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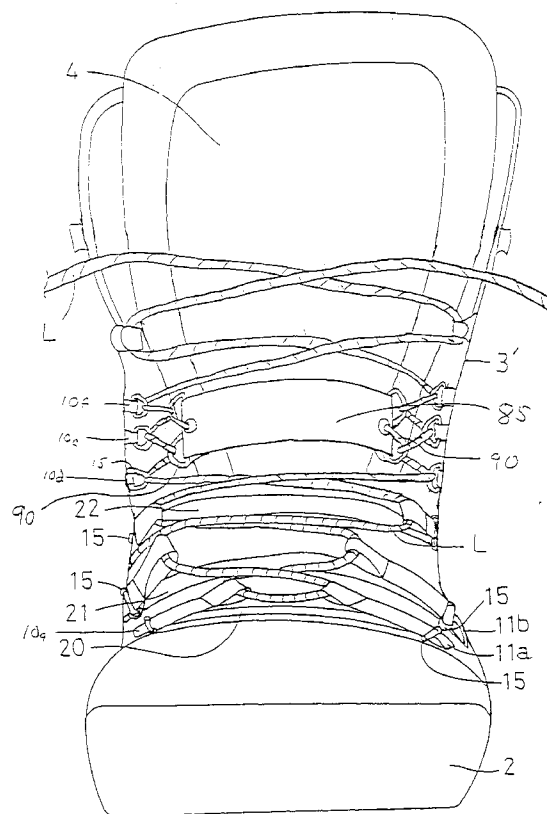
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(54) Snowboard boot power lacing configuration

(57) The invention relates to a shoe lacing configuration where short straps attached to sides of an article of footwear are formed with loops. A secondary lacing strap (85) includes loops (90) through which a lace extends. The lace extends through lacing means formed on opposite sides of a boot and further extends through the loops in the secondary lacing strap. The secondary lacing strap has the effect of doubling the force applied to the lace on the opposite sides of the boot in a manner similar to that of a block and tackle thus improving the lace tightening characteristics of the article of footwear.

Fig. 14



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Description

BACKGROUND OF THE INVENTION

A. Field Of The Invention

[0001] The invention relates to a lacing configuration for footwear and in particular to a lacing configuration for a snowboard boot.

B. Description Of The Related Art

[0002] The laces on boots and large articles of footwear generally are difficult to tighten, especially when wet.

[0003] Boots are usually formed with a sole and an upper portion. The upper portion is usually made of a pliable material such as leather or a leather-like material. The upper portion is usually formed with central opening. A tongue is formed on a lower end of the opening, the tongue extending between the sides of the opening. The sides of the opening are usually formed with loops or eyelets through which a lace extends. The lace typically extends through the loops or eyelets in a criss-cross manner, going from side to side through the loops and eyelets. Typically the eyelets or loops are formed on opposite sides of the opening in equal numbers at equally spaced apart intervals, defining pairs of eyelets or loops.

[0004] When putting the boots on, the lower portions of the laces must typically be pulled tight near eyelets or loops separately from the tightening of the ends of the lace. For example, a large boot typically has seven or eight pairs of eyelets or loops through which the lace extends. Often a boot user must pull portions of the lace near a second or third set of eyelets tight and then successively move up the pairs of eyelets, grab the corresponding portions of the lace and tighten it further until the top or ends of the lace are finally tightened. Such an operation is particularly difficult if the boot and lace are wet from prior usage of the boot. Whether the lace is wet or dry, the criss-cross configuration of the lace and friction make it very difficult to tighten the lace easily.

SUMMARY OF THE INVENTION

[0005] One object of the present invention is to provide an article of footwear with a lace configuration which is easier to tighten.

[0006] In accordance with one aspect of the present invention, an article of footwear includes a sole portion made of a sole forming material and an upper portion adhered to the sole portion. The upper portion is formed with a generally central extending tongue portion on an upper surface thereof. Opposite sides of the upper portion are configured for receiving a lace for drawing the opposite sides of the upper portion toward one another. A lacing strap is configured to receive the lace through

portions thereof. The lacing strap and the lace are for providing leverage for tightening the article of footwear on the foot.

[0007] Preferably, the lacing strap is disposed between the opposite sides of the upper portion proximate an ankle supporting portion of the article of footwear.

[0008] Preferably, the article of footwear also includes a first short strap and a second short strap fixed to lower edges of the upper portion, the first short strap being fixed to a left side of the upper portion and the second short strap being fixed to a right side of the upper portion. The first and second short straps are positioned at generally corresponding right and left sides of the upper portion. Each of the first and second short straps define a loop having a ring extending through the loop. A long strap extends through the ring of the first short strap and further extending through the ring of the second short strap. The first long strap has loops formed at each end thereof. The lace is extendable in a criss-cross manner through the loops formed in the long strap, respectively, for tightening the article of footwear on a foot, the long strap providing further leverage to the lace for tightening the article of footwear on the foot.

[0009] Preferably, the article of footwear also includes a third short strap and a fourth short strap fixed to lower edges of the upper portion. The third short strap is fixed to a left side of the upper portion and the fourth short strap is fixed to a right side of the upper portion. The first, second, third and fourth short straps are spaced apart from one another on the right and left sides of the upper portion. Each of the third and fourth short straps defines a loop having a ring extending through the loop. A second long strap extends through the ring of the third short strap and further extends through the ring of the fourth short strap. The second long strap has loops formed at each end thereof. The lace is extendable in a criss-cross manner through the loops formed in the long strap and the second long strap, respectively, for further tightening the article of footwear on a foot, the long strap and the second long strap providing leverage to the lace for tightening the article of footwear on the foot.

[0010] Preferably, the article of footwear further includes a fifth short strap and a sixth short strap fixed to lower edges of the upper portion. The fifth short strap is fixed to a left side of the upper portion and the sixth short strap is fixed to a right side of the upper portion. The first, second, third, fourth, fifth and sixth short straps are spaced apart from one another on the right and left sides of the upper portion. Each of the fifth and sixth short straps define a loop having a ring extending through the loop. A third long strap extends through the ring of the fifth short strap and further extends through the ring of the sixth short strap. The third long strap has loops formed at each end thereof. The lace is extendable in a criss-cross manner through the loops formed in the long strap and the second and third long straps, respectively, for tightening the article of footwear on a foot. The long strap and the second and third long straps provide fur-

ther leverage to the lace for tightening the article of footwear on the foot.

[0011] Preferably, all of the rings are made of metal.

[0012] Preferably, each of the loops in the long strap, the second and third straps are formed from a looped section of strap material which defines a ring through which the lace extends.

[0013] Preferably, the lacing strap is formed with plastic loops for receiving the lace.

[0014] Preferably, the lacing strap is formed with fabric loops for receiving the lace.

[0015] Preferably, the lacing strap is formed with eyelets for receiving the lace.

[0016] Preferably, the lacing strap is formed with a width that is at least five times larger than the width of the lace.

[0017] The lacing strap of the present invention provides an article of footwear with additional tightening means. Specifically, the force applied when a lace is tightened is amplified such that the boot is more securely fastened to the foot in the region of the lacing strap.

[0018] The various long straps of the present invention provide additional tightening means for amplifying the force from the lace on the foot within the article of footwear.

[0019] These and other objects, features, aspects and advantages of the present invention will become more fully apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings where like reference numerals denote corresponding parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a front view of a boot having a double lacing configuration in accordance a first embodiment of the present invention, where a long lace extends through rings of a plurality of straps;

Fig. 2 is a side view of the boot depicted in Fig. 1;

Fig. 3 is a side perspective view of several straps similar to the straps of the boot depicted in Figs. 1 and 2, with the lace removed to provide greater clarity, in accordance with a second embodiment of the present invention;

Fig. 4 is a front perspective view of a single strap of the boot depicted in Fig. 3, with the boot, the lace and other straps removed to provide greater clarity;

Fig. 5 is a front perspective view similar to Fig. 4, showing a single strap of a boot in accordance with the first embodiment of the present invention;

Fig. 6 is an end view of portion of a prior art boot lacing configuration;

Fig. 7 is an end view of a portion of a boot using the lacing configuration in accordance with the present invention;

Fig. 8 is a front view similar to Figs. 4 and 5, showing

short straps and long straps in accordance with a third embodiment of the present invention;

Figs. 9, 10, 11 and 12 are front views of various rings that may be employed in the first and second embodiments of the present invention;

Fig. 13 is a side view of a snowboard boot in accordance with a fourth embodiment of the present invention in which the snowboard boot includes a secondary lacing strap;

Fig. 14 is a front view of the snowboard boot depicted in Fig. 13;

Fig. 15 is a front view of the secondary lacing strap depicted in Figs. 13 and 14 shown removed from the snowboard boot;

Fig. 16 is a front view of an alternate secondary lacing strap similar to that depicted in Fig. 15;

Fig. 17 is a front view of yet another alternate secondary lacing strap similar to those depicted in Figs. 15 and 16, and

Fig. 18 is a force diagram depicting a representation of the forces acting between a lace L and the secondary lacing strap.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] A boot 1 is shown in Fig. 1 which includes a power lacing configuration in accordance with a first embodiment of the present invention. The boot 1 shown in Figs. 1 and 2 is a snowboard boot. However, the lacing configuration in accordance with the present invention may be employed on any of a variety of boots or footwear. For instance, the lacing configuration could be used on running shoes, bicycle racing shoes, hiking boots, ski boots, snowboard boots or others.

[0022] The boot 1 includes a sole portion 2 made of a sole forming material and an upper portion 3 adhered to the sole portion 2. The upper portion 3 is formed with a generally central extending tongue portion 4 which extends between sides of an opening formed in the upper portion 3. Each side of the upper portion 3 is formed with a plurality of short straps. The short straps are divided into two sets of straps, a first set of short straps 10a, 10b, 10c, 10d and 10e and a second set of short straps 11a, 11b, 11c, 11d and 11e. The first set of short straps are fixed to a lower edge of a first side of the upper portion 3, and the second set of short straps are fixed to a lower edge of a second side of the upper portion 3, as shown in Figs. 1 and 2.

[0023] The short strap 10a and the short strap 11a are positioned at corresponding locations on the first and second sides of the upper portion 3. Similarly, the short strap 10b and the short strap 11b are positioned at corresponding locations on the first and second sides of the upper portion 3. Similarly, all the other short straps of the first set of short straps (10c, 10d and 10e) and the second set of short straps (11c, 11d and 11e) are positioned at corresponding locations on the first and sec-

ond sides of the upper portion 3. All of the short straps of the of the first set of straps 10a, 10b, 10c, 10d and 10e and of the second set of straps 11a, 11b, 11c, 11d and 11e are spaced apart from each other by predetermined intervals which may vary depending on the footwear application.

[0024] It should be appreciated that the number of short straps in each of the first and second set of short straps may vary. In the preferred embodiment depicted five short straps are included in each of the first and second sets of short straps. However the number of short straps in each set may be less or more depending on the type of footwear on which the lacing configuration of the present invention is to be employed. For example, only one short strap on each side of a shoe could be utilized, especially if the shoe is small. On a pair of running shoes, perhaps each of the first and second sets of short straps might have only two or three short straps. However, on a pair of boots, for instance, hiking boots, ski boots or the snow board boots depicted in Figs. 1 and 2, five short straps in each of the first and second sets of short straps is the preferred embodiment.

[0025] Each of the short straps in the first and second sets of short straps are formed with a loop at an end thereof. A ring 15 extends through each end loop of short straps 10a, 10b, 10c, 10d, 10e, 11a, 11b, 11c, 11d and 11e.

[0026] A first long strap 20 extends through the ring 15 of the short strap 10a and further extends through the ring 15 of the short strap 11a. The first long strap 20 has loops formed at each end thereof. A second long strap 21 extends through the ring 15 of the short strap 10b and further extends through the ring 15 of the short strap 11b. The second long strap 21 has loops formed at each end thereof.

[0027] A third long strap 22 extends through the ring 15 of the short strap 10c and further extending through the ring 15 of the short strap 11c. The third long strap 22 having loops formed at each end thereof. A fourth long strap 23 extends through the ring 15 of the short strap 10d and further extends through the ring 15 of the short strap 11d. The fourth long strap 23 has loops formed at each end thereof. A fifth long strap 24 extends through the ring 15 of the short strap 10e and further extends through the ring 15 of the short strap 11e. The fifth long strap 24 has loops formed at each end thereof.

[0028] A lace L extends in a criss-cross manner through the loops formed in the first, second, third, fourth and fifth long straps 20, 21, 22, 23 and 24, respectively, for tightening the article of footwear on a foot. The first second, third, fourth and fifth long straps 20, 21, 22, 23 and 24 provide leverage to the lace for tightening the article of footwear on the foot.

[0029] It should be appreciated, that the number of long straps 20, 21, 22, 23 and 24 corresponds to the number of straps in each set of short straps. Specifically, in the depicted embodiment there are five long straps 20, 21, 22, 23 and 24. The five long straps extend

through the five short straps in the first set of short straps 10a, 10b, 10c, 10d and 10e and through the five short straps in the second set of short straps 11a, 11b, 11c, 11d and 11e. The long straps further extend over the opening in the upper portion 3 and across the tongue 4. In other shoe applications, the number of long straps 20, 21, 22, 23 and 24 could be varied. As was discussed above with respect to the short straps, in a small shoe application only one long strap 20 might be required. In a running shoe or bicycling shoe, two or three long straps might be employed. The five long straps 20, 21, 22, 23 and 24 are believed to be the optimal number of long straps for a snowboard boot such as that depicted in Figs. 1 and 2.

[0030] In the lacing configuration of the present invention, the rings 15 are preferably made of metal, specifically a plated steel or stainless steel to reduce friction contact between the long straps 20, 21, 22, 23 and 24 and the rings 15. However, the rings 15 could be made of any of a variety of materials such as brass, plastic, etc. Further, the rings 15 could be replaced with connectors, such as a riveted connector with a loop formed on the end through which the long straps 20, 21, 22, 23 or 24 may extend. The connectors could be riveted to the ends of the short straps 10a-10e and 11a-11e.

