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"AN ARTICLE OF FOOTWEAR"

This invention relates to an article of footwear.

The desirability of providing the ground-engaging part, more especially the heel, of an article of footwear, with a shock-absorption capacity greater than is practicably obtainable by the resilience of the material used in the construction of the article per se has been recognised for many years. To make walking on hard pavements, for example, more comfortable it has been proposed to incorporate helical metal compression springs or gas springs. For example, U.K. Patent Specification No. 200,368 of 1922 proposes the use of air springs in both the sole and heel regions of a boot. The problem remains, however, that comfort is determined by the relationship between the weight of the wearer, the hardness of the surface on which he is walking and the rate of the spring medium. It is a sine qua non that the spring medium should be capable of restoring the shape of the unloaded article between steps, but this can be achieved with a spring medium of such low shock-absorption as to represent very little improvement in wearer comfort. On the other hand a high shock-absorption characteristic is achieved with a relatively "hard" spring which may cause discomfort through excessive "bounce".

Prior art efforts to overcome this problem, i.e. to adapt the spring rate to the particular user, have involved (a) in the case of gas springs the introduction or exhaustion of gas (for example U.K. Patent Specification No. 200,368) and

(b) in the case of rubber or metal springs their replacement with springs of different rate (for example U.K. Patent Specifications Nos. 390,368 and 427,126). Neither of these solutions is satisfactory because a source of compressed gas is not always readily available, and whereas metal springs suited to the user's weight may be selected they cannot readily be changed whenever he walks on different surfaces. These operations are in any case elaborate and expensive and not easily carried out by the wearer as occasion demands and without access to special equipment or accessories.

U.K. Patent Specification No. 456,979 discloses a heel sprung by a helical compression spring the rate of which can be varied by turning a screw. Here, however, the same screw determines the limit of telescopic extension of the two parts of the heel and consequently any variation of the spring rate will also affect the height of the unloaded heel and alter the extent of telescopic extension of the two heel components. U.K. Patent Specification No. 456,979 is not regarded by the present Applicant as a practicable proposal, for example because of the manifest danger of loosening of the woodscrew, but even with improvements of a non-inventive character this Specification does not disclose a sprung heel which can be readily adjusted by the wearer without affecting characteristics of the heel distinct from the rate of the spring.

A principal object of the present invention is to overcome the drawbacks of prior art proposals and fulfil this long-felt want in a simple and commercially practicable manner.

In accordance with the present invention there is provided an article of footwear having a ground-engaging part which comprises upper and lower components capable of limited movement toward and away from one another, a spring medium between said components and a member adjustably movable with respect to one of said components to vary the rate of the spring without alteration of the limit stop positions to which the unloaded components are urged by the spring medium.

In preferred constructions the components have peripheral walls one of which telescopically receives the other, said walls defining an enclosure for the spring medium and having respective, oppositely-directed abutments which come into contact to prevent separation of the components.

A collapsible member between said components may define an enclosure for the spring medium, and the collapsible member may be reinforced by a wall extending from one of said components toward the other adjacent the collapsible member, said wall serving also to limit the approach of said components.

The collapsible member may be of concertina configuration, and radially innermost and radially outermost portions of the member may be thickened or otherwise reinforced to provide annular bead formations which become stacked when the member is collapsed, thereby limiting the approach of said components.

In embodiments in which the enclosure is defined by a collapsible member the components may be additionally interconnected by a telescopic link articulated to one of the

components and adapted to prevent relative lateral movement of said components except accompanied by relative angular movement about the point of articulation.

The adjustable member preferably comprises a head portion which is rotatable but non-axially displaceable relative to said one component, the head portion being engageable on the side of said one component remote from the other for rotating the same and being integral on the other side of said one component with a screw-threaded shank portion in engagement with a screw-threaded bore in a compression element, the arrangement being such that rotation of the shank causes axial displacement relative thereto of the compression element which in turn varies the rate of the spring medium.

The head preferably has a formation for engagement by a tool to rotate the same and a peripheral formation for keying engagement with a plug which covers the head in use of the article and is non-rotatable relative to said one component but which plug is disengageable from said head to permit access thereto by said tool.

Said spring medium may be a gas spring in an enclosure between said components and the adjustable member may be adjustably movable relative to one of the components into or out of the enclosure, thereby to vary the volume of the enclosure and hence the rate of the gas spring.

Alternatively, said spring medium may be a body of elastomeric material, in which case the compression element preferably spans the area within the, or the innermost, wall and is in sliding contact therewith.

