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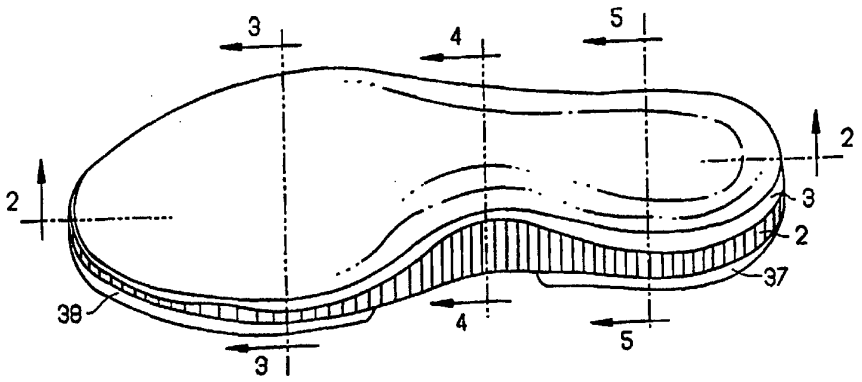

(57) Abstract

The present invention provides a composite shoe bottom having a lower layer (2), an upper layer (3) and an outsole (37, 38).

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COMPOSITE SHOE CONSTRUCTION

CROSS-REFERENCE TO RELATED APPLICATIONS
(For U.S. Application Only)

This is a continuation-in-part of application Serial No. 08/055,935, filed April 30, 1993, which is a continuation-in-part of application Serial No. 07/649,525, filed February 1, 1991, now abandoned, which is a continuation of application Serial No. 06/871,017, filed June 4, 1986, now U.S. Patent 5,025,573.

FIELD OF THE INVENTION

This invention relates to shoes. In particular, this invention relates to improvements in the configurations and materials used in the construction of shoe bottoms for various types of footwear.

BACKGROUND OF THE INVENTION

Historically, shoe bottoms have been constructed for the most part with flat top and bottom surfaces. This sort of shoe bottom was normally made of single density polyurethane (PU) or blown polyvinylchloride (PVC) materials. The upper of the shoe would be glued onto the top of the sole or the upper could be "direct attached" through a molding process that would capture the upper in the molded sole. The bottom could be the lowermost layer of the sole if the urethane was sufficiently abrasion-resistant. Alternatively, a

rubber outsole could be cemented onto the unit bottom, as is typically done in the manufacture of running shoes.

Eventually, it became known to contour the top surface of the bottom unit to provide a heel cup and a slight arch. This made the shoe more comfortable because the foot would rest on a surface similar to its shape as opposed to a flat surface which felt like flat feet on a firm floor.

When the contour surface is used with a dual-density bottom, that is, two different densities of PU, the lowermost (outer) portion is formed of a uniform thickness. This portion can be used for its abrasion resistance. The softer portion is positioned on top of this uniform portion to provide comfort and cushioning, since the firmer material would be too hard for comfort. Further, the respective volumes of the softer and firmer materials are such that the volume of soft material is maximized and the volume of firmer material is minimized.

The prior known structures have always had to trade cushioning for stability. If the bottom is soft for good cushioning, then the foot rocks from side to side, which is unstable. Even existing soles with contoured topmost surfaces have this type of trade-off. It has been proposed, for example, in U.S. Patent Nos. 4,399,620 (Funck) and 4,446,633 (Scheinhaus et al.) to contour the lower wear-resistant layer but to provide a relatively flat second layer that is deformable rather than double contoured. The designs taught in each of these patents, however, provides a flat surface that must be deformed by the foot to obtain a satisfactory shape, thus losing much of the support which was to be provided by the bottom.

SUMMARY OF THE INVENTION

The present invention provides a composite shoe bottom that has a lower shaped support layer with a lower surface and an increased height around the periphery of the heel area and an irregular contoured upper stabilizing surface for the wearer's foot; an upper cushioning layer of a material that is softer than said lower layer, said upper layer having a varying thickness which is pre-shaped to a contour complementary to the bottom surface of the wearer's foot and having an increased height around the periphery of the heel area and in the arch area to form a raised arch support and to provide an irregular contoured upper stabilizing surface for the wearer's foot; and means for forming an outsole secured to at least a portion of the lower surface of the lower support layer and comprising at least one strip of a wear resistant material which is positioned upon the lower layer in an area which will experience abrasion or shock.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of one embodiment of the invention;

Fig. 2 is a transverse cross-section along lines 2--2 of Fig. 1;

Fig. 3 is a transverse cross-section along lines 3--3 of Fig. 1;

Fig. 4 is a transverse cross-section along lines 4--4 of Fig. 1;

Fig. 5 is a transverse cross-section along lines 5--5 of Fig. 137;

Fig. 6 is a bottom view of an alternative design for the toe of the shoe of Fig. 1;

Fig. 7 is a bottom view of an alternative design for the heel portion of the shoe of Fig. 1;

Fig. 8 is a perspective view of another embodiment of the invention;

Fig. 9 is a transverse cross-section along lines 9--9 of Fig. 8;

Fig. 10 is a perspective view of yet another embodiment of the invention;

Fig. 11 is a transverse cross-section along lines 11--11 of Fig. 10;

Fig. 12 is a transverse cross-section along lines 12--12 of Fig. 10;

Fig. 13 is a side view of a double contour, double density ladies' dress shoe which is constructed in accordance with the present invention;

Figs. 14-16 are longitudinal sectional views of three alternative embodiments for the shoe of Fig. 13;

Figs. 17-18 are lateral sectional views taken across the width of the shoes of Figs. 15-16 at the heel thereof;

Figs. 19-21 are lateral sectional views taken along the length of the shoe of Fig. 13 at the forefront thereof for the three embodiments of Figs. 14-16;

Figs. 22 and 23 together present an exploded view of a sports shoe which is constructed in accordance with the present invention;

Fig. 24 is a side view of a sports shoe which is constructed in accordance with the present invention;

Fig. 25 is a transverse cross-section along lines 25--25 of Fig. 24; and

Fig. 26 is a transverse cross-section along lines 26--26 of Fig. 24.

