with the outlet(s) 24.

Referring to Figure 2, in which parts corresponding to parts in Figure 1 have the same reference numerals, the shoe shown has a single cavity 14 in the sole portion 11 which is connected through a check valve 20 with an opening 18 in an inner sole member 33 of the shoe and which is further vented to atmosphere through a variable restriction throttle valve 26 in the wall of the cavity 14 which provides the external rear surface of the heel of the shoe. As shown in Figure 4, the variable restriction throttle valve 26 is adjustable by means of a rotatable knob 28 projecting from the rear of the heel and which may, as illustrated, have an associated scale and indicator providing a visual indication of the setting of the valve. (The scale may, as shown, be calibrated in terms of the corresponding loading by the weight of the wearer or the desired spring force or the like).

Referring to Figure 2, the sole of the shoe is made in two parts, from a lower layer or part 31 and an upper or inner sole member 33, both formed of an appropriate elastomeric material such as rubber or resilient plastic and bonded together. The cavity 14 is defined by a recess in the upper side of the lower layer 31 which is closed off by the bonding of the member 33 to the upper surface of the lower layer 31.

As shown in Figure 5, the upper surface of the member 33 is formed with a pattern of interconnecting channels including a plurality of short channel sections 37 which extend to the outer lateral surface of the sole to provide air intakes exposed around the exterior of the shoe. The opening 18 from the valve 20 opens into a central one of these channels. The channels formed in the upper surface of member 33 may be exposed directly to the wearer's foot, or said upper surface may be covered by an insole (not shown) of porous sheet material. Accordingly, the alternate compression and decompression of the cavity 14 as the wearer walks and runs in the shoe, in addition to drawing air into the cavity 14 through valve 20 to replace that

lost through the valve 26 also produces a circulation of air from the interior, through the passages 37 and along the network of channels, towards the opening 18, thereby ventilating the feet of the wearer. It will be appreciated that, quite apart from the action of the cavity 14 and valve 20, there is a degree of compression and decompression of the upper layer 33 during walking so that air is to some extent expelled from the system of channels taken as a whole when the wearer's weight is placed on the sole and fresh air is correspondingly drawn in when such pressure is released, thereby further enhancing the ventilation effect.

CLAIMS

1. An article of footwear incorporating in the heel and/or sole thereof at least one cavity connected via a variable throttling valve with the surrounding air whereby said cavity can act as an air cushion, the resilience, and/or damping capacity of which may be adjusted by adjustment of said variable throttling valve.

2. An article of footwear according to claim 1, including at least one inlet check valve connecting said cavity with the surrounding air, whereby air can be drawn into said cavity by the resilience of the material of the sole or heel when the latter is relieved of the weight of the wearer.

3. An article of footwear according to claim 1 or claim 2, wherein said inlet check valve is connected with the surrounding air via one or more openings in the insole of the article of footwear, whereby the pumping action of the hollow sole or heel in conjunction with the check valve provides a circulation of atmospheric air into and through the space defined beneath the upper of the article of footwear.

4. An article of footwear incorporating in a heel/sole assembly thereof at least two cavities interconnected by a passage incorporating a variable throttling valve, whereby one said cavity can act as an air cushion whilst the other acts as an air reservoir, the resilience and/or damping capacity of said one cavity being variable by adjustment of said variable throttling valve.

Fig.1.