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In embodiments in which a gas spring is used, the enclosure of the gas spring may be defined by an annular collapsible element which extends between the compression element and the other of said components, the compression element having a peripheral recess into which the collapsible element will be received if the compression element is forced into contact with said other component.

Alternatively, the cross-sectional area of the compression element may be less than that of the enclosure and a, or a second, collapsible element may extend in gas-tight manner between said one component and the periphery of the compression element.

Where a link is used, separation of said components may be limited by the abutment of an enlargement of one part of the link with a shoulder in a bore of another part of the link, said other part of the link being constituted by said screw-threaded shank portion. Said components may be the upper and lower components of a hollow heel structure.

Preferred embodiments of the invention will now be described with reference to the accompanying drawings, in which:-

Figures 1 and 2 are sectional elevations of a hollow heel structure taken respectively on the lines G-G and H-H of Figure 3,

Figure 3 is a plan view of the heel of Figures 1 and 2 with upper parts removed,

Figures 4 and 5 are views similar to Figure 1 with the heel in different states of compression,

Figure 6 is an exploded view illustrating the different components of the heel of Figures 1 - 5,

Figures 7 and 8 are sectional elevations of a second embodiment of a hollow heel in accordance with the invention, taken respectively on the lines I-I and J-J of Figure 9,

Figure 9 is a plan view with upper parts removed of the heel of Figures 7 and 8,

Figures 10 and 11 illustrate the heel of Figures 7 - 9 in different states of compression,

Figure 12 is an exploded view of the heel of Figures 7 - 11, showing the different elements of its construction,

Figures 13, 14 and 15 are similar side sectional elevations of a third embodiment of a hollow heel in accordance with the invention showing the elastomeric spring in different states of compression,

Figure 16 is an exploded view of the heel of Figures 13 - 15, showing the elements of its construction,

Figures 17 and 18 illustrate optional variants of the embodiment of Figures 13 - 16,

Figure 19 is a side sectional elevation of a fourth embodiment of a hollow heel in accordance with the invention,

Figure 20 illustrates the heel of Figure 19 in three angular attitudes,

Figure 21 is a sectional plan view taken on the line XXI-XXI of Figure 20, and

Figures 22 - 24 illustrate a fifth embodiment of a hollow heel in accordance with the invention, Figure 22

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being a perspective view showing outer parts of the heel in phantom lines, Figure 23 being a side sectional elevation and Figure 24 being an exploded view showing the individual elements of the construction.

The hollow heel for a boot or shoe illustrated in Figures 1 - 6 comprises upper and lower parts 1 and 2 which are relatively telescopic but the extension of each of which relative to the other is limited by flanges 1A and 1B, as shown in Figure 1. The upper part 1 of the heel is connected to the underside of the rear portion of the sole 27 of the associated article of footwear by T-flanges 31 on the sole 27 which locate in T-slots 34 in the heel part 1 and by an apertured lug 32 on the sole 27 which locates in a recess in the upper surface of the part 1 and is held therein by a pin 37.

In a central position the rear portion of the sole 27 is formed with a hole 41 in which a plug 44 can be seated. The plug 44 has a radial lug 47 which engages in a radial extension 41A of the hole 41 when the plug is seated in the hole, to prevent rotation of the plug 44 in the hole 41 for a reason to be later explained, and the plug is formed with a slit 45 in which any suitable instrument, such as a screwdriver or penknife, can be inserted when it is desired to remove the plug 44 from the hole 41.

The heel illustrated is a spring heel to which resilience is imparted by a gas spring. The gas spring is constituted by a mass of gas (such as air) trapped in a sealed enclosure 5 within the hollow heel, the enclosure

being formed by a collapsible tubular concertina-like membrane 58 sealed at its opposite ends by a disc 60 fixed to the lower heel part 2, and by a disc 59 fixed to a compression element 54.

The compression element 54 has a central, internally screw-threaded blind bore 53 and has peripheral lugs 55 which, by engaging in grooves 56 in the inner periphery of the wall of the upper heel component 1, prevent rotation of the element 54 while permitting it to move in the up-and-down direction. Such up-and-down movement is controlled by the external screw-threads of a shank of a rotatable member 49, which has a reduced-diameter head portion 48 held against axial displacement in a hole 43 in the upper heel component 1 by a circlip 50. The circlip 50 engages in a peripheral groove 57 in the head 48 below peripheral splines 51 of the head which, when the plug 44 is positioned as in Figures 1 and 2, engage the teeth 46 so that the plug prevents rotation of the rotary part 48, 53 of the compression member 48, 53, 54. The free end of the head 48 is formed with a slot 52 which can be engaged by a suitable tool such as a screwdriver, or even a coin, when it is desired to adjust the compression member 48, 53, 54 after removing the plug 44.

