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(54) Shoe Soles.

(57) A shoe sole (l4) having at its bottom surface (l4a) a curvilinear flex groove (24) located at the narrowing region (22) forwardly of the wider region (20) of the shoe sole and extending from the medial side (24b) to the lateral side (24a) in a forwardly oriented arc having its forwardmost portion (24c) offset toward the medial side (24b), to underlie the inner space of the foot forwardly of the metatarsal heads and rearwardly of the phalangeal portions that serve for surface engagement.

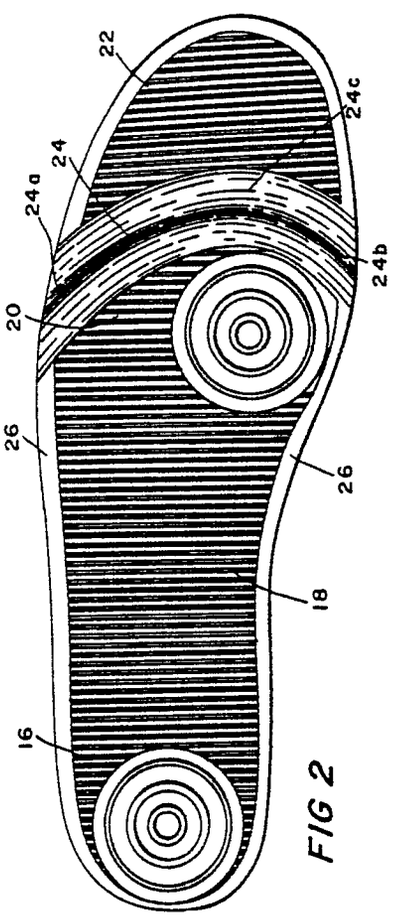

FIG 2

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SHOE SOLES

This invention relates to footwear and particularly to a multidirectional toe-off shoe sole structure.

Shoe soles have had a variety of features imparted to them over the years, often for the purpose of accommodating the natural action of the foot structure during locomotion, and/or improving foot action that is defective in some respect. It is known that the human foot is a series of complex arrangements of bones, tendons, ligaments and muscles which produce a sequence of cooperative lateral and longitudinal movements during use. Although a great deal is presently known concerning these foot movements, understanding thereof is yet incomplete. Moreover, because each person's foot varies considerably from those of others, efforts are constantly made to improve footwear for optimizing locomotion action. Yet, because shoes must be mass produced for practical reasons, accommodating the variety of individual foot peculiarities is not totally possible. An object of this invention is to provide a special shoe structure which will aid in accommodating differing individual feet with a mass produced shoe and is directed to improving a shoe sole comprising an elongated sole having a bottom surface, an upper surface and a periphery including medial and lateral sides, the upper surface having a rear portion for engaging the heel of a foot, a narrow central portion to be beneath the instep of the foot, a wide portion to underlie and engage the metatarsal heads of the foot and a narrowing region forwardly of the wide portion for underlying the inner space of the foot occurring just forwardly of the metatarsal heads and engaging the forward ends of the phalanges of the foot. According to the present invention, the sole has a curvilinear groove in the bottom surface at the said narrowing region forwardly of the said wide portion, extending from the medial side, forwardly and then rearwardly in the arc to the lateral side, configurated and located to underlie the inner space of the foot forwardly of the metatarsal heads for allowing toe-off in a variety of forward directions.

The present invention thus provides a shoe having a novel sole structure for increasing accommodation of the shoe to the peculiarities of individual varying foot action by allowing toe-off for proper weight transfer through the gait cycle at any forward angle. The almost infinite number of directions of weight transfer from the shoe enables proper toe-off for the peculiarities of the particular foot. It accommodates individual variations in bone alignment of the forefoot structure, and aids in extension of the phalanges at toe-off. The radius of the flex groove addresses rotational shear in the forefoot encompassed during resupination of the foot.

Preferably, the arc of the groove has its forwardmost apex laterally off centre of the sole toward the medial side. The groove may have various cross-sections, but preferably has in cross-sectional configuration a concave curved upper portion blending into convex curved junctures with the said bottom surface.

The invention also includes, according to another aspect, a shoe comprising an upper connected to a sole having the curvilinear groove referred to above.