[0031] In Fig. 5, the configuration of the long strap 23 is shown in greater detail with the boot 1 and other straps removed. The shape and configuration of the long strap 23 is generally the same as the other long straps 20, 21, 22 and 24 except that the length of the long straps vary. Specifically, the long strap 20 is the shortest of the long straps. Long strap 21 is longer than long strap 20, strap 22 is longer than strap 21, strap 23 is longer than strap 22 and long strap 24 is longer than strap 23. Other than length, each of the long straps 20, 21, 22, 23 and 24 is generally configured uniformly.

[0032] The lace L extends in a criss-cross manner through the loops formed in the ends of the first, second, third, fourth and fifth long straps 20, 21, 22, 23 and 24. However, in an alternate embodiment

[0033] In Figs. 3 and 4 a second embodiment of the present invention is depicted. In the second embodiment, the long straps 20, 21, 22, 23 and 24 are formed with loops and each end thereof, and further includes a separate connector or separate ring 50. The separate rings 50 may be generally the same type of ring or connector as the ring 15. The lace L extends through the separate rings 50 in a manner similar to the way the lace L extends through the loops of the long straps in the first embodiment.

[0034] As shown in Fig. 6, traditional prior art lacing configurations have a lace extending through apertures formed in the sides of an upper shoe portion. A force F applied to the lace causes the lace to be pulled through the apertures for tightening. Any resistance or friction in the aperture with respect to the lace causes the lace to become difficult to tighten. Further, the force F itself contributes to the creation of friction.

[0035] In the present invention, as depicted in Fig. 7, the force F1 applied to the long strap 23 is further applied to the short straps 10d and 11d and is amplified in a manner similar to a block and tackle in that the movement of the long strap 23 is half that of the lace L due to the configuration of the long strap 23 through the ends of the short straps 10d and 11d. Further, the force F1 is amplified such that a force F2 acting on the short straps 10d and 11d is generally twice the force F1.

[0036] A third embodiment of the present invention is depicted in Fig. 8. In Fig. 8, long straps 23" and 24" extend through loops formed in the short straps 10d', 10e', 11d' and 11e'. A lace L further extends through loops formed in the long straps 23" and 24". In the third embodiment, the rings 15 are completely eliminated. All of the long and short straps of the present invention can similarly be configured with loops and ends thereof thus eliminating the need for the rings 15.

[0037] One ring 15 is depicted in Fig. 9, shown removed from the boot 1. The ring 15 also represents the rings 50 in that the rings 15 and 50 need not be the loop as depicted in Fig. 9. Alternatively, the rings 15 and 50 could be shaped with a more rectangular shape such as the ring 15a depicted in Fig. 10. Further, the rings 15 and 50 might also be replaced with the triangular shaped connector 15b. As well, the rings 15 and 50 could be replaced with the connector 15c depicted in Fig. 12. The connector 15c includes a ring and a connector portion C which is riveted to, for example, the short strap 10b.

[0038] A fourth embodiment of the present invention is depicted in Figs. 13 and 14. The snowboard boot depicted in Figs. 13 and 14 includes a sole portion 2 and an upper portion 3' adhered to the sole portion 2. The upper portion 3' also includes a generally central extending tongue portion 4 which extends between sides of an opening formed in the upper portion 3'. As with the above described embodiments, each side of the upper portion 3' is formed with a plurality of short straps. The short straps are divided into two sets of straps, a first set of short straps 10a, 10b, 10c, 10d, 10e and 10f and a second set of short straps 11a, 11b, 11c, 11d, 11e and 11f. The first set of short straps are fixed to a portion of a first side of the upper portion 3', and the second set of short straps are fixed to a lower edge of a second side of the upper portion 3', as shown in Figs. 13 and 14.

[0039] All of the short straps of the first set of straps 10a, 10b, 10c, 10d, 10e and 10f and of the second set of straps 11a, 11b, 11c, 11d, 11e and 11f are spaced apart from each other by predetermined intervals which may vary depending on the footwear application, and include a ring 15, similar to the rings 15 described above.

[0040] Long straps 20, 21 and 22 each extend through corresponding rings 15, as shown in Figs. 13 and 14, in a manner similar to that described above. Further a lace L extend through loops formed in the ends of each of the long straps 20, 21 and 22.

[0041] Proximate an ankle supporting portion A of the

snowboard boot, there is a secondary lacing strap 85. The secondary lacing strap 85 extends over a front, upper surface of the boot proximate the ankle supporting portion A of the snowboard boot. The secondary lacing strap 85 includes loops 90 through which the lace L extends. The secondary lacing strap 85 has the effect of mechanically increasing the tightening capabilities of the lace L in a manner similar to that of the long straps 20, 21 and 22 (as described above with respect to Fig. 7). Thus, by employing the secondary lacing strap 85, the ankle support portion A of the snowboard boot is more easily tightened and therefore, the ankle portion of a persons foot is more securely bound within the ankle supporting portion A of the snowboard boot.

[0042] Specifically, the addition of the secondary lacing strap 85 provides increased leverage with respect to the force applied by the lace L. The forces acting on the secondary lacing strap 85 may be modeled in a manner similar to the arrangement shown in Fig. 18. The wall B represents one side of the snowboard boot. A roller R₂ fixed to the wall B represents one of the eyelets in the side of the snowboard boot. The line L₁ represents the lace L, and the line L₂ and rollers R₁, and R₃ represent the loops 90 of the secondary lacing strap 85. The line L₁ extends around the rollers R₁, R₂ and R₃ and is fixed to the wall B at each end thereof. The line L₂ extends between the rollers R₁ and R₃ thus supports the weight W.

[0043] The representation in Fig. 18 is an approximation of the forces acting on the Lace L, one side of the snowboard boot and the secondary lacing strap 85.

[0044] As is clear from the representation provided in Fig. 18, the forces applied by the weight W are distributed on the wall B by the roller arrangement. Further, the forces acting on the line L₁ are approximately 1/4 of the weight W. Since the line L₁ represents the lace L and the weight W represents the secondary lacing strap 85, it is apparent that the force acting the lace L is much less than the corresponding forces applied by the secondary lacing strap 85. Accordingly, when tightening the lace L, the applied from the lace L is multiplied by the multiple loops 90 and eyelets in the side of the boot such that the foot within the ankle portion of the boot A is securely supported.

[0045] The configuration of the lace L and the secondary lacing strap 85 is such that the total summation of all forces applied by the lace L on the secondary lacing strap 85 may be much greater than the actual tensile strength of the lace L, since, as is shown in Fig. 18, the force on the secondary lacing strap 85 may be up to four times the amount of force on any single portion of the lace L. However, in actual practice of the present invention, the total summation of forces applied by the lace L on the secondary lacing strap 85 may only be about three times the force on any single portion of the lace L.