To reduce friction the inner part 1 and the outer part 2 of the hollow heel each have ribs 9 contacted by the other part. A sealing ribbon 10 is located between the parts in a recess in part 2 but to allow the entry and expulsion of air between parts 1 and 2 outside the enclosure 5 a channel 11 is provided in the wall of part 2.

In use of the heel 1, 2 illustrated the rate of the gas spring 5 can be adjusted at any time by the wearer, without simultaneously varying the overall height of the unloaded heel (Figures 1 and 2) by removing the plug 44 from the hole 41 in the sole 27, rotating the rotatable part 48,49 of the compression member by means of a tool inserted in the slot 52 and then repositioning the plug 44 to hold the rotatable part 48,49 in its new position. Rotation of the part 48,49 in one sense will drive the part 54 downward, thereby placing gas (such as air) in the enclosure 5 under greater initial pressure while its rotation in the other sense will relieve the pressure of the gas spring 5.

As shown in Figure 4, telescopic contraction of the heel under abnormal forces is limited by abutment of the free end of the wall of part 1 with the bottom of part 2. In the exceptional circumstances that the pressure in gas spring 5 has been increased by moving the element 54 down so far that, when the heel "bottoms out" under an exceptional load, the element 54 will contact the floor of heel part 2 at the same time as, or even before, the wall of part 1 the fully collapsed membrane 58 will, as shown in Figure 5, be received into an annular peripheral recess of the element 54.

The exploded view of Figure 6 shows how the heel assembly of Figures 1 - 5 can be put together. The heel part 1 with the compression member 48,49,54 mounted therein is inserted in the heel part 2 by passing the

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ribbed flange 1A under the ribbed flange 1B. At the same time the gas spring 5 is positioned in heel part 2, after which the front of heel part 2 is closed off by inserting T-formations 17 on opposite sides of a front wall 16 in T-grooves 18 at opposite extremities of the wall of part 2. A flange 22 enters a slot 21 and notches 20 snap over protrusions 19. T-formations 31 of the sole 27 are now slid into T-slots 34 in part 1, lug 32 is pressed into its recess in part 1 until locking pin 37 can be inserted and finally the plug 44 is positioned in hole 41 to engage the splines on head 48.

The embodiment of Figures 7 - 12 resembles that of Figures 1 - 6 and like parts have like references. In this case, however, the axially movable compression element 54A does not act on the collapsible element 58A but instead is of lesser diameter than the element 58A which extends into contact with the underside of the top of heel part 1. However, the compression element 54A is connected to a second, inner collapsible element 62 extending between element 54A and the underside of the top of part 1. The effect of axially displacing the element 54A by rotating the element 48A is thus not to compress the element 58A but to vary the volume of the gas spring 5 and therefore the pressure prevailing therein, assuming that the mass of the gas is constant. To prevent the element 54A being screwed fully off the element 48A a cord 64 passes through an eye 66 in part 54A and emerges from a bore in part 48A to be engaged by a clip 65.

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The collapsible element 58 of Figures 1 - 6, or each collapsible element 58A and 62 of Figures 7 - 12 may be of bellows-like configuration and may be made of metal. They may be manufactured in the following way. An originally cylindrical metal tube may be first subjected to lateral forces to give it a bellows-like configuration and then subjected to longitudinal forces to give it the desired length. As shown in Figure 12 two tubes 58A and 62 of different length and diameter are then assembled, as by welding, with discs 60 and 63 which close one of their respective ends and a washer 59A which bridges the other end of the larger tube 58A and the other end of the smaller tube 62 defining the gas-tight enclosure 5.

In use gas, such as air, is introduced at suitable pressure into the enclosure 5 before it is sealed. When the wearer of the article of footwear wishes to alter the resilient characteristics of the heel he first removes the plug 44, e.g. by insertion of a penknife or screwdriver in the slit 45 and then by engaging the recess 52 with a suitable tool, such as a screwdriver, he rotates the member 48A so that the bellows 62 is extended, as shown in Figure 11 or contracted, as shown in Figure 10. The effect of extending the bellows 62 is to "harden" the resilient heel, because the volume of the enclosure 5 is reduced, while the effect of contracting the bellows 62 is to "soften" the resilient heel because the volume of the enclosure 5 is effectively increased, the mass of the gas

in the enclosure 5 in both cases remaining constant. Having adjusted the heel to his satisfaction the wearer simply replaces the plug 44 in the hole 41, whereupon the teeth 46 engage the splines of the head 48 to prevent any unintended rotation and consequently any unintended alteration of the rate of the gas spring 5.