The invention may be carried into practice in various ways but one shoe embodying the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure I is a side elevational view of the shoe;

Figure 2 is a bottom view of the shoe in Figure I;

Figure 3 is a photo reproduction of an ink blot footprint plus a dash-line diagrammatic indication of the shoe sole outline, a dash-line indication of the progressive line of contact of the foot to the ground, and an indication of the location of the flex groove forwardly of the metatarsal heads and behind the ground engaging portions of the phalanges;

Figure 4 is a side elevational diagrammatic view of a foot showing the location of the inner space under which the flex groove lies; and

Figure 5 is a bottom view of a foot diagrammatically showing the location of the flex groove beneath the inner space.

The drawings show a casual shoe I0 which has an upper I2 secured around the periphery 26 of a sole member I4. This sole has a lower ground-engaging surface I4a and an upper foot-engaging surface I4b. An inner sole (not shown) or other conventional components may be employed as desired in conjunction with the upper surface I4b.

This sole has a conventional heel portion I6 to accommodate the area underlying the heel of a human foot F contained in the shoe, and a narrow intermediate portion I8 which underlies the instep of the foot. The sole then widens out in conventional fashion toward the front of the shoe to the widest portion 20 which underlies the metatarsal heads of the foot bone structure. The forwardmost portion 22 of the sole then narrows from this widest portion, and underlies the phalanges of the foot.

Beginning immediately forwardly of the widest portion 20, so as to be forward of the metatarsal heads, is a special curvilinear groove 24. Specifically, it is directly beneath the "inner space" of the foot existing between the metatarsal heads and the forward, ground-engaging portions of the phalanges. This curvilinear groove lies beneath the rearward phalangeal bones.

The groove extends between the lateral side 24a of sole periphery 26 and the medial side 24b, in an arcuate path projecting forwardly of the sole from these two sides. The forwardmost apex portion 24c of the groove is laterally offset from the centre of the sole, toward the medial side, so that it is slightly toward the centre of the sole from the great toe. This special groove 24 enables an almost infinite number of forward directions of flex and weight transfer upon toe-off during locomotion.

The cross-sectional configuration of the groove is preferably smoothly curved, having at its upper deepest portion a concave generally semicircular curvature (Figure I), while merging gradually into two convex curved edge portions blending with the bottom surface I4a of the sole.

The curvilinear configuration of the groove from side to side adds volume to the groove to aid flexibility and enable further extension of the phalanges at toe-off. The ability of the curve of the flex groove to address an almost infinite number of forward directions of movement in a casual shoe facilitates proper weight transfer through the entire gait cycle. The radius of the flex groove addresses rotational shear in the forefoot, encompassed during resupination of the foot. The depth of the groove may vary somewhat. Used in conjunction with a unitary type sole, the flex groove may be considerably deeper for more surface area in the groove, which in turn results in increased flexibility.

In use of the shoe sole for walking, the usual basic pattern of foot to ground engagement is depicted by the dash-line sequence 25 in Figure 3. As is known, it begins at 25a at the heel, proceeds toward the metatarsal head 25b at the lateral side of the foot, then across the metatarsal heads to the head 25c behind the great toe on the medial side. During subsequent toe-off, the fleshy material 27 forwardly of the metatarsal heads and then the forward ends of the toes provide the engagement area, with the phalanges being extended for a springing action in the forward direction. Toe-off for the particular person's foot may be directly ahead as per the arrows in Figure 5. Yet with different people and their own unique foot structures, toe-off direction can differ angularly from straight ahead. The novel sole readily accommodates any such individual locomotion toe-off direction characteristic because of the curvilinear groove which enables sole bending at that angular direction, for smooth comfortable action.

Certain additional advantages and slight modifications of the structure may, of course, be visualized by those in the art upon studying the foregoing and the illustrated preferred embodiment.

