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Kuviopalajärjestely paineilmarengasta tai kulutuspintanauhaa varten
Mönsterbitarrangemang för ett pneumatiskt däck eller ett slityteband
A tread block arrangement for a pneumatic tyre or a tread band

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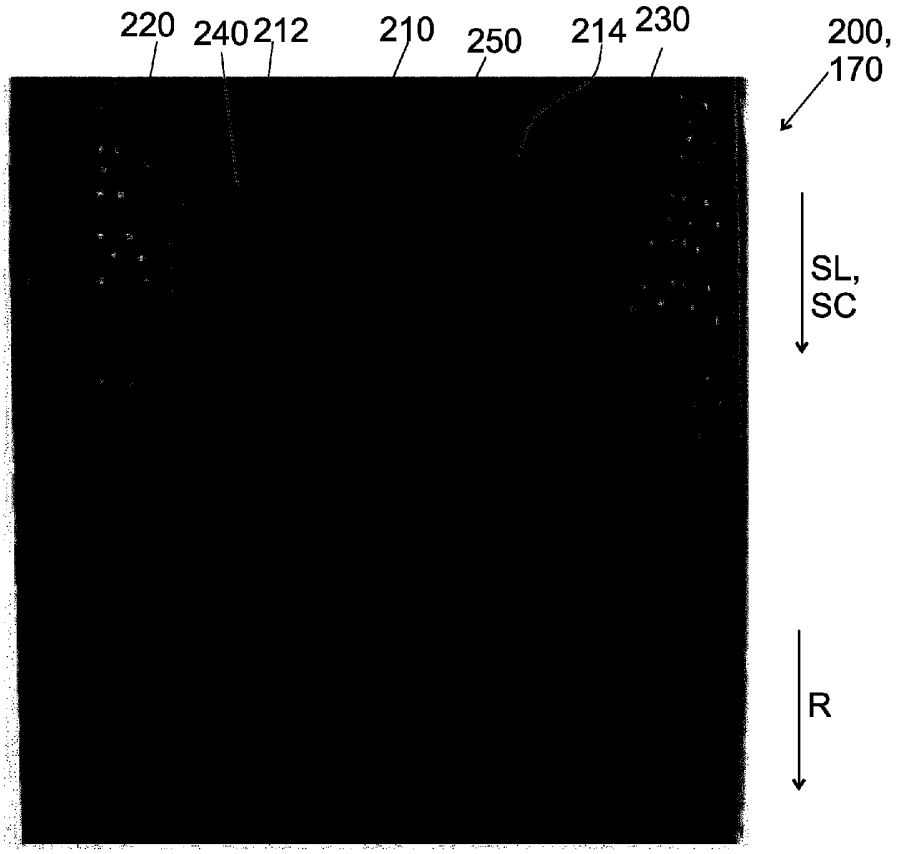
A tread block arrangement (200) suitable for a pneumatic tire (100) or for a tread band (150) for a pneumatic tire (100). The tread block arrangement (200) comprises a middle block (210) extending through the tread block arrangement (200) in a longitudinal direction (SC, SL); primary shoulder blocks (220); secondary shoulder blocks (230); primary intermediate blocks (240) arranged, in the transversal direction (ST, AX), in between some of the primary shoulder blocks (220) and the middle block (210); and secondary intermediate blocks (250) arranged, in the transversal direction (ST, AX), in between some of the secondary shoulder blocks (230) and the middle block (210). The middle block (210) comprises primary transversal parts (212) and secondary transversal parts (214) such that [A] at least half of a primary intermediate block (240) is arranged in the longitudinal direction (SC, SL) in between two primary transversal parts (212) of the middle block (210), and [B] at least half of a secondary intermediate block (250) is arranged, in the longitudinal direction in between two secondary transversal parts (214) of the middle block (210). The tread block arrangement (200) may be arranged on a pneumatic tire (100) or a tread band (150).

Kuviopalajärjestely (200), joka soveltuu paineilmarenkaaseen (100) tai paineilmarenkaan (100) kulutuspintanauhaan (150). Kuviopalajärjestely (200) käsittää keskikuviopalan (210), joka ulottuu kuviopalajärjestelyn (200) poikki pituussuunnassa (SC, SL); ensisijaisia reunakuviopaloja (220); toissijaisia reunakuviopaloja (230); ensisijaisia välikuviopaloja (240), jotka on järjestetty poikkisuunnassa (ST, AX) ensisijaisten reunakuviopalojen (220) ja keskikuviopalan (210) väliin; ja toissijaisia välikuviopaloja (250), jotka on järjestetty poikkisuunnassa (ST, AX) toissijaisten reunakuviopalojen (230) ja keskikuviopalan (210) väliin. Keskikuviopala (210) käsittää ensisijaisia poikittaisosia (212) ja toissijaisia poikittaisosia (214) siten, että [A] ainakin puolet ensisijaisesta välikuviopalasta (240) on järjestetty pitkittäissuunnassa (SC, SL) keskikuviopalan (210) kahden ensisijaisen poikittaisosan (212) väliin, ja [B] ainakin puolet toissijaisesta välikuviopalasta (250) on järjestetty pitkittäissuunnassa keskikuviopalan (210) kahden toissijaisen poikittaisosan (214) väliin. Kuviopalajärjestely (200) voi olla järjestetty paineilmarenkaaseen (100) tai kulutuspintanauhaan (150).



A tread block arrangement for a pneumatic tyre or a tread band

Technical field

The invention relates to vehicle tires and tread bands used for vehicle tires. The invention relates to a tread of tire or a tread band .

Background

The surface of a vehicle tire forms a tread, which forms, when the tire is in use, a rolling contact against a ground surface. The tread is responsible for grip, handling, and other driving properties of the tire. The tread limits grooves that guide water and/or slush away to help the other parts of the tread to grip the ground. The grooves are left in between tread blocks. The properties of a tire are constantly developed.

Tire treads have been disclosed e.g. in the publications JP2004075025, US2008149237, and US2011240192. Such treads comprise a middle block in between primary shoulder blocks and secondary shoulder blocks. The middle block may comprise transversal parts.

Summary

The purpose the present invention is to present a tread block arrangement forming a tread of a tire or a tread band for a tire, which, when applied on a tire, improves grip and handling on snow, ice, and bare road.

According to an embodiment, a tread block arrangement 200 comprises a middle block 210 extending through the tread block arrangement 150 in a direction (SC, SL) that is perpendicular to a transversal direction (ST, AX) and perpendicular to the thickness of the tread block arrangement 150; primary shoulder blocks 220 forming a first longitudinal boundary B1 of the tread block arrangement 200; secondary shoulder blocks 230 forming a second longitudinal boundary B2 of the tread block arrangement 200; primary intermediate blocks 240 arranged, in the transversal direction (ST, AX), in between some of the primary shoulder blocks 220 and the middle block 210; and secondary intermediate blocks 250 arranged, in the transversal direction

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(ST, AX), in between some of the secondary shoulder blocks 230 and the middle block 210. Each block (210, 220, 230, 240, 250) of the tread block arrangement 200 is separated from another block (210, 220, 230, 240, 250) of the tread block arrangement 200 by a portion of a main groove 310. The middle block 210 comprises primary transversal parts 212 and secondary transversal parts 214 such that [A] at least half of a primary intermediate block 240 is arranged in a direction (SC, SL) that is perpendicular to the transverse direction (ST, AX) and perpendicular to the thickness of the tread block arrangement 200 in between two primary transversal parts 212 of the middle block 210 and [B] at least half of a secondary intermediate block 250 is arranged, in a direction (SC, SL) that is perpendicular to the transverse direction (ST, AX) and perpendicular to the thickness of the tread block arrangement 200 in between two secondary transversal parts 214 of the middle block 210. Moreover, at least some of the primary intermediate blocks (240) are provided with a groove (320) having [i] a first end (322) limited by the primary intermediate block (240) and [ii] a second end (324) that joins a portion of a main groove (310) and/or at least some of the primary transversal parts (212) of the middle block (210) are provided with a groove (320) having [i] a first end (322) limited by the primary transversal part (212) and [ii] a second end (324) that joins a portion of a main groove (310). The tread block arrangement 200 may be arranged on a pneumatic tire 100 or a tread band 150.

This and other embodiments are disclosed in the appended claims and in the description.

Brief description of the drawings

Fig. 1a shows a pneumatic tire having a tread block arrangement forming the tread of the tire,
Fig. 1b shows applying a tread band onto a preform of a tire,
Fig. 1c shows half of a cross-section of a tire,
Fig. 2a shows, as a top view, a part of a tread of a tire,
Fig. 2b shows, in a perspective view, a part of a tread of a tread band,
Fig. 2c shows, as a top view, a part of a tread of a tire or a tread band,
Fig. 2d shows, as a side view, a groove ending in tread block in more detail,
Fig. 2e shows, as a top view, a groove ending in tread block in more detail,

Figs. 3a to 3c show, as a top view, a pitch, i.e. a part of a tread block arrangement,

Figs. 4 to 7 show, as a top view, a part of a tread block arrangement, and

Fig. 8 shows a tread and its division to two symmetric parts.

Detailed description

Fig. 1a shows a pneumatic tire 100 having a tread block arrangement 200 forming a tread 170 of the tire 100. The tread 170 of the tire 100 (or a tread band 150) refers to the rubber on its circumference that makes contact with the ground surface 900 (e.g. the road or the ground). The tread 170 is meant for a rolling contact against a ground surface 900. The tread 170 is the top surface of the tread block arrangement 200.