The embodiment of the invention illustrated in Figures 13 - 16 differs from the previous embodiments in that the gas spring 5 is replaced by a spring in the form of a body 70 of resilient material, such as foam rubber (natural or synthetic) and the rate of the spring is varied by varying the amount of compression applied to the body 70 by a compression element 54B. In other respects, however, this embodiment of a hollow heel resembles those of Figures 1 - 6 and 7 - 12 and like parts have like reference numerals.

In the embodiment of Figures 13 - 16 the body 70 of foam rubber is encapsulated in a rigid lining member 72 which serves to prevent extrusion of the foam rubber outwardly of the wall of part 1 of the heel and which receives the compression element 54B as a tight sliding fit. The compression element 54B is reinforced on its upper surface by flanges 69 to prevent distortion under load. To prevent the compression element 54B becoming detached from the rotary element 49 the screw-thread of the latter terminates at 68.

Figure 13 shows the compression element 54B in its highest possible position within the hollow heel, so that

the spring 70 is as "soft" as possible. In Figure 14 the spring 70 has been "hardened" as much as possible by displacing the compression element 54B as far as possible down the rotary element 48B. Figure 15 illustrates what happens when the heel, "hardened" as in Figure 14, is subjected to an exceptional load. In these conditions the body 70 is fully compressed but will return the parts 1 and 2 of the heel to the position of Figure 14 when the heel is relieved of load.

Figures 17 and 18 illustrate optional variants of the embodiment of Figures 13 - 16. In Figure 17 the lining member 72 can be dispensed with because the lower heel part 2B is telescopically received in the upper heel part 1B, instead of vice versa. The outwardly-directed, ribbed flange at the upper end of the wall of part 2B is entrapped by an inwardly directed flange 89 fixed by screws to the lower end of the wall of part 1B. In Figure 18 the wall of the lower part 2C is telescopically received in an annular slot in the wall of the upper heel part 1C. Relative telescopic movement of the parts 1C and 2C is limited by pins 91 which extend inward of the slot from the wall of part 1C and are engaged in respective channels 92 in the wall of part 2C.

The embodiments of Figures 19 and 20, 21 differ from the remaining embodiments by the absence of mutually telescopic, rigid walls on the upper and lower parts of the hollow heel. In these embodiments a rigid wall 1D depends from the upper wall part but this serves primarily

to limit downward movement of the upper part relative to the lower part, as well as helping to prevent distortion of the collapsible wall 2D of the lower heel part. In Figure 19 both the radially innermost and the radially outermost portions of the bellows-like collapsible element 2D are thickened as at 2E. These thickenings both reinforce the structure of the collapsible element 2D and adopt a stacked formation if the element 2D is fully compressed, in effect providing solid inner and outer annuli which protect from distortion the thinner, web portions of the element 2D which connect them.

In place of the co-operating flanges 1A, 1B of previous embodiments movement away from one another of the ground-engaging part 29 of the lower part 2D of the heel and its upper part 1D is limited by a telescopic link 93 having an enlarged head reciprocable in a bore in the rotatable element 48D. This bore is of reduced diameter at its lower end to provide an annular shoulder which the enlarged head of the link 93 will abut when the heel is of maximum permitted height. An advantage of the embodiments of Figures 19, 20 and 21 over those previously described is that angular movement between the upper and lower heel parts 1D and 29 is permissible except under conditions of maximum load as exemplified by the lowest of the three views of Figure 20. The link 93 and co-operating bore in the part 48D prevent relative lateral movement of the upper and lower parts of the heel except accompanied by relative angular movement about the point 94 of articulation of the link 93

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to the lower heel part 2D. The extent of permitted angular deflection in a given direction can be controlled by the shape of a recess 95 in which the lower end of the link 93 is seated, and angular deflection in a given direction can be prevented altogether by an upright stop 96. In a preferred construction relative angular movement between the upper and lower parts of the heel is permitted in one direction only, the stop 96 being of rearwardly-opening horseshoe shape as shown in Figure 21. By this arrangement, as illustrated by the successive views of Figure 20, maximum shock-absorption is provided when, in walking, the rear of the heel first strikes the ground, by the permitted angular deflection of the two parts of the heel. This advantage is obtained, however, without instability of the heel to forces applied laterally or forwardly.