DETAILED DESCRIPTION OF THE INVENTION

Figs. 1-5 show a composite shoe bottom according to the invention. In this embodiment, the outsole is formed of various pieces or strips of wear-resistant material, which may be placed adjacent each other with or without spaces between them. When these strips are spaced or contain a gap between them, the flexibility of the sole is enhanced. As shown in Figs. 1 and 2, wear-resistant outsole materials 37 and 38 are provided at least in the areas of the heel and beneath the ball of the foot in the toe portion. The material used for these outsole layers 37, 38 is preferably rubber or an abrasion-resistant polyurethane which is harder than the polyurethane of the upper or lower layers, or other similar materials. These outsole materials provide traction and abrasion resistance such that the shoe may have a relatively long useful life. When the outsole materials 37 and 38 are made of high density polyurethane, they can be integrally molded with the other layers. Otherwise, the outsole materials may be glued, ultrasonically welded or otherwise attached to the molded combination of the upper and lower layers.

It is not necessary for the outsole materials 37 and 38 to be used in complete pieces in this embodiment, as it is also contemplated that a series of strips of such materials 37A, 37B, 37C, 38A, 38B, 38C, 38D, as shown in Fig. 2, can be used. In this arrangement, some of the strips can be made of harder materials than the others for placement in the

portions of the sole which experience the greatest degree of wear or abrasion. These strips can be applied horizontally as shown in Fig. 2 or vertically as shown in Figs. 3 and 5. Also, although not shown in these Figures, these strips can extend along the complete bottom of the lower layer to form a complete outsole. Also, spaces can be provided between these strips to increase the flexibility of the sole.

Another variation of the invention is shown in Figs. 1-5, wherein the lower layer extends completely around and surrounds the upper layer. In this arrangement, the greatest degree of lateral support is provided to both the upper layer and the user's foot. Furthermore, when the lower layer 2 is made of a relatively harder polyurethane material that has abrasion resistant properties, it may be molded to a form which would include pieces 37 and 38. In addition, it is possible to mold only certain strips (e.g., 38B, 38D, 37A) to be of a harder rubber, polyurethane or like material. The remaining strips or pieces of the sole can then be glued or otherwise attached to the lower layer. If desired, the harder materials can be first provided on the lower surface of the lower layer in the appropriate locations, and the remainder of the outsole can be formed by molding a different polyurethane into the spaces between the harder materials.

The lower and upper layers can have a variety of different configurations and can have shock inserts, stabilizers, or other additional components as shown in U.S. Patent 5,025,573, the content of which is expressly incorporated herein by reference thereto.

Fig. 6 illustrates another way in which the sole portion 38 can be made with strips of different hardness materials. For example, portion 41, a

peripheral band, can be made of the hardest material to facilitate the wear resistance of the shoe as it is worn and used, whereas portion 40 could be made of a slightly softer material to provide additional cushioning and suitable wear resistance. Portion 42 which does not experience anywhere near as much abrasion or wear as portions 40 and 41 can be made of a softer material for even greater cushioning of the foot.

Similarly, in Fig. 7, portion 45 can be made of the hardest and most wear resistant material used in the sole, since this area experiences the greatest stress and wear. Also, portion 44 can be made of a slightly softer wear-resistant material since abrasion and stress at that point is less. Portion 46 again can be a softer material for cushioning of the foot and for absorbing impact or shock while running, playing sports or conducting other strenuous activities. Different levels of effective cushioning can also be achieved by varying the thickness of the strips. In yet another embodiment, the hardest or thickest strips can be provided in the areas which will experience the highest degree of abrasion or wear, and the remainder of the outsole can be molded around the strips, i.e., in the gaps and spaces between the strips and the balance of the bottom side of the sole. If desired, threads or grooves may also be provided to facilitate traction or flexibility when the shoe is worn. These threads or grooves would typically be situated between the wear strips.

Figs. 8 and 9 illustrate another embodiment of the invention wherein the upper layer 44 is formed with a recessed portion 49 in the shape of the bottom of the user's foot, whereas the lower layer 45 may be similar to other embodiments. In this version,

however, the forward end of the lower layer 45 extends to the front portion of the shoe to form a toe guard 46 and the rearward end of the lower layer 45 extends to the rear portion of the shoe to form a heel guard 47. As noted above, it is preferred to mold the upper and lower layers together since this forms a unitary structure. When gluing or other means of adhesively attaching the layers is used, grooves 48 may be provided on the upper surface of the lower layer for engagement with corresponding ribs positioned in the lower surface of the upper layer. These grooves 48 assure that the layers are in proper mating engagement when being attached by the adhesive so that the layers are positioned correctly with respect to each other in the final construction of the shoe sole. In addition, these grooves would increase the flexibility of the sole by providing lateral depressions which can bend more easily than a solid structure.

Figs. 10-12 illustrate a women's high heel shoe in accordance with the invention. This shoe is formed of a molded body component 50, preferably of a polyurethane material, but other materials can be used, which has a last (foot form) 51 secured to the top thereof and which optionally encloses a stabilizer 52 therein. The outsole is formed of various pieces or strips of wear-resistant material. For example, wear resistant outsole materials 53 and 54 are provided at least in the areas of the heel and beneath the ball of the foot in the toe portion. The material used for these outsole layers 53, 54 is preferably rubber or an abrasion-resistant polyurethane which is harder than the polyurethane which may be used for the body component 50. As noted above, outsole materials which provide traction and abrasion resistance are used so that the shoe may have a relatively long

useful life. These outsole materials can be made of high density polyurethane and integrally molded or can be made of other materials and glued, ultrasonically welded or otherwise attached to the body component. As described above, it is not necessary for the outsole materials 53 and 54 to be used in complete pieces in this embodiment, as it is also contemplated that a series of strips of such materials, applied horizontally, vertically, or in patterns can be selected to provide the optimum performance of the shoe in the desired wearing environment. Although the outsole materials are shown as being flat, they can be provided with contours, grooves or threads to increase the flexibility and traction of the sole, if desired.