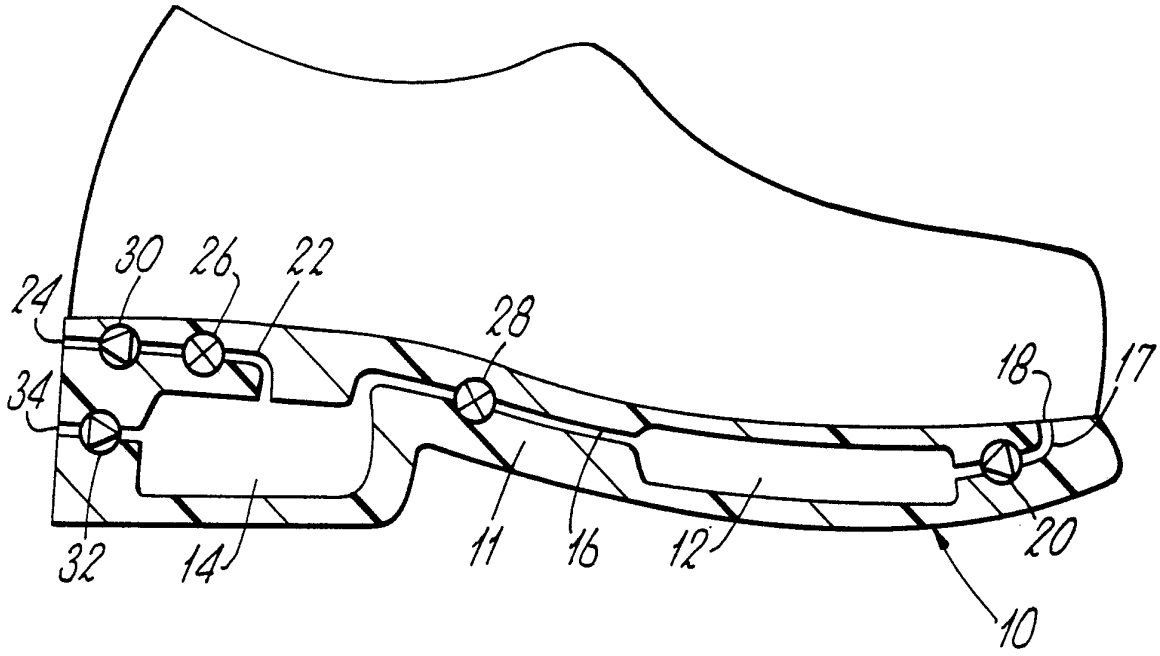


Fig.2.

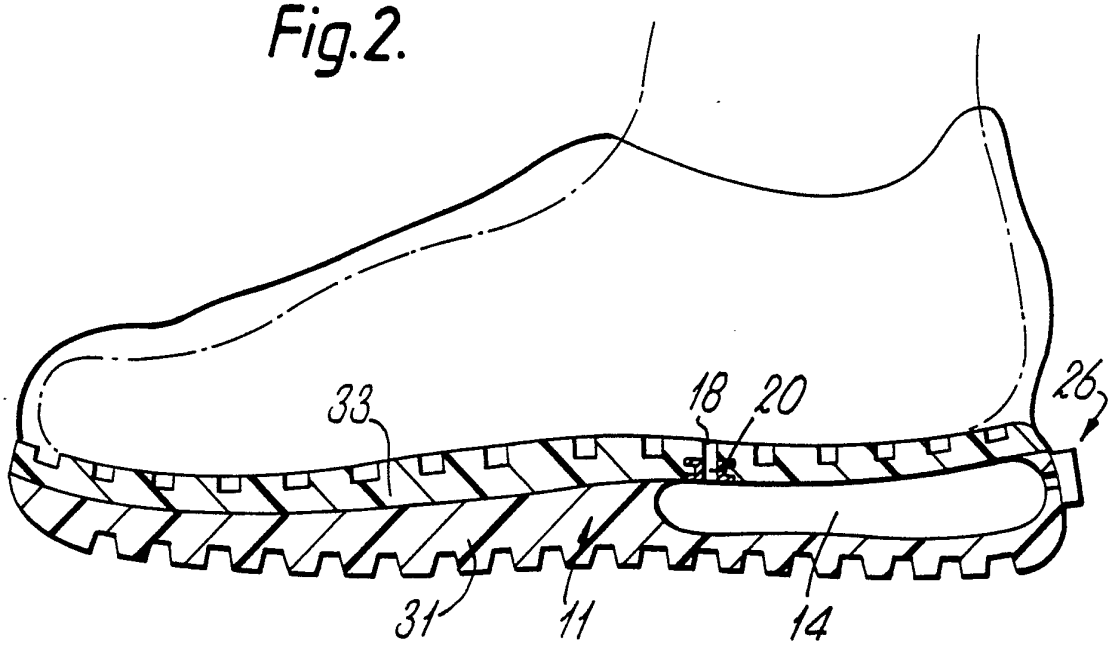


Fig.3.

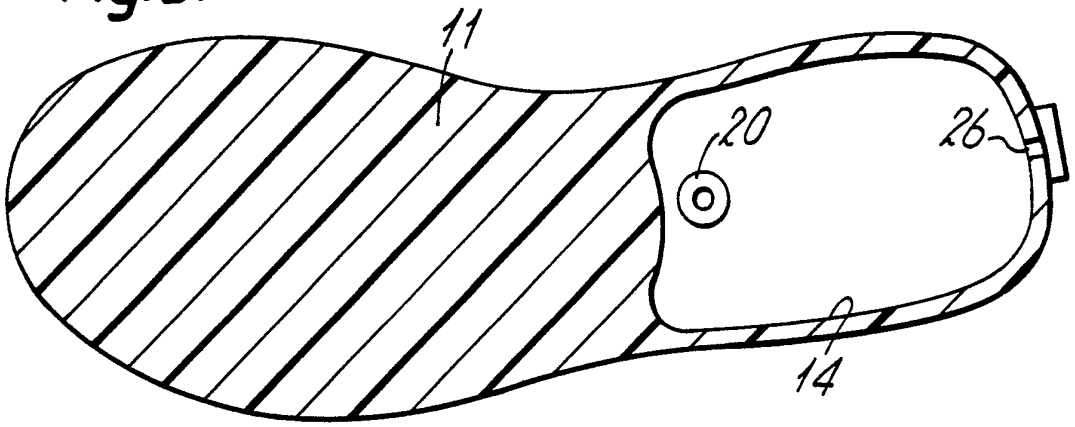


Fig.4.