Claims

I. A shoe sole (I4) comprising an elongated sole having a bottom surface (I4a), an upper surface (I4b) and a periphery (26) including medial (24b) and lateral (24a) sides, the upper surface (I4b) having a rear portion (I6) for engaging the heel of a foot, a narrow central portion (I8) to be beneath the instep of the foot, a wide portion (20) to underlie and engage the metatarsal heads of the foot and a narrowing region (22) forwardly of the wide portion for underlying the inner space of the foot occurring just forwardly of the metatarsal heads and engaging the forward ends of the phalanges of the foot, characterised in that the sole (I4) has a curvilinear groove (24) in the bottom surface (I4a) at the said narrowing region (22) forwardly of the said wide portion (20), extending from the medial side (24b), forwardly and then rearwardly in the arc to the lateral side (24a), configurated and located to underlie the inner space of the foot forwardly of the metatarsal heads for allowing toe-off in a variety of forward directions.

2. A shoe sole according to Claim I in which the arc of the groove (24) has its forwardmost apex (24c) laterally off centre of the sole toward the medial side (24b).

3. A shoe sole according to Claim I or Claim 2 in which the groove (26) has in cross sectional configuration a concave curved upper portion blending into convex curved junctures with the said bottom surface (I4a).

4. A shoe (I0) comprising a sole (I4) and an upper (I2) connected thereto, the sole being according to Claim I or Claim 2 or Claim 3.