Figs. 13-21 illustrate a double contour, double density ladies' dress shoe 60 which is constructed in accordance with the present invention. Specifically, this shoe includes a lower support layer 62, which can be made in one piece as shown from a plastic or rigid foam material, and an upper 64. The lower support layer 62 must be made of a sufficiently rigid material to provide the necessary support to span the areas between the user's heel and toes (shank support). Thus, the stiffness and hardness of the material must be tailored to the type of shoe, with the higher spike heels requiring a stiffer material than would be used for shoes having low or moderate height heels. The lower support layer 62 may also include an outsole of a relatively harder, wear resistant material as a single layer covering the entire bottom surface of layer 62 or in the form of a series of strips positioned at least beneath the ball and toe area as well as beneath the heel area, as shown in the embodiment of Fig. 10.

The construction of the lower support layer 62 and the various upper layers which may be positioned upon it are shown in Figs. 14-16. The lower support layer 62 of Fig. 14 includes an integral heel for strength, and has an upper surface which is slightly contoured in the heel area, preferably by being slightly raised along the outer perimeter to provide cushioning to the heel of the user. The remaining upper surface of layer 62, i.e., the toe and instep portions, may be flat or may include raised areas for additional cushioning and support for the user's foot. Upon the upper surface of layer 62 is provided a foam layer 66, which, as shown in other Figures, preferably has an uppermost surface which is contoured to be complemental to the foot of the user. This layer 66 is made of a material which is softer than that of the lower layer 62. For example, the lower layer could be made of a polyurethane having a Shore A hardness of about 60 to 90 or higher, while the upper layer could be made of a softer polyurethane or EVA (ethyl vinyl acetate) having a Shore A hardness of about 40 to 60. If desired, the upper surface of foam layer 66 can be configured to include a raised portion in the toe area, a cupped heel area and an instep arch for additional cushioning and support of the user's foot. However, by contouring the upper surface of the lower support layer 62, only a single upper foam layer would be needed to provide sufficient support and cushioning to the user's foot.

Instead of lower support layer 62, a conventional lasting board made of heavy paper, cardboard, or another fairly rigid material, can be used as the support surface for the shoe. A single piece foam layer, which is similar to upper layer 66 described above, is then attached to this board, along with an

upper 64 and an outsole. This single piece foam layer may be contoured as described above with regard to foam layer 66, and the upper surface is preferably configured to be complemental to the user's foot. This foam layer may have also have different densities to provide different levels of cushioning to different portions of the wearer's foot. If desired, a covering can be placed upon the top surface of the foam layer. This covering, which may be made of leather, cambrelle or soft polyurethane, is commonly referred to as a sock liner. Thus, the entire shoe can be constructed from a minimum number of components, while also providing a high level of comfort and cushioning to the user's foot.

Fig. 15 illustrates an embodiment which is similar to that of Fig. 14, except that the rigid support layer 62 does not include an integrally molded heel. Instead, a separate heel made of a rigid thermoplastic material is attached to the layer 62. The upper surface of the support layer 62 and the foam layer 66 could be configured in the same manner as described above in Fig. 15.

The embodiment of Figs. 16 and 18 is similar to that of Fig. 15 except that shock foam inserts 72 are included beneath the toe and heel portions of foam layer 66. These shock foam inserts 72 are made of an impact absorbing foam and are provided for shoes which will experience relatively heavy or large shock forces, such as would typically occur during extended walking, standing, or other lengthy or strenuous physical activities. This construction provides the greatest degree of comfort when the shoe is used for those purposes.

Figs. 17 and 18 illustrate the attachment of the upper 64 to the support layer 62 in the heel area for

the shoes of Figs. 15 and 16, respectively, while Fig. 18 further illustrates the positioning of the shock foam insert 72 in the heel area for the shoe of Fig. 17. In these Figures, an outsole 74 is shown on the bottom surface of the heel.

Fig. 19 illustrates the forefoot area of the shoe of Fig. 15 in cross-section to detail the attachment of the upper 64 to the support layer 62. An outsole 74 is also shown. In Fig. 20, a slightly different configuration is provided for the support layer 62, in that it has a raised perimeter 78 and a relatively flat inner area 76. In this arrangement, the raised perimeter portions 78 provide support for the perimeter of the user's foot, as well as room for attachment of the upper 64. It is desirable for a shock foam insert to be utilized with an upper foam layer that has a raised portion in the toe area, as shown in Fig. 20. Also, the arch and heel areas of the upper foam layer 66 can also be raised or contoured to provide an upper surface which is complementary to the foot of the user. Fig. 21 illustrates the positioning of the shock foam insert 72 in the toe area for the shoe of Fig. 16 as well as the attachment of the upper 64 and outsole 74 to the support layer 62.

Figs. 22-26 illustrate a sport or walking shoe made in accordance with the present invention. The shoe depicted in Fig. 22 comprises an upper 81, which may be made of leather, canvas, nylon, man-made materials, or any flexible material having sufficient strength. The midsole has a contoured firm lower 83 in accordance with the present invention as described above. The outsole 84 is made of rubber or a rugged polyurethane elastomer or other suitable wear-resistant material. Fig. 23 shows a soft contoured

insert 82, which provides a footbed in accordance with the present invention. The insert, the upper surface of which may be fully or partially covered by a sockliner 86, is designed to be inserted into the shoe and to rest upon the radial wrap 85 that constitutes the shoe's upper in the area where said radial wrap covers the midsole 83. If desired, the insert may be secured to the radial wrap by an adhesive. Also, this insert 82 can be made in any of the manners described in U.S. Patent 5,205,573.

Fig. 24 illustrates the shoe in assembled form, indicating the upper 81, the midsole 83, and the outsole 84, as well as the locations of the two cross-sections shown in Figs. 25 and 26. Fig. 25 illustrates the heel area of the shoe of Fig. 24 in cross-section. In Fig. 25, the outsole 84 and the contoured midsole 83 are shown in their actual positions, but the footbed 82 is shown elevated in order to detail its relative positioning within the heel area of the shoe. Likewise, in Fig. 26, the outsole 84, the contoured midsole 83, and the upper 81 are shown in their actual positions, but the footbed 82 is shown elevated in order to detail its relative positioning within the toe area of the shoe. In both Figs. 25 and 26, it is clear that the footbed will rest upon the radial wrap. It is possible that upper 81 will not entirely wrap around and under footbed 82, but will attach to the upper inside portions of midsole 83.

Having thus clearly described our invention in a manner which is fully understandable to persons skilled in the art, it is intended that the appended claims cover the preferred embodiments as well as any

and all modifications which may be devised by such persons but which would fall within the true spirit and scope of the present invention.