The embodiment of the invention illustrated in Figures 22 - 24 resembles those of Figures 1 - 6 and 7 - 12, like parts having like reference numerals, but in this embodiment the gas spring 5 is constituted by a tubular membrane 78 which is sealed in a gas-tight manner to the periphery of the compression element 54 at one end and to the periphery of a disc 79 at its other end. Both of these peripheries have grooves 81 in which the respective end of the membrane 78 is clamped by a ring 80. Additional rings 82 occupy corrugations along the length of the membrane 78 to reinforce it. As in the embodiment of Figures 7 - 12 a

cord 64 passed through a loop in the compression element 54 and held by a U-shaped member 65 seated in the head 48A prevents total separation between the rotary part 48A and the axially-movable part 54 of the compression component.

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CLAIMS

1. An article of footwear having a ground-engaging part which comprises upper and lower components capable of limited movement toward and away from one another, a spring medium between said components and a member adjustably movable with respect to one of said components to vary the rate of the spring without alteration of the limit stop position to which the unloaded components are urged by the spring medium.

2. An article as claimed in claim 1, wherein the components have peripheral walls one of which telescopically receives the other, said walls defining an enclosure for the spring medium and having respective, oppositely-directed abutments which come into contact to prevent separation of the components.

3. An article as claimed in claim 1, wherein a collapsible member between said components defines an enclosure for the spring medium.

4. An article as claimed in claim 3, wherein the collapsible member is reinforced by a wall extending from one of said components toward the other adjacent the collapsible member, said wall serving also to limit the approach of said components.

5. An article as claimed in claim 3 or claim 4, wherein the collapsible member is of concertina configuration.



6. An article as claimed in claim 5, wherein radially innermost and radially outermost portions of the member are thickened or otherwise reinforced to provide annular head formations which become stacked when the member is collapsed, thereby limiting the approach of said components.

7. An article as claimed in any one of claims 3 - 6, wherein the components are additionally interconnected by a telescopic link articulated to one of the components and adapted to prevent relative lateral movement of said components except accompanied by relative angular movement about the point of articulation.

8. An article as claimed in any one of the preceding claims, wherein the adjustable member comprises a head portion which is rotatable but non-axially displaceable relative to said one component, the head portion being engageable on the side of said one component remote from the other for rotating the same and being integral on the other side of said one component with a screw-threaded shank portion in engagement with a screw-threaded bore in a compression element, the arrangement being such that rotation of the shank causes axial displacement relative thereto of the compression element which in turn varies the rate of the spring medium.

9. An article as claimed in claim 8, wherein the head has a formation for engagement by a tool to rotate the same and a peripheral formation for keying engagement





with a plug which covers the head in use of the article and is non-rotatable relative to said one component but which plug is disengageable from said head to permit access thereto by said tool.

10. An article as claimed in any one of the preceding claims, wherein said spring medium is a gas spring in an enclosure between said components and wherein the adjustable member is adjustably movable relative to one of the components into or out of the enclosure, thereby to vary the volume of the enclosure and hence the rate of the gas spring.

11. An article as claimed in any one of claims 1 - 9, wherein said spring medium is a body of elastomeric material.

12. An article as claimed in claim 10 or claim 11 as appendant through claim 8 or claim 9 upon claim 2, claim 4, or any one of claims 5 - 7 as appendant to claim 2 or claim 4, wherein the compression element spans the area within the, or the innermost, wall and is in sliding contact therewith.

13. An article as claimed in claim 12 as appendant through claim 10 upon claim 2, wherein the enclosure of the gas spring is defined by an annular collapsible element which extends between the compression element and the other of said components, the compression element having a peripheral recess into which the collapsible element will be received if the compression element is forced into contact with said other component.



14. An article as claimed in claim 10 as appendant to claim 8 or claim 9, wherein the cross-sectional area of the compression element is less than that of the enclosure and wherein a, or a second, collapsible element extends in gas-tight manner between said one component and the periphery of the compression element.

15. An article as claimed in claim 12 as appendant through claim 11 upon claim 7, wherein separation of said components is limited by the abutment of an enlargement of one part of the link with a shoulder in a bore of another part of the link, said other part of the link being constituted by said screw-threaded shank portion.

16. An article as claimed in any one of the preceding claims, wherein said components are upper and lower components of a hollow heel structure.

17. An article of footwear substantially as described in the Description with reference to and as shown in Figures 1 - 6, Figures 7 - 12, Figures 13 - 16, Figure 17, Figure 18, Figure 19, Figures 20 and 21 or Figures 22 - 24, of the accompanying drawings.

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