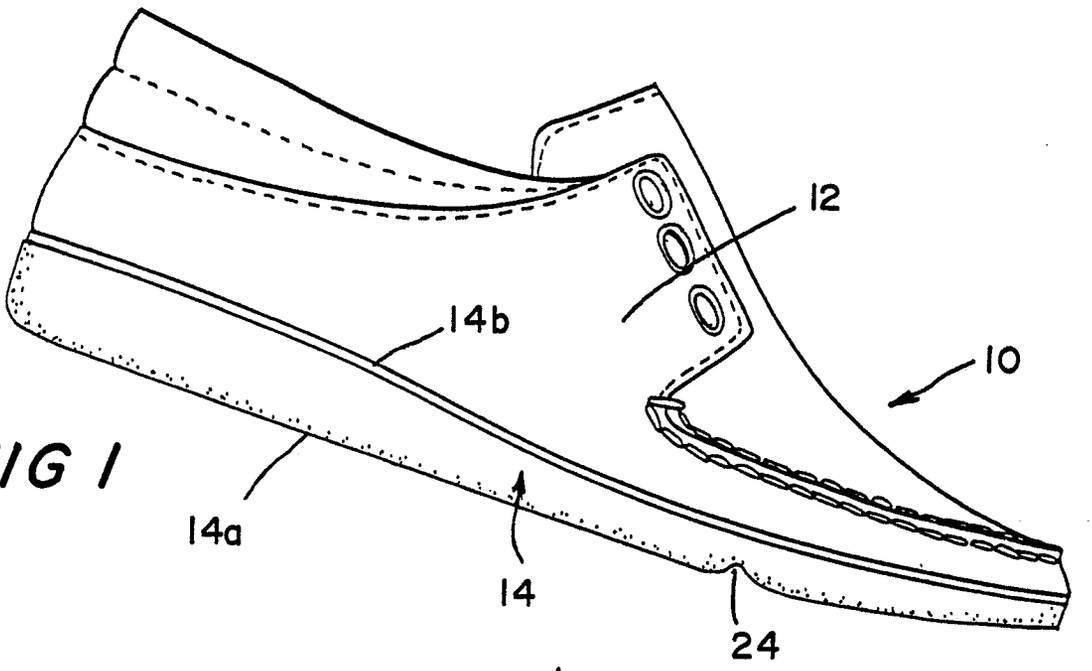

FIG 1

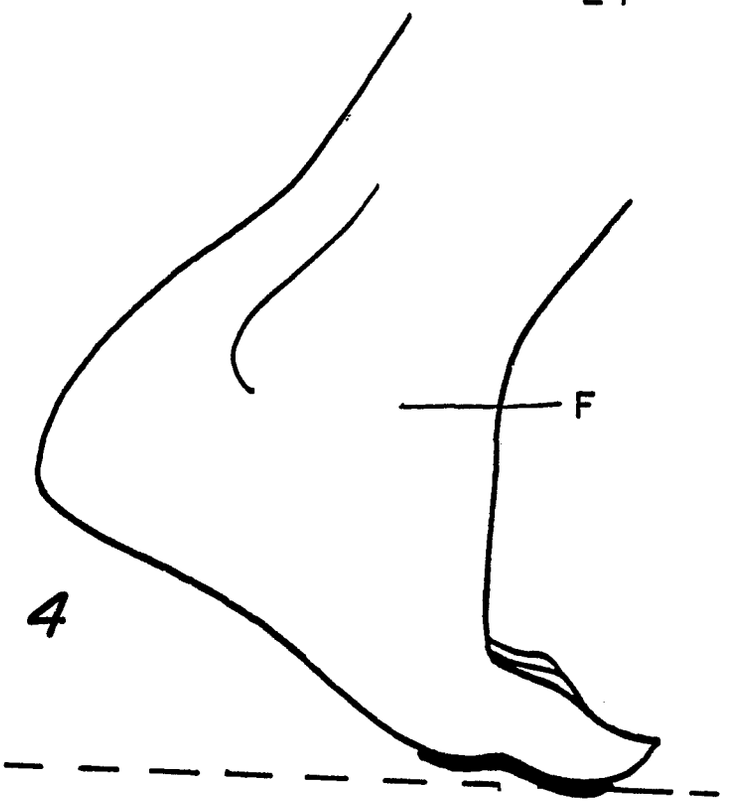

FIG 4

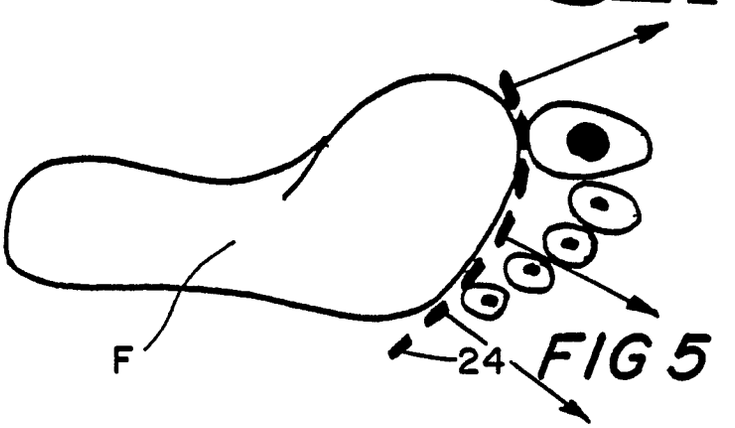