THE CLAIMS

What is claimed is:

1. A composite shoe bottom having a toe area, arch area, and heel area comprising:

a lower shaped layer having a predetermined hardness, a lower surface and an increased height around the periphery of the heel area and in the arch area to form a raised arch support and an irregular contoured upper stabilizing surface for the wearer's foot;

an upper cushioning layer of a material which is softer than said lower layer and is superposed in face-to-face relation upon said upper surface of the lower layer, said upper layer having a varying thickness which is pre-shaped to a contour complementary to the bottom surface of the wearer's foot and having an increased height around the periphery of the heel area and in the arch area to form a raised arch support and to provide an irregular contoured upper stabilizing surface for the wearer's foot; and

means for forming an outsole secured to at least a portion of the lower surface of the lower support layer and comprising at least one strip of a wear resistant material which is positioned upon the lower layer in an area which will experience abrasion or shock.

2. The composite shoe bottom of claim 1 wherein the at least one strip is positioned beneath the heel area adjacent the rearmost portion of the lower layer and extending toward the toe area.

3. The composite shoe bottom of claim 1 wherein the at least one strip is configured and positioned to extend along at least a portion of the periphery of the heel area.

4. The composite shoe bottom of claim 1 wherein a first strip is positioned adjacent the toe area beneath the ball of the wearer's foot and a second strip is positioned in the heel area beneath the user's heel.

5. The composite shoe bottom of claim 1 wherein a plurality of strips of wear resistant material are used, wherein some of the strips are softer than the others to provide shock absorption to the upper and lower layers.

6. The composite shoe bottom of claim 1 wherein a plurality of strips of wear resistant material are used, wherein some of the strips are thicker than the others to provide shock absorption to the upper and lower layers.

7. The composite shoe bottom of claim 1 wherein an outsole-forming material is applied to the lower surface of the lower layer in areas which are not covered by the at least one strip to form an outsole which is contiguous with the lower surface of the lower layer.

8. The composite shoe bottom of claim 1 wherein the outsole extends to the upper layer along at least one side of the lower layer.

9. The composite shoe bottom of claim 1 wherein an outsole is formed from a plurality of the outsole portion strips.

10. The composite shoe bottom of claim 1 wherein a portion of the outsole extends to the upper layer along the forward end of the lower layer.

11. The composite shoe bottom of claim 1 wherein a portion of the outsole extends to the upper layer along the rearmost end of the lower layer.

12. The composite shoe bottom of claim 1 wherein portions of the outsole extend to the upper layer along the forward and rearmost ends of the lower layer.

13. The composite shoe bottom of claim 1 wherein the first strip covers the toe area of the lower layer and the adjacent area beneath the ball of the user's foot, and the second strip covers the heel area of the lower layer.

14. The composite shoe bottom of claim 1 wherein the first strip is spaced apart from the second strip.

15. The composite shoe bottom of claim 1 further comprising at least one stabilizing insert for providing greater support to the wearer's foot.

16. The composite shoe bottom of claim 1 wherein one of the lower and upper layers includes a plurality of positioning ribs and the other includes a plurality of locating grooves, wherein the ribs and groves are configured for mating engagement when the layers are secured together.

17. The composite shoe bottom of claim 1 wherein the ribs are located on the upper layer and the grooves are located on the lower layer, and the upper and lower layers are adhered together to form the shoe bottom.

18. The composite shoe bottom of claim 1 wherein the upper and lower layers are joined by an adhesive.

19. The composite shoe bottom of claim 1 wherein the upper and lower layers are integrally molded together.

20. The composite shoe bottom of claim 1 wherein the lower layer is made of a plastic material which is sufficiently rigid to provide support to the user's foot.

21. The composite shoe bottom of claim 1 wherein the lower layer comprises a lasting board and the upper layer comprises a one piece molded relatively soft polyurethane layer.

22. The composite shoe bottom of claim 1 which further comprises a sock liner provided upon the upper surface of the upper layer.

23. The composite shoe bottom of claim 1 which further comprises an upper and a separate heel, each of which is attached to the lasting board.

24. The composite shoe bottom of claim 1 wherein the lower support layer includes an integral heel portion, and the means for forming an outsole is included at least on the heel portion and on the

bottom surface of the lower layer beneath the ball of the wearer's foot.

25. The composite shoe bottom of claim 1 further comprising shock absorbing inserts positioned beneath a portion of at least one of the heel area of the upper layer or the bottom surface of the upper layer beneath the ball of the wearer's foot.

26. The composite shoe bottom of claim 1 wherein the lower layer further comprises raised perimeter portions for providing support for the user's foot, and a relatively flat inner area for receiving one or both of the shock foam inserts.

27. The composite shoe bottom of claim 1 wherein the lower layer has a shore A hardness of about 50 to 100, the upper layer has a shore A hardness of about 30 to 60 and the lower layer has a greater hardness than the upper layer.

28. The composite shoe bottom of claim 1 wherein the areas between the strips are provided with a molded polyurethane material or EVA.

29. The composite shoe bottom of claim 1 wherein the molded polyurethane material is molded to have a plurality of grooves or threads to enhance the traction and flexibility of the shoe.

30. The composite shoe bottom of claim 1 wherein the one piece foam layer has different densities to provide different levels of cushioning to different portions of the wearer's foot.

31. A composite shoe bottom having a toe area, arch area, and heel area comprising:

a lower shaped support layer having a lower surface, an increased height around the periphery of the heel area, and an irregular contoured upper stabilizing surface for the wearer's foot;

means for forming a shoe upper superposed upon the upper surface of the lower layer; and

an upper cushioning layer of a material which is softer than said lower layer and which is superposed upon the shoe upper forming means in the area where it contacts the lower layer, the upper cushioning layer having a varying thickness which is pre-shaped to a contour complementary to the bottom surface of the wearer's foot and having an increased height around the periphery of the heel area and in the arch area to form a raised arch support and to provide an irregular contoured upper stabilizing surface for the wearer's foot.

32. The composite shoe bottom of claim 31 further comprising means for forming an outsole secured to at least a portion of the lower surface of the lower support layer and comprising at least one strip of a wear resistant material which is positioned upon the lower layer in an area which will experience abrasion or shock.

