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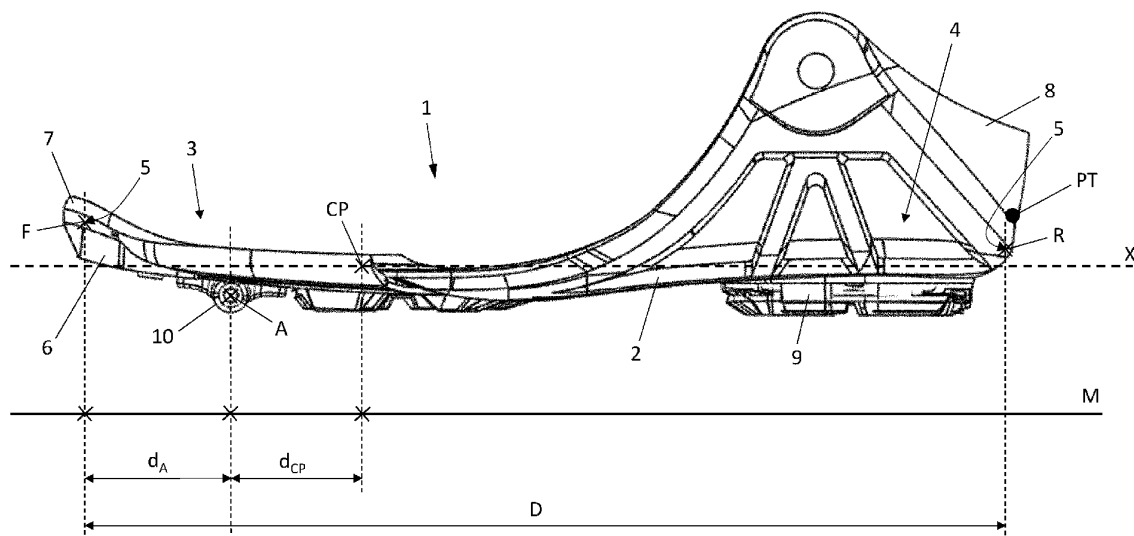
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KH MA MD TN(72) Inventor: **Erik Svensson, John****Seattle, WA Washington 98101 (US)**(74) Representative: **SSM Sandmair****Patentanwälte Rechtsanwalt****Partnerschaft mbB****Joseph-Wild-Straße 20****81829 München (DE)**(71) Applicant: **Madshus AS****2836 Biri (NO)**(54) **SKI BOOT WITH CONNECTING STRUCTURE FOR PIVOTING MOVEMENT**

(57) A ski boot, preferably for Nordic skiing, the ski boot comprising:

a sole (1) having a sole forefoot portion (3) and a sole heel portion (4) located along a longitudinal axis (X) of the ski boot, an upper, the sole (1) and the upper enclosing a boot internal space for accommodating a skier's foot, and a connecting structure (10) for securement of the ski boot to a ski binding of a ski, the connecting structure (10) defining a lateral pivot axis (A) beneath the sole forefoot portion (3) for pivoting movement of the ski boot relative to the ski, the sole (1), optionally, comprising a sole upstanding portion (7, 8), the upper and/or the sole upstanding portion (7, 16), if present, extending upwards

from an upward facing surface of the sole (1) along a boot internal rim (5) that borders the upward facing surface of the sole (1) within the boot internal space, the longitudinal axis (X) extending from a rearmost point on the boot internal rim (5) and through a central region of the sole forefoot portion (3), as seen in a top view onto the upward facing surface of the sole (1), and the pivot axis (A), in the top view, intersecting the longitudinal axis (X) at an axial distance, d_A , from a front axis (F) that is tangential to a foremost end of the boot internal rim (5) and orthogonal to the longitudinal axis (X), wherein $d_A > 20$ mm.



Figur 5

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Description

[0001] The invention relates to a ski boot comprising a connecting structure for securement of the ski boot to a ski binding of a ski, the connecting structure defining a pivot axis for pivoting movement of the ski boot relative to the ski. The ski boot may in particular be a ski boot for Nordic skiing.

[0002] EP 2 724 634 B1 discloses a ski boot comprising a connecting structure with a rigid lateral bar for securement of the ski boot to a toe piece of a ski binding such that the ski boot can be pivoted about a lateral axis defined by the rigid bar. The pivot axis of ski boots, like those known from EP 2 724 634 B1, are located a few millimeters from the front end of the ski boot beneath or closely in front of the tip of the skier's foot.

[0003] It is an object of the invention to improve such ski boots with respect to the transmission of power from the skier to the ski for cross-country skiing.

[0004] The invention is accordingly directed to a ski boot, suited for cross-country or Nordic skiing. The ski boot comprises a sole having a sole forefoot portion and a sole heel portion located along a longitudinal axis of the ski boot, and an upper attached to or formed with the sole such that the sole and the upper enclose a boot internal space for accommodating a person's foot. The sole may be formed as a whole in one piece or comprise a sole base and one or more outsole elements in integrated sole designs. The sole may comprise, for example, a forefoot outsole element on an underside of the sole forefoot portion and/or a heel outsole element on an underside of the sole heel portion of a sole base in such integrated embodiments. The ski boot furthermore comprises a connecting structure for securement of the ski boot to a ski binding of a ski, preferably but not exclusively, a ski and ski binding for cross-country or Nordic skiing. The connecting structure defines a lateral pivot axis beneath the sole forefoot portion for pivoting movement of the ski boot relative to the ski.

[0005] The upper may extend upwards from an upward facing surface of the sole along a boot internal rim that borders the upward facing surface of the sole within the boot internal space. If the sole comprises a one or more sections of, which could be formed by the sole base and/or an outsole element the sole upstanding portion extends upwards from the upward facing surface of the sole along the boot internal rim and does accordingly border the upward facing surface of the sole along the boot internal rim. The sole upstanding portion, if present, may extend upwards from the sole upward facing surface all around and define the boot internal rim. The sole upstanding portion, if present, may alternatively extend upwards from the sole upward facing surface only in one or more sections and the upper may border the sole upward facing surface in the remainder. When the sole and a lower part of the upper and/or the sole upstanding portion are seen in a top view onto the sole surface the boot internal rim marks an outer skirt for the foot of a person

wearing the ski boot.

[0006] The invention proposes to locate the pivot axis backwards as compared with the prior art, closer to the ball or metatarsophalangeal joints of the skier's foot. According to the invention, the pivot axis intersects the longitudinal axis of the ski boot at an axial distance d_A of more than 20 mm from a virtual front axis that is tangential to a foremost end of the boot internal rim and orthogonal to the longitudinal axis. The axial distance d_A is measured along the longitudinal axis. The longitudinal axis, as seen in the top view onto the sole, extends from a rearmost point on the boot internal rim and through a center region of the sole forefoot portion.

[0007] The axial distance d_A may advantageously be greater than 25 mm and may be equal or greater than 30 mm or may be equal or greater than 35 mm.

[0008] In advantageous embodiments the axial distance d_A is smaller than 80 mm and, as preferred, equal or smaller than 60 mm. The axial distance d_A may even more expediently be chosen from the range of 30 to 55 mm or 46 ± 6 mm.

[0009] As seen in the top view, the longitudinal axis may pass through a center point located on a straight connecting line that connects, within the sole forefoot portion, a most medial point and a most lateral point of the boot internal rim. The center point is in the middle between the most medial point and the most lateral point measured along the connecting line, i.e. the center point is equidistant along the connecting line to each of these two points.

[0010] The connecting line may serve as a substitute for a straight line that intersects, in a top view, the metatarsal tibiale and the metatarsale fibulare of a person's foot having a foot size that corresponds to the size of the ski boot. The center point on that connecting line is representative for the center point of the metatarsophalangeal joints of a person whom the ski boot fits.

[0011] It has been found that placing the pivot axis well behind the toes tip and in front of the center point is an optimal compromise between efficient power transmission during cross-skiing on the one and control of the ski on the other hand. Due to the backward placement the skier can push backwards against the ski with greater force than is possible with the conventional placement of the pivot axis. The placement in front of the center point, on the other hand, allows for a sufficient degree of freedom of pivotal movement. Shifting the pivot axis back further, for example, directly beneath the center point, would be to the detriment of ski control since the skier would have to be lifted higher above the ski to allow for pivoting about the pivot axis by 30° or more.

[0012] The pivot axis may intersect the ski boot longitudinal axis, in the top view, in a section in the middle between the front axis and the center point. If d_{CP} is the axial distance of the pivot axis from the center point, measured along the longitudinal axis, an optimum can be achieved if d_A is within $d_{CP} \pm 30\%$, i.e. if $0.7 \cdot d_{CP} < d_A < 1.3 \cdot d_{CP}$. The axial distance d_A may even better be

chosen to be larger than $0.8 \cdot d_{CP}$ or $0.9 \cdot d_{CP}$. Expedient upper limits are $d_A \leq 1.2 \cdot d_{CP}$ or $d_A \leq 1.1 \cdot d_{CP}$.

[0013] The axial position of the pivot axis may additionally or alternatively be described in relation to an overall axial length of the sole upward facing surface. The overall axial length is measured in the top view along the longitudinal axis as the axial distance D between the front axis and the rearmost point of the boot internal rim. The axial distance may advantageously be chosen from the range of $0.1 \cdot D \leq d_A \leq 0.2 \cdot D$. The pivot axis intersects the longitudinal axis in embodiments fulfilling these two relations with an axial offset to the front axis of 10 to 20% of the overall length. The axial offset d_A may even more preferred be equal or greater than $0.12 \cdot D$ and/or it may be equal or smaller than $0.18 \cdot D$.

[0014] The axial position of the pivot axis may additionally or alternatively be described in relation to anatomical characteristics of a foot of a person having a foot size corresponding with the ski boot size and wearing the ski boot. A longitudinal axis of the foot is orthogonal to a plane that is tangential to a foremost end and orthogonal to a plane that is tangential to a rearmost end, the pternion, of the foot. The pivot axis of the ski boot, in a top view onto the foot encased by or overlaid with the ski boot, intersects the foot longitudinal axis between the plane that is tangential to the foot foremost end and a center point of the metatarsophalangeal joints of the foot at an axial distance d_{FA} from the foremost contact plane and an axial distance d_{CP} from the foot center point of the metatarsophalangeal joints. The center point of the metatarsophalangeal joints and the pternion are located on the foot longitudinal axis and the axial distances d_{FA} and d_{CP} are measured along the longitudinal axis of the foot. Related to the foot, it is advantageous if d_{FA} is larger than $0.7 \cdot d_{CP}$.

[0015] The values and value ranges described above with respect to the axial distances d_A and d_{CP} in relation to the longitudinal axis, the front axis and the center point of the ski boot hold in good approximation also for the axial distances d_{FA} and d_{CP} if those are related to a foot which the ski boot encases and matches in terms of foot size and ski boot size. The relations, limits and ranges described with respect to d_A may be substituted or supplemented by the same relations, limits and ranges described instead with respect to d_{FA} . The longitudinal axis and the center point of the foot may coincide exactly or in good approximation with the longitudinal axis and the center point of the sole upward facing surface. One should bear in mind, however, that the front axis of the boot internal rim is a certain although small axial distance offset forward of the plane that is tangential to the foremost end of the foot. The axial distance between the front axis of the boot internal rim and the plane that is tangential to the foremost end of the foot provides for a clearance between the foremost end of the foot and an opposing inner surface of the ski boot.

[0016] The connecting structure may be provided in one piece as a cleat, for example, a metal cleat. The cleat

may be joint directly to the sole. If the sole comprises two or more components joint together to form an integrated sole, for example a sole base and one or more outsole elements such as a forefoot outsole element and/or a heel outsole element, the connecting structure or cleat may advantageously be joint directly to the sole base. The connecting structure or cleat may be joint with the sole or the sole base of an integrated sole by material bond, exclusively or including also positive and/or non-positive locking. In preferred embodiments, however, the connecting structure may be joint with the stand-alone sole or the sole base of the integrated sole by positive and/or non-positive locking only and, as most preferred, by non-positive locking only. The connecting structure or cleat may, in particular, be pressed tightly against the sole or sole base by means of a screw connection.

[0017] The feature of mounting the connecting structure directly on a sole formed in one piece or on a sole base of an integrated sole is advantageous as such and not only in combination with the positioning of the pivot axis in relation to the front axis of the boot internal rim and/or in relation to the center point of the sole upward facing surface and/or the overall length of the sole upward facing surface and/or in relation to the center point of a foot having a foot size that matches with the ski boot size.

[0018] Advantageous features are also described in the claims and each combination of the claims.

[0019] In the following, specific aspects of the ski boot will be outlined. The reference signs and expressions set in parenthesis are referring to example embodiments explained further below with reference to figures. The reference signs and expressions are, however, only illustrative and do not limit the respective aspect to any specific component or feature of the example embodiments. The aspects can be formulated as claims in which the reference signs and expressions set in parenthesis are omitted or replaced by appropriate others.

Aspect 1. A ski boot, preferably for Nordic skiing, the ski boot comprising:

- 1.1 a sole (1) having a sole forefoot portion (3) and a sole heel portion (4) located along a longitudinal axis (X) of the ski boot,
- 1.2 an upper (15), the sole (1) and the upper (15) enclosing a boot internal space for accommodating a skier's foot, and
- 1.3 a connecting structure (10) for securement of the ski boot to a ski binding of a ski, the connecting structure (10) defining a lateral pivot axis (A) beneath the sole forefoot portion (3) for pivoting movement of the ski boot relative to the ski,
- 1.4 the sole (1), optionally, comprising a sole upstanding portion (7, 8),
- 1.5 the upper (15) and/or the sole upstanding portion (7, 16), if present, extending upwards from an upward facing surface of the sole (1) along a boot internal rim (5) that borders the up-

ward facing surface of the sole (1) within the boot internal space,

1.6 the longitudinal axis (X) extending from a rearmost point (RP) on the boot internal rim (5) and through a central region of the sole forefoot portion (3), as seen in a top view onto the upward facing surface of the sole (1), and

1.7 the pivot axis (A), in the top view, intersecting the longitudinal axis (X) at an axial distance, d_A , from a front axis (F) that is tangential to a foremost end of the boot internal rim (5) and orthogonal to the longitudinal axis (X),

1.8 wherein $d_A > 20$ mm.

Aspect 2. Ski boot according to aspect 1, wherein $d_A > 25$ mm.

Aspect 3. Ski boot according to any one of the preceding aspects, wherein $d_A \geq 30$ mm or $d_A \geq 35$ mm.

Aspect 4. Ski boot according to any one of the preceding aspects, wherein $d_A < 80$ mm.

Aspect 5. Ski boot according to any one of the preceding aspects, wherein $d_A \leq 60$ mm.

Aspect 6. Ski boot according to any one of the preceding aspects, wherein the longitudinal axis (X), in the top view, passes through a center point (CP) located on a straight connecting line (BG) that connects, in the sole forefoot portion (3), a most medial point (MP) and a most lateral point (LP) of the boot internal rim (5), the center point (CP) being equidistant, along the connecting line (BG), to the most medial point (MP) and the most lateral point (LP).

Aspect 7. Ski boot according to the preceding aspect, wherein the connecting line (BG), in the top view, intersects the metatarsale tibiale (MT) and the metatarsale fibulare (MF) of a skier's foot having a size corresponding to the ski boot size.

Aspect 8. Ski boot according to any one of the preceding aspects, wherein the longitudinal axis (X), in the top view, passes through a center point (CP) located in a vertical ball girth cross-section of the boot internal space in the middle between a most medial point (MP) and a most lateral point (LP) of the vertical ball girth cross section.

Aspect 9. Ski boot according to the preceding aspect, wherein the vertical ball girth cross section intersects the metatarsale tibiale (MT) and the metatarsale fibulare (MF) of a skier's foot having a size corresponding to the ski boot size.

Aspect 10. Ski boot according to any one of aspects 6 to 9, wherein the pivot axis (A), in the top view,

intersects the longitudinal axis (X) forward of the center point (CP).

Aspect 11. Ski boot according to any one of aspects 6 to 10, wherein the pivot axis (A), in the top view, intersects the longitudinal axis (X) at an axial distance, d_{CP} , from the center point (CP), and wherein $d_A > 0.7 \cdot d_{CP}$.

Aspect 12. Ski boot according to any one of aspects 6 to 11, wherein $d_A < 1.3 \cdot d_{CP}$.

Aspect 13. Ski boot according to any one of aspects 6 to 12, wherein $d_A \geq 0.8 \cdot d_{CP}$ or $d_A \geq 0.9 \cdot d_{CP}$.

Aspect 14. Ski boot according to any one of aspects 6 to 13, wherein $d_A \leq 1.2 \cdot d_{CP}$ or $d_A \leq 1.1 \cdot d_{CP}$.

Aspect 15. Ski boot according to any one of the preceding aspects, wherein $0.1 \cdot D \leq d_A \leq 0.2 \cdot D$, D being the axial distance of the rearmost point (RP) from the front axis (F) measured, in the top view, along the longitudinal axis (X).

Aspect 16. Ski boot according to any one of the preceding aspects, wherein $0.12 \cdot D \leq d_A$ and/or $d_A \leq 0.18 \cdot D$.

Aspect 17. Ski boot according to any one of the preceding aspects, wherein to measure any axial distance or length, such as d_A and/or d_{CP} and/or D,

- the ski boot is secured to a ski that is laying on a plane of measurement (M), the connecting structure (10) being secured to a toe piece of a ski binding mounted on the ski and the heel portion (4) resting on the ski binding,
- the pivot axis (A), the front axis (F), and the longitudinal axis (X), the center point (CP) if required, and the rearmost point (RP) if required, are projected each orthogonally onto the plane of measurement (M), and
- the respective axial distance or length, d_A and/or d_{CP} and/or D, is measured in the plane of measurement (M) along the longitudinal axis (X).

Aspect 18. A ski boot, preferably for Nordic skiing, the ski boot comprising:

18.1 a sole (1) having a sole forefoot portion (3) and a sole heel portion (4) located along a longitudinal axis (X) which is orthogonal to a plane that is tangential to a foremost end and orthogonal to a plane that is tangential to a rearmost end (PT) of the foot of a person having a foot size corresponding with the ski boot size and wearing the ski boot,

18.2 an upper (15), the sole (1) and the upper (15) enclosing a boot internal space for accommodating a skier's foot, and

18.3 a connecting structure (10) for securement of the ski boot to a ski binding of a ski, the connecting structure (10) defining a pivot axis (A) beneath the sole forefoot portion (3) for pivoting movement of the ski boot relative to the ski,

18.4 the pivot axis (A), in a top view onto the sole (1), intersecting the longitudinal axis (X) between the foot foremost end and a center point (CP) of the foot metatarsophalangeal joints at an axial distance, d_{FA} , from the foot foremost end and an axial distance, d_{CP} , from the foot center point (CP), and

18.5 the foot center point (CP) being located on the longitudinal axis (X) and the axial distances (d_{FA} , d_{CP}) measured along the longitudinal axis (X),

18.6 wherein $d_{FA} > 0.7 \cdot d_{CP}$.

Aspect 19. Ski boot according to the preceding aspect in combination with any one of the other aspects, wherein $d_{FA} = d_A + \Delta$, Δ being an axial distance between the front axis (F) of the boot internal rim (5) and the plane that is tangential to the foremost end of the foot to provide for a clearance between the foremost end of the foot and an axially opposing inner surface (7; 15) of the ski boot.

Aspect 20. Ski boot according to any one of the preceding aspects, wherein the connecting structure (10) is a cleat mounted directly on the sole (1).

Aspect 21. A ski boot, preferably for Nordic skiing, the ski boot comprising:

21.1 a sole (1) having a sole forefoot portion (3) and a sole heel portion (4) located along a longitudinal axis (X) of the ski boot,

21.2 a connecting structure (10) for securement of the ski boot to a ski binding of a ski, the mounting element (10) defining a pivot axis (A) beneath the sole forefoot portion (3) for pivoting movement of the ski boot relative to the ski, and

21.3 wherein the connecting structure (10) is a cleat mounted directly on the sole (1).

Aspect 22. Ski boot according to the preceding aspect in combination with any one of the other aspects.

Aspect 23. Ski boot according to any one of the preceding aspects, wherein the connecting structure (10) comprises an attachment base (11) for attaching the connecting structure (10) to the sole (1) and a bearing structure (13) that protrudes from the attachment base (11) and carries a left engagement mem-

ber (14) and a right engagement member (14) for engagement with the ski binding.

Aspect 24. Ski boot according to the preceding aspect, wherein the left engagement member (14) and the right engagement member (14) are engagement pins that protrude laterally from the bearing structure (13) and are supported by the bearing structure (13) movably in the lateral direction towards each other against a biasing force.

Aspect 25. Ski boot according to any one of the preceding aspects, wherein the sole (1) comprises a sole base (2) and a forefoot outsole element (6) attached to the sole base (2), and wherein the connecting structure (10), in a top view onto an underside of the ski boot, is mounted on the sole base (2) adjacent to the forefoot outsole element (6) or in a recess (16) of the forefoot outsole element (6).

Aspect 26. Ski boot according to any one of the preceding aspects, wherein the sole (1) or a sole base (2) is made of a polymer material that is re-enforced with fibers and/or particles and/or formed structures.

Aspect 27. Ski boot according to any one of the preceding aspects, wherein the sole (1) or a sole base (2) is made of a polymer material in which one or more layers or mats of re-enforcing fibers are embedded.

[0020] The invention is explained below by way of example with reference to figures. Features disclosed there, each individually and in any combination of features, advantageously develop the subjects of the claims and also the embodiments and aspects described above. There is shown:

- Fig. 1 a sole of a ski boot in an isometric side view,
- Fig. 2 a top view onto an upward facing surface of the sole,
- Fig. 3 an isometric view showing an underside of the sole,
- Fig. 4 a top view onto the underside of the sole,
- Fig. 5 a side view of the sole placed above a virtual plane of measurement,
- Fig. 6 a top view onto a schematically illustrated foot,
- Fig. 7 a boot forefoot portion in a longitudinal section of the ski boot, and
- Fig. 8 a modified boot forefoot portion in a longitudinal section of the ski boot.

[0021] Figure 1 is an isometric view of a sole 1 of a ski boot showing the sole 1 mainly from the side, slightly from above and from the rear to the front. The sole 1 is an integrated sole 1 comprising a sole base 2, a forefoot outsole element 6, and a heel outsole element 9 both attached to the underside of the sole base 2. The outsole

elements 6 and 9 may be joint to the sole base 2, for example, by material bond. The jointing may be supplemented by positive and/or non-positive locking of one or both of the elements 6 and 9 to the sole base 2. The sole 1, in the example embodiment the sole base 2 in combination with the forefoot outsole element 6, provides an upward facing surface on which the foot of the skier is resting during use.

[0022] The sole base 2 may expediently be formed in one-piece of a polymer material that is re-enforced with fibers and/or formed structures and/or particles. It may in particular be moulded. The sole base 2 may have a laminate structure.

[0023] The ski boot may be divided into three general regions, namely, a forefoot region, a midfoot region, and a heel region. Sole 1 comprises correspondingly a sole forefoot portion 3, a sole midfoot portion, and a sole heel portion 4. Sole 1 also includes a lateral side and a medial side. Forefoot portion 3 corresponds with the toes and the joints connecting the metatarsals with the phalanges. Midfoot portion corresponds with the arch area of the foot, and heel portion 4 corresponds with rear portions of the foot, including the calcaneus bone. Lateral side and medial side correspond with opposite sides of sole 1 and the ski boot.

[0024] The ski boot comprises an upper. The sole 1 and the upper enclose a boot internal space for accommodating a skier's foot. The upper may be formed separately and joint with the sole 1 or formed with the sole 1, for example with the sole base 2, in one piece, for example by additive or generative processes. A lower part of the upper is shown in the figures 7 and 8 and denoted there with reference number 15. In the example embodiment, the forefoot outsole element 6 is dished and comprises an upstanding portion 7 that extend upwards around the front end and along adjacent side sections of the upward facing surface of the sole 1. The sole base 2 comprises an upstanding portion 8 that extends upwards from the sole upward facing surface and wraps up around the back and sides in the heel portion 4. The upstanding portion 8 may be provided with holes, as illustrated, to enable an ankle cuff or part of an ankle cuff to be connected to the sole base 2 in a hinged manner.

[0025] In the ready-to-use ski boot the upstanding portions 7 and 8 and the upper extend from the sole upward facing surface along a boot internal rim 5 that marks the outer skirt of the sole upward facing surface within the boot internal space. The sole upward facing surface constitutes the underside of the boot internal space whereas upstanding portions 7 and 8 and the upper provide for the remainder of the envelope of the boot internal space. The upstanding portions 7 and 8 may be regarded to constitute part of the upper in so far as they limit the boot internal space to the front and to the medial and lateral sides, i. e. upstanding portions 7 and 8 border the sole upward facing surface and, hence, the skier's foot to the front, the rear, and also to the sides.

[0026] Figure 2 is a top view onto the sole upward fac-

ing surface. The sole surface formed by the integrated sole 1 and enclosed by the boot internal rim 5 extends along a longitudinal axis X of the ski boot between a virtual front axis F and a virtual rear axis R which are both orthogonal to the longitudinal axis X and tangential to a foremost end and a rearmost end of the boot internal rim 5, respectively. The rear axis R intersects the longitudinal axis X at a rearmost point RP of the rim 5. A straight connecting line BG connects a most medial point MP and a most lateral point LP both located in the sole forefoot portion 3 on the boot internal rim 5. CP denotes a center point located in the middle between the most medial point MP and the most lateral point LP on connecting line BG. The longitudinal axis X intersects the rear axis R at the rearmost point RP and the connecting line BG at the center point CP.

[0027] The ski boot comprises a connecting structure 10 for securement to a toe piece of a ski binding of a ski, for example, a ski and ski binding for cross-country or Nordic skiing. The connecting structure 10 defines a lateral pivot axis A beneath the sole forefoot portion 3 to allow for pivoting movement of the ski boot relative to the ski.

[0028] Figure 3 is an isometric view of the sole 1 showing its underside where the connecting structure 10 is mounted. The connecting structure 10 is mounted directly to the sole base 2. The ski boot differs from prior art ski boots which comprise connecting structures mounted to outsole elements such as the forefoot outsole element 6 and not directly to a sole base such as sole base 2. The forefoot outsole element 6 comprises a recess 16 in the region where the connecting structure 10 is located to allow for directly jointing the connecting structure 10 to the sole base 2.

[0029] The connecting structure 10 is joint to the sole base 2 by non-positive locking. The joint connection is a screw connection, as preferred, but could instead be formed as a riveted joint or the like. The non-positive locking could be complemented by positive locking and/or material bonding. A purely non-positive locking, in particular a pure screw connection, is however the preferred joint between the connecting structure 10 and the sole base 2.

[0030] The connecting structure 10 is formed in one piece as a cleat and may in particular be a metal cleat. It comprises an attachment base 11 with through-holes 12 for fastening elements such as screws or rivets that penetrate the attachment base 11 to fasten the connecting structure 10 to the sole base 2. The connecting structure 10 furthermore comprises a bearing structure 13 that protrudes downwardly from the attachment base 11 to define the pivot axis A at a vertical distance from the sole 1. The bearing structure 13 accommodates engagement members 14, a left and a right engagement member 14, moveably in the lateral direction parallel to the pivot axis A. The engagement members 14 may be formed as pins. They may be biased, for example spring-loaded, each to an outward position and can be suppressed towards one

another, against the biasing or spring force. To secure the ski boot to the ski binding the ski boot is pressed towards a toe piece of the ski binding such that the engagement members 14 first yield against the biasing force and then snap forward into respective holes or deepening of the toe piece of the ski binding thereby securing the ski boot to the toe piece of the ski binding and establishing the pivot axis A of the ski boot relative to the ski.

[0031] In the example embodiment, the left and right engagement members 14 are movable laterally relative to the ski boot. In modifications the engagement members 14 may be immovable relative to the rest of the connecting structure 10. In such modifications the toe piece of the ski binding may provide for the movability to enable a snap-in securement of connecting structure 10 to the ski binding. In further modifications the protruding engagement members 14 could be substituted by holes or deepening in the bearing structure 13 and the ski binding provided with corresponding engagement pins or the like that protrude laterally to engage into the holes or deepening of the modified connecting structure 10. In yet further embodiments, the connecting structure 10 may comprise a rigid lateral bar to define pivot axis A.

[0032] Figure 4 is a top view onto the underside of the sole 1. As can be seen, the pivot axis A is positioned relatively far to the rear, as compared with conventional ski boots, to improve the efficiency of power transmission when pushing back on the ski during cross-country skiing. The pivot axis A intersects the longitudinal axis X in a mid-section between the front axis F and the center point CP.

[0033] As described above with respect to figures 1 and 2, the longitudinal axis X extends from the rearmost point RP of the boot internal rim 5 in the forward direction through the center point CP on the connecting line BG. The axes F and R are parallel one to the other and orthogonal to the longitudinal axis X. Front axis F is tangential to the boot internal rim 5 at the foremost point of rim 5. Rear axis R is tangential to the boot internal rim 5 at the rearmost point RP of the rim 5.

[0034] The pivot axis A intersects the longitudinal axis X between the front axis F and the center point CP at an axial distance d_A from the front axis F and an axial distance d_{CP} from the center point CP. The axial distances d_A and d_{CP} may be equal. In the example embodiment, they are only approximately the same in that the axial distance d_A is slightly larger than the axial distance d_{CP} . It is advantageous if $d_A > 0.7 \cdot d_{CP}$. Better results can be achieved if $d_A \geq 0.8 \cdot d_{CP}$. The results are best if $d_A \geq 0.9 \cdot d_{CP}$. The pivot axis A should, on the other hand, not be located too far towards the rear in order not to restrict the pivoting movement of the ski unnecessarily. Good results are achieved if $d_A < 1.3 \cdot d_{CP}$. More advantageously $d_A \leq 1.2 \cdot d_{CP}$ or $d_A \leq 1.1 \cdot d_{CP}$.

[0035] An overall axial length of the sole upward facing surface is measured in the top view along the longitudinal axis X as the axial distance D between the front axis F

and the rearmost point RP or rear axis R of the boot internal rim 5. The axial distance d_A may advantageously be chosen such that $0.1 \cdot D \leq d_A \leq 0.2 \cdot D$. The pivot axis A intersects the longitudinal axis in embodiments fulfilling these two relations with an axial offset d_A to the front axis F of 10 to 20% of the overall length D. The axial offset d_A may even more preferred be equal or greater than $0.12 \cdot D$ and/or it may be equal or smaller than $0.18 \cdot D$.

[0036] Figure 5 shows the sole 1 in a side view and in relation to a supporting plane that may serve as a plane of measurement M. To measure the axial distances d_A and d_{CP} a ski equipped with a ski binding suitable for co-operation with the ski boot is placed on the plane of measurement M. The ski boot is connected to the ski by engaging the connecting structure 10 with the toe piece of the ski binding and the ski boot is pivoted towards the ski such that the sole 1 is resting on a heel piece of the ski binding if the ski binding regularly comprises a heel piece, or directly on the ski if the ski binding does not regularly comprise a heel piece. In figure 5 the sole 1 occupies a position it is supposed to occupy in relation to the plane of measurement M supporting the ski. The pivot axis A, the front axis F, the center point CP, the rear axis R, and the longitudinal axis X are then projected each orthogonal onto the plane of measurement M. The axial distances d_A and d_{CP} and D are measured along the longitudinal axis X on the plane of measurement M.

[0037] The rear axis R of rim 5 is shown to extend axially offset forward of the rearmost point of the boot internal space. The rearmost point of the boot internal space is denoted PT for its correspondence to the rearmost point, the pternion, of a foot that matches the ski boot in size. In further embodiments, rear axis R may extend exactly below or slightly to the rear of PT.

[0038] Figure 6 is a top view onto the underside of a foot. Figure 6 serves to explain anatomical measures helpful to understand the background of the invention. The foot size is measured along the longitudinal axis X as the length between a rearmost plane contacting the foot at the rearmost point of the heel, the so-called pternion PT, and a foremost plane contacting the tip of the toes. The two planes are parallel one to the other and orthogonal to the longitudinal axis X. The front axis F and the rear axis R, which are tangential to the boot internal rim 5 are shown in dotted lines. For a ski boot of a ski boot size corresponding to the foot size L the front axis F intersects the longitudinal axis X at a certain, typically small distance forward of the foremost plane of contact. This axial offset is denoted as clearance Δ . Clearance Δ may measure a few millimeters and may, for example, be 3 ± 2 mm. The rear axis R intersects the longitudinal axis X at a certain distance forward of the rearmost plane of contact but could alternatively extend in the rearmost plane of contact or slightly aft of it, as mentioned above.

[0039] The metatarsophalangeal joints are represented by the straight line BG which is the orthogonal projection of the ball girth cross-section onto a plane supporting the foot. The line BG passes through the metatarsale

tibiale MT and the metatarsale fibulare MF. Line BG also passes through a most medial point and a most lateral point of the foot. The longitudinal axis X extends from the pternion PT forward and through the center point CP which is located on the line BG in the middle between MP and LP.

[0040] The pivot axis A defined by the connecting structure 10 is also shown. Pivot axis A is slightly tilted towards the longitudinal axis X, mainly to show that pivot axis A must not necessarily be exactly orthogonal to the longitudinal axis X. The deviation from a right angle is only a few degrees. The pivot axis A intersects the longitudinal axis X between the foremost plane of contact and the foot center point CP at an axial distance d_{FA} from the foremost plane of contact and an axial distance d_{CP} from the foot center point CP.

[0041] Figure 6 may be regarded as an overlay of a foot having the foot size L and the ski boot having a corresponding boot size. The longitudinal axis X of the ski boot is an approximation for the foot longitudinal axis X. The same is true with respect to the connecting line BG and the center point CP of the ski boot which correspond to the ball girth line BG of the foot and the foot center point CP. The boot internal rim 5 (Fig. 2) is a line that follows the outer contour of the foot of corresponding size with a certain outsize, i. e. the front axis F is located a certain although small distance forward of the foremost tip of the toes and the most medial and most lateral points MP and LP on the boot internal rim 5 are at a certain although small distance to the left and right of the corresponding points MP and LP of the foot.

[0042] Figures 7 and 8 are schematic illustrations showing the front part of the ski boot in a longitudinal section along the longitudinal axis X.

[0043] Figure 7 shows an embodiment in which an upper 15 is joint with the sole 1 at an inner circumferential surface of upstanding portion 7. The lower part of upper 15 limits the boot internal space available for the foot in the boot forefoot region. In the boot forefoot region the boot internal rim 5 that skirts the sole upward facing surface is accordingly defined by the sole upward facing surface in conjunction with the upper 15.

[0044] Figure 8 shows an embodiment that is modified in that the upper 15 surrounds the upstanding portion 7, i. e. the upper 15 is joint to the sole 1 at the outer circumferential surface of the upstanding portion 7. Now, upstanding portion 7 limits the boot internal space available for the foot in the boot forefoot region. In the boot forefoot region the boot internal rim 5 that skirts the sole upward facing surface is accordingly defined by the sole upward facing surface in conjunction with the upstanding portion 7 of the sole 1, in the example embodiment, of the forefoot outsole element 6.

[0045] Figures 7 and 8 also show the mounting of the connecting structure 10 directly on the sole base 2. The forefoot outsole element 6 is spared to form the recess 16 in which the connecting structure 10 is located for directly mounting it on the sole base 2, for example, by

screw connection or rivet joint.

Reference signs:

5 [0046]

1	sole
2	sole base
3	sole forefoot portion
10 4	sole heel portion
5	boot internal rim
6	forefoot outsole element
7	upstanding portion
8	upstanding portion
15 9	heel outsole element
10	connecting structure
11	attachment base
12	through-hole
13	bearing structure
20 14	engagement member
15	upper
16	recess
A	pivot axis
25 BG	connecting line
CP	center point
D	overall axial distance
d_A	axial distance from front axis F
d_{CP}	axial distance from center point CP
30 d_{FA}	axial distance from toes tip
Δ	clearance
F	front axis
L	length of foot
LP	most lateral point
35 M	plane of measurement
MF	metatarsale fibulare
MP	most medial point
MT	metatarsale tibiale
R	rear axis
40 RP	rearmost point
X	longitudinal axis

Claims

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1. A ski boot, preferably for Nordic skiing, the ski boot comprising:

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- 1.9 a sole (1) having a sole forefoot portion (3) and a sole heel portion (4) located along a longitudinal axis (X) of the ski boot,
- 1.10 an upper (15), the sole (1) and the upper (15) enclosing a boot internal space for accommodating a skier's foot, and
- 1.11 a connecting structure (10) for securement of the ski boot to a ski binding of a ski, the connecting structure (10) defining a lateral pivot axis (A) beneath the sole forefoot portion (3) for piv-

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- oting movement of the ski boot relative to the ski,
 1.12 the sole (1), optionally, comprising a sole upstanding portion (7, 8),
 1.13 the upper (15) and/or the sole upstanding portion (7, 16), if present, extending upwards from an upward facing surface of the sole (1) along a boot internal rim (5) that borders the upward facing surface of the sole (1) within the boot internal space,
 1.14 the longitudinal axis (X) extending from a rearmost point (RP) on the boot internal rim (5) and through a central region of the sole forefoot portion (3), as seen in a top view onto the upward facing surface of the sole (1), and
 1.15 the pivot axis (A), in the top view, intersecting the longitudinal axis (X) at an axial distance, d_A , from a front axis (F) that is tangential to a foremost end of the boot internal rim (5) and orthogonal to the longitudinal axis (X),
 1.16 wherein $d_A > 20$ mm.
2. Ski boot according to claim 1, wherein $d_A > 25$ mm.
3. Ski boot according to any one of the preceding claims, wherein $d_A \geq 30$ mm or $d_A \geq 35$ mm.
4. Ski boot according to any one of the preceding claims, wherein $d_A < 80$ mm or $d_A \leq 60$ mm.
5. Ski boot according to any one of the preceding claims, wherein the longitudinal axis (X), in the top view, passes through a center point (CP) located on a straight connecting line (BG) that connects, in the sole forefoot portion (3), a most medial point (MP) and a most lateral point (LP) of the boot internal rim (5), the center point (CP) being equidistant, along the connecting line (BG), to the most medial point (MP) and the most lateral point (LP).
6. Ski boot according to the preceding claim, wherein the pivot axis (A), in the top view, intersects the longitudinal axis (X) forward of the center point (CP).
7. Ski boot according claim 5 or claim 6, wherein the pivot axis (A), in the top view, intersects the longitudinal axis (X) at an axial distance, d_{CP} , from the center point (CP), and wherein $d_A > 0.7 \cdot d_{CP}$.
8. Ski boot according to any one of claims 5 to 7, wherein $d_A < 1.3 \cdot d_{CP}$.
9. Ski boot according to any one of claims 5 to 8, wherein $d_A \geq 0.8 \cdot d_{CP}$ and/or $d_A \leq 1.2 \cdot d_{CP}$.
10. Ski boot according to any one of the preceding claims, wherein $0.1 \cdot D \leq d_A \leq 0.2 \cdot D$,
 D being the axial distance of the rearmost point (RP) from the front axis (F) measured, in the top view, along the longitudinal axis (X).
11. Ski boot according to any one of the preceding claims, wherein to measure any axial distance or length, such as d_A and/or d_{CP} and/or D,
 - the ski boot is secured to a ski that is laying on a plane of measurement (M), the connecting structure (10) being secured to a toe piece of a ski binding mounted on the ski and the heel portion (4) resting on the ski binding,
 - the pivot axis (A), the front axis (F), and the longitudinal axis (X), the center point (CP) if required, and the rearmost point (RP) if required, are projected each orthogonally onto the plane of measurement (M), and
 - the respective axial distance or length, d_A and/or d_{CP} and/or D, is measured in the plane of measurement (M) along the longitudinal axis (X).
12. Ski boot according to any one of the preceding claims, wherein the connecting structure (10) is a cleat mounted directly on the sole (1).
13. Ski boot according to any one of the preceding claims, wherein the connecting structure (10) comprises an attachment base (11) for attaching the connecting structure (10) to the sole (1), and a bearing structure (13) that protrudes from the attachment base (11) downwards and carries one or more engagement members (14) for engagement with the ski binding.
14. Ski boot according to any one of the preceding claims, wherein the sole (1) comprises a sole base (2) and a forefoot outsole element (6) attached to the sole base (2), and wherein the connecting structure (10), in a top view onto an underside of the ski boot, is mounted on the sole base (2) adjacent to the forefoot outsole element (6) or in a recess (16) of the forefoot outsole element (6).
15. Ski boot according to any one of the preceding claims, wherein the sole (1) or a sole base (2) is made of a polymer material that is re-enforced with fibers and/or particles and/or formed structures.

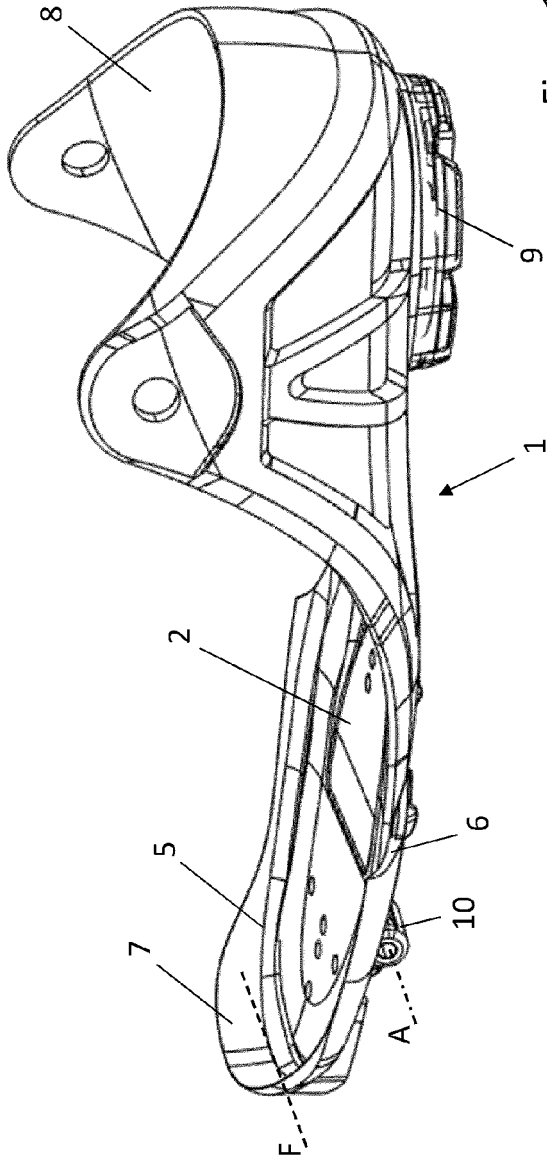


Figure 1

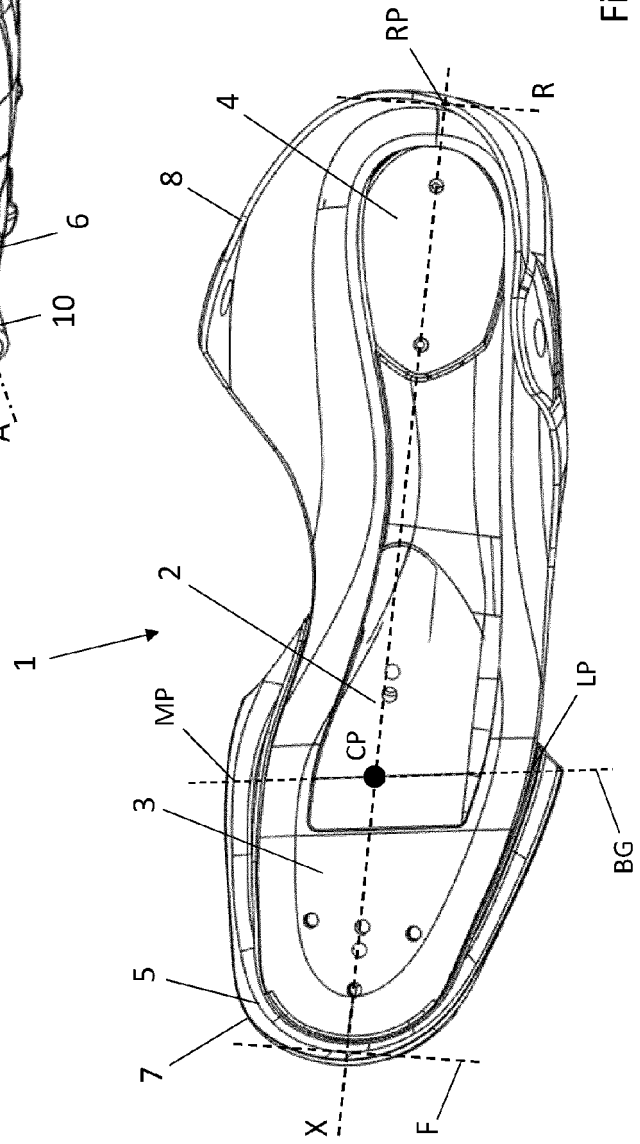


Figure 2

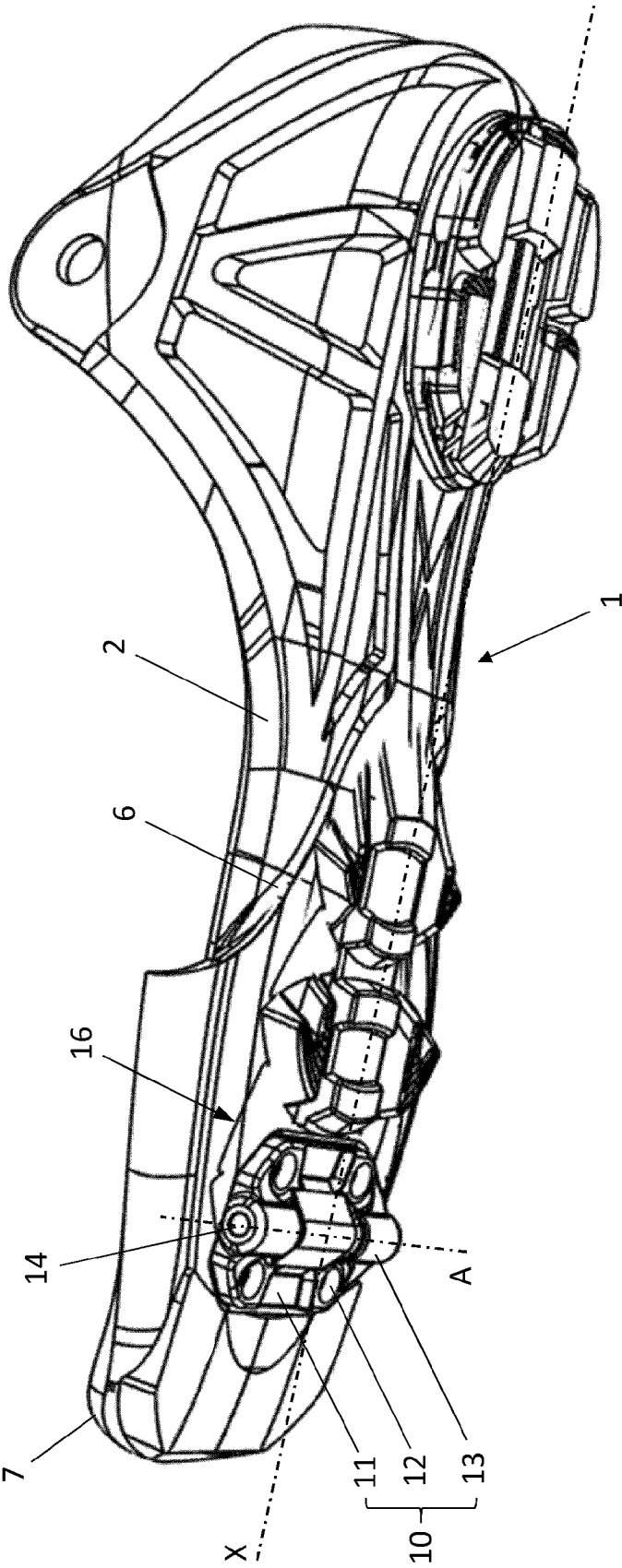
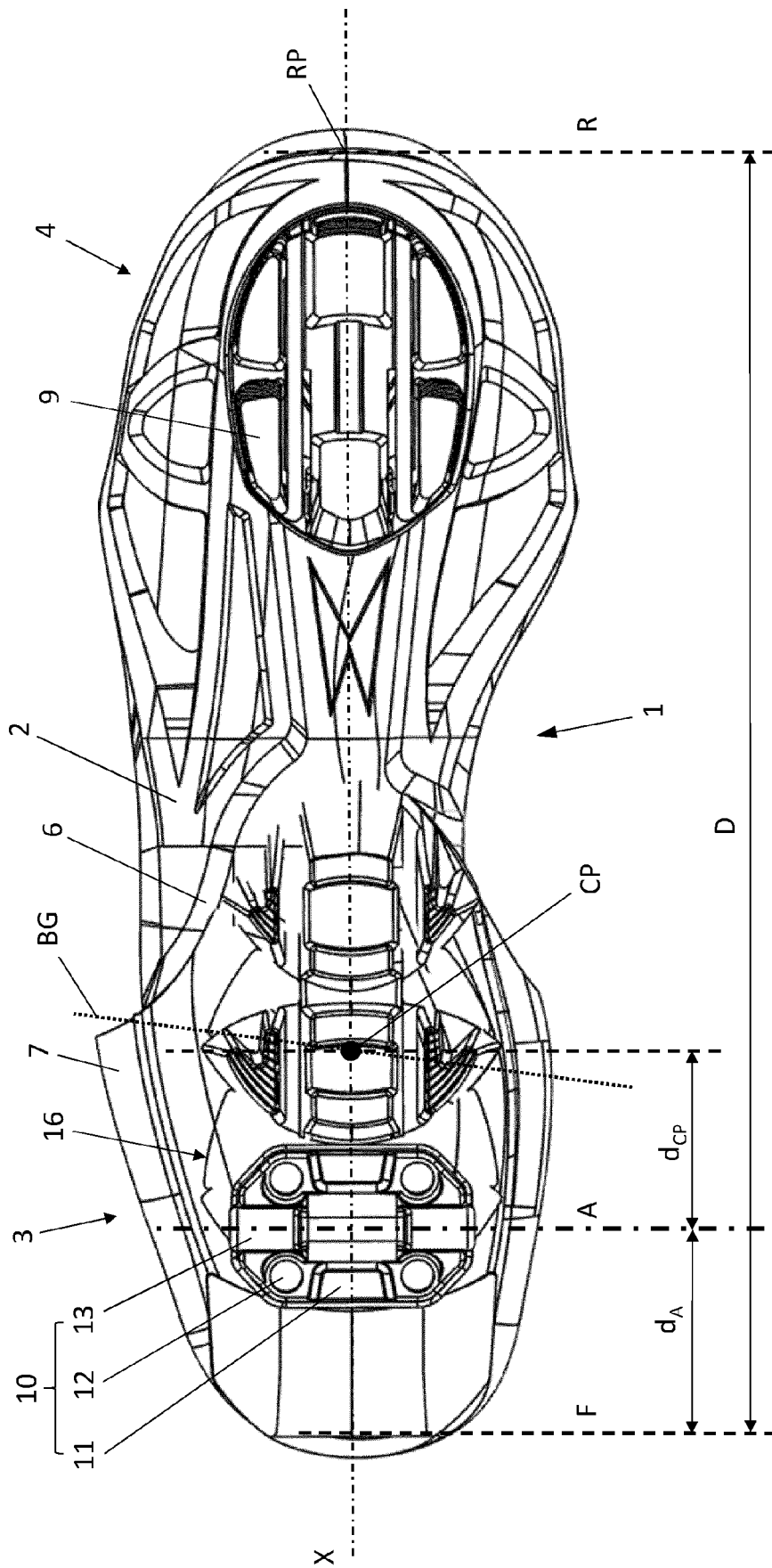
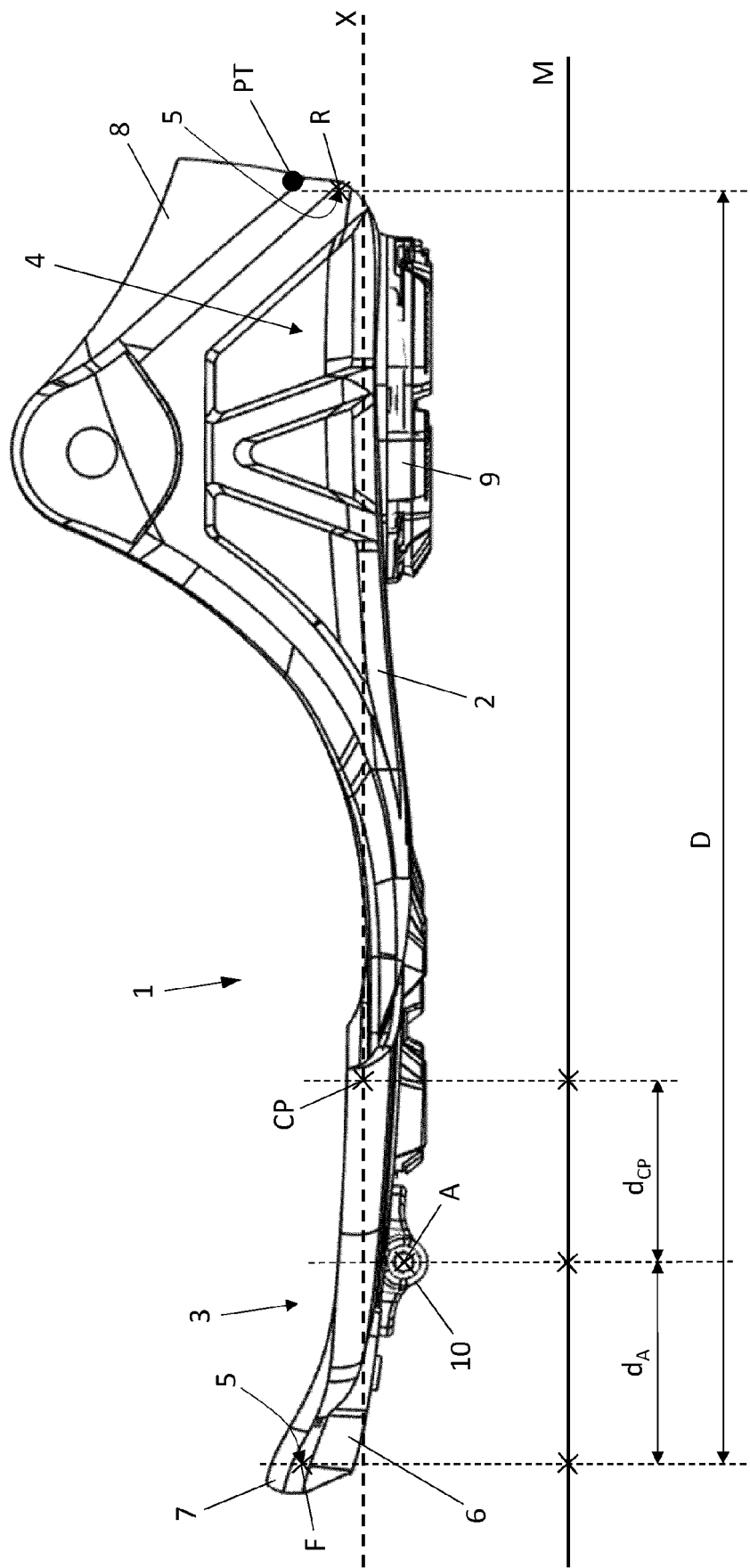


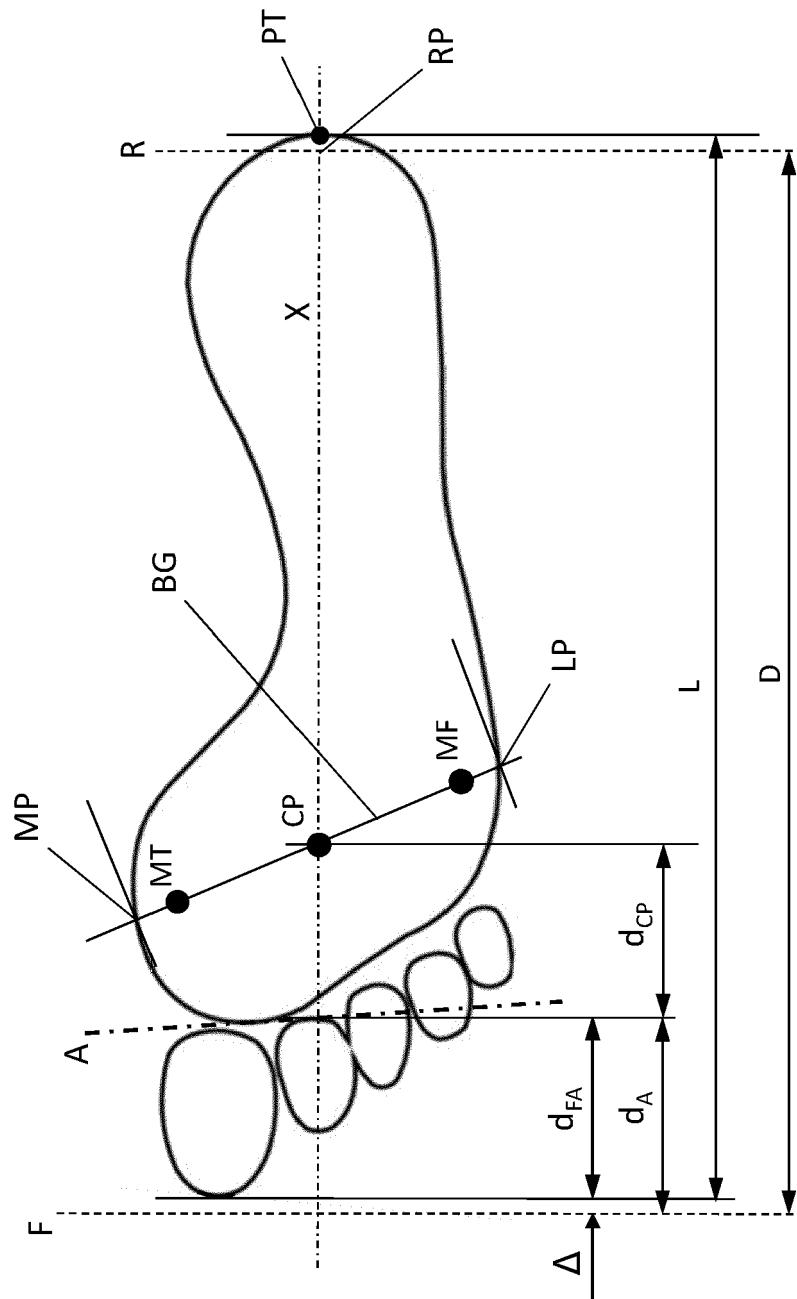
Figure 3



Figur 4



Figur 5



Figur 6

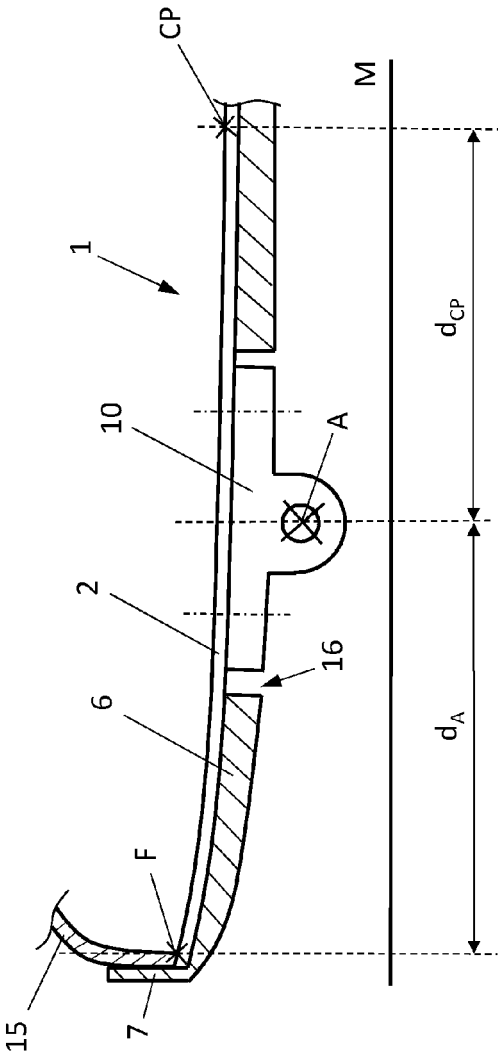


Figure 7

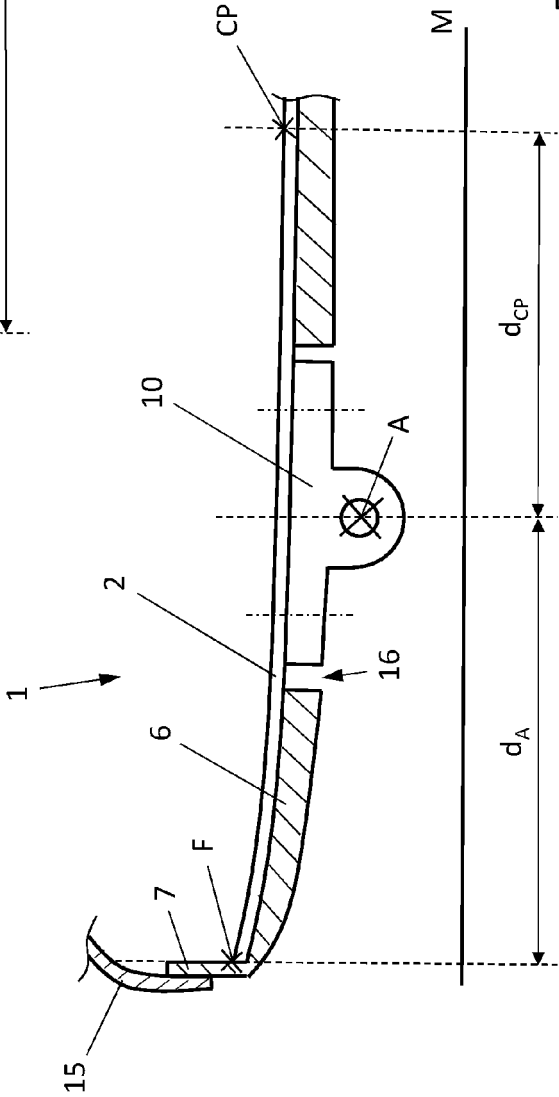


Figure 8



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A	* paragraphs [0001], [0024], [0027], [0037]; claim 2; figures 1-3,5-7 *	14	
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A	* paragraphs [0002], [0017], [0019], [0020], [0036], [0040]; figures 1,2,4 *		
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