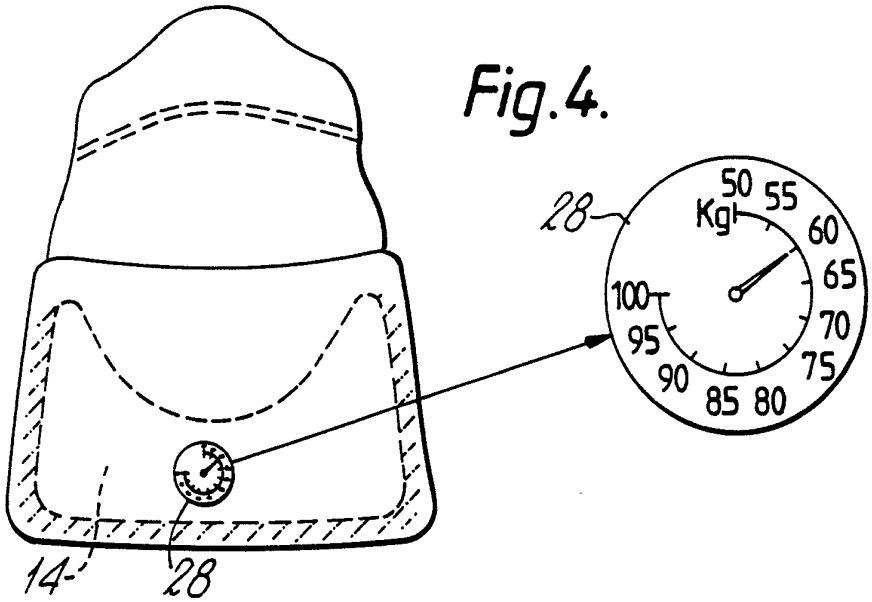
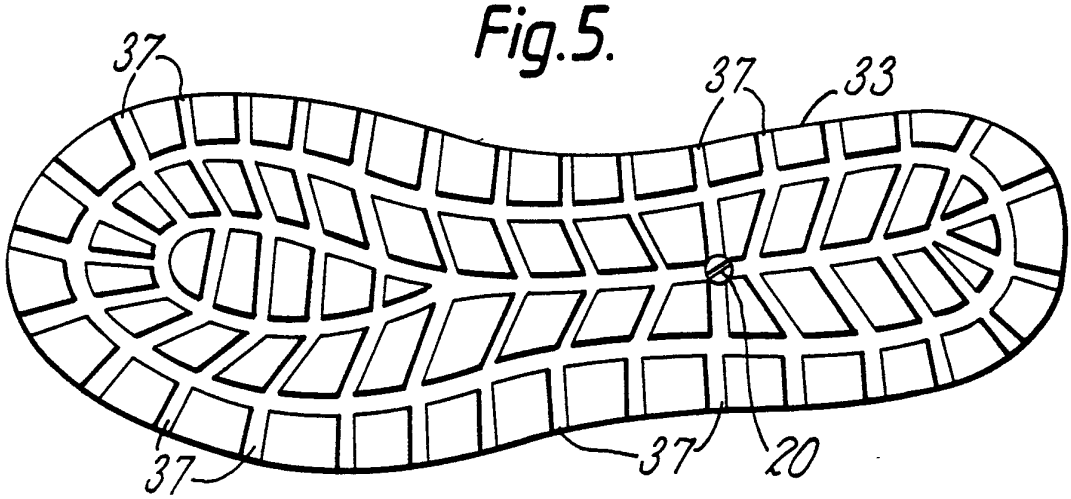


Fig.5.



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 86/00775

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: A 42 B 13/20; A 43 B 7/06

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	A 43 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	WO, A, 8200571 (E. LORENZ) 4 March 1982 --	1-4
A	GB, A, 2114425 (CLARKS) 24 August 1983 --	1-4
A	FR, A, 2452889 (W. REBER) 31 October 1980	1-4

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[10] Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
30th January 1987	25 FEV. 1987
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. VAN MOL

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 86/00775 (SA 15604)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 05/02/87

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A- 8200571	04/03/82	DE-A-	3031818	08/04/82
		SE-A-	8202506	21/04/82
		EP-A-	0058190	25/08/82
GB-A- 2114425	24/08/83	None		
FR-A- 2452889	31/10/80	DE-A-	3012945	23/10/80
		JP-A-	55133203	16/10/80
		US-A-	4312140	26/01/82