33. The composite shoe bottom of claim 31 wherein the lower layer comprises a lasting board and the upper layer comprises a one piece molded relatively soft polyurethane or EVA layer.

34. The composite shoe bottom of claim 31 which further comprises a sock liner provided upon the upper surface of the upper layer.

35. The composite shoe bottom of claim 34 wherein the sock liner and upper layer form an integral component which is inserted into the shoe upper forming means.

36. The composite shoe bottom of claim 31 wherein the upper layer is attached to the shoe upper forming means by an adhesive.

37. The composite shoe bottom of claim 31 wherein the shoe upper comprises a radial wrap at least in the toe area or partial radial/surrounding pieces.

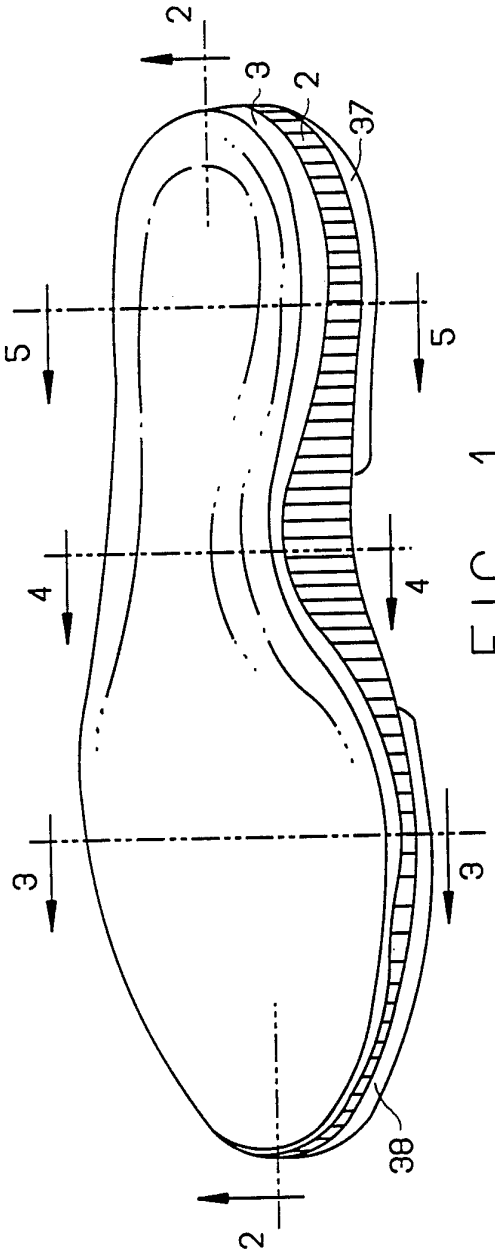


FIG. 1

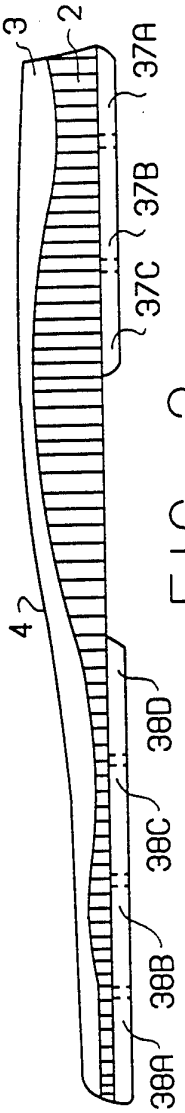
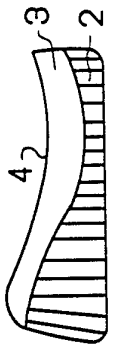