The direction of rotation of the tire 100 is indicated by the arrow R. The direction of rotation is parallel to a circumferential direction SC of the tire. The axial and radial directions of the tire 100 are indicated by the AX and SR, respectively. The tread block arrangement 200 can be formed onto the tire 100 e.g. in a moulding process. A longitudinal direction of the tread block arrangement is parallel to the circumferential direction SC of the pneumatic tire 100; and curves along the circumferential direction SC. Moreover, at each point, the longitudinal direction of the tread block arrangement, i.e. the circumferential direction SC, is perpendicular to a transversal direction AX and perpendicular to the thickness of the tread block arrangement 200.

As an alternative to moulding, a tread band 150 may be applied onto a preform 110 of a tire to form the tire 100 with the tread. Referring to Fig. 1b, the tread band 150 may be a band extending in a longitudinal direction SL. Herein the longitudinal direction SL, is perpendicular to a transversal direction ST and perpendicular to the thickness of the tread band 150.

When applied onto the preform 110, the circumferential direction SC of the preform 110 is parallel with the longitudinal direction SL of the tread band 150. The tread band has also a transversal direction ST, which is applied to be parallel with the axial direction AX of the preform 110. The tread 170 of the tread band 150 faces outwards, and forms the tread 170 of the tire 100.

In this way, the tread band 150 also comprises a tread block arrangement 200 forming the tread 170.

Figure 1c shows a half of a cross section of the pneumatic tyre 100. The tread 170 includes a first and a second longitudinal boundary (B1and B2, respectively) of the tread block arrangement 200, and the tread 170 is left in between these boundaries. The transversal direction ST is parallel to the axial direction AX. The radial direction SR is substantially parallel to a normal of a the tread 170, and parallel to the thickness of the tread block arrangement 200 (or tread band 150, is applied). The circumferential direction SC is perpendicular to the plane of Fig. 1c (see also Figs. 1a and 1b).

The longitudinal direction (SL, SC) of the tread block arrangement 200 is parallel to the longitudinal direction SL of the tread band 150 or parallel to the circumferential direction of the pneumatic tire 100; depending on whether the arrangement 200 is part of a tread band 150 or a pneumatic tire 100. In contrast to the direction of rotation R, the longitudinal direction (SL, SC) may refer to either of the longitudinal directions. The transversal direction (ST, AX) of the tread block arrangement 200 is parallel to the transversal direction ST of the tread band 150 or parallel to the axial direction AX of the pneumatic tire 100; depending on whether the arrangement 200 is part of a tread band 150 or a pneumatic tire 100. The thickness of the tread block arrangement 200 is parallel to the radial direction SR of the pneumatic tire 100 or the thickness of the tread band 150.

Figure 2a shows a tread 170 of a pneumatic tire 100 in more detail. Figure 2b shows schematically the tread 170 as a surface of a tread band 150. The tread 170 is formed by a tread block arrangement 200. Figure 2c shows the tread block arrangement 200 in more detail. The tread block arrangement 200 comprises

- a middle block 210 extending through the tread block arrangement 200 in a longitudinal direction SL, which is perpendicular to a transversal direction ST, AX and perpendicular to the thickness of the tread block arrangement 200,
- primary shoulder blocks 220 forming a first longitudinal boundary B1 of the tread block arrangement 200,

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- secondary shoulder blocks 230 forming a second longitudinal boundary B2 of the tread block arrangement 200,
- primary intermediate blocks 240, that are arranged in the transversal direction ST, AX in between some of the primary shoulder blocks 220 and the middle block 210, and
- secondary intermediate blocks 250, that are arranged in the transversal direction ST, AX in between some of the secondary shoulder blocks 230 and the middle block 210.

The first longitudinal boundary B1 of the tread block arrangement 200 is an outer boundary of the tread block arrangement 200. The second longitudinal boundary B2 of the tread block arrangement 200 is an outer boundary of the tread block arrangement 200. The second longitudinal boundary B2 is arranged opposite to the first longitudinal boundary B1. The tread block arrangement is left in between the first longitudinal boundary B1 and the second longitudinal boundary B2.

When the tread block arrangement 200 is arranged on a pneumatic tire 100, the thickness of the tread block arrangement 200 is parallel to the radial direction of the tire 100 and the transversal direction ST, AX (of the tread block arrangement) is parallel to the axial direction of the tire. When the tread block arrangement 200 is arranged on a tread band 150, the thickness of the tread block arrangement 200 is parallel to the thickness of the tread band 150 and the transversal direction ST, AX (of the tread block arrangement) is parallel to the transversal direction ST of the tread band 150.

The term "block" refers to a part of the tread block arrangement that is separated from other blocks by a portion of a main groove 310. Thus, every two points of a tread block can be connected by a line (not necessarily a straight line) that does not cross a main groove 310. The line runs within the tread block. Correspondingly, a point of a tread block can only be connected to a point of another tread block by a line (not necessarily a straight line) that runs within the tread block arrangement and crosses a main groove 310. The term "runs within" means that the line does not extend from a tread block to another tread block above the tread or below the tread. In other words, the term crossing refers to crossing of the projection of the line with the groove, when projected onto the tread. In this way, each block (210, 220, 230, 240,

250) of the tread block arrangement 200 is separated from another block (210, 220, 230, 240, 250) of the tread block arrangement 200 by a portion of a main groove 310. A main groove has a depth and a width. The depth of a main groove may be at least 6 mm, such as at least 8 mm. The width of a main groove may be at least 1 mm, such as at least 1.5 mm or at least 2 mm. A tread block may comprise sipe or sipes, of which width is typically less. In this way, in an embodiment, each block (210, 220, 230, 240, 250) of the tread block arrangement 200 is separated from another block (210, 220, 230, 240, 250) of the tread block arrangement 200 by a portion of a main groove 310, wherein the minimum width of the portion of the main groove 310 is at least 1 mm, such as at least 1.5 mm or at least 2 mm. In this way, in an embodiment, each block (210, 220, 230, 240, 250) of the tread block arrangement 200 is separated from another block (210, 220, 230, 240, 250) of the tread block arrangement 200 by a portion of a main groove 310, wherein the minimum depth of the portion of the main groove 310 is at least 5 mm, such as at least 6 mm or at least 8 mm.

The middle block 210 extends continuously in a longitudinal direction SL, SC. On a tread band 150, the middle block 210 extends continuously from one end to an opposite end. On a tire 100 the middle block 210 extends continuously around the circumference of the tire 100. Herein the continuous extensions means that the middle block 210 is only one block, whereby it is not an arrangement of blocks separated by a main groove.

In an embodiment, no tread block is arranged, in a transversal direction AX, ST, in between a portion of a primary intermediate block 240 and the primary shoulder block 220 that is arranged in the transverse direction from the portion of the primary intermediate block 240. Herein the portion of the primary intermediate block 240 refers to the portion that is closest to the first longitudinal boundary B1. In an embodiment, no tread block is arranged, in the transversal direction, in between a primary intermediate block 240 and the middle block 210.

In an embodiment, no tread block is arranged, in a transversal direction AX, ST, in between a portion of a secondary intermediate block 250 and the secondary shoulder block 230 that is arranged in the transverse direction from the portion of the secondary intermediate block 250. Herein the portion

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of the secondary intermediate block 250 refers to the portion that is closest to the second longitudinal boundary B2. In an embodiment, no tread block is arranged, in the transversal direction, in between a secondary intermediate block 250 and the middle block 210.

The middle block 210 of the tread block arrangement 200 comprises primary transversal parts 212 and secondary transversal parts 214 such that
- at least half of a primary intermediate block 240 is arranged, in a direction SC, SL perpendicular to the transverse direction ST, AX and perpendicular to the thickness of the tread block arrangement 200, in between two primary transversal parts 212 of the middle block (210), and
- at least half of a secondary intermediate block 250 is arranged, in a direction SC, SL perpendicular to the transverse direction ST, AX and perpendicular to the thickness of the tread block arrangement and 200, in between two secondary transversal parts 214 of the middle block 210.

In an embodiment, at least 60 % or at least 70 % of a primary intermediate block 240 is arranged, in a direction SC, SL perpendicular to the transverse direction ST, AX and perpendicular to the thickness of the tread block arrangement 200, in between two primary transversal parts 212 of the middle block (210).

In an embodiment, at least 60 % or at least 70 % of a secondary intermediate block 250 is arranged, in a direction SC, SL perpendicular to the transverse direction ST, AX and perpendicular to the thickness of the tread block arrangement and 200, in between two secondary transversal parts 214 of the middle block 210.

In order to leave said at least half, at least 60 %, or at least 70 % of an intermediate block 240, 250 in between the transversal parts 212, 214, the width (as measured in the transversal direction ST, AX) of the middle block 210 should be reasonable compared to the width of the tread block arrangement 200. In an embodiment, the width (WM, Fig. 2c) of the middle block 210 is at least one fourth (25 %) of the width (W, Fig. 2c) of the tread block arrangement 200. In an embodiment, the width WM of the middle block 210 is at least one third (33 %) or at least 40 % of the width W of the tread block arrangement.

In an embodiment, the tread blocks are arranged such that at least half, at least 60 %, or at least 70 % of each primary intermediate block 240 is arranged, in the aforementioned direction SC, SL, in between a first primary transversal part 212 and a second primary transversal part 212 of the middle block 210. In an embodiment, no other tread block except for the primary intermediate block 240 is arranged, in the aforementioned direction SC, SL, in between the first primary transversal part 212 and the second primary transversal part 212. Herein the first primary transversal part 212 and the second primary transversal part 212 may refer to such two primary transversal parts 212 that are closest to each other.

In an embodiment, the tread blocks are arranged such that at least half, at least 60 %, or at least 70 % of each secondary intermediate block 250 is arranged, in the aforementioned direction SC, SL, in between a first secondary transversal part 214 and a second secondary transversal part 214 of the middle block 210. In an embodiment, no other tread block except for the secondary intermediate block 250 is arranged, in the aforementioned direction SC, SL, in between the first secondary transversal part 214 and the second secondary transversal part 214. Herein the first secondary transversal part 214 and the second secondary transversal part 214 may refer to such two secondary transversal parts 214 that are closest to each other.

In an embodiment, no tread block is arranged, in a transversal direction AX, ST, in between a portion of a primary transversal part 212 of the middle block 210 and the primary shoulder block 220 that is arranged in the transverse direction from the portion of the primary transversal part 212 of the middle block 210. Herein the portion of the primary transversal part 212 of the middle block 210 refers to the portion that is closest to the first longitudinal boundary B1.

In an embodiment, no tread block is arranged, in a transversal direction AX, ST, in between a portion of a secondary transversal part 214 of the middle block 210 and the secondary shoulder block 230 that is arranged in the transverse direction from the portion of the secondary transversal part 214 of the middle block 210. Herein the portion of the secondary transversal part

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214 of the middle block 210 refers to the portion that is closest to the second longitudinal boundary B2.

A tread band 150 comprises the tread block arrangement 200. A pneumatic tire 100 comprises the tread block arrangement 200. A pneumatic tire 100 comprises a cylindrical part 110 and the tread band 150 arranged on the cylindrical part 110 such that the tread 170 of the tread band 150 forms a tread 170 of the pneumatic tire 100. The tread 170 of the pneumatic tire 100 is meant for a rolling contact against the ground surface 900.

It has been noticed, that when the middle block 210 is so wide that at least a half (or at least 60 % or at least 70 %) of a primary intermediate block 240 and at least a half (or at least 60 % or at least 70 %) of a secondary intermediate block 240 is left in between the transversal parts 212, 214, the middle block 210 is reasonably rigid in the transversal direction. Moreover the rigidity improves the handling of the vehicle, in particular when driving in a curve. However, since the intermediate blocks 240, 250 are separated by a portion of a main groove from the middle block 210, the corresponding portions of main groove improve grip in transversal direction. It is supposed that the edges of the blocks bite firmly to ground surface 900. Furthermore, since at least a half (or at least 60 % or at least 70 %) of a primary intermediate block 240 and a secondary intermediate block 250 is left in between the parts 212, 214, reasonable long edges of the tread blocks improve grip also in the circumferential direction SC.

In an embodiment, in the longitudinal or circumferential direction (SL, SC), at least a part, such as at least a half, at least 60 %, or at least 70 %, of each primary intermediate block 240, except for a first and a last primary intermediate blocks 240 at least in case of a tread band 150, is arranged, in that direction, in between two primary transversal parts 212 of the middle block 210. In an embodiment, in the longitudinal or circumferential direction (SL, SC), at least a part, such as at least a half, at least 60 %, or at least 70 %, of each secondary intermediate block 250, except for the first and last secondary intermediate blocks 250 at least in case of a tread band 150, is arranged, in that direction, in between two secondary transversal parts 214 of the middle block 210. Such first and last intermediate blocks 240, 250 can be seen e.g. in Fig. 2b.

Referring to Fig. 2c, in an embodiment

- at least some of the primary intermediate blocks 240 and/or
- at least some of the primary transversal parts 212 of the middle block 210

are provided with a side wall of a groove 320 and an end wall of the groove 320 such that the groove 320 has a first end 322 limited by the tread block (240, 210) having the groove 320. The groove 320 further has a second end 324, which joins a main groove portion 310. The first end 322 is closed, while the second end 324 opens to the main groove portion 310.

Referring still to Fig. 2c, in an embodiment

- at least some of the secondary intermediate blocks 250 and/or
- at least some of the secondary transversal parts 214 of the middle block 210

are provided with a side wall of a groove 320 and an end wall of the groove 320 such that the groove 320 has a first end 322 limited by the tread block (250, 210) having the groove 320. The groove 320 further has a second end 324, which joins a main groove portion 310. The first end 322 is closed, while the second end 324 opens to the main groove portion 310.

The grooves 320 act as snow grip boosters. The grooves 320 improve the snow grip, but still maintain the stability of the tread block arrangement 200. The tread block arrangement 200 may be formed of different layers rising from belts, giving support to the tread blocks, improving stability at black roads, and still improving grip on snowy and icy surfaces. Referring to Fig. 2d, when the tread block arrangement 200 is formed of layers, the groove 320, which is limited by a tread block (240, 250, 212, 214) and which ends in the tread block (240, 250, 212, 214), has a non-constant depth. For example, the sidewalls of the groove 320 may be inclined relative to the bottom of the groove, as indicated in Fig. 2e. In the alternative, the sidewalls of the groove 320 may comprise steps. In an embodiment (see Fig. 2d), the groove 320 has an inclined bottom. The bottom of the groove 320 declines towards the second end 324.

In an embodiment, the groove 320 has at least two different depths. For example, the groove 320 at the second end 324 may be deeper than at the

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first end 322. In an embodiment, the groove 320 has at least three different depths. The (at least two or at least three) different depths each are at least 0.5 mm and differ from every other one of the different depths by at least 0.5 mm. In an embodiment, the groove 320 joins a main groove portion 310 at such a point, wherein the longitudinal direction D310 of the main groove portion 310 forms an angle ϕ of at most 60 degrees with the transversal direction ST, AX.

Referring to Fig. 2e, in an embodiment, at least some of the primary intermediate blocks 240 are provided with grooves 320 that open in a first direction of groove opening DGO1 and at least some of the primary transversal parts 212 of the middle block 210 are provided with grooves 320 that open in a second direction of groove opening DGO2. The angle between the first direction DGO1 and the second direction DGO2 may be more than 120 degrees, e.g. more than 150 degrees. Thus, the grooves 320 of the primary intermediate blocks 240 may open to a substantially reverse direction DGO1 compared to the direction DGO2 into which the grooves 320 of the primary transversal parts 212 of the middle block 210 open.

In an embodiment, at least some of the secondary intermediate blocks 250 are provided with grooves 320 that open in a third direction of groove opening and at least some of the secondary transversal parts 214 of the middle block 210 are provided with grooves 320 that open in a fourth direction of groove opening. The angle between the third and the fourth directions of groove opening may be more than 120 degrees, e.g. more than 150 degrees. Thus, the grooves 320 of the secondary intermediate blocks 250 may open to a substantially reverse direction compared to the direction into which the grooves 320 of the secondary transversal parts 214 of the middle block 210 open.

In an embodiment, at least 25 % or at least 50 % of the primary intermediate blocks 240 are provided with a groove 320 having an ending in the corresponding primary intermediate block 240. In an embodiment, at least 25 % or at least 50 % of the secondary intermediate blocks 250 are provided with a groove 320 having an ending in the corresponding secondary intermediate block 250. In an embodiment, at least 25% or at least 50% of the primary transversal parts 212 of the middle block 210 are provided with a

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groove 320 having an ending in the corresponding primary transversal part 212. In an embodiment, at least 25% or at least 50% of the secondary transversal parts 214 of the middle block 210 are provided with a groove 320 having an ending in the corresponding secondary transversal part 214. In an embodiment, at least some of the primary intermediate blocks 240, at least some of the secondary intermediate blocks 250, at least some of the primary transversal parts 212 of the middle block 210, and at least some of the secondary transversal parts 214 of the middle block 210 are provided with a groove 320 having an ending. The ending of the groove 320 may be arranged in the corresponding block provided with the groove 320.

Fig. 3a indicates directions of the tread blocks in the tread block arrangement 200. Fig. 3a shows a pitch 400, i.e. a part of a tread block arrangement 200. Referring to Fig. 3a, a primary transversal part 212 of the of the middle block 210 extends in a longitudinal direction D212 of the primary transversal part 212. The longitudinal direction D212 of the primary transversal part forms a first primary angle $\alpha 1$ of from 10 degrees to 60 degrees with the transversal direction ST, AX. Such an angle may apply to each one of the primary transversal parts 212. In such a case, each longitudinal direction D212 of the primary transversal part in question forms an angle of from 10 degrees to 60 degrees with the transversal direction ST, AX. The angle between the transversal direction ST, AX and the longitudinal direction D212 of each one of the primary transversal parts 212 may be constant. In case the angle $\alpha 1$ is too large, the grip of the tread reduces, because the edges of the parts 212 become substantially longitudinal. In case the angle $\alpha 1$ is too small, the V-shaped corner of the parts 212 and 214 will not drive efficiently water and/or slush away from underneath the tread 170. This issue will be discussed in more detail later.

In an embodiment, a secondary transversal part 214 of the of the middle block 210 extends in a longitudinal direction D214 of the secondary transversal part 214. The longitudinal direction D214 of the secondary transversal part in question forms a second primary angle $\alpha 2$ of from 10 degrees to 60 degrees with the transversal direction ST, AX. Such an angle may angle may apply to each one of the secondary transversal parts 214. In such a case, each longitudinal direction D214 of the secondary transversal part in question forms an angle of from 10 degrees to 60 degrees with the

transversal direction ST, AX. The angle between the transversal direction ST, AX and the longitudinal direction D214 of each one of the secondary transversal parts 214 may be constant.

In an embodiment a primary intermediate block 240 extends in a longitudinal direction D240 of the primary intermediate block 240. The longitudinal direction D240 of the primary intermediate block forms a third primary angle $\alpha 3$ of from 10 degrees to 60 degrees with the transversal direction ST, AX. Such an angle may angle may apply to each one of the primary intermediate blocks 240. In such a case, each longitudinal direction D240 of the primary intermediate block in question forms an angle of from 10 degrees to 60 degrees with the transversal direction ST, AX. The angle between the transversal direction ST, AX and the longitudinal direction D240 of each one of the primary intermediate blocks 240 may be constant.

In an embodiment, a secondary intermediate block 250 extends in a longitudinal direction D250 of the secondary intermediate 250. The longitudinal direction D250 of the secondary intermediate block 250 forms a fourth primary angle $\alpha 4$ of from 10 degrees to 60 degrees with the transversal direction ST, AX. Such an angle may angle may apply to each one of the secondary intermediate blocks 250. In such a case, each longitudinal direction D250 of the secondary intermediate block in question forms an angle of from 10 degrees to 60 degrees with the transversal direction ST, AX. The angle between the transversal direction ST, AX and the longitudinal direction D250 of each one of the secondary intermediate blocks 240 may be constant.

The term “extend” in connection with a tread block (240, 250) or a part of a tread block (212, 214) is used above in the meaning that the corresponding tread block (or part thereof), which is a three dimensional objects, extends in the direction of the greatest extent of the tread block (or part thereof). Conventionally, the term “length” is used for the greatest extent of the three different orthogonal measures. Thus, aforementioned longitudinal direction of the tread block or part thereof is parallel to the direction of a length of the tread block or part thereof, wherein the length is greater than a width and greater than a thickness of the tread block or part thereof.

When the transversal parts (212, 214) are so arranged, the longitudinal direction D212 of a primary transversal part 212 forms a first secondary angle $\gamma 1$ with the longitudinal direction D214 of a secondary transversal part 214. Moreover, the first secondary angle $\gamma 1$ opens in a direction DO1. It has been found that the tread functions well, when the direction DO1 is reverse to the direction of rotation R (See Fig. 3a). In such a use, the tip of the wedge formed by the transversal parts (212, 214) hits the ground surface 900 first, and guides water and/or slush efficiently away from underneath the tread 170. As indicated in Fig. 3a, the two direction D212 and D214, at a point of their crossing, forms two angles, of which one is more than 180 degrees and the other is less than 180 degrees. The first secondary angle $\gamma 1$ refers to that one of the angles that is less than 180 degrees. The direction DO1 to which the angle opens divides the angle $\gamma 1$ to two equally large parts.

When the intermediate blocks (240, 250) are so arranged, the longitudinal direction D240 of a primary intermediate block 240 forms a second secondary angle $\gamma 2$ with a longitudinal direction D250 of a secondary intermediate block 250. The second secondary angle $\gamma 2$ opens in a direction DO2. Preferably also the direction DO2 is reverse to the direction of rotation R. As indicated in Fig. 3a, the two direction D240 and D250, at a point of their crossing, forms two angles, of which one is more than 180 degrees and the other is less than 180 degrees. The second secondary angle $\gamma 2$ refers to that one of the angles that is less than 180 degrees. The direction DO2 to which the angle opens divides the angle $\gamma 2$ to two equally large parts.

Correspondingly, the tread block arrangement 200 is intended for use on a pneumatic tire 100 having, in said use, said direction of rotation R. A pneumatic tire 100 or a tread band 150 may be provided with a first marking 510 indicative of a preferred direction of rotation R of the tread block arrangement 200. When in use, the tire is arranged such that the tire rotates in the direction of rotation when the vehicle having the tire installed on a wheel moves forward.

As indicated in Fig. 2c, in an embodiment, in the transverse direction ST, the center of the middle block 210 is arranged at the center of the tread block arrangement 200. This has the technical effect that, since the angles of the intermediate tread blocks (240, 250) and/or the angles of the transversal

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parts (212, 214) define a direction of rotation R, either side of the tire can be used equally well as the outer side of the tire; i.e. the facing away from the center of the vehicle in which the tire is used. Thus, all wheels of a vehicle can be equipped with identical tires.

As indicated above, the tread blocks are separated from each other by potions of main groove 310. Fig. 3b indicates some of the portions of the main groove in more detail. Referring to Fig. 3b,

- a first primary longitudinal main groove portion 312 is left, in the transversal direction ST, AX, in between a primary shoulder block 220 and a primary intermediate block 240,
- a first secondary longitudinal main groove portion 314 is left, in the transversal direction ST, AX, in between a secondary shoulder block 230 and a secondary intermediate block 250,
- a second primary longitudinal main groove portion 316 is left, in the transversal direction ST, AX, in between a primary shoulder block 220 and a primary transversal part 212, and
- a second secondary longitudinal main groove portion 318 is left, in the transversal direction ST, AX, in between a secondary shoulder block 250 and a secondary transversal part 214.

In particular,

- the first primary longitudinal main groove portion 312 is left, in the transversal direction ST, AX, in between such parts of a primary shoulder block 220 and a neighbouring primary intermediate block 240 that are closest to each other,
- the first secondary longitudinal main groove portion 314 is left, in the transversal direction ST, AX, in between such parts of a secondary shoulder block 230 and a neighbouring secondary intermediate block 250 that are closest to each other,
- a second primary longitudinal main groove portion 316 is left, in the transversal direction ST, AX, in between such parts of a primary shoulder block 220 and a neighbouring primary transversal part 212 that are closest to each other, and
- a second secondary longitudinal main groove portion 318 is left, in the transversal direction ST, AX, in between such parts of a secondary shoulder

block 250 and a neighbouring secondary transversal part 214 that are closest to each other.

Referring to Fig. 3b, the first primary longitudinal main groove portion 312 is provided with a bottom protrusion 313. Preferably, the bottom protrusion 313 is shaped in such a way that the depth of the first primary longitudinal main groove portion 312 at the central part of the first primary longitudinal main groove portion 312 is less than the depth of the first primary longitudinal main groove portion 312 at a boundary area of the first primary longitudinal main groove portion 312. In an embodiment, the first primary longitudinal main groove portion 312 has at least two different depths. In an embodiment, the first primary longitudinal main groove portion 312 has at least three different depths. The (at least two or at least three) depths each are at least 2 mm and differ from every other one of the different depths by at least 0.5 mm. Hereinabove, the boundary area of the first primary longitudinal main groove portion 312 refers to an area located apart from the central part of the first primary longitudinal main groove portion 312 in a longitudinal direction D312 of the first primary longitudinal main groove portion 312.

Referring to Fig. 3b, the first secondary longitudinal main groove portion 314 is provided with a bottom protrusion 315. Preferably, the bottom protrusion 315 is shaped in such a way that the depth of the first secondary longitudinal main groove portion 314 at the central part of the first secondary longitudinal main groove portion 314 is less than the depth of the first secondary longitudinal main groove portion 314 at a boundary area of the first secondary longitudinal main groove portion 314. In an embodiment, the first secondary longitudinal main groove portion 314 has at least two different depths. In an embodiment, the first secondary longitudinal main groove portion 314 has at least three different depths. The (at least two or at least three) depths each are at least 2 mm and differ from every other one of the different depths by at least 0.5 mm. Hereinabove, the boundary area of the first secondary longitudinal main groove portion 314 refers to an area located apart from the central part of the first secondary longitudinal main groove portion 314 in a longitudinal direction D314 of the first secondary longitudinal main groove portion 314.

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Referring to Fig. 3b, the second primary longitudinal main groove portion 316 is provided with a bottom protrusion 317. Preferably, the bottom protrusion 317 is shaped in such a way that the depth of the second primary longitudinal main groove portion 316 at the central part of the second primary longitudinal main groove portion 316 is less than the depth of the second primary longitudinal main groove portion 316 at a boundary area of the second primary longitudinal main groove portion 316. In an embodiment, the second primary longitudinal main groove portion 316 has at least two different depths. In an embodiment, the second primary longitudinal main groove portion 316 has at least three different depths. The (at least two or at least three) depths each are at least 2 mm and differ from every other one of the different depths by at least 0.5 mm. Hereinabove, the boundary area of the second primary longitudinal main groove portion 316 refers to an area located apart from the central part of the second primary longitudinal main groove portion 316 in a longitudinal direction D316 of the second primary longitudinal main groove portion 316.

Referring to Fig. 3b, the second secondary longitudinal main groove portion 318 is provided with a bottom protrusion 319. Preferably, the bottom protrusion 319 is shaped in such a way that the depth of the second secondary longitudinal main groove portion 318 at the central part of the second secondary longitudinal main groove portion 318 is less than the depth of the second secondary longitudinal main groove portion 318 at a boundary area of the second secondary longitudinal main groove portion 318. In an embodiment, the second secondary longitudinal main groove portion 318 has at least two different depths. In an embodiment, the second secondary longitudinal main groove portion 318 has at least three different depths. The (at least two or at least three) depths each are at least 2 mm and differ from every other one of the different depths by at least 0.5 mm. Hereinabove, the boundary area of the second secondary longitudinal main groove portion 318 refers to an area located apart from the central part of the second secondary longitudinal main groove portion 318 in a longitudinal direction D318 of the second secondary longitudinal main groove portion 318.

Having one or more of the longitudinal main groove portions (312, 314, 316, 318) provided with a bottom protrusion (313, 315, 317, 319) has the technical effect that the bottom protrusion(s) efficiently drive water and/or slush out of

the longitudinal main groove portions. This improves the grip of the tire. In addition, the protrusions stiffen the tread and in this way improve handling of the vehicle. Preferably, a first primary longitudinal main groove portion 312, a first secondary longitudinal main groove portion 314, a second primary longitudinal main groove portion 316, and a second secondary longitudinal main groove portion 318 is provided with a bottom protrusion (313, 315, 317, 319).

Referring to Fig. 3c, in an embodiment, the first primary longitudinal main groove portion 312 extends in a longitudinal direction D312 of the first primary longitudinal main groove portion 312. The direction D312 forms a first tertiary angle β1 of from 60 degrees to 85 degrees with the transversal direction ST, AX. In an embodiment, the first secondary longitudinal main groove portion 314 extends in a longitudinal direction D314 of the first secondary longitudinal main groove portion 314. The direction D314 forms a second tertiary angle β2 of from 60 degrees to 85 degrees with the transversal direction ST, AX. In an embodiment, the second primary longitudinal main groove portion 316 extends in a longitudinal direction D316 of the second primary longitudinal main groove portion 316. The direction D316 forms an third tertiary angle β3 of from 60 degrees to 85 degrees with the transversal direction ST, AX. In an embodiment, the second secondary longitudinal main groove portion 318 extends in a longitudinal direction D318 of the second secondary longitudinal main groove portion 318. The direction D318 forms a fourth tertiary angle β4 of from 60 degrees to 85 degrees with the transversal direction ST, AX.

This has the effect that, since the longitudinal main groove portions 312, 314, 316, 318 are not precisely parallel to a longitudinal direction (St, SC), also these edges of the tread block provide grip for the tread and also in the forward and backward directions.

The term “extend” in connection with a groove is used above in the meaning that the corresponding groove, which is a three dimensional space, extends in the direction of the greatest extent of the groove. Conventionally, the term “length” is used for the greatest extent of the three different orthogonal measures. Thus, aforementioned longitudinal direction of the groove is parallel to the direction of a length of the groove or the part of the groove,

wherein the length is greater than a width or a depth of the groove (or part of a groove).

Referring to Figs. 4 and 7, in an embodiment, along a longitudinal line 550, every second tread block is a primary transversal part 212 of the middle block 210, and (the other) every second tread block is a primary intermediate block 240. This has the technical effect that the tread is reasonably rigid in a transversal direction, since (only) every second tread block is a separate primary intermediate block 240 (i.e. soft), while (only) every second tread block is an integral part of the middle block 210 (i.e. stiff). In an embodiment, along a longitudinal line 555, every second tread block is a secondary transversal part 214 of the middle block 210, and (the other) every second tread block is a secondary intermediate block 250.

With reference to Fig. 4, in an embodiment, a first primary shoulder block 220a is arranged, in a longitudinal direction SC, SL, next to a neighbouring second primary shoulder block 220b and a neighbouring third primary shoulder block 220c. At least half of the first primary shoulder block 220a is arranged, in the a longitudinal direction SL, SC in between the second primary shoulder block 220b and the third primary shoulder block 220c. Moreover, to have the aforementioned reasonable rigidity, the first primary shoulder block 220a is arranged, in the transversal direction ST, AX, next to a neighbouring primary transversal part 212 of the middle block 210, the second primary shoulder block 220b is arranged, in the transversal direction ST, AX, next to a neighbouring primary intermediate block 240; and the third primary shoulder block 220c is arranged, in the transversal direction ST, AX, next to another neighbouring primary intermediate block 240.

Hereinabove, the term “next to” refers to a neighbouring tread block, i.e. such a tread block that no other tread block is left in between the tread blocks in question.

Referring to Fig. 4, in an embodiment, the width of the first primary shoulder block 220a is greater than the width of the second primary shoulder block 220b. In Fig. 4, the width of the second primary shoulder block 220b equals the width of the third primary shoulder block 220c. Herein the width refers to the dimension in the transversal direction ST, AX, even if this dimension may

be greater than the dimensions in other directions. Moreover, the first primary shoulder block 220a is arranged in the transversal direction next to a neighbouring primary transversal part 212 of the middle block 210.

Preferably, except for a first and a last primary transversal part 212 of the middle block 210, in the transversal direction next to each primary transversal part 212 of the middle block 210, a neighbouring first primary shoulder block 220a is arranged such that in the longitudinal direction next to the first primary shoulder block 220a is arranged a neighbouring second primary shoulder block 220b and a neighbouring third primary shoulder block 220c; the second primary shoulder block 220b and a third primary shoulder block 220c being arranged in the transversal direction next to neighbouring primary intermediate blocks 240. In case of a tread band 150 such considerations do not apply for the first and the last primary transversal parts (i.e. at an end of the tread band), since the tread band ends. However, preferably in the pneumatic tire 100 these considerations apply.

Since this preferably applies also on the other side of the middle block, in an embodiment, such as the embodiment of Fig. 4, a first secondary shoulder block 230a is arranged, in a longitudinal direction SL, SC next to a neighbouring second secondary shoulder block 230b and a neighbouring third secondary shoulder block 230c. At least half of the first secondary shoulder block 230a is arranged, in the longitudinal direction SL, SC in between the second secondary shoulder block 230b and the third secondary shoulder block 230c. Moreover, the first secondary shoulder block 230a is arranged, in the transversal direction ST, AX, next to a neighbouring secondary transversal part 214 of the middle block 210, the second secondary shoulder block 230b is arranged, in the transversal direction ST, AX, next to a neighbouring secondary intermediate block 250, and the third secondary shoulder block 230c is arranged, in the transversal direction ST, AX, next to another neighbouring secondary intermediate block 250.

Referring to Fig. 4, in an embodiment, the width of the first secondary shoulder block 230a is greater than the width of the second secondary shoulder block 230b. In Fig. 4, the width of the second secondary shoulder block 220b equals the width of the third secondary shoulder block 220c. Herein the width refers to the dimension in the transversal direction ST, AX,

even if this dimension may be greater than the dimensions in other directions. Moreover, the first secondary shoulder block 230a is arranged in the transversal direction next to a neighbouring secondary transversal part 214 of the middle block 210.

Preferably, except for a first and a last secondary transversal part 214 of the middle block 210, in the transversal direction next to each secondary transversal part 214 of the middle block 210, a neighbouring first secondary shoulder block 230a is arranged such that in the longitudinal direction next to the first secondary shoulder block 230a is arranged a neighbouring second secondary shoulder block 230b and a neighbouring third secondary shoulder block 230c; the second secondary shoulder block 220b and a third secondary shoulder block 220c being arranged in the transversal direction next to neighbouring secondary intermediate blocks 250. In case of a tread band 150 such considerations do not apply at an end of the tread band, since the tread band ends. However, preferably in the pneumatic tire 100 these considerations apply.

Referring to Fig. 4, in order to improve the stiffness of the tread 170 in the longitudinal direction SL, SC, preferably an integral portion 216 of the middle block 210 extends straight through the tread block arrangement 200 in the longitudinal direction SL, SC. The term "integral portion" herein refers to a straight portion of the middle block 210 that is free from portions of a main groove 310. The integral portion may comprise sipes. On a pneumatic tire 100, such a straight integral portion extends along the circumference of the tire 100. As well known to a skilled person, the main groove and the sipes have different dimensions. For example, a groove has a width of at least 1.5 mm, more typically at least 2 mm or at least 3 mm. For example, a sipe has a width of less than 1.5 mm, more typically at most 1.0 mm or at most 0.5 mm.

In an embodiment, the tread block arrangement 200 comprises a first number N1 of primary shoulder blocks 220 and a second number N2 of secondary shoulder blocks 230. On a pneumatic tire 100, the first number N1 may be even, i.e. the first number may be expressed as an integer multiple of two (i.e. $N1=2\times N$, wherein N is an integer). The second number N2 may be even, i.e. the first number may be expressed as an integer multiple of 2. The second number N2 may equal the first number N1. This has been found to

reduce the noise of the tire in use. Furthermore, in such a configuration it is possible to have, along a longitudinal line 550, every second tread block a primary transversal part 212 of the middle block 210, and (the other) every second tread block a primary intermediate block 240. This, as indicated above, also improves the grip. However, in a tread band 150, the first and second numbers (N1, N2) may be odd or even.

In an embodiment, the tread block arrangement 200 comprises a third number N3 of primary transversal parts 212 of the middle block 210 and a fourth number N4 number of secondary transversal parts 214 of the middle block 210. In an embodiment, the fourth number N4 equals the third number N3. From the point of view of noise, it may be beneficial that, in a pneumatic tire 100, at least one of the third number N3 and the fourth number N4 is even (i.e. expressible as an integer multiple of two). This does not necessarily apply to a tread band 150. In such a configuration it is possible to have, along a longitudinal line 555, every second tread block a secondary transversal part 214 of the middle block 210, and (the other) every second tread block a secondary intermediate block 250.

Referring to Fig. 5, in an embodiment the primary shoulder blocks 220 and the secondary shoulder blocks 230 are arranged such that a first imaginary transversal straight line 500 is arrangeable in a longitudinal direction SL, SC in between two neighbouring secondary shoulder blocks 230b, 230a such that the first imaginary transversal straight line 500 propagates through a primary shoulder block 220, 220b. Herein the transversal straight line 500 is parallel to the transversal direction AX, ST. Preferably each imaginary transversal straight line 500 that is arranged in a longitudinal direction SL, SC in between two neighbouring secondary shoulder blocks 230, propagates through a primary shoulder block 220.

This has the effect that the grip does not depend on the orientation of the tire relative to the ground surface 900. As the tire rotates, the primary shoulder blocks 220 and the secondary shoulder blocks 230 escape from the footprint subsequently, and not simultaneously. This makes the grip more uniform.

In addition or alternatively, a second imaginary transversal straight line 505 is arrangeable in a longitudinal direction in between two neighbouring primary

shoulder blocks 220b, 220a such that the second imaginary transversal straight line 505 propagates through a secondary shoulder block 230, 230a. Preferably, each imaginary transversal straight line 505 that is arranged in a longitudinal direction SC, SL in between two neighbouring primary shoulder blocks 220, propagates through a secondary shoulder block 230.

Moreover, preferably the main groove portions 310 in between primary shoulder blocks 220 are substantially transversal. Preferably, the main groove portions 310 in between primary shoulder blocks 230 are substantially transversal. In an embodiment, the main groove portion 310 that is left in between the two neighbouring secondary shoulder blocks (230b, 230a) and through which the first imaginary transversal straight line 500 can be arranged to run, extends in a direction that forms an angle of at most 25 degrees with the transversal direction AX, SL. The interpretation of the term "extends" has been discussed above. In an embodiment, the main groove portion 310 that is left in between the two neighbouring primary shoulder blocks (220b, 220a) and through which the second imaginary transversal straight line 505 can be arranged to run, extends in a direction that forms an angle of at most 25 degrees with the transversal direction AX, SL. The interpretation of the term "extends" has been discussed above. Having the main groove portions oriented in that way improves the grip in the longitudinal direction, i.e. forward and backward.

As indicated above, at least some of the tread blocks may limit an end wall of a groove 320. Figure 6 shows two grooves 340 and 350 in more detail. Such grooves are limited by the middle block 210 of the tread block arrangement 200. The grooves 340, 350 do not extend straight, but have a bend point 344, 354. The function of the bend point is to provide more edges to the tread blocks thereby improving the grip and/or effectively softening the tread block.

In Fig. 6, a primary transversal part 212 of the of the of the middle block 210 limits a side wall of a groove 340 and an end wall 342 of the groove 340. The groove 340 extends from the end wall 342 to a bend point 344 of the groove 340 and from the bend point 344 to an intersection 346 of a main groove portion 348. In Fig. 6, the main groove portion 348 extends from the intersection 346 into two directions as the main groove portions 348a and 348b. At the bend point 344, the direction of extension of the groove 340 may

change e.g. by at least 45 degrees or by at least 75 degrees. In an embodiment, at 25 % or at least 50 % of the primary transversal parts 212 of the of the of the middle block 210 comprise a groove (340, 320), e.g. a groove 340 with a bend point 344.

In the embodiment of Fig. 6, only the following three groove portions extend from the intersection 346

- the groove 340,
- a first half 348a of the main groove portion 348 extending in a first direction, and
- a second half 348b of the main groove portion 348 extending in a direction that is different to the first direction.

The direction to which the second half 348b of the main groove portion 348 extends from the intersection 346 may be reverse to the direction to which the first half 348a of the main groove portion 348 extends from the intersection 346.

In Fig. 6, a secondary transversal part 214 of the of the of the middle block 210 limits a side wall of a groove 350 and an end wall 352 of the groove 350. The groove 350 extends from the end wall 352 to a bend point 354 of the groove 350 and from the bend point 354 to an intersection 356 of a main groove portion 358. In Fig. 6, the main groove portion 358 extends from the intersection 356 into two directions as the main groove portions 358a and 358b. At the bend point 354, the direction of extension of the groove 350 may change e.g. by at least 45 degrees or at least 75 degrees. In an embodiment, at least 25 % or at least 50 % of the secondary transversal parts 214 of the of the of the middle block 210 comprise a groove (350, 320), e.g. a groove 350 with a bend point 354.

In the embodiment of Fig. 6, only the following three groove portions extend from the intersection 356

- the groove 350,
- a first half 358a of the main groove portion 358 extending in a first direction, and
- a second half 358b of the main groove portion 358 extending in a direction that is different to the first direction.

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The direction to which the second half 358b of the main groove portion 358 extends from the intersection 356 may be reverse to the direction to which the first half 358a of the main groove portion 358 extends from the intersection 356.

Even if not shown, a primary intermediate block 240 may be provided with a groove (340, 350) having a bend point (344, 354) in the aforementioned meaning. Even if not shown, a secondary intermediate block 250 may be provided with a groove (340, 350) having a bend point (344, 354) in the aforementioned meaning.

Referring to Figs. 3c, 4 and 7, the tread block arrangement 200 may comprise pitches 400, 400a1, 400a2, 400a, 400b, 400c. A pitch includes a portion of the tread blocks of the tread block arrangement 200. The tread block arrangement 200 can be formed of pitches applied next to each other. As an example, the tread block arrangement 200 of Figs. 4 and 7 both have a first pitch (400a1, 400a) and a second pitch (400a2, 400a). The second pitch (400a2, 400a) is arranged in the longitudinal direction SL, SC relative to the first pitch (400a1, 400). Moreover, the tread block configuration of the second pitch (400a, 400a2) is identical to the tread block configuration of the first pitch (400a, 400a1). The term tread block configuration refers to the size and shape of the tread blocks, in addition to their positions relative to each other.

As indicated in Fig. 4, the second pitch may be arranged next to the first pitch. However, it has been found that when pitches of different size are used, the noise of the tire 100 can be reduced. Thus, preferably, the tread block arrangement 200 further has a third pitch (400b, 400c in Fig. 7). The tread block configuration of the third pitch (400b, 400c) is different from to the tread block configuration of the first pitch (400a, 400a1). The third pitch may be arranged in between the first pitch and the second pitch. For example, the pitch 400b of Fig. 7 is smaller than the first pitch 400a. For example, the pitch 400c of Fig. 7 is larger than the first pitch 400a.

In an embodiment, the first pitch 400a, the second pitch 400b, and the third pitch 400c, each, comprise only two primary shoulder blocks 220, only two

secondary shoulder blocks 230, a part of the middle block 210, the part of the middle block 210 comprising only one primary transversal part 212 and only one secondary transversal part 214, only one primary intermediate block 240, and only one secondary intermediate block 240.

The tread block arrangement is particularly applicable on a winter tire. In an embodiment, a pneumatic tire 100 comprises a second marking 520 (see Fig. 1) indicative of the tire 100 being suitable for use as a winter tire. In an embodiment, a tread band 150 comprises a second marking 520 indicative of the tire 100 being suitable for use as a winter tire. The tire 100 (or the read band 150) may comprise a third marking 530 indicative of a maximum driving speed for the tire 100.

A winter tire may comprise studs. For applying studs, some of the tread blocks may be provided with stud recessions 420. Studs may be provided in the stud recessions 420. Moreover, to soften the tread blocks, some of the tread block may be provided with sipes 410.

In an embodiment
- the middle block 210,
- at least some of the primary shoulder blocks 220,
- at least some of the secondary shoulder blocks 230,
- at least some of the primary intermediate blocks 240, and
- at least some of the secondary intermediate blocks 250

are provided with at least a sipe 410. This applies to the tread block arrangement 200, the tread band 150, and the pneumatic tire 100.

In an embodiment
- the middle block 210,
- at least some of the primary shoulder blocks 220,
- at least some of the secondary shoulder blocks 230,
- at least some of the primary intermediate blocks 240, and
- at least some of the secondary intermediate blocks 250

are provided with at least a stud recession 420. This applies to the tread block arrangement 200, the tread band 150 and the pneumatic tire 100. A stud may have been provided in the stud recession 420.

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A tread block may be provided with a first marking 422 surrounding a first stud recession. A tread block may be provided with a second marking 424 surrounding a second stud recession. The second marking may be different from the first marking. A tire 100 needs not to comprise any studs. A tire 100 needs not to comprise any stud recessions. A tire 100 needs not to comprise any markings for stud recessions.

In an embodiment, some of the stud recessions 420 form a first group G1 and some of the stud recessions 420 form a second group G2. Each stud recession 420 of the first group G1 is surrounded by a first marking 422 and each stud recession 420 of the second group G2 is encircled by a second marking 424 that is different from the first marking 422. However, all the first markings 422 are identical. Moreover, all the second markings 424 are identical. The number of stud recessions in the first group G1 may be at least 2, at least 5, or at least 10. The number of stud recessions in the second group G2 may be at least 2, at least 5, or at least 10. Studs of a first type may be provided in the recessions of the first group G1. Studs of a second type may be provided in the recessions of the second group G2.

In an embodiment, the tread blocks (210, 220, 230, 240, 250) of the tread block arrangement 200 are made of soft rubber for improved grip. Herein soft rubber has a shore (A) hardness of at most 75 ShA, at most 70 ShA, at most 65 ShA, at most 60 ShA or at most 55 ShA at the temperature 23 °C. The soft rubber may have a shore (A) hardness of at least 40 ShA or at least 45 ShA at the temperature 23 °C. Preferable, the soft rubber has a shore (A) hardness of from 45 ShA to 70 ShA or from 45 ShA to 65 ShA. In general, softer material improves grip, but, to some degree, reduces handling of the vehicle and increases wear of the tire.

With reference to Fig. 8, in an embodiment, the tread block arrangement 200 forms a tread 170, which can be divided to two equally large parts 170a and 170b by a longitudinal central line LCL. As indicated in Fig. 8, the second part 170b is a transferred mirror image of the first part 170a. The second part 170b, after a translation in the longitudinal direction SL, SC, forms a mirror image of the first part 170a. The second part 170b, after a translation in the longitudinal direction SL, SC, forms a mirror image of the first part 170a

about a plane including the longitudinal central line LCL and the direction of thickness of the tread block arrangement 200.

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Claims:

1. A tread block arrangement (200) suitable for a pneumatic tire (100) or for a tread band (150) for a pneumatic tire (100), the tread block arrangement (200) comprising

- primary shoulder blocks (220),
- secondary shoulder blocks (230),
- a middle block (210) extending through the tread block arrangement (200) in a direction (SC, SL) that is perpendicular to a transversal direction (ST, AX) and perpendicular to the thickness of the tread block arrangement (200) in between the primary shoulder blocks (220) and the secondary shoulder blocks (230),
- primary intermediate blocks (240) arranged in between some of the primary shoulder blocks (220) and the middle block (210) in the transversal direction (ST, AX),
- secondary intermediate blocks (250) arranged in between some of the secondary shoulder blocks (230) and the middle block (210) in the transversal direction (ST, AX), wherein

- each block (210, 220, 230, 240, 250) of the tread block arrangement (200) is separated from another block (210, 220, 230, 240, 250) of the tread block arrangement (200) by a portion of a main groove (310),

- the middle block (210) comprises primary transversal parts (212) and secondary transversal parts (214) such that

- at least half of a primary intermediate block (240) is arranged in between two primary transversal parts (212) of the middle block (210) in a direction (SC, SL) that is perpendicular to the transverse direction (ST, AX) and perpendicular to the thickness of the tread block arrangement (200), and
- at least half of a secondary intermediate block (250) is arranged in between two secondary transversal parts (214) of the middle block (210) in a direction (SC, SL) that is perpendicular to the transverse direction (ST, AX) and perpendicular to the thickness of the tread block arrangement (200),

characterized in that

- at least some of the primary intermediate blocks (240) are provided with a groove (320) having [i] a first end (322) limited by the primary intermediate

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block (240) and [ii] a second end (324) that joins a portion of a main groove (310) and/or

- at least some of the primary transversal parts (212) of the middle block (210) are provided with a groove (320) having [i] a first end (322) limited by the primary transversal part (212) and [ii] a second end (324) that joins a portion of a main groove (310).

2. The tread block arrangement (200) of claim 1, wherein

- at least some of the secondary intermediate blocks (250) are provided with a groove (320) having [i] a first end (322) limited by the secondary intermediate block (250) and [ii] a second end (324) that joins a portion of a main groove (310) and/or

- at least some of the secondary transversal parts (214) of the middle block (210) are provided with a groove (320) having [i] a first end (322) limited by the secondary transversal part (214) and [ii] a second end (324) that joins a main groove portion (310).

3. The tread block arrangement (200) claim 1 or 2, wherein

- each one of the primary transversal parts (212) of the of the middle block (210) extend in a longitudinal direction (D212) of the primary transversal part in question (212), wherein

- each longitudinal direction (D212) of the primary transversal part in question forms an angle (α1) of from 10 degrees to 60 degrees with the transversal direction (ST, AX),

- each one of the secondary transversal parts (214) of the of the middle block (210) extend in a longitudinal direction (D214) of the secondary transversal part in question (214), wherein

- each longitudinal direction (D214) of the secondary transversal part in question forms an angle (α2) of from 10 degrees to 60 degrees with the transversal direction (ST, AX),

- each one of the primary intermediate blocks (240) extend in a longitudinal direction (D240) of the primary intermediate block in question (240), wherein

- each longitudinal direction (D240) of the primary intermediate block in question forms an angle (α3) of from 10 degrees to 60 degrees with the transversal direction (ST, AX), and

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- each one of the secondary intermediate blocks (250) extend in a longitudinal direction (D250) of the secondary intermediate block in question (250), wherein
- each longitudinal direction (D250) of the secondary intermediate block in question (250) forms an angle ($\alpha 4$) of from 10 degrees to 60 degrees with the transversal direction (ST, AX).

4. The tread block arrangement (200) of claim 3, wherein
- a longitudinal direction (D212) of a primary transversal part (212) forms a first secondary angle ($\gamma 1$) with a longitudinal direction (D214) of a secondary transversal part (214) such that
- the first secondary angle ($\gamma 1$) opens in a direction (DO1) that is reverse to a direction of rotation (R), and
- a longitudinal direction (D240) of a primary intermediate block (240) forms a second secondary angle ($\gamma 2$) with a longitudinal direction (D250) of a secondary intermediate block (250) such that
- the second secondary angle ($\gamma 2$) opens in a direction (DO2) that is reverse to the direction of rotation (R), wherein
- the tread block arrangement (200) is intended for use on a pneumatic tire (100) having, in use, a direction of rotation (R),

5. The tread block arrangement (200) of any of the claims 1 to 4, wherein
- a first primary longitudinal main groove portion (312) is left in the transversal direction (ST, AX) in between a primary shoulder block (220) and a primary intermediate block (240),
- a first secondary longitudinal main groove portion (314) is left in the transversal direction (ST, AX) in between a secondary shoulder block (230) and a secondary intermediate block (250),
- a second primary longitudinal main groove portion (316) is left in the transversal direction (ST, AX) in between a primary shoulder block (220) and a primary transversal part (212),
- a second secondary longitudinal main groove portion (318) is left in the transversal direction (ST, AX) in between a secondary shoulder block (250) and a secondary transversal part (214); and
- at least one of the first primary longitudinal main groove portion (312), the first secondary longitudinal main groove portion (314), the second primary longitudinal main groove portion (316), and the second secondary

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longitudinal main groove portion (318) is provided with a bottom protrusion (313, 315, 317, 319);

preferably

- the first primary longitudinal main groove portion (312), the first secondary longitudinal main groove portion (314), the second primary longitudinal main groove portion (316), and the second secondary longitudinal main groove portion (318) are provided with a bottom protrusion (313, 315, 317, 319).

6. The tread block arrangement (200) of the claim 5,

- the first primary longitudinal main groove portion (312) extends in a longitudinal direction (D312) of the first primary longitudinal main groove portion forming an angle ($\beta 1$) of from 60 degrees to 85 degrees with the transversal direction (ST, AX),
- the first secondary longitudinal main groove portion (314) extends in a longitudinal direction (D314) of the first secondary longitudinal main groove portion forming an angle ($\beta 2$) of from 60 degrees to 85 degrees with the transversal direction (ST, AX),
- the second primary longitudinal main groove portion (316) extends in a longitudinal direction (D316) of the second primary longitudinal main groove portion forming an angle ($\beta 3$) of from 60 degrees to 85 degrees with the transversal direction (ST, AX), or
- the second secondary longitudinal main groove portion (318) extends in a longitudinal direction (D318) of the second secondary longitudinal main groove portion forming an angle ($\beta 4$) of from 60 degrees to 85 degrees with the transversal direction (ST, AX);

preferably

- all the angles ($\beta 1$, $\beta 2$, $\beta 3$, and $\beta 4$) are from 60 degrees to 85 degrees.

7. The tread block arrangement (200) of any of the claims 1 to 6, wherein

[A]

- a first primary shoulder block (220a) is arranged in a direction (SC, SL) that is perpendicular to the transverse direction (ST, AX) next to a second primary shoulder block (220b) and a third primary shoulder block (220c),
- at least half of the first primary shoulder block (220a) is arranged in the direction (SC, SL) perpendicular to the transverse direction (ST, AX) in between the second primary shoulder block (220b) and the third primary shoulder block (220c),

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- the first primary shoulder block (220a) is arranged in the transversal direction (ST, AX) next to a primary transversal part (212) of the middle block (210),
- the second primary shoulder block (220b) is arranged in the transversal direction (ST, AX) next to a primary intermediate block (240), and
- the third primary shoulder block (220c) is arranged in the transversal direction (ST, AX) next to another primary intermediate block (240); and

[B]

- a first secondary shoulder block (230a) is arranged in a direction (SC, SL) perpendicular to the transverse direction (ST, AX) next to a second secondary shoulder block (230b) and a third secondary shoulder block (230c),
- at least half of the first secondary shoulder block (230a) is arranged in the direction (SC, SL) perpendicular to the transverse direction (ST, AX) in between the second secondary shoulder block (230b) and the third secondary shoulder block (230c),
- the first secondary shoulder block (230a) is arranged in the transversal direction (ST, AX) next to a secondary transversal part (214) of the middle block (210),
- the second secondary shoulder block (230b) is arranged in the transversal direction (ST, AX) next to a secondary intermediate block (250), and
- the third secondary shoulder block (230c) is arranged in the transversal direction (ST, AX) next to another secondary intermediate block (250).

8. The tread block arrangement (200) of any of the claims 1 to 7, wherein
- an integral portion (216) of the middle block (210) extends straight through the tread block arrangement (200) in a direction that is perpendicular to the transverse direction (ST, AX) and perpendicular to the thickness of the tread block arrangement (200).

9. The tread block arrangement (200) of any of the claims 1 to 8, comprising
- a first number (N1) of primary shoulder blocks (220),
- a second number (N2) of secondary shoulder blocks (230),
- a third number (N3) of primary transversal parts (212) of the middle block (210) and
- a fourth number (N4) number of secondary transversal parts (214) of the middle block (210); wherein

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- the fourth number (N4) equals the third number (N3), and/or
- the first number (N1) is even and the second number (N2) is even.

10. The tread block arrangement (200) of any of the claims 1 to 9, wherein
- the primary shoulder blocks (220) and the secondary shoulder blocks (230) are arranged such that
- a first imaginary transversal straight line (500) can be arranged in between two neighbouring secondary shoulder blocks (230b, 230a) in a direction (SL) that is perpendicular to the transversal direction (ST, AX) and perpendicular to the thickness of the tread block arrangement (200) such that the first imaginary transversal straight line (500) propagates through a primary shoulder block (220, 220b) and/or
- a second imaginary transversal straight line (505) can be arranged in between two neighbouring primary shoulder blocks (220b, 220a) in a direction (SL) that is perpendicular to the transversal direction (ST, AX) and perpendicular to the thickness of the tread block arrangement (200) such that the second imaginary transversal straight line (505) propagates through a secondary shoulder block (230, 230a);
preferably
- each imaginary transversal straight line (500) arranged in between two neighbouring secondary shoulder blocks (230) in a longitudinal or circumferential direction (SL, SC) propagates through a primary shoulder block (220) and
- each imaginary transversal straight line (505), arranged in between two neighbouring primary shoulder blocks (220) in a longitudinal or circumferential direction (SL) propagates through a secondary shoulder block (230).

11. The tread block arrangement (200) of any of the claims 1 to 10, wherein
- at least one of
  - a primary transversal part (212) of the of the middle block (210),
  - a secondary transversal part (214) of the of the middle block (210),
  - a primary intermediate block (240), and
  - a secondary intermediate block (250)

  limits an end wall (342, 352) of a groove (340, 350), wherein
- the groove (340, 350) extends

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- from the end wall (342, 352) to a bend point (344, 354) of the groove (340, 350) and
- from the bend point (344, 354) of the groove (340, 350) to an intersection (346, 356) of a main groove portion (348, 358).

12. The tread block arrangement (200) of claim 11, wherein
- from the intersection (346, 356) only the following three groove portions extend:
  - the groove (340, 350),
  - a first half (348a, 358a) of the main groove portion (348, 358) extending in a first direction, and
  - a second half (348b, 358b) of the main groove portion (348, 358) extending in a direction that is different from, e.g. reverse to, the first direction

13. The tread block arrangement of any of the claims 1 to 12, having
- a first pitch (400, 400a, 400a1) including a first portion of the tread blocks of the tread block arrangement (200) and
- a second pitch (400, 400a, 400a2) including a second portion of the tread blocks of the tread block arrangement (200), wherein
- the second pitch (400, 400a, 400a2) is arranged in a longitudinal direction (SL, SC) relative to the first pitch (400, 400a, 400a1) and
- the tread block configuration of the second pitch (400, 400a, 400a2) is identical to the tread block configuration of the first pitch (400, 400a, 400a1);
preferably
- the tread block arrangement (200) further has a third pitch (400, 400b, 400c), wherein
- the tread block configuration of the third pitch (400, 400b, 400c) is different from to the tread block configuration of the first pitch (400, 400a, 400a1);
preferably
- the first pitch, the second pitch, and the third pitch, each comprise
  - only two primary shoulder blocks (220),
  - only two secondary shoulder blocks (230),
  - a part of the middle block (210), the part of the middle block (210) comprising only one primary transversal part (212) and only one secondary transversal part (214),
  - only one primary intermediate block (240), and

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- only one secondary intermediate block (240).

14. A pneumatic tire (100) or a tread band (150) for a pneumatic tire (100), the pneumatic tire (100) or the tread band (150) comprising the tread block arrangement (200) of any of the claims 1 to 13, wherein

[A]

- the transversal direction (ST, AX) of the tread block arrangement (200) is parallel to the axial direction (AX) of the pneumatic tire (100) and
- the thickness of the tread block arrangement (200) is parallel to the radial direction (SR) of the pneumatic tire (100) or

[B]

- the transversal direction (ST, AX) of the tread block arrangement (200) is parallel to the transversal direction (ST) of the tread band (150) and
- the thickness of the tread block arrangement (200) is parallel to the thickness of the tread band (150).

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Patenttivaatimukset:

1. Kuviopalajärjestely (200), joka soveltuu paineilmarenkaaseen (100) tai paineilmarenkaan (100) kulutuspintaan (150), joka kuviopalajärjestely (200) käsittää

- ensisijaisia reunakuviopaloja (220),
- toissijaisia reunakuviopaloja (230),
- keskikuviopalan (210), joka ulottuu kuviopalajärjestelyn (200) poikki suunnassa (SC, SL), joka on kohtisuora poikkisuuntaan (ST, AX) nähden ja kohtisuora kuviopalajärjestelyn (200) paksuuteen nähden, ensisijaisten reunakuviopalojen (220) ja toissijaisten reunakuviopalojen (230) välissä,
- ensisijaisia välikuviopaloja (240), jotka on järjestetty poikkisuunnassa (ST, AX) ensisijaisten reunakuviopalojen (220) ja keskikuviopalan (210) väliin,
- toissijaisia välikuviopaloja (250), jotka on järjestetty poikkisuunnassa (ST, AX) toissijaisten reunakuviopalojen (230) ja keskikuviopalan (210) väliin, jolloin

– kuviopalajärjestelyn (200) kutakin kuviopalaa (210, 220, 230, 240, 250) erottaa kuviopalajärjestelyn (200) toisesta kuviopalasta (210, 220, 230, 240, 250) pääuraosuus (310),

– keskikuviopala (210) käsittää ensisijaisia poikittaisosia (212) ja toissijaisia poikittaisosia (214) siten, että

- ainakin puolet ensisijaisesta välikuviopalasta (240) on järjestetty keskikuviopalan (210) kahden ensisijaisen poikittaisosan (212) väliin suunnassa (SC, SL), joka on kohtisuora poikkisuuntaan (ST, AX) nähden ja kohtisuora kuviopalajärjestelyn (200) paksuuteen nähden, ja
- ainakin puolet toissijaisesta välikuviopalasta (250) on järjestetty keskikuviopalan (210) kahden toissijaisen poikittaisosan (214) väliin suunnassa (SC, SL), joka on kohtisuora poikkisuuntaan (ST, AX) nähden ja kohtisuora kuviopalajärjestelyn (200) paksuuteen nähden,

tunnettu siitä, että

– ainakin osaan ensisijaisista välikuviopaloista (240) on järjestetty ura (320), jolla on [i] ensimmäinen pää (322), jota rajoittaa ensisijainen välikuviopala (240), ja [ii] toinen pää (324), joka liittyy pääuraosuuteen (310), ja/tai

– ainakin osaan keskikuviopalan (210) ensisijaisista poikittaisosista (212) on järjestetty ura (320), jolla on [i] ensimmäinen pää (322), jota rajoittaa ensisijainen poikittaisosa (212), ja [ii] toinen pää (324), joka liittyy pääuraosuuteen (310).

2. Patenttivaatimuksen 1 mukainen kuviopalajärjestely (200), jossa
– ainakin osaan toissijaisista välikuviopaloista (250) on järjestetty ura (320), jolla on [i] ensimmäinen pää (322), jota rajoittaa toissijainen välikuviopala (250), ja [ii] toinen pää (324), joka liittyy pääuraosuuteen (310), ja/tai
– ainakin osaan keskikuviopalan (210) toissijaisista poikittaisosista (214) on järjestetty ura (320), jolla on [i] ensimmäinen pää (322), jota rajoittaa toissijainen poikittaisosa (214), ja [ii] toinen pää (324), joka liittyy pääuraosuuteen (310).

3. Patenttivaatimuksen 1 tai 2 mukainen kuviopalajärjestely (200), jossa
– kukin keskikuviopalan (210) ensisijaisista poikittaisosista (212) jatkuu kyseisen ensisijaisen poikittaisosan (212) pituussuunnassa (D212), jolloin
– kukin kyseisen ensisijaisen poikittaiskuviopalan pituussuunta (D212) muodostaa 10–60 asteen kulman (α1) poikkisuunnan (ST, AX) kanssa,
– kukin keskikuviopalan (210) toissijaisista poikittaisosista (214) jatkuu kyseisen toissijaisen poikittaisosan (214) pituussuunnassa (D214), jolloin
– kukin kyseisen toissijaisen poikittaisosan pituussuunta (D214) muodostaa 10–60 asteen kulman (α2) poikkisuunnan (ST, AX) kanssa,
– kukin ensisijainen välikuviopala (240) jatkuu kyseisen ensisijaisen välikuviopalan (240) pituussuunnassa (D240), jolloin
– kukin kyseisen ensisijaisen välikuviopalan pituussuunta (D240) muodostaa 10–60 asteen kulman (α3) poikkisuunnan (ST, AX) kanssa, ja
– kukin toinen välikuviopala (250) jatkuu kyseisen toissijaisen välikuviopalan (250) pituussuunnassa (D250), jolloin
– kukin kyseisen toissijaisen välikuviopalan pituussuunta (D250) muodostaa 10–60 asteen kulman (α4) poikkisuunnan (ST, AX) kanssa.

4. Patenttivaatimuksen 3 mukainen kuviopalajärjestely (200), jossa
– ensisijaisen poikittaisosan (212) pituussuunta (D212) muodostaa ensimmäisen toissