



US 20120291242A1

(19) **United States**(12) **Patent Application Publication**
DONNADIEU(10) **Pub. No.: US 2012/0291242 A1**(43) **Pub. Date: Nov. 22, 2012**(54) **LOCKING DEVICE FOR LACE STRANDS,
TIGHTENING SYSTEM HAVING SUCH
DEVICE, AND FOOTWEAR HAVING SUCH
SYSTEM****Publication Classification**(51) **Int. Cl.**
A43C 7/08

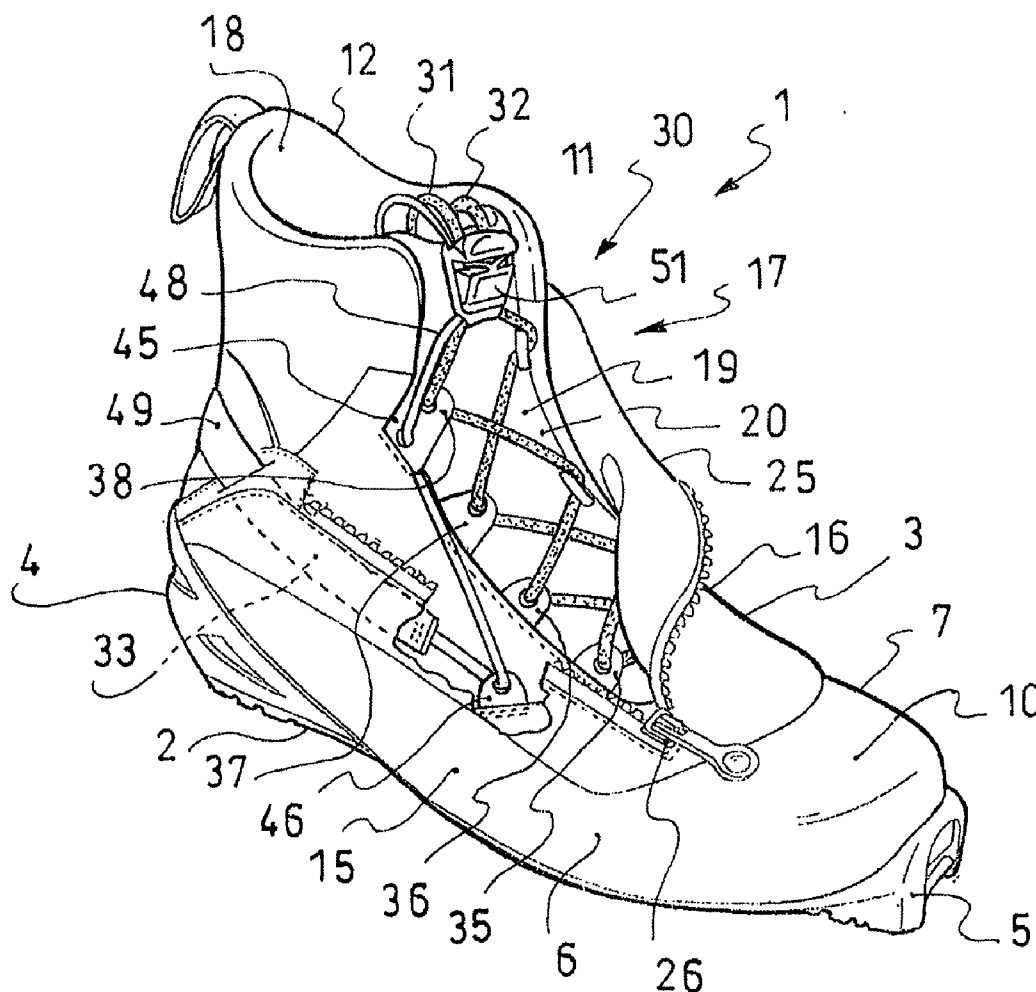
(2006.01)

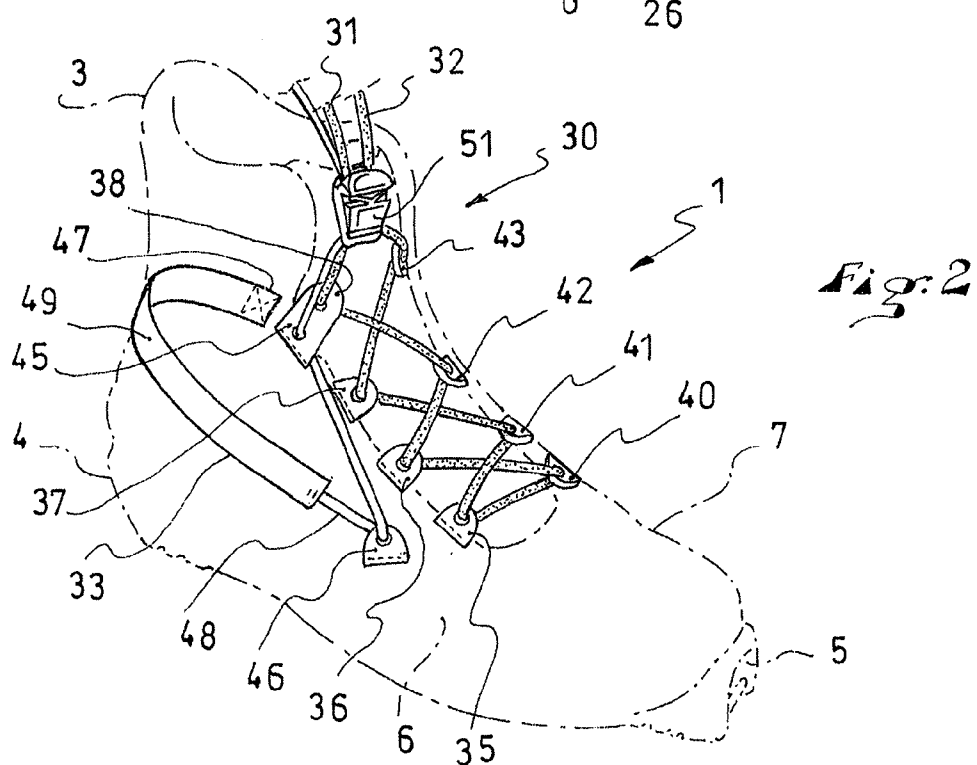
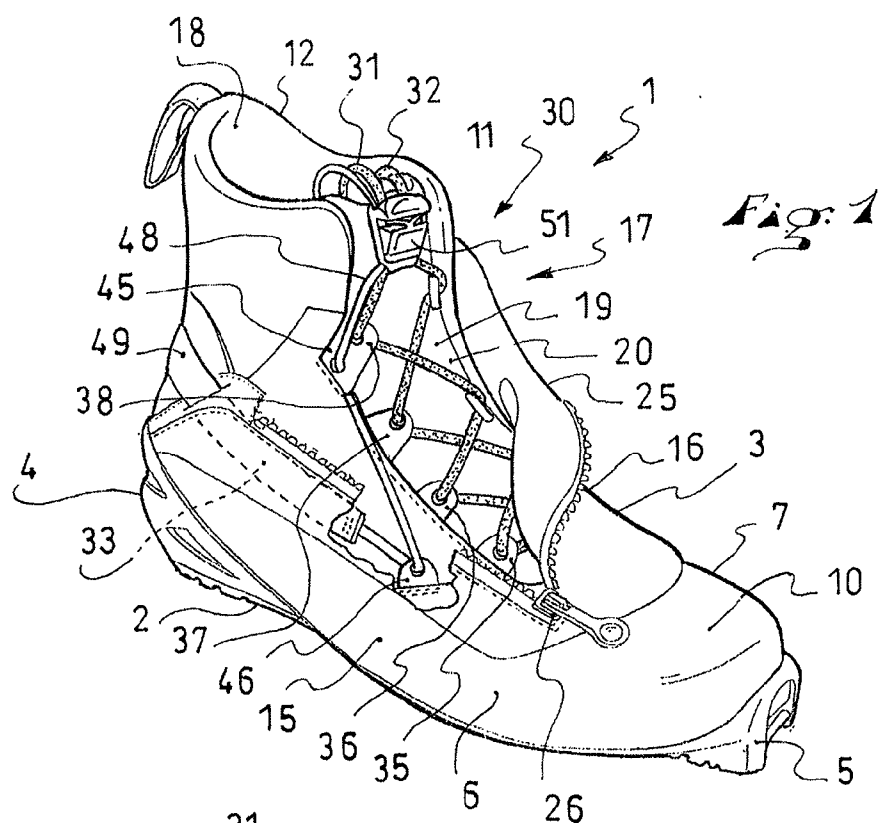
(52) **U.S. Cl.** **24/712.7**(57) **ABSTRACT**

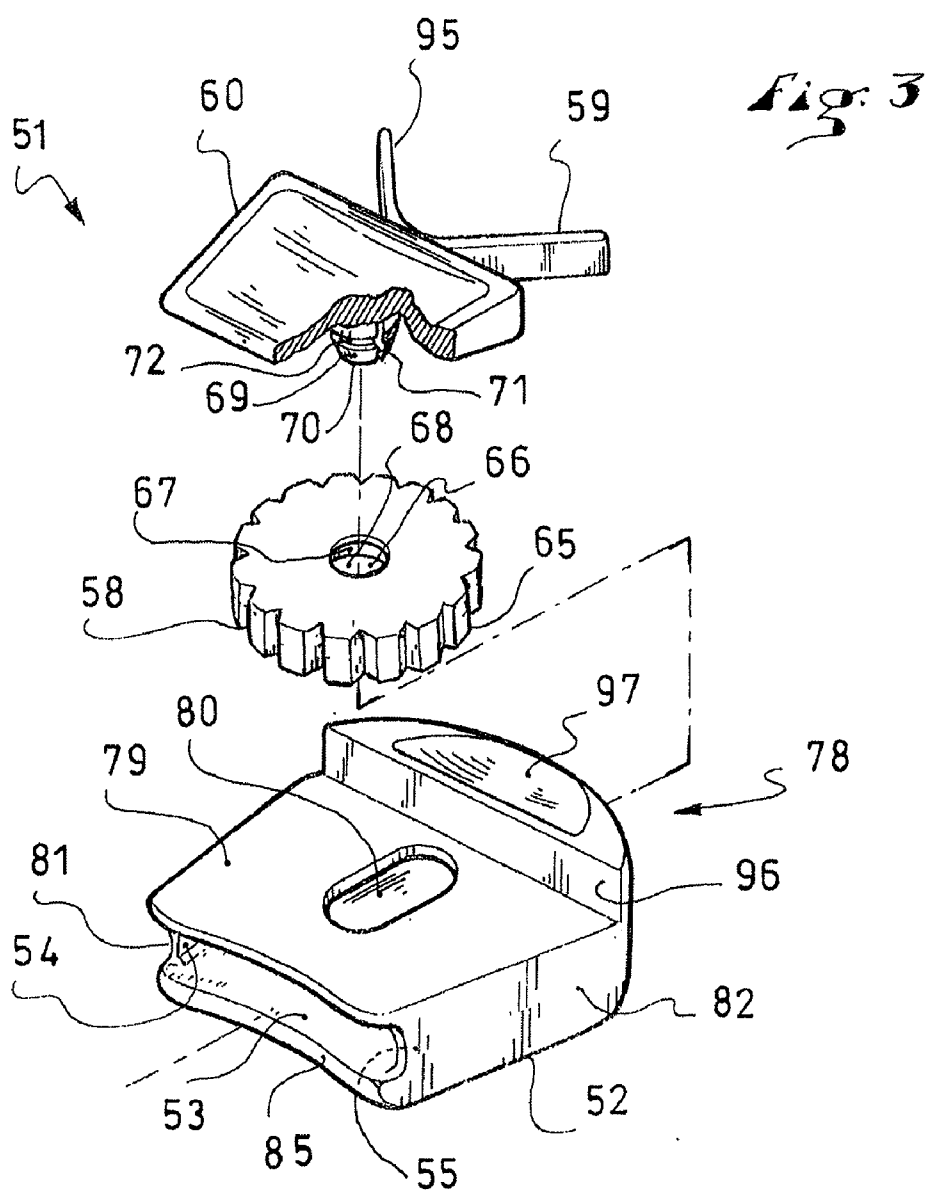
A device for locking strands of laces, including a hollow body demarcating a cavity, the cavity defining at least one passageway for passage of the lace strands, the locking device including a locking member, the locking member being movable between a locking position and a release position, the locking device operating via cooperation of the locking member with each passageway to lock each lace strand by a wedging effect, an elastic mechanism biasing the locking member towards the locking position. The locking device acts for at least three lace strands, and at least one passageway is adapted to receive two superposed lace strands.

(75) **Inventor:** **Thierry DONNADIEU**, Sillingy
(FR)(73) **Assignee:** **SALOMON S.A.S.**, Metz-Tessy
(FR)(21) **Appl. No.:** **13/471,937**(22) **Filed:** **May 15, 2012**(30) **Foreign Application Priority Data**