FIG. 2



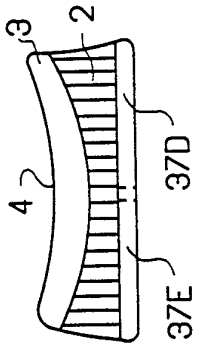


FIG. 4

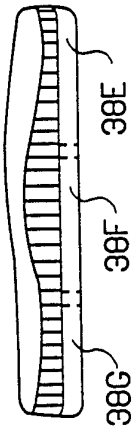


FIG. 3

FIG. 5

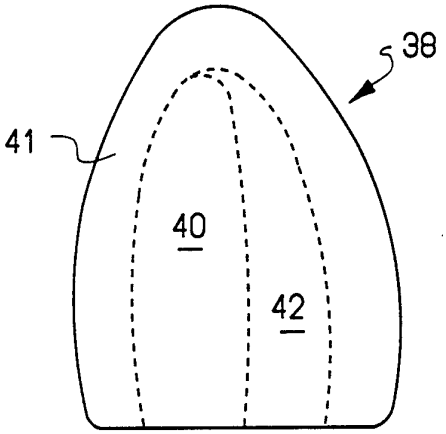


FIG. 6

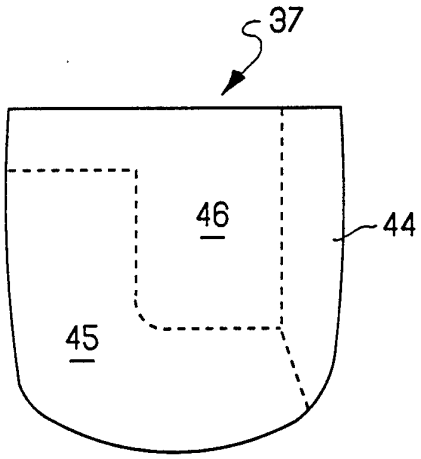


FIG. 7

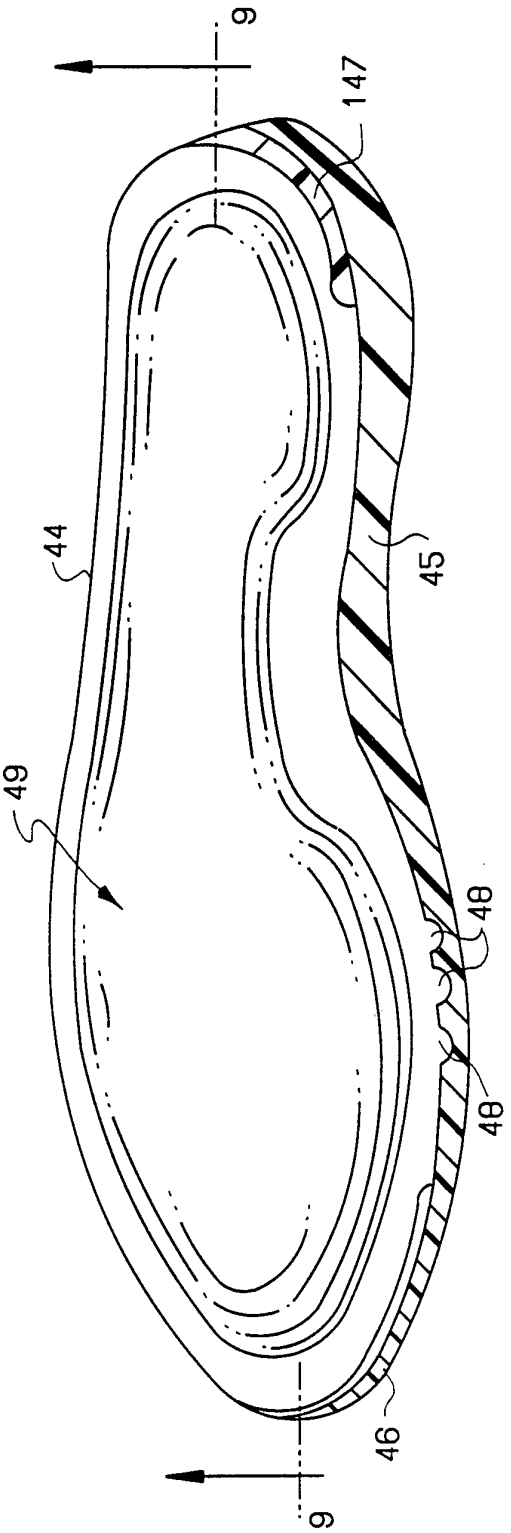


FIG. 8

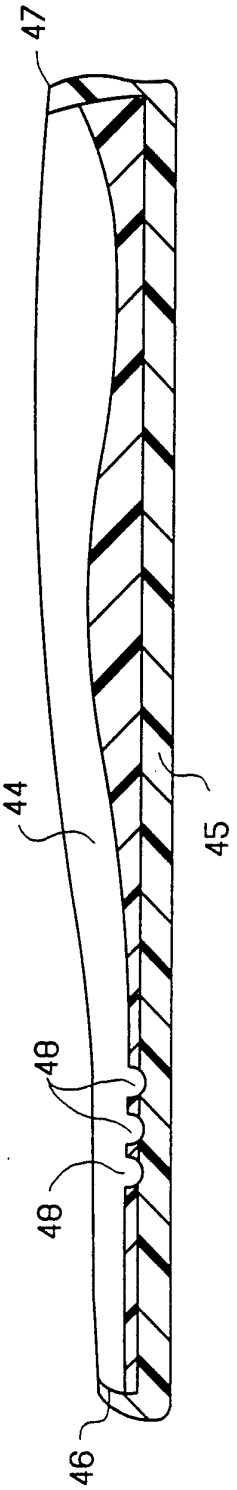


FIG. 9

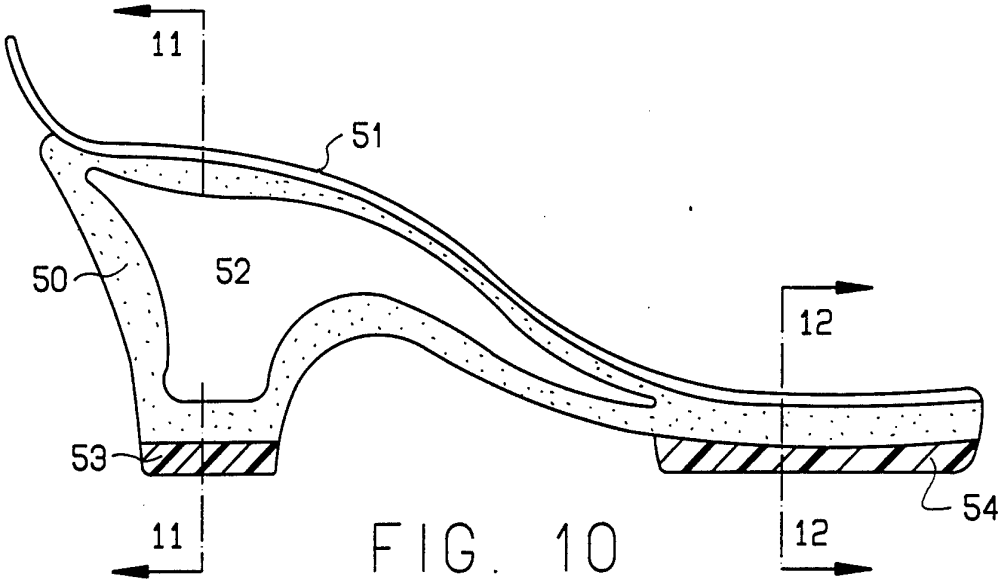


FIG. 10

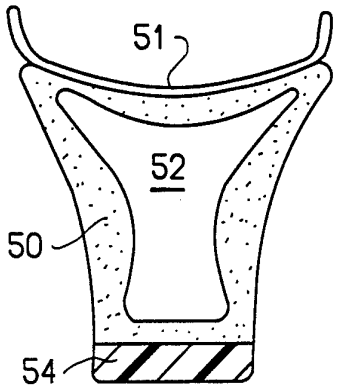


FIG. 11

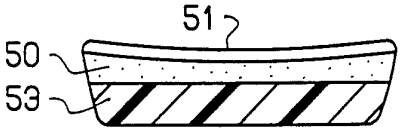


FIG. 12

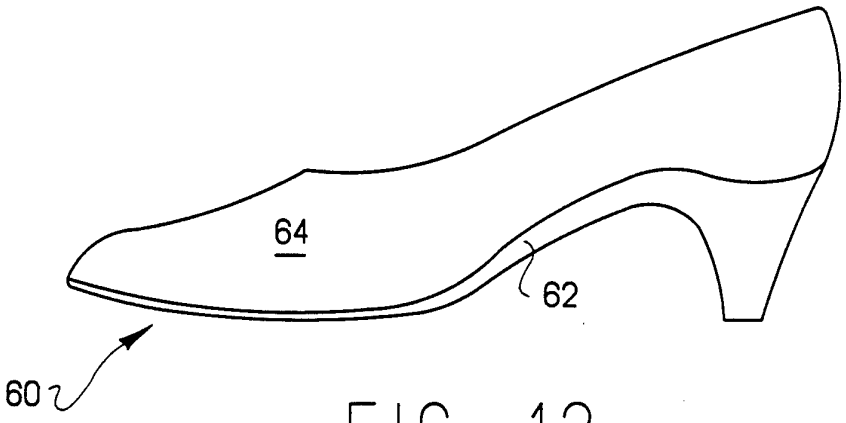


FIG. 13

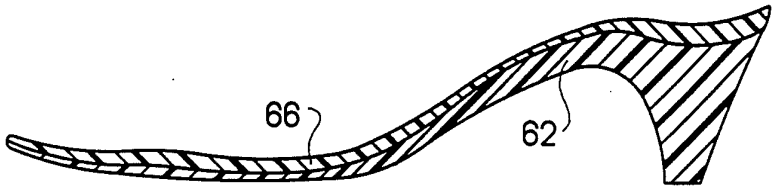


FIG. 14

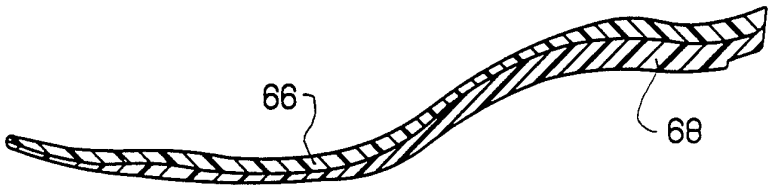


FIG. 15

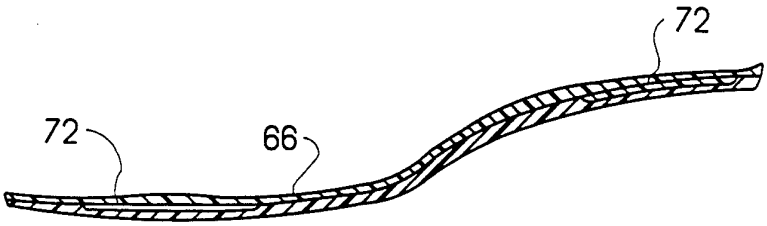


FIG. 16

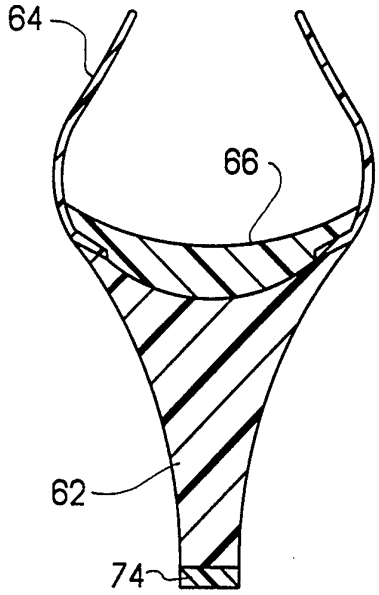


FIG. 17

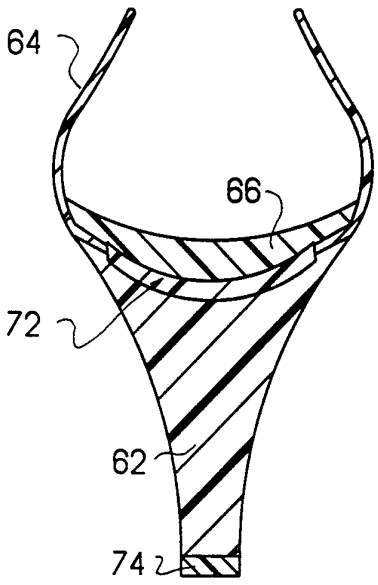


FIG. 18

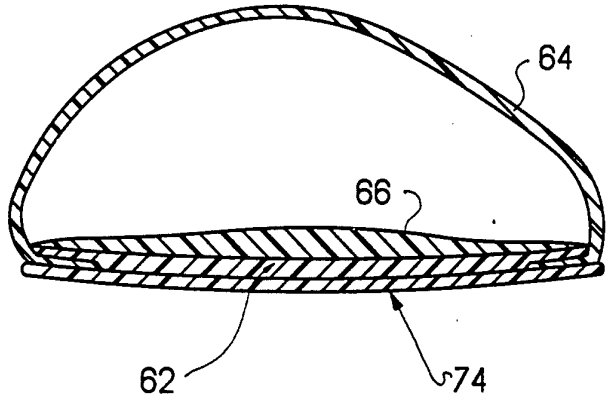


FIG. 19

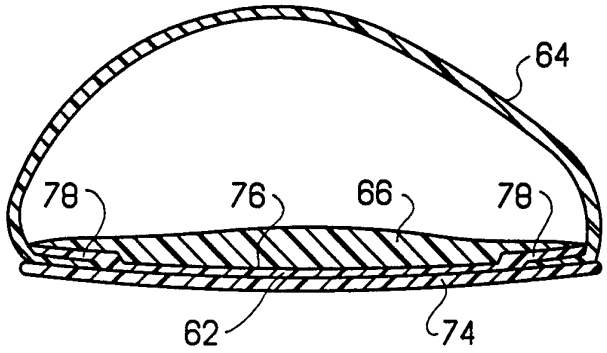


FIG. 20

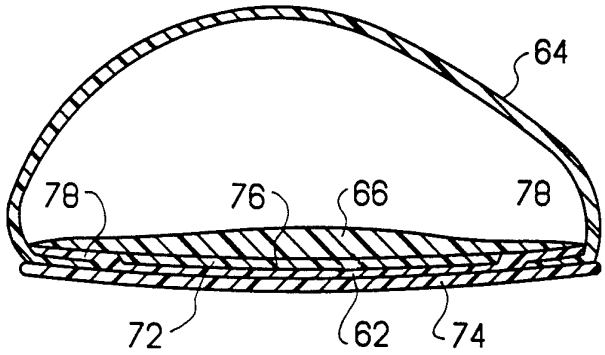


FIG. 21

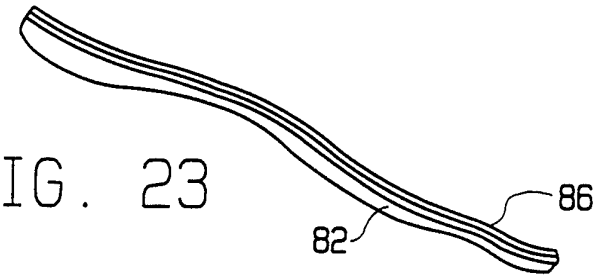


FIG. 23

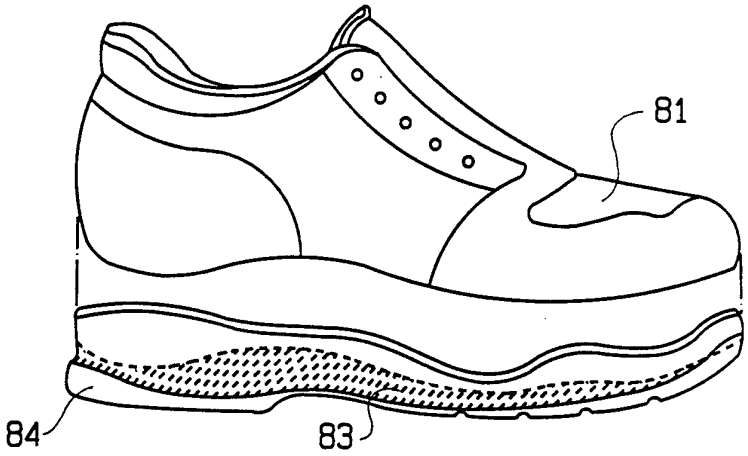


FIG. 22

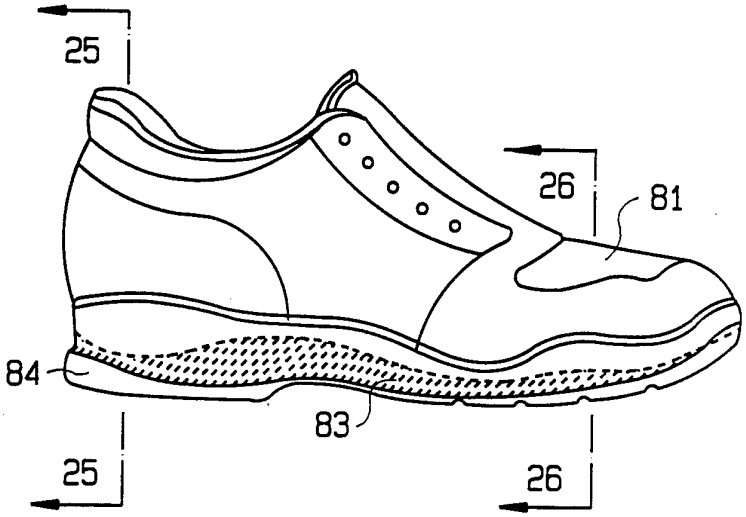


FIG. 24

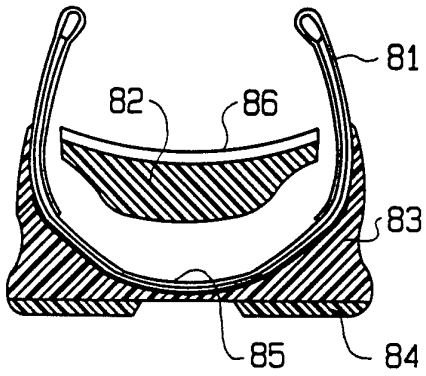


FIG. 25

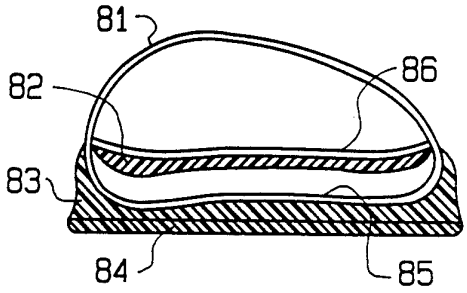


FIG. 26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/04718

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A43B 13/14, 13/12
US CL :36/30R, 31, 28
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. : Please See Extra Sheet.

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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,399,620 (FUNCK) 23 AUGUST 1983, ENTIRE DOCUMENT	1-37
Y	US, A, 4,676,010 (CHESKIN) 30 JUNE 1987, ENTIRE DOCUMENT	1-30, AND 32
Y	US, A, 5,025,573 (GIESE ET AL) 25 JUNE 1991, ENTIRE DOCUMENT	4-7, 13-17, 28, 30-37
Y	US, A, 4,547,979 (HARADA ET AL) 22 OCTOBER 1985, ENTIRE DOCUMENT	5
Y	US, A, 4,831,750 (MULLER) 23 MAY 1989, ENTIRE DOCUMENT	8, 10-12
Y	US, A, 4,759,136 (STEWART) 26 JULY 1988, ENTIRE DOCUMENT	15

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

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier document published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search
14 JULY 1994

Date of mailing of the international search report
JUL 26 1994

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/04718

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A 4,667,423 (AUTRY ET AL) 26 MAY 1987, ENTIRE DOCUMENT	16-17, 21, 33
Y	US, A, 4,161,828 (BENSELER ET AL) 24 JULY 1979, ENTIRE DOCUMENT	22, 25, 34
Y	US, A, 2,502,774 (ALIANELLO) 04 APRIL 1950, ENTIRE DOCUMENT	23
Y	US, A, 4,694,591 (BANICH ET AL) 22 SEPTEMBER 1987, ENTIRE DOCUMENT	30
Y	US, A, 4,124,946 (TOMLIN) 14 NOVEMBER 1978, ENTIRE DOCUMENT	31-37
A	US, A, 4,677,767 (DARBY) 07 JULY 1987	
A	US, A, 4,213,255 (OLBERZ ET AL) 22 JULY 1980	
A	US, A, 4,798,010 (SUGIYAMA) 17 JANUARY 1989	
A	WO, A, 83/04166 (SCHMOHL) 08 DECEMBER 1983	
A	DE, A, 3,635,831 (GOLLER) 11 MAY 1988	