FIG 5

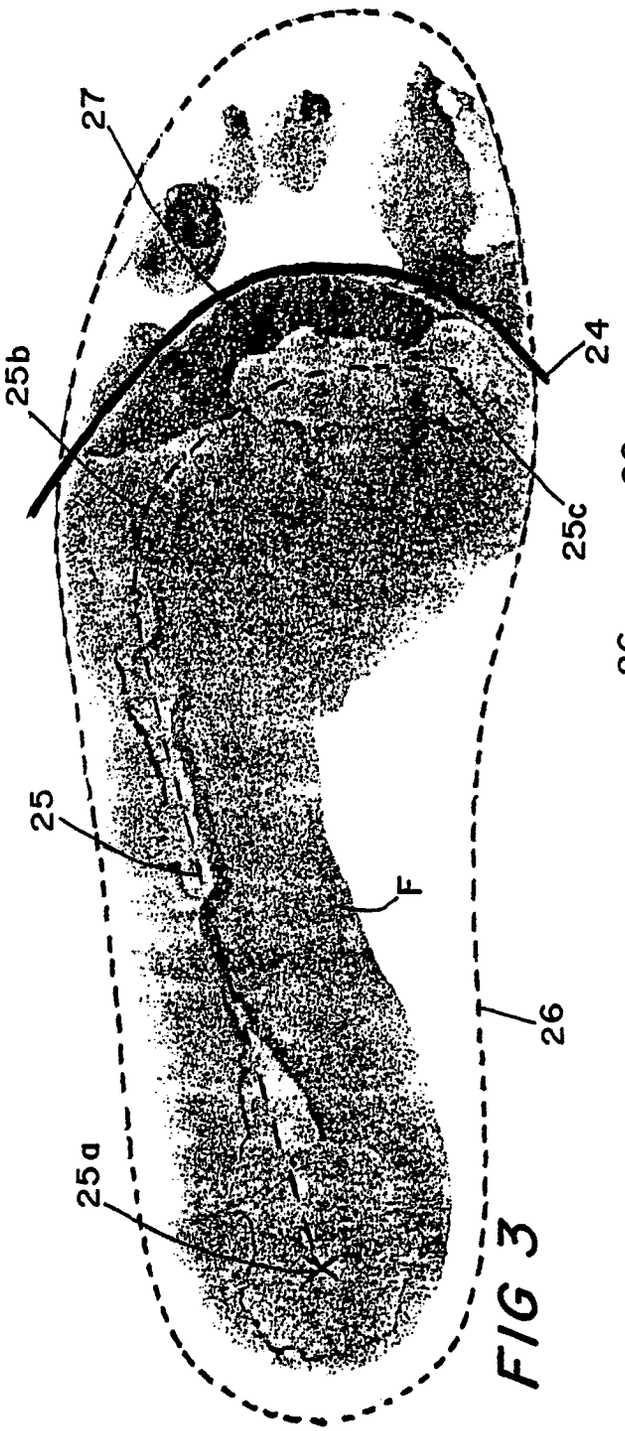

FIG 3

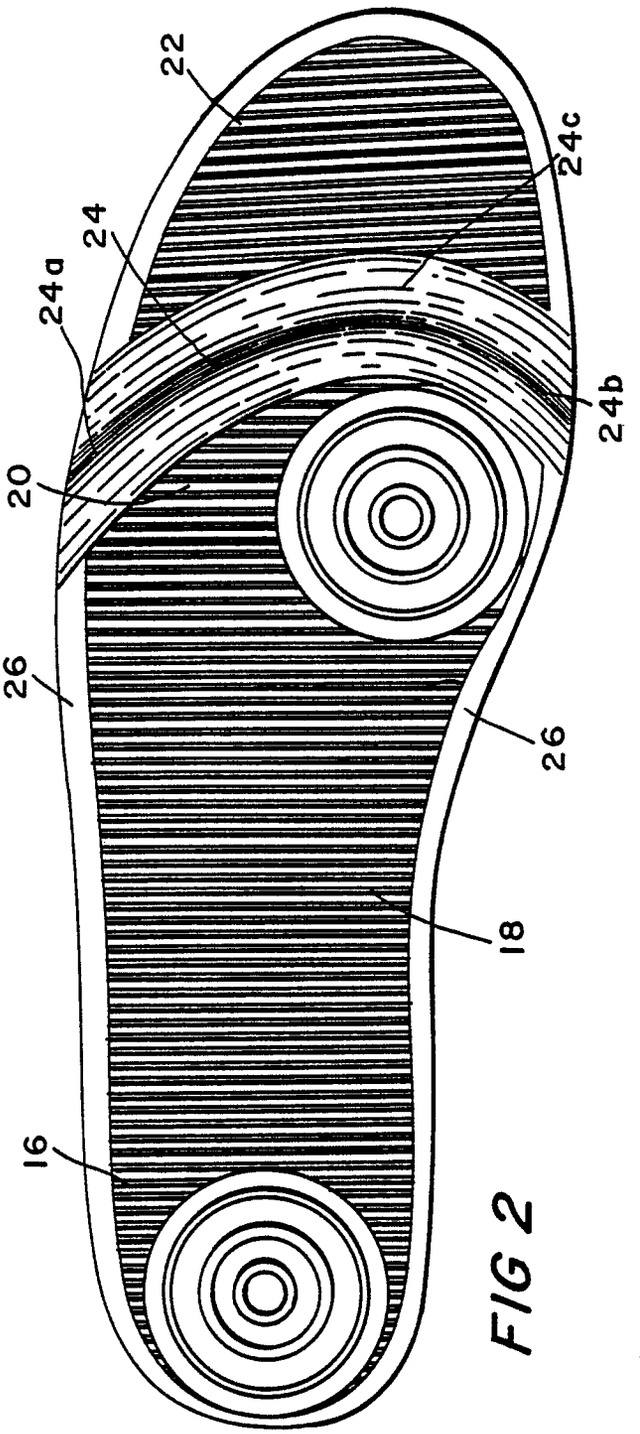

FIG 2