May 16, 2011 (FR) 11 01486







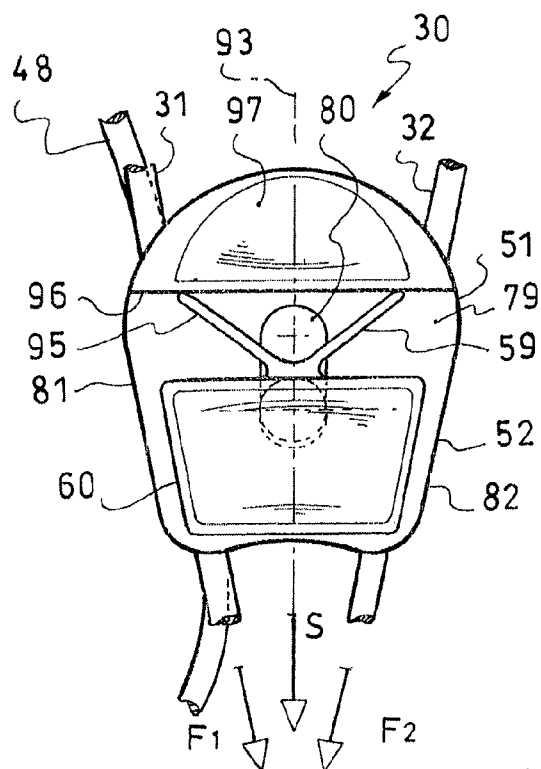


Fig. 4

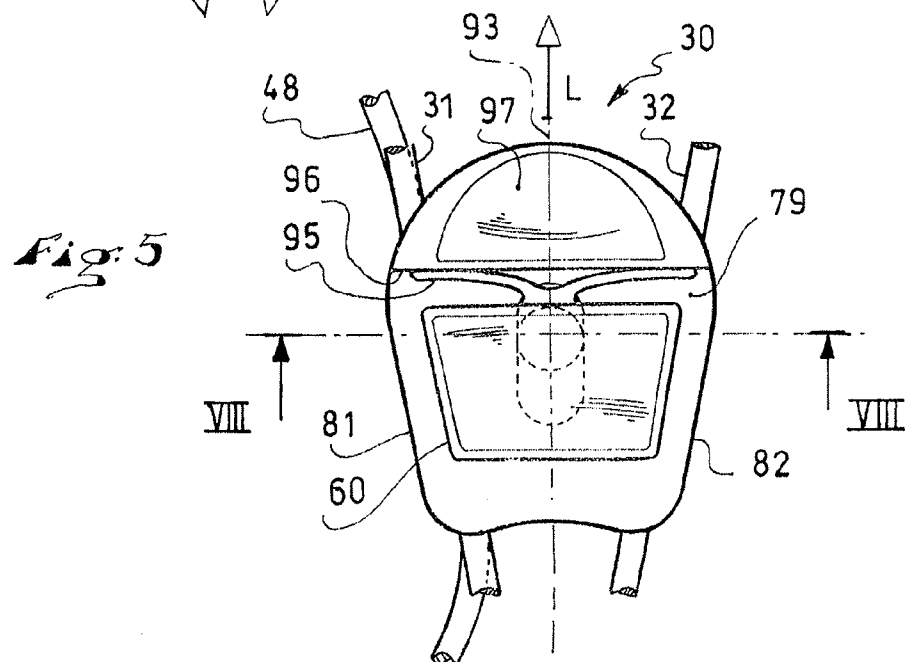


Fig. 5

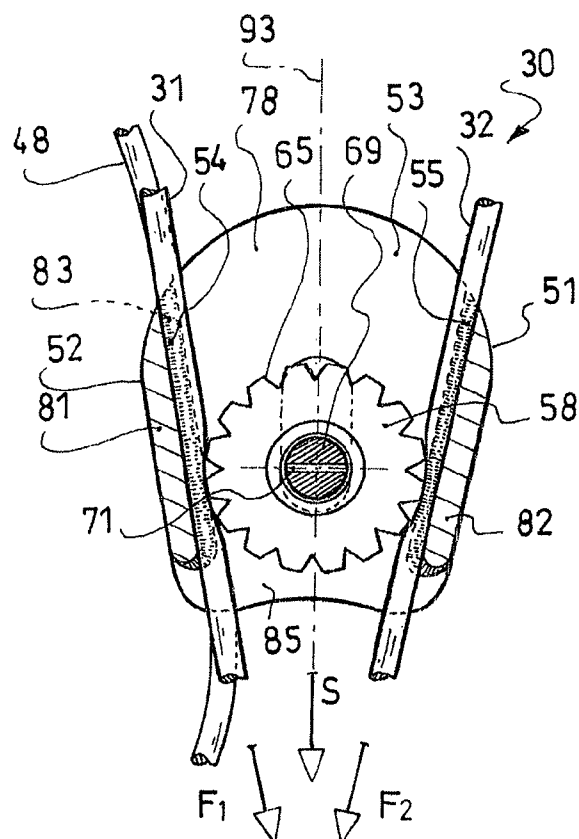
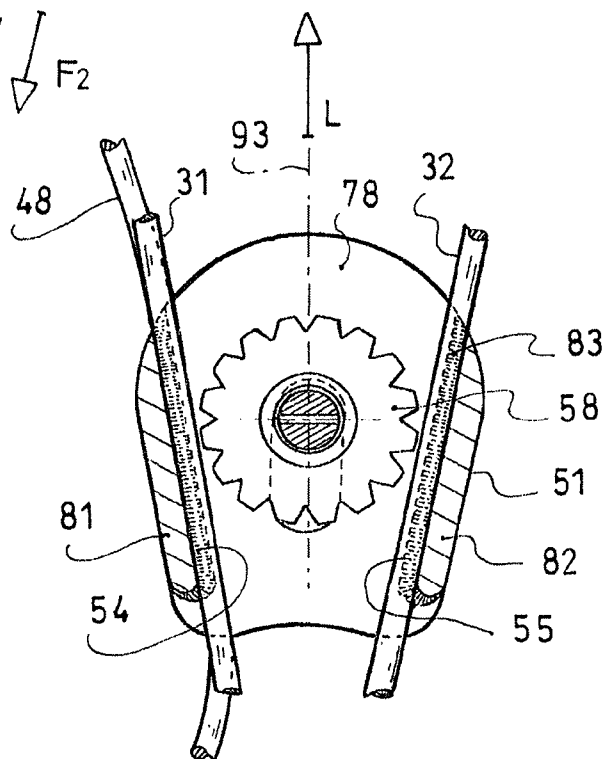
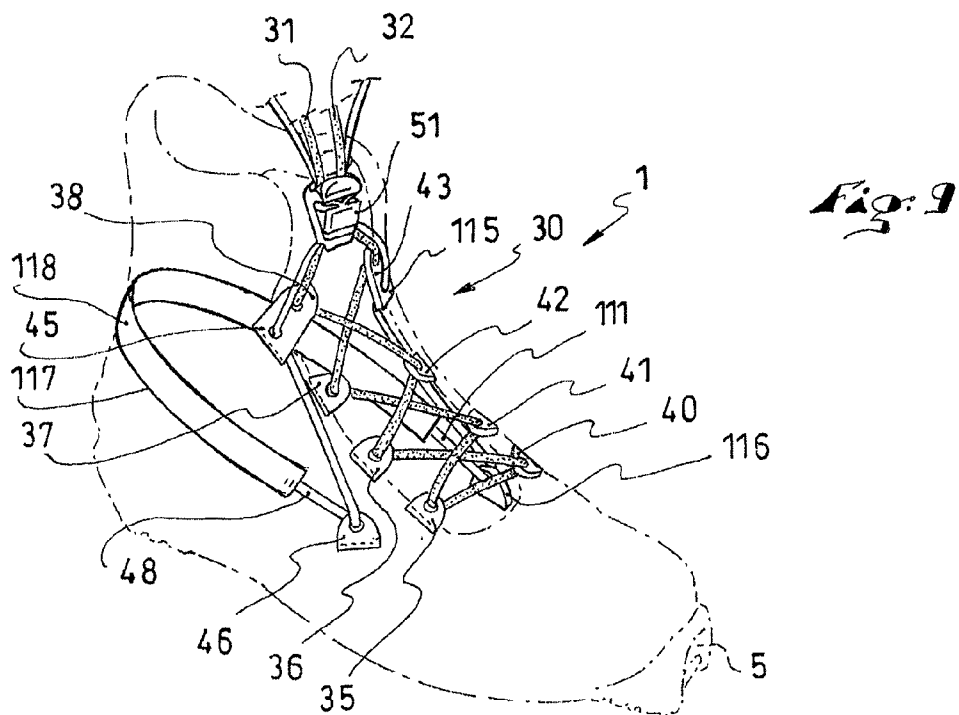
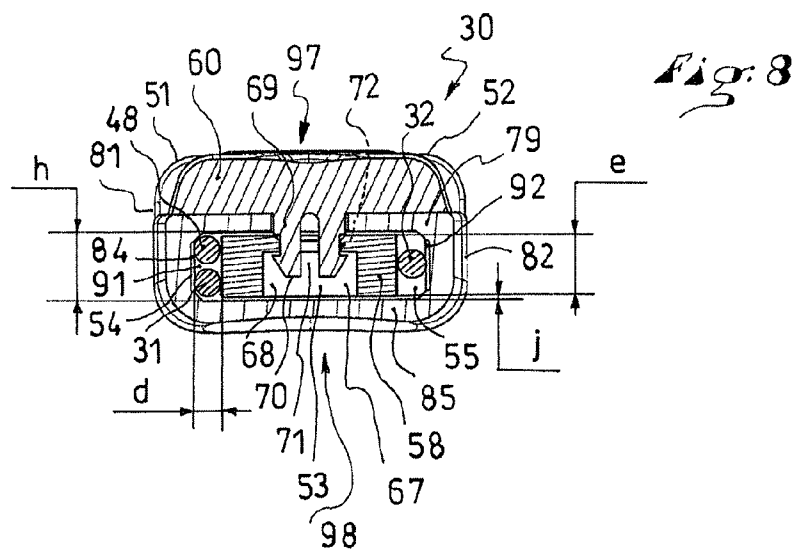
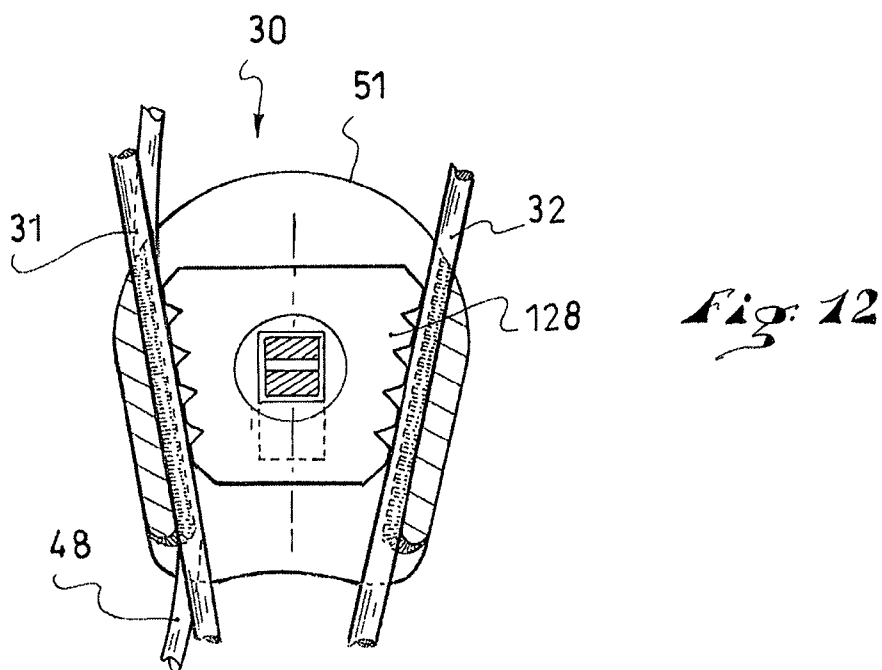
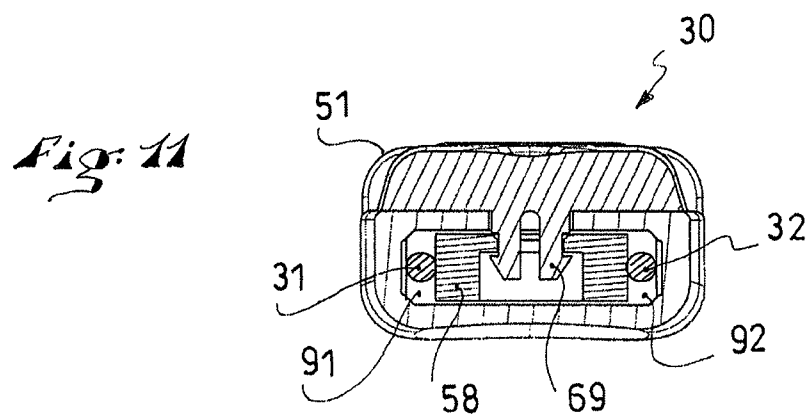
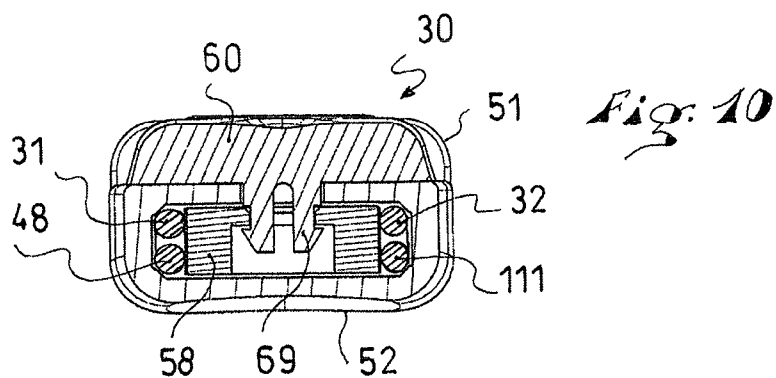