[0046] It should be understood that, although the loops 90 are shown as a fabric, lace-like or leather-like material in Figs. 13, 14 and 15, the loops 90 could be

formed of a plastic material such as the loops 90' in Fig. 16. Further, the loops 90 or 90' could be metal rings similar to the rings 15. Further, the loops 90 may be eliminated and the secondary lacing strap 85 could alternatively be formed with metal eyelets or reinforced openings 91, such as is shown in Fig. 17.

[0047] Further, it should be understood that the secondary lacing strap 85 could be used on a boot that does not include the long straps 20, 21 and 22. In other words, the lace L could be laced through the rings 15 (or the equivalent) directly and then through the loops 90 in the secondary lacing strap 85.

[0048] Further, the secondary lacing strap 85 has a width that is significantly greater than the width of the lace L. For instance, the width of the secondary lacing strap 85 is at least five times the width of the lace L and further may be more than ten times as large as the width of the lace L.

[0049] various details of the invention may be changed without departing from its spirit nor its scope. Furthermore, the foregoing description of the embodiments according to the present invention is provided for the purpose of illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

[0050] Summarized, the invention relates to a shoe lacing configuration where short straps attached to sides of an article of footwear are formed with loops. A secondary lacing strap includes loops through which a lace extends. The lace extends through lacing means formed on opposite sides of a boot and further extends through the loops in the secondary lacing strap. The secondary lacing strap has the effect of doubling the force applied to the lace on the opposite sides of the boot in a manner similar to that of a block and tackle thus improving the lace tightening characteristics of the article of footwear.

Claims

1. An article of footwear comprising:

a sole portion made of a sole forming material;
an upper portion adhered to said sole portion,
said upper portion formed with a generally central extending tongue portion on an upper surface thereof, opposite sides of said upper portion being configured for receiving a lace for drawing said opposite sides of said upper portion toward one another;
a lacing strap configured to receive the lace through portions thereof, said lacing strap and the lace for providing leverage for tightening the article of footwear on the foot.

2. The article of footwear as set forth in claim 1 wherein said lacing strap is disposed between said oppo-

site sides of said upper portion proximate an ankle supporting portion of the article of footwear.

3. The article of footwear as set forth in claim 2, further comprising:

a first short strap and a second short strap fixed to lower edges of said upper portion, said first short strap fixed to a left side of said upper portion and said second short strap fixed to a right side of said upper portion, said first and second short straps being positioned at generally corresponding right and left sides of said upper portion, each of said first and second short straps defining a loop having a ring extending through said loop; and
a long strap extending through said ring of said first short strap and further extending through said ring of said second short strap, said first long strap having loops formed at each end thereof, wherein the lace is extendable in a criss-cross manner through said loops formed in said long strap, respectively, for tightening the article of footwear on a foot, said long strap providing leverage to said lace for tightening the article of footwear on the foot.

4. The article of footwear as set forth in claim 3 further comprising:

a third short strap and a fourth short strap fixed to lower edges of said upper portion, said third short strap fixed to a left side of said upper portion and said fourth short strap fixed to a right side of said upper portion, said first, second, third and fourth short straps being spaced apart from one another on the right and left sides of said upper portion, each of said third and fourth short straps defining a loop having a ring extending through said loop; and
a second long strap extending through said ring of said third short strap and further extending through said ring of said fourth short strap, said second long strap having loops formed at each end thereof, and wherein the lace is extendable in a criss-cross manner through said loops formed in said long strap and said second long strap, respectively, for tightening the article of footwear on a foot, said long strap and said second long strap providing leverage to said lace for tightening the article of footwear on the foot.

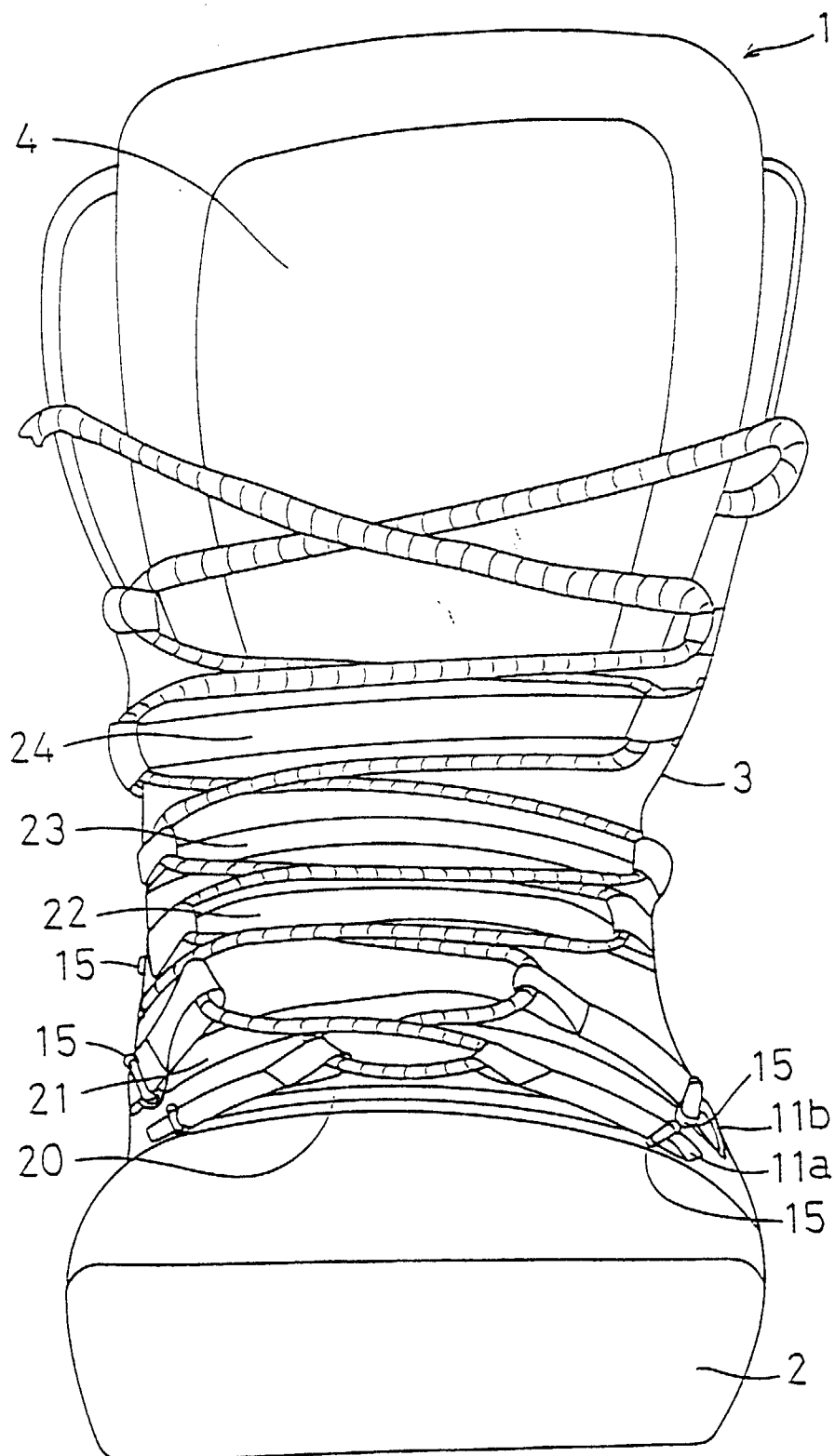
5. The article of footwear as set forth in claim 4 further comprising:

a fifth short strap and a sixth short strap fixed to lower edges of said upper portion, said fifth short strap fixed to a left side of said upper por-

tion and said sixth short strap fixed to a right side of said upper portion, said first, second, third, fourth, fifth and sixth short straps being spaced apart from one another on the right and left sides of said upper portion, each of said fifth and sixth short straps defining a loop having a ring extending through said loop;
 a third long strap extending through said ring of said fifth short strap and further extending through said ring of said sixth short strap, said third long strap having loops formed at each end thereof; and wherein the lace is extendable in a criss-cross manner through said loops formed in said long strap and said second and third long straps, respectively, for tightening the article of footwear on a foot, said long strap and said second and third long straps providing leverage to said lace for tightening the article of footwear on the foot.

6. The article of footwear as set forth in claim 5 wherein all of said rings are made of metal. 5
7. The article of footwear as set forth in claim 6 wherein each of said loops in said long strap, said second and third straps are formed from a looped section of strap material which defines a ring through which said lace extends. 10
8. The article of footwear as set forth in claim 1 wherein said lacing strap is formed with plastic loops for receiving the lace. 15
9. The article of footwear as set forth in claim 8 wherein each end of said lacing strap is formed with at least two of said plastic loops. 20
10. The article of footwear as set forth in claim 1 wherein said lacing strap is formed with fabric loops for receiving the lace. 25
11. The article of footwear as set forth in claim 10 wherein each end of said lacing strap is formed with at least two of said fabric loops. 30
12. The article of footwear as set forth in claim 1 wherein said lacing strap is formed with eyelets for receiving the lace. 35
13. The article of footwear as set forth in claim 12 wherein each end of said lacing strap is formed with at least two of said eyelets. 40
14. The article of footwear as set forth in claim 1 wherein said lacing strap is formed with a width that is at least five times larger than the width of the lace. 45

Fig.1 -



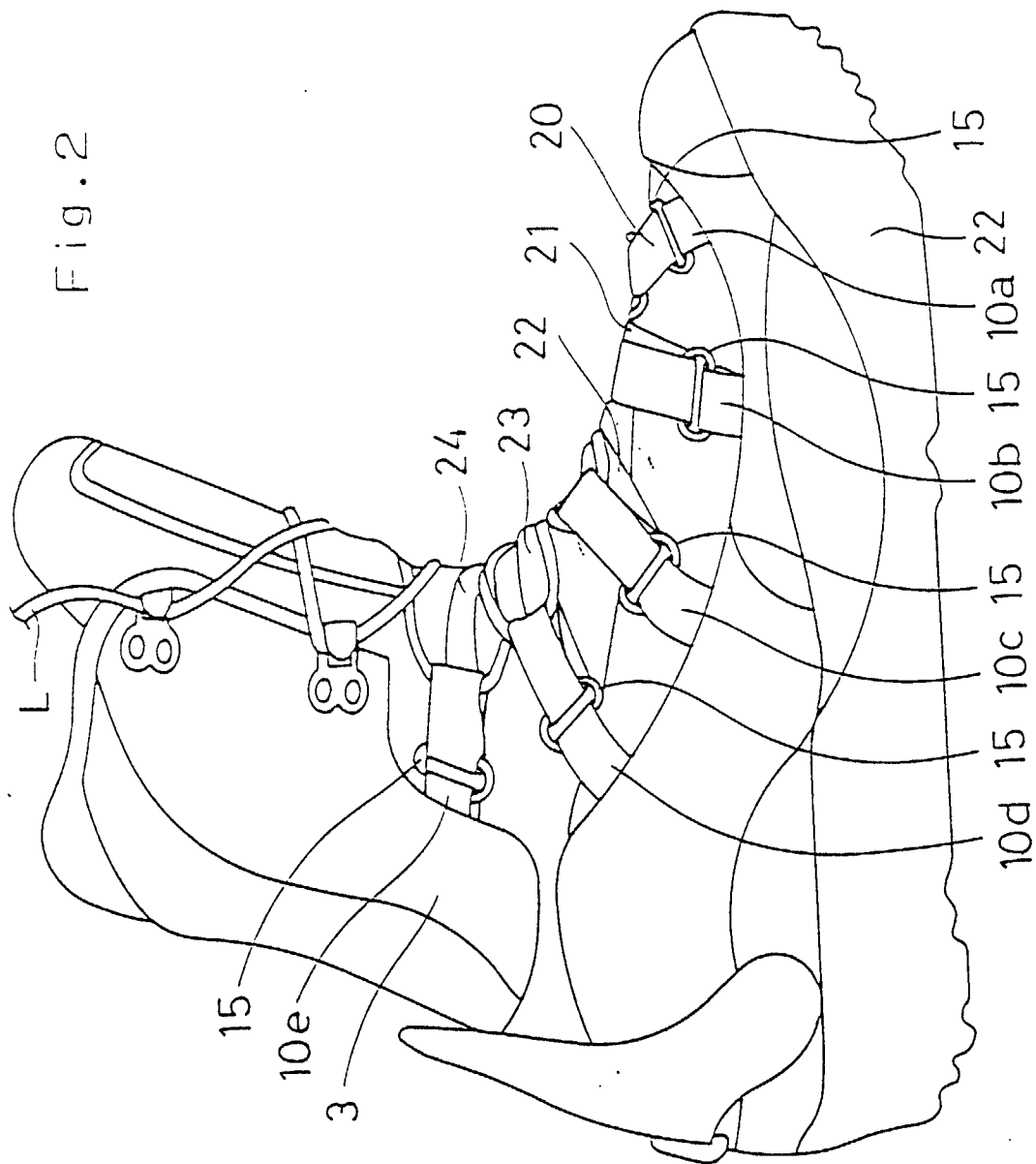
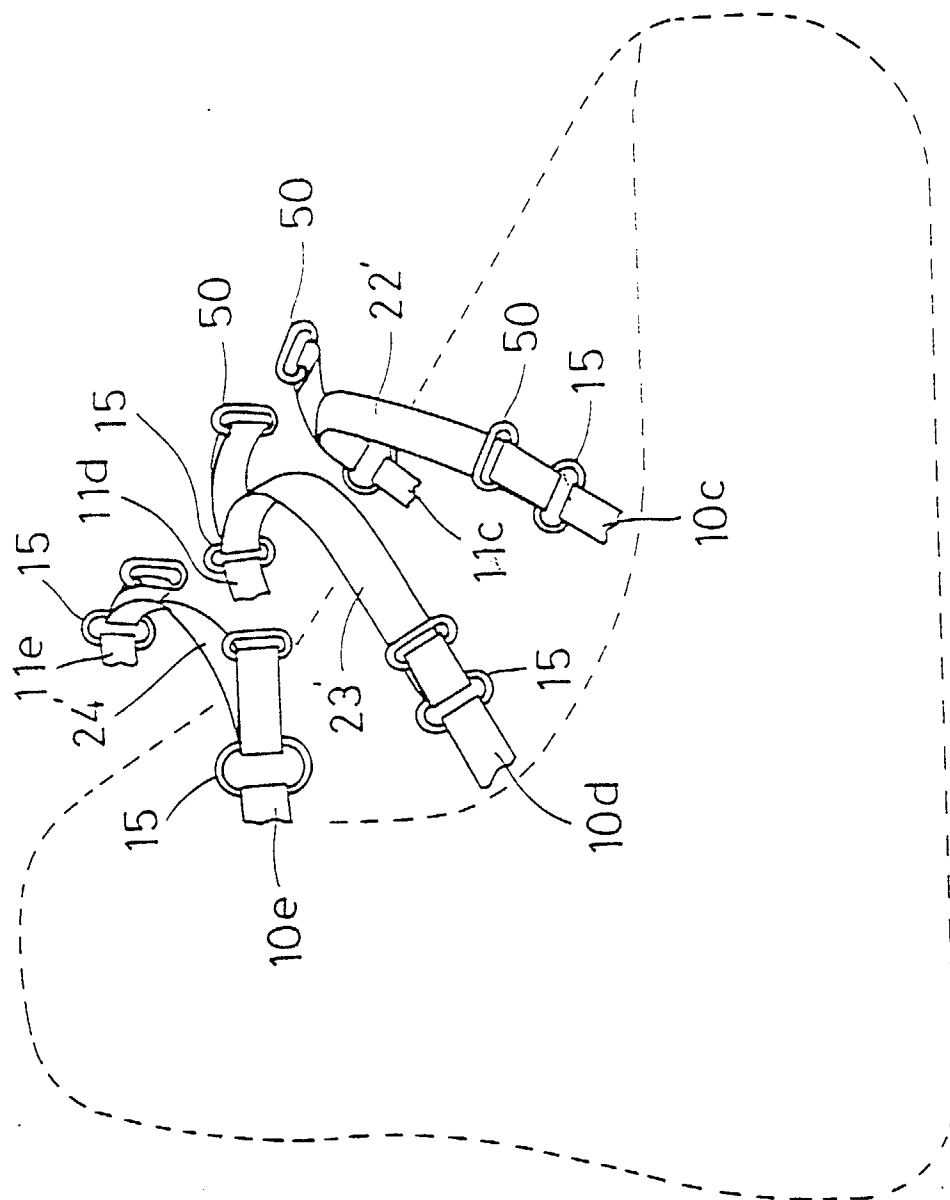


Fig. 3



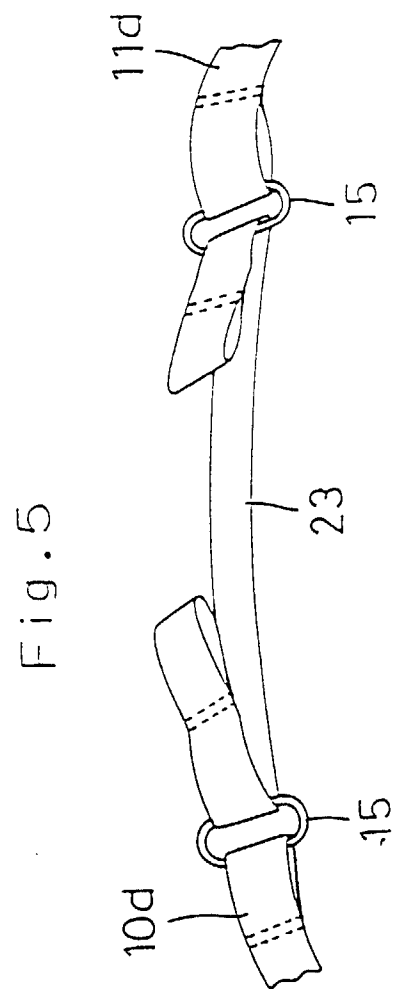
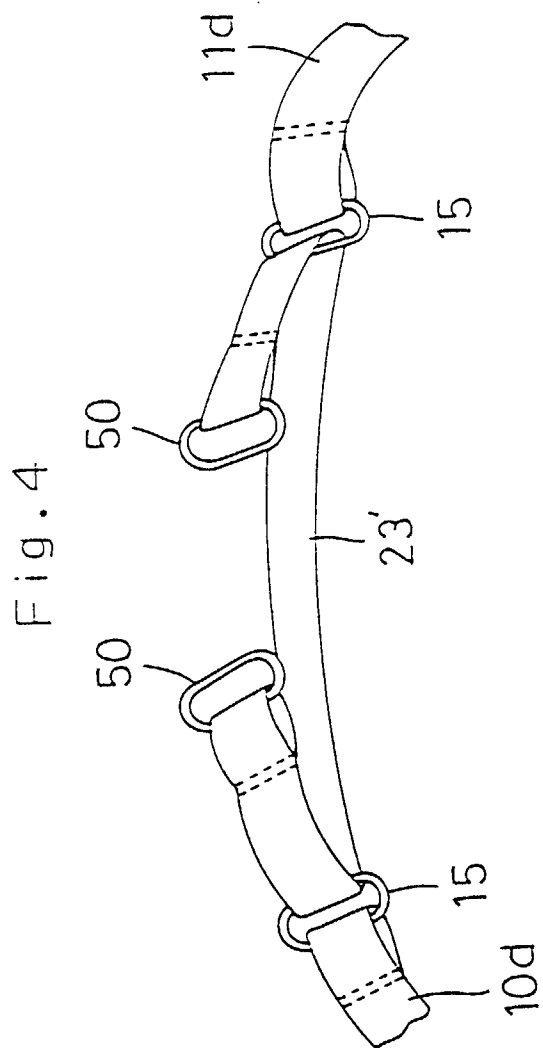


Fig. 6

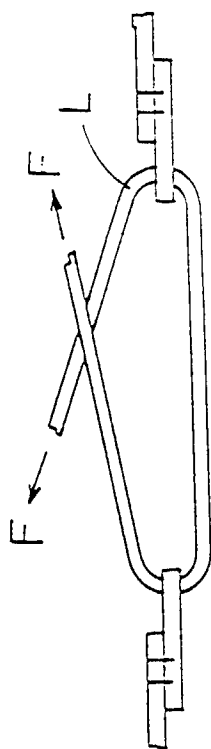


Fig. 7

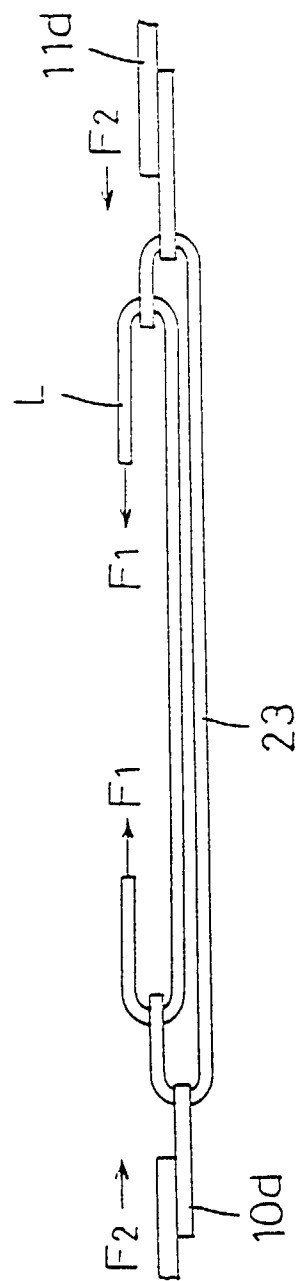


Fig. 8

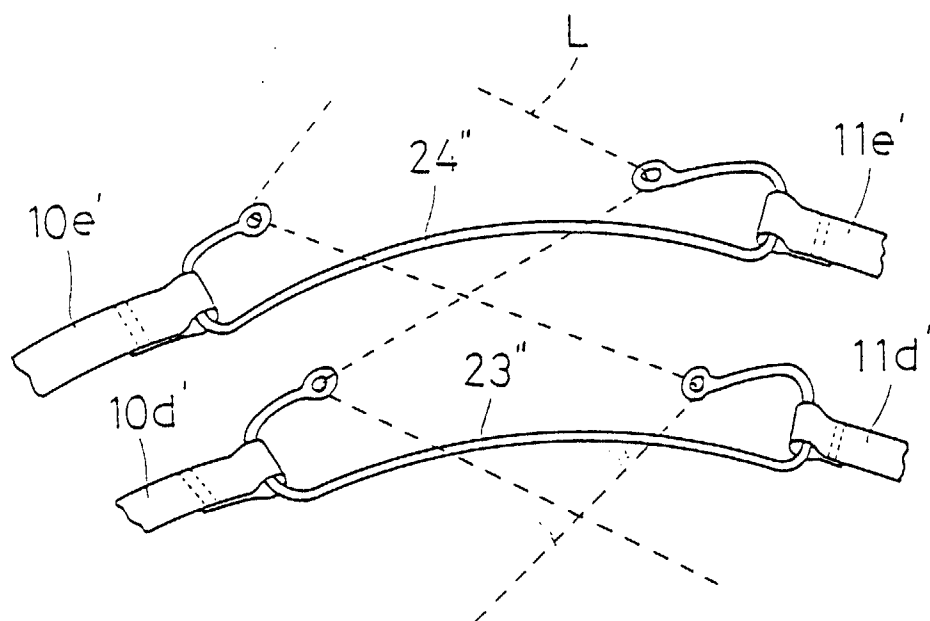


Fig. 9

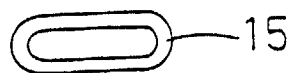


Fig. 10

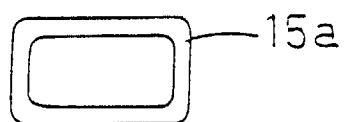


Fig. 11

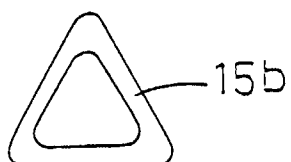
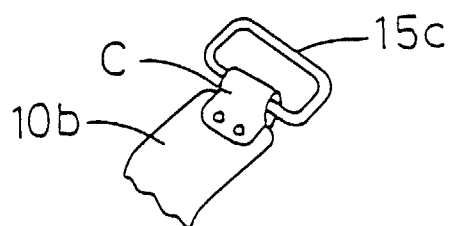


Fig. 12



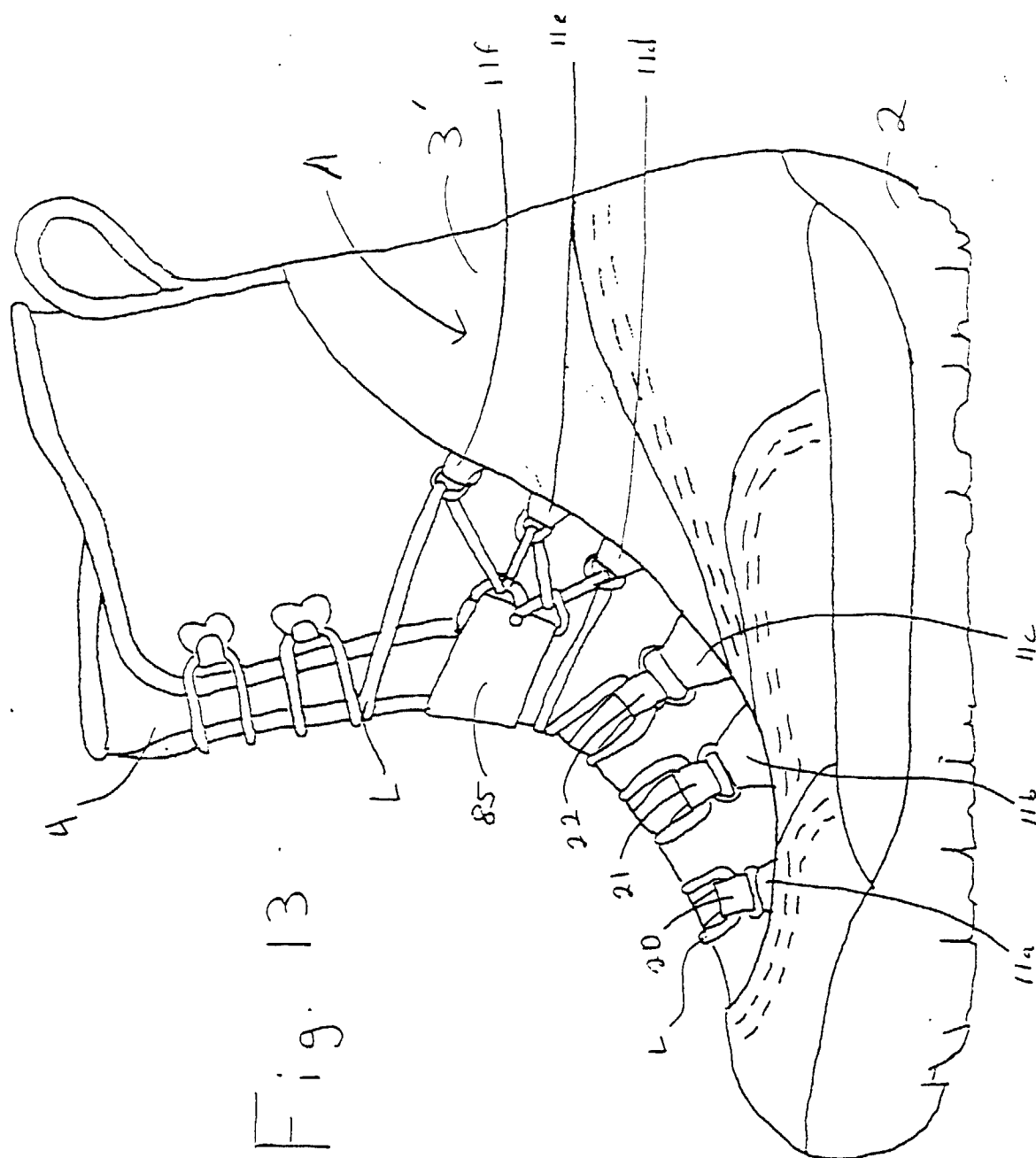


Fig. 14

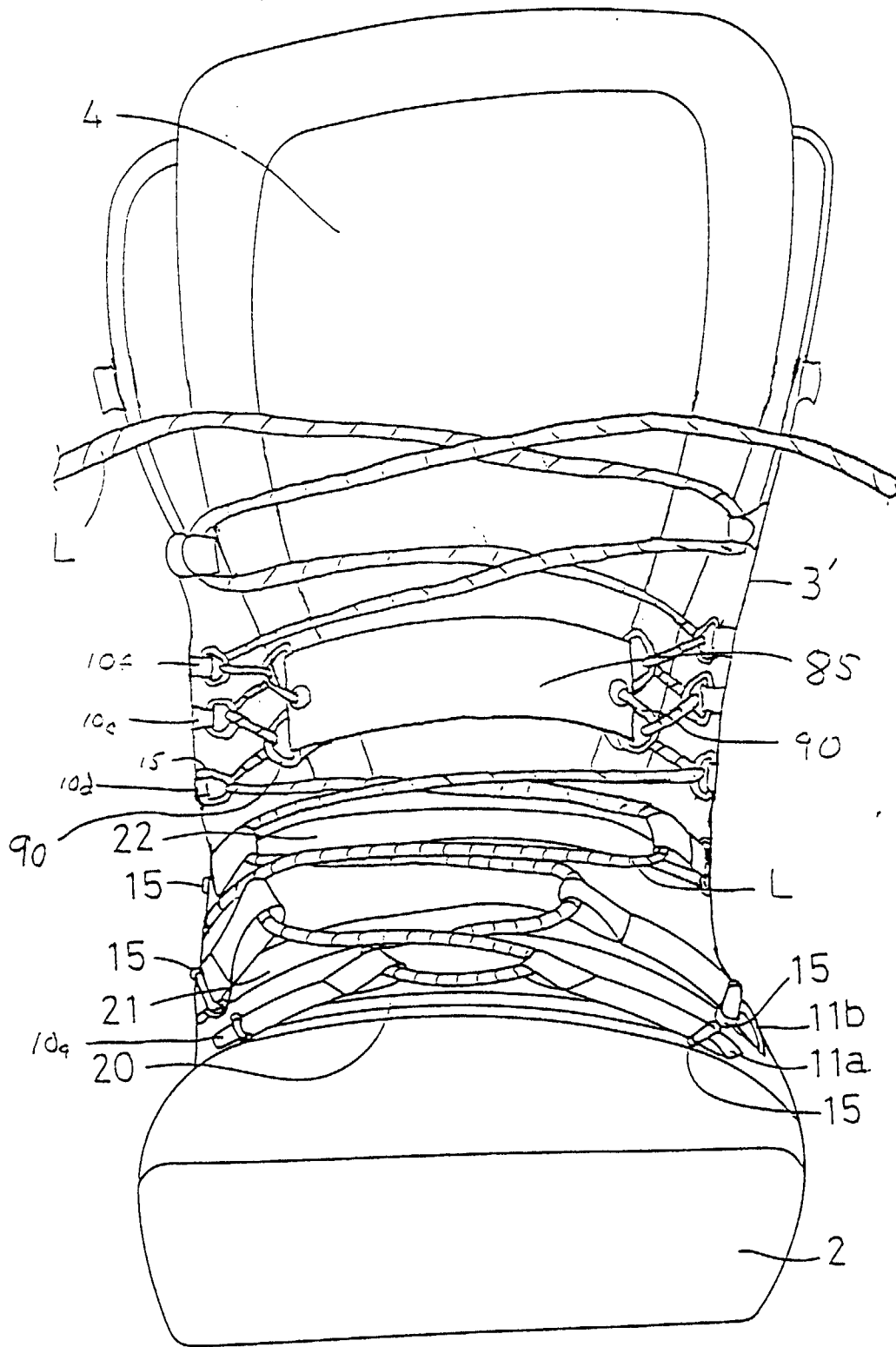


Fig. 15

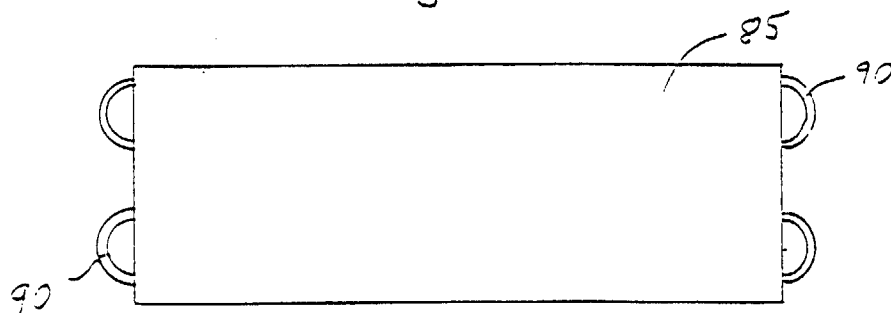


Fig. 16

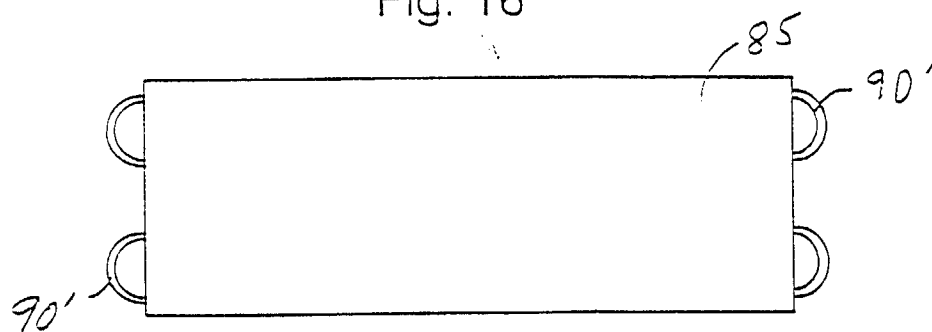


Fig. 17

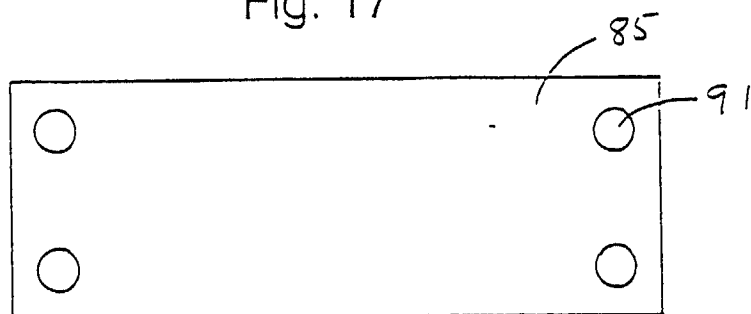


Fig. 18