Fig. 6

Fig. 7







**LOCKING DEVICE FOR LACE STRANDS,
TIGHTENING SYSTEM HAVING SUCH
DEVICE, AND FOOTWEAR HAVING SUCH
SYSTEM**

**CROSS-REFERENCE TO RELATED
APPLICATION**

[0001] This application is based upon French patent application Ser. No. 11/01486, filed May 16, 2011, the disclosure of which is hereby incorporated by reference thereto in its entirety, and the priority of which is claimed under 35 U.S.C. §119.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The invention relates to a mechanical device for locking flexible strands such as cables, ropes, yarn, laces, and any other similar product or elongated element of similar form.

[0004] In a particular field of endeavor, the invention relates to the locking of laces of an article of footwear, such as a shoe or boot, but also to the locking of cords, laces, ropes, cables, etc. adapted to connect portions of an article such as a garment, helmet, bag, and the like.

[0005] Still, more specifically, the invention relates to the field of sports, and particularly to articles of footwear, such as shoes or boots for cross-country skiing, downhill skiing, snowboarding, walking, running, hiking, biking, and the like.

[0006] 2. Background Information

[0007] It is known to lock flexible strands using a mechanism or device. See, for example, commonly owned U.S. Pat. No. 5,477,593.

[0008] Also, U.S. Pat. No. 4,665,590 discloses a cord retainer assembly comprising a hollow body demarcating a cavity which defines a passageway for the strands of a cord. A locking member is movable in the cavity, between a locking position and a release position, for reversibly locking the strands. The device according to U.S. Pat. No. 4,665,590 is described as a reversible lock for reversibly locking the closure of a bag, such as a laundry or mail bag. If it were to be used to reversibly tighten two quarters of a shoe or boot, for example, the user could adjust the tightening to a desired level.

[0009] However, such tightening would not always be distributed satisfactorily for the tightening of such footwear. Indeed, in the context of certain types of footwear, it is sometimes desirable that different zones be tightened differently and to tighten such zones at different levels. Such is the case for footwear, for example, in which certain parts of the foot must be held firmly, while other parts are allowed more freedom. Therefore, it has been proposed to differentiate the tightening zones.

[0010] For example, U.S. Patent Application Publication No. 2008/0250618 (a family member of document WO 2007/057926) discloses a device for reversibly locking four lace strands. Two of the lace strands are assigned to tightening a first zone of the article of footwear, and the other two to tightening a second zone. To act on the four lace strands, according to US 2008/0250618, the locking device demarcates four cavities, each of which defines a passageway for the strands. Each cavity houses a locking member that is movable between a locking position and a release position. For each strand, the locking is obtained by a wedging effect between

the locking member and a passageway defined in the cavity, taking into account that an elastic mechanism biases the locking member toward its locking position.

[0011] In the footwear according to document US 2008/0250618, the tightening is differentiated in two zones, which enables the user to better adjust the support of the foot in relation to the support of the lower leg. Therefore, use of the footwear is more comfortable. The device according to this document has a complex structure. Indeed, four cavities, four passageways, four locking members, and four elastic mechanisms are necessary to tighten the four lace strands.

[0012] Further, the implementation of the device according to US 2008/0250618 is complicated, because the tension of the four strands must be adjusted separately. Moreover, the device is bulky and expensive to manufacture.

SUMMARY

[0013] In view of the preceding, the invention generally seeks to improve a locking device adapted to reversibly tighten two different zones of an article such as those mentioned above.

[0014] More specifically, the invention simplifies a device for reversibly locking lace strands, in terms of its structure, as well as its implementation.

[0015] In addition, the invention reduces the space requirement of the device.

[0016] Further, the invention lowers the manufacturing cost of a locking device.

[0017] To this end, the invention provides a device for locking lace strands, or strands of other elongated flexible elements, such device comprising a hollow body demarcating a cavity, the cavity defining at least one passageway for passage of the lace strands, the locking device including a locking member, the locking member being movable between a locking position and a release position, the locking device operating via the cooperation of the locking member with each passageway to lock each lace strand by a wedging effect, an elastic mechanism biasing the locking member toward the locking position.

[0018] The locking device according to the invention acts for at least three lace strands and at least one passageway is capable of receiving two superposed lace strands. The device acts simultaneously for the three laces, and at least two laces are housed in the same passageway.

[0019] Therefore, the locking member of the invention cooperates with three lace strands, or more. It can be said that the locking member of the device immobilizes or releases all of the lace strands passing through the cavity. An unexpected result is that all of the lace strands are maintained in the locking configuration even when each lace is subject to a different tensioning force. This means that the locking device according to the invention maintains the tension states of the laces.

[0020] Important among the resulting advantages is simplicity. The reversible locking device according to the invention has a simple structure, and it is implemented in a simple fashion. Indeed, a single action of the locking member against the action of the elastic mechanism releases all of the lace strands.

[0021] Another advantage of the device according to the invention is that of reduced space requirement. Indeed, a single locking mechanism is needed for all the lace strands. Consequently, the implementation of the locking device on an article is easier.

[0022] Yet another advantage is lower manufacturing cost, compared to other known devices, due to the reduced number of parts.

[0023] Broadly speaking, it could be said that the invention improves a locking device adapted to reversibly tighten two different zones of an article, such as an article of footwear, a garment, a bag, or the like.

BRIEF DESCRIPTION OF DRAWINGS

[0024] Other characteristics and advantages of the invention will be better understood from the following description, with reference to the annexed drawings showing, by way of non-limiting embodiments, how the invention can be embodied, and in which:

[0025] FIG. 1 is a front perspective view of a boot of a first embodiment of the invention showing a system for tightening the boot upper, the system including a device for reversibly locking a plurality of lace strands;

[0026] FIG. 2 is a schematic perspective view, similar to FIG. 1, which shows the passageway of the constituent elements of the tightening system;

[0027] FIG. 3 is an exploded perspective view of the locking device used on the boot of FIGS. 1 and 2;

[0028] FIG. 4 is an external top view of the locking device in the position for locking, or wedging, the lace strands;

[0029] FIG. 5 is an external view, similar to FIG. 4, of the locking device in the position for releasing the lace strands;

[0030] FIG. 6 is a cross-sectional view, along lines of contact of the lace strands and the passageways, of the locking device in the position for locking the lace strands;

[0031] FIG. 7 is a view similar to that of FIG. 6, with the locking device in the position for releasing the lace strands;

[0032] FIG. 8 is a cross section along the line VIII-VIII of FIG. 5;

[0033] FIG. 9 is a view similar to that of FIG. 2, of a second embodiment of the invention;

[0034] FIG. 10 is a view similar to that of FIG. 8, of the second embodiment of the invention;

[0035] FIG. 11 is a view similar to that of FIG. 8, of a third embodiment of the invention;

[0036] FIG. 12 is a view similar to that of FIG. 7, for a fourth embodiment of the invention.

DETAILED DESCRIPTION

[0037] The first embodiment of the invention, described below, more particularly relates to footwear, such as a sports boot, and, for example, an article of footwear for the practice of cross-country or telemark skiing. However, the invention applies to other disciplines and to other fields of endeavor, as mentioned above.

[0038] The first embodiment is illustrated below with reference to FIGS. 1-8.

[0039] As shown in FIGS. 1 and 2, an article of sports footwear, such as a cross-country ski boot, is adapted to receive the foot of the user.

[0040] As known, such as from commonly owned U.S. Patent Application Publication No. 2009/0100717, the disclosure of which is hereby incorporated by reference thereto in its entirety, the boot 1 includes an outsole 2 and an upper 3. The boot 1 extends lengthwise from a rear end, or heel 4, to a front end, or tip 5; and widthwise between a lateral side 6 and a medial side 7.

[0041] As shown, the upper 3 includes a lower portion 10, provided to surround the foot of the wearer, and an upper portion 11, provided to surround the ankle and extend above the ankle. However, an article of footwear to which the invention is suitable can have only the lower portion, extending below the ankle or at the ankle.

[0042] According to the first illustrated embodiment, the boot 1 extends height-wise, from the sole 2 to an upper end 12, that is to say, up to the free end of the upper portion 11 or of the upper 3.

[0043] The boot 1 is structured to allow good flexion of the leg or good foot rolling movement, as well as the transmission of sensory information or steering impulses or thrusts. Therefore, the upper 3 is relatively flexible. The sole may be relatively rigid, for example for the practice of skate-skiing, i.e., with skate steps, or more flexible for the practice of classic skiing, i.e., with alternate steps.

[0044] The boot 1 includes a lateral portion 15 and a medial portion 16. The portions 15, 16 include quarters that are adapted to cover the foot.

[0045] In the example shown, the portions 15, 16 are affixed to the sole by known techniques such as gluing, sewing, or any equivalent. The portions 15, 16 are arranged so that the boot 1 has a foot insertion opening 17, which extends from the upper end 12 towards the front end 5. Towards the upper end 12, the opening 17 has an upper subdivision 18 adapted to allow the foot therethrough, and also to surround the ankle after the boot is put on. In the area of the instep, between the upper end 12 and the front end 5, the opening 17 has a lower subdivision 19 allowing for a variation in the dimension of the opening and the fitting volume. The upper 18 and lower 19 subdivisions are co-extensive.

[0046] The upper 3 includes a tongue 20 arranged between the lateral 15 and medial 16 portions, in the area of the lower subdivision 19 of the opening 17, in order to provide the upper 3 with continuity. However, the tongue could be omitted. In such a case, the portions 15, 16 can remain separate or be superposed or overlapped. Alternatively, a gusset can connect the portions to one another.

[0047] Also, although not essential or required, the boot 1 includes a flap 25 provided to reversibly cover the lower subdivision 19 of the opening 17. The flap 25 extends from one portion 15, 16 to the other to improve the sealing of the boot.

[0048] According to the first embodiment, the flap 25 is fixedly secured to the medial portion 16. A reversible closure 26 makes it possible to affix the flap 25 also to the lateral portion 15. For example, the reversible closure 26 includes a zipper. However, any other structure could be provided to obtain the closure, such as a series of snap-fasteners, for example.

[0049] The boot 1 also comprises a tightening system 30 provided to reversibly tighten zones of the upper 3. The tightening system 30 includes a first linkage or lace strand 31 and a second linkage or lace strand 32, provided to exert a reversible tightening of the upper 3 towards the instep, in the area or zone of the lower subdivision 19 of the opening 17. The tightening system 30 also includes a third linkage or lace strand 33, provided to exert a reversible tightening around the heel or the ankle, that is to say, towards the rear end or heel 4. The word "lace" is used as a term of convenience and not to limit such tightening linkage to a particular type and includes elements such as those described as laces or as cords, ropes, cables, filiform elements, etc., made of different respective

materials suitable for its application. Further, such linkages can have any of various cross sections, diameters, and thicknesses, such cross sections including circular, oval, flat, rectangular, etc.

[0050] With respect to the lower subdivision **19** of the opening **17** or of what can be referred to as a tightening zone, in a non-limiting arrangement and according to the first embodiment, the tightening system **30** includes lateral keepers **35**, **36**, **37**, **38**, or lace guides, for example four in number, arranged on the lateral portion **15**. The tightening system **30** also includes medial keepers **40**, **41**, **42**, **43**, or lace guides, for example four in number, arranged on the medial portion **16**. The lateral and medial keepers are affixed to the upper **3** in the area of the lower subdivision **19** of the foot insertion opening **17**. The keepers **35** to **38** and **40** to **43** are sliding keepers, so that the linkages/strands **31**, **32** can slide freely therein. As further described below, this facilitates the tightening or loosening of the upper.

[0051] According to the first illustrated embodiment, the first linkage **31** is a lace strand and the second linkage **32** is also a lace strand. The first lace **31** and second lace **32** extend one another, i.e., they are co-extensive, to form a loop, in the area of the forwardmost portion of the lower subdivision **19** of the foot insertion opening **17** or tightening zone. The first **31** and second **32** lace strands could alternatively be provided to remain distinct. In this case, they would be attached to the upper **3**, for example in the area of the forwardmost portion of the lower subdivision **19**.

[0052] Each lace strand **31**, **32** alternately runs from the lateral portion **15** to the medial portion **16**, passing through some of the lateral keepers **35** to **38** and medial keepers **40** to **43**. The tightening of the upper **3** in the area of the lower subdivision **19**, including tensioning the lace strands **31**, **32** and maintaining the tensions, is explained below.

[0053] Initially, with respect to tightening the heel or the ankle, the tightening system **30** includes a lateral initial keeper **45** located on the lateral portion **15**, at the border between the lower portion **10** and the upper portion **11** of the upper **3**. The tightening system **30** also includes a lateral intermediate keeper **46**, located on the lateral portion **15**, between the initial keeper **45** and the front end **5**. The initial **45** and intermediate **46** keepers are sliding keepers, as described further below. The tightening system **30** further includes a final keeper **47**, located on the medial portion **16**. The final keeper **47** is fixed. The opposite is also within the scope of the invention. In such case, there would be a sliding initial keeper on the medial portion, a sliding intermediate keeper on the medial portion **16**, and a fixed final keeper on the lateral portion **15**.

[0054] In any case, the third linkage **33** comprises a lace strand **48** and a linkage in the form of a strap **49**, the lace and the strap being co-extensive. The third linkage **33** passes through the sliding initial keeper **45**, then through the sliding intermediate keeper **46**, and then runs along the upper **3** by extending around the heel, between the sole **2** and the upper end **12**, to arrive at the fixed final keeper **47**. Consequently, the lace strand **48** passes through the sliding keepers **45**, **46** and the strap extends the lace **48** between the intermediate keeper **46** and the final keeper **47**.

[0055] Finally, the locking device **51** according to the first embodiment of the invention is structured and arranged for exactly three linkages or lace strands **31**, **32**, **48**, i.e., no more and no less than three linkages or lace strands.

[0056] The overall tightening of the upper **3**, that is to say, in the area of both the lower subdivision **19** and the heel or ankle, is explained next.

[0057] Initially, the tightening system **30** of the boot **1** includes a device **51** for locking the lace strands **31**, **32**, **48**. As can be understood, not only with reference to FIGS. **1** and **2**, but also FIGS. **3** to **8**, the device **51** for locking the lace strands **31**, **32**, **48** comprises a hollow body **52** demarcating a cavity **53**. The cavity defines at least one passageway **54**, **55** for passage of the lace strands **31**, **32**, **48**. The locking device **51** includes a locking member **58**, which is movable between a locking position and a release position, the device **51** functioning via cooperation of the locking member **58** with each passageway **54**, **55** to lock each lace strand **31**, **32**, **48** by a wedging effect. An elastic mechanism **59** biases the locking member **58** towards the locking position.

[0058] According to the invention, the locking device **51** is structured and arranged for at least three lace strands **31**, **32**, **48**. In other words, the single locking member **58** cooperates with all of the laces which, here, are for example three in number. Therefore, the locking member **58** immobilizes or releases all of the laces. In the locking configuration, all the lace strands **31**, **32**, **48** are held in tension, even though each lace strand is tensioned differently or even though at least one of the lace strands is tensioned differently from the other two. In fact, the locking device **51** according to the invention maintains the tension states of the lace strands in their respective tightness levels. The device **51** according to the invention is advantageously simple, due to its structure, and it is easy to use.

[0059] As shown more particularly in FIG. **3**, the locking device **51**, according to a non-limiting embodiment, includes three parts, including the hollow body **52**, the circular-shaped locking member **58**, and a pusher or push-button **60** located outside of the body **52** and connected to the locking member **58** for maneuvering the locking member. The push-button **60** actuates the locking member **58** in translation.

[0060] The locking member **58** here is comprised of a wheel provided with teeth **65** on its periphery. In the center of the wheel **58** is a hole **66** aligned with a countersink **67** to define an eyelet **68** for the ratchet-reception of an axle **69** of the pusher, which constitutes the axis of rotation of the wheel **58**. The axle **69**, circular and extending directly from the pusher **60**, has an outward projecting side **70** for connection to the wheel **58**. The side **70** has an axial slit **71** along a portion of its length, and is recessed by a peripheral receiving groove **72** for receiving the wheel **58**. The end of the outward projecting side has the shape of a truncated cone. The wheel **58** is rotatably mounted on the axle **69**. In practice, only one rotation of a few degrees is necessary to complete the balancing of the tensions, during the locking. Alternatively, it is possible for the wheel to be fixed, i.e., not to be rotatable.

[0061] This structure enables the ratchet-assembly of the wheel **58** onto the axle **69**, whereby the two are press-fitted, or snapped, together.

[0062] The body **52**, as shown in FIGS. **6** and **7**, internally demarcates the cavity **53** adapted to house the toothed wheel **58** and defines, as described below, two passageways **54**, **55** for the passage and wedging of the lace strands **31**, **32**, **48**.

[0063] To mount the locking device **51**, the wheel **58** is positioned within the cavity **53** of the body **52** by passing through an opening **78** provided at one axial end of the body, and the pusher **60** is snap-fastened via its axle **69** in the eyelet **68** of the wheel **58** by extending through the wall of the upper

surface 79 of the body 52 through a slot 80 arranged in the upper surface 79, or upper wall, along an axial longitudinal direction of the body.

[0064] The pusher or push-button 60 thus mounted is translationally movable in relation to the body 52, along the slot 80, and in the longitudinal direction of the hollow body 52, along the direction of the arrows L or S shown in FIGS. 4 and 5, for example.

[0065] The dimensions of the groove 72 and hole 66 of the wheel 58 are provided so that the wheel 58 is mounted to rotate freely about the axle 69.

[0066] FIGS. 6, 7, and 8 more particularly show the embodiment of the passageways 54, 55 and the cooperation of the locking member or wheel 58 therewith.

[0067] The passageways 54, 55 are located in the cavity 53, along each of the two lateral surfaces 81, 82 of the body 52, and comprise serrations 83.

[0068] In order to receive the laces 31, 32, 48, the passageways 54, 55 have a groove-shaped cross section that can be rounded or formed of straight segments 84, as shown in FIG. 8. As explained further below, this promotes a strong pinching of the lace strands 31, 32, 48 between the locking member 58 and an associated passageway 54, 55.

[0069] According to the first embodiment, the height h of the cavity 53 is equal to the thickness e of the locking member 58, increased by a functional clearance j. This functional clearance j is between 0 and 15% of the thickness e of the member 58, taking into account that values between 2 and 7% yield good results. The height of the cavity and of the locking member also corresponds to that of two superposed lace strands. Alternatively, the locking member is structured and arranged such that the height, or thickness, thereof is at least sufficient to engage both of the two superposed lace strands, particularly in the locking position of the locking member. Alternatively, also, the diameter or thickness (the latter at least considered in the direction of the height h of the cavity) of a respective lace strand, in a tensioned state, is no more than one-half the height h of the cavity. Stated differently, in the orientation of the exemplary non-limiting embodiment of the locking device shown in FIGS. 1 and 2, for example, the two superposed lace strands are superposed in a longitudinal vertical plane, or substantially so, with the boot outsole supported on a horizontal surface.

[0070] The cavity 53 of the hollow body 52 defines two passageways 54, 55 for passage of the lace strands 31, 32, 48, namely, a first passageway 54 along the first lateral surface 81 and a second passageway 55 along the second lateral surface 82. The locking member 58 is arranged in the cavity 53, between the first 54 and second 55 passageways of the lace strands 31, 32, 48. As a result, each passageway 54, 55 has a height equal to the height h of the cavity 53 and is adapted to receive at least two superposed lace strands. This guides the lace strands 31, 32, 48 opposite the locking member or wheel 58. More specifically, the first passageway 54 here guides two lace strands 31, 48 and the second passageway 55 guides a single lace 32. In the locking situation, unexpectedly, as further described below, the device 51 maintains the tightening or locking of the three lace strands 31, 32, 48, even though they have different tensions or at least one of the lace strands has a tension different from the other two.

[0071] In order to maintain each of the lace strands 31, 32, 48 in contact with an associated passageway 54, 55, it is provided that, when the locking member or wheel 58 is in a release position, the shortest distance between the locking

member 58 and a passageway 54, 55 is between 40 and 75% of the height h of the cavity. The height h is twice the diameter of the laces, or slightly greater. This ensures the superposition of at least a pair of the lace strands. Thus, the first 91 and second 92 openings for passage of the lace strands, as respectively demarcated by the first 54 and second 55 passageways, the wheel 58, the upper surface 79, and the lower surface 85 each have a shape elongated in a direction perpendicular to the upper 79 and lower 85 surfaces. This keeps the two lace strands 31, 48 one above the other in the area of the locking member 58, in the direction perpendicular to the surfaces 79, 85. In other words, each of the lace strands 31, 48 is opposite both the passageway 54 and the locking member 58. As a result, the strands are locked or unlocked simultaneously.

[0072] As shown in FIGS. 6 and 7, the passageways 54, 55 are substantially rectilinear, and their non-parallel directions converge to intersect along the axis of symmetry 93 of the locking device 51, in the direction S.

[0073] There are two end positions of the pusher 60, one of which corresponds to the locking of the lace strands 31, 32, 48 and the other to the release of the lace strands.

[0074] The locking position is shown in particular in FIGS. 6 and 8.

[0075] As shown in FIG. 6, the wheel 58, which is constantly biased in the S direction in the locking position, tightens the lace strands 31, 32, 48 by pressing the laces to the bottom of the passageways 54, 55 of the body 52.

[0076] The locking of the lace strands 31, 32, 48 is thus achieved by a wedging effect via cooperation of the passageways 54, 55 and the wheel 58.

[0077] The advantage provided by the locking via a wedging effect is that the tightening value of the lace strands 31, 32, 48 by the wheel 58 is proportional to the tension forces exerted on the strands and results only from these forces.

[0078] Another advantage, related to the fact that the wheel 58 is mounted to rotate about the axle 69, is that a difference in the tension forces F1, F2 on the lace strands does not cause jamming of the system or relative sliding of one of the strands in relation to the locking member 58.

[0079] An elastic mechanism, shown in particular in FIGS. 4 and 5, is also incorporated into the locking device 51. This elastic mechanism may take any of various forms or shapes.

[0080] The elastic mechanism comprises two elastic tongues 95, or tabs, for example, which extend in V-shaped formation from the center of the pusher 60, and whose free ends are provided so as to be supported on a flange 96 formed by an edge of the body 52 to bias the pusher 60 in the locking direction S as shown in FIG. 4. The tongues 95 may also have a different shape.

[0081] Therefore, these tongues 95 also bias the wheel 58 in the locking direction S, via its axle 69 affixed to the pusher 60.

[0082] Thus, the locking member 58 is elastically biased in the locking direction of the lace strands 31, 32, 48 via its axle of rotation 69.

[0083] In the illustrated embodiment, the axle 69, the pusher 60, and the tongues 95 are formed in one piece, i.e., a unitary element.

[0084] The parts and operation described above provide the advantage of having a precise and immediate lace locking without requiring external action on the locking member 58.

[0085] In addition, as shown particularly in FIG. 8, the body 52 has cavities 97, 98 on its upper and lower surfaces, respectively, adapted to facilitate the ergonomic engagement of the body 52 during locking.

[0086] The depressions of the cavities **97, 98** of the body **52** each correspond substantially to the shape of a surface of a finger oriented so as to exert a force in the direction S of FIG. 6.

[0087] It is therefore easier for the user to pull on the laces with one hand and to press on the locking device **51** with the other hand to move the latter along the lace strands, up to the desired locking position. Once this position is reached, it suffices to release the device **51**, without having to exert any other action on the pusher, in order to obtain the desired tightening, the wheel **58**, biased by the tongues **95**, automatically exerting the desired wedging effect. One advantage is that the locking manipulation is easier.

[0088] The release operation is carried out with one hand, by tension on the locking device **51**. The tension is required to bias the pusher **60** in an unlocking direction, along the direction L of FIG. 7. The release operation is also easier.

[0089] The other embodiments of the invention are illustrated below with reference to FIGS. 9-12. For convenience, the elements shared with the first embodiment are designated by the same reference numerals. Differences are highlighted.

[0090] The second embodiment, illustrated with reference to FIGS. 9 and 10, features a boot **1** with a tightening system **30** comprising a locking device **51**.

[0091] Specific to the second embodiment is that the locking device **51** is structured and arranged for exactly four lace strands **31, 32, 48, 111**. The first two lace strands **31, 32** are identical or similar to those of the first embodiment: they tighten the lower subdivision **19** of the foot insertion opening **17** or tightening zone. The other two laces **48, 111** participate in the tightening of the heel or the ankle.

[0092] The tightening system **30** still includes a lateral initial keeper **45** and an intermediate keeper **46** located, as noted, on the lateral portion **15**. Similarly, the tightening system **30**, this time, includes a medial initial keeper **115** and a medial intermediate keeper **116** located on the medial portion **16**. The third linkage **117** successively includes the lateral lace **48**, a surrounding strap **118**, and the medial lace **111**.

[0093] In order to reversibly tighten the upper **3**, the four lace strands **31, 32, 48, 111** cooperate with the locking device **51**. The latter receives two laces on each passageway **54, 55**. The operation and effects obtained are identical or similar to those according to the first embodiment.

[0094] The third embodiment is illustrated with reference to FIG. 11.

[0095] The tightening system **30** for this embodiment also functions when the locking device **51** is operative for two lace strands **31, 32**, although it is designed to accept at least three laces.

[0096] In this case, the lace strands **31, 32** occupy a reduced space in the passage openings **91, 92**.

[0097] The fourth embodiment is shown with reference to FIG. 12. Particular to this embodiment is the structure of the locking member **128**. The locking member **128** has the general shape of a wedge. For example, without being limiting to this embodiment, the locking member **128** has a trapezoidal shape. Therefore, the tightening of the lace strands **31, 32, 48** is obtained by wedging effect alone.

[0098] In general, the invention is made from materials and using implementation techniques known to one having ordinary skill in the art. For example, each component of the locking device can be made from a plastic material.

[0099] The invention is not limited to the embodiments described above and shown in the drawings, and includes all technical equivalents that fall within the scope of the claims that follow.

[0100] For example, although the locking member **58** has been described in the form of a wheel or a wedge, it may alternatively have another shape.

[0101] The locking member may also include a plurality of parts. For example, two wheels mounted on the axle **69** of the pusher **60** to lock four lace strands can be provided. In such a case, each locking member acts for at least two lace strands, the locking device acting properly for at least three lace strands, and there is only one elastic mechanism which biases all of the locking members.

[0102] Each lace, and consequently each lace strand, is provided to have the same diameter. This facilitates the implementation of the locking device. However, laces of various diameters or thicknesses may alternatively be provided.

[0103] The invention applies to a tightening system **30** comprising a locking device **51** as described hereinabove.

[0104] The invention also applies to an article comprising a tightening system with the locking device. In particular, the invention relates to a boot **1** including the tightening system described above.

[0105] In addition to the foregoing, the invention disclosed herein by way of exemplary embodiments suitably may be practiced in the absence of any element or structure which is not specifically disclosed herein.

1. A device for locking lace strands, the device comprising:
 - a locking member;
 - a hollow body demarcating a cavity;
 - the cavity of the hollow body defining at least one passageway for passage of the lace strands;
 - the locking member being structured and arranged to be movable between a locking position and a release position;
 - in the locking position, the locking member being positioned in relation to at least the one passageway to lock each of the lace strands within at least the one passageway by a wedging effect;
 - in the release position, the locking member being positioned in relation to at least the one passageway to allow movement of the lace strands in relation to at least the one passageway;
 - an elastic mechanism biasing the locking member toward the locking position;
 - the locking device being structured and arranged to lock at least three lace strands;
 - at least the one passageway being structured and arranged to receive, superposed, at least two of the at least three lace strands.
2. A locking device according to claim 1, wherein:
 - a height of the cavity is equal to a thickness of the locking member, increased by a functional clearance.
3. A locking device according to claim 1, wherein:
 - a height of the cavity is equal to the combined cross-sectional heights of the two superposed lace strands.
4. A locking device according to claim 3, wherein:
 - the locking member is structured and arranged to have a thickness sufficient to engage both of the two superposed lace strands in the locking position of the locking member.

5. A locking device according to claim 1, wherein:
the at least one passageway comprises a first passageway and a second passageway, both defined by the cavity of the hollow body, for passage of the at least three lace strands;
the locking member is arranged in the cavity between the first and second passageways of the lace strands.
6. A locking device according to claim 1, wherein:
when the locking member is in the release position, a shortest distance between the locking member and a passageway is between 40 and 75% of a height of the cavity.
7. A locking device according to claim 1, wherein:
the locking device comprises no more than a single locking member.
8. A locking device according to claim 1, wherein:
the locking device comprises three parts comprising:
the hollow body;
the locking member; and
a pusher located outside of the hollow body and connected to the locking member for manipulating the locking member.
9. A locking device according to claim 1, wherein:
the locking member comprises a wheel.
10. A locking device according to claim 8, wherein:
the locking member comprises a wheel.
11. A locking device according to claim 10, wherein:
the wheel is positioned within the cavity;
the pusher includes an axle, the axle being snap-fastened to the wheel via the axle extending through an upper wall of the body through a slot extending through the upper wall, along an axial longitudinal direction of the body.
12. A locking device according to claim 1, wherein:
the locking member has the general shape of a wedge.
13. A locking device according to claim 8, wherein:
the elastic mechanism comprises two elastic tongues extending from the pusher;
the tongues have respective free ends positioned to be supported on a flange formed by an edge of the body for biasing the pusher in the locking direction.
14. A locking device according to claim 1, wherein:
each of the three lace strands has an identical diameter or thickness.
15. A tightening system comprising:
at least three lace strands;
a locking device for locking the lace strands, the locking device comprising:
a locking member;
a hollow body demarcating a cavity;
the cavity of the hollow body defining at least one passageway for passage of the lace strands;
the locking member being structured and arranged to be movable between a locking position and a release position;
in the locking position, the locking member being positioned in relation to at least the one passageway to lock each of the lace strands within at least the one passageway by a wedging effect;
in the release position, the locking member being positioned in relation to at least the one passageway to allow movement of the lace strands in relation to at least the one passageway;
an elastic mechanism biasing the locking member toward the locking position;
the locking device being structured and arranged to lock at least the three lace strands;
at least the one passageway being structured and arranged to receive, superposed, at least two of the at least three lace strands.
16. A tightening system according to claim 15, wherein:
a height of the cavity is equal to a thickness of the locking member, increased by a functional clearance.
17. A tightening system according to claim 15, wherein:
a height of the cavity is equal to the combined cross-sectional heights of the two superposed lace strands.
18. A tightening system according to claim 17, wherein:
the locking member is structured and arranged to have a thickness sufficient to engage both of the two superposed lace strands in the locking position of the locking member.
19. A tightening system according to claim 15, wherein:
the at least one passageway comprises a first passageway and a second passageway, defined by the cavity of the hollow body, for passage of the at least three lace strands;
the locking member is arranged in the cavity between the first and second passageways of the lace strands.
20. A tightening system according to claim 19, wherein:
the first passageway receives the superposed lace strands;
the second passageway receives a number of lace strands different from that of the superposed lace strands.
21. A tightening system according to claim 15, wherein:
the locking device acts on no more and no less than the three lace strands.
22. A tightening system according to claim 15, wherein:
the locking device acts on no more and no less than four lace strands.
23. An article comprising:
a tightening system comprising:
at least three lace strands;
a locking device for locking the lace strands, the locking device comprising:
a locking member;
a hollow body demarcating a cavity;
the cavity of the hollow body defining at least one passageway for passage of the lace strands;
the locking member being structured and arranged to be movable between a locking position and a release position;
in the locking position, the locking member being positioned in relation to at least the one passageway to lock each of the lace strands within at least the one passageway by a wedging effect;
in the release position, the locking member being positioned in relation to at least the one passageway to allow movement of the lace strands in relation to at least the one passageway;
an elastic mechanism biasing the locking member toward the locking position;
the locking device being structured and arranged to lock at least the three lace strands;
at least the one passageway being structured and arranged to receive, superposed, at least two of the at least three lace strands.

24. An article according to claim **23**, wherein:
the article is an article of footwear;
the article of footwear comprising:
two independent zones to be tightened;
a first of the two superposed lace strands extends to a first
of the two independent zones and a second of the two
superposed lace strands extends to a second of the two
independent zones.

25. An article according to claim **24**, wherein:
the first of the two independent zones comprises tightening
zone extending over a foot area of the article of footwear;
the second of the two independent zones comprises a tight-
ening zone at a heel area of the article of footwear.

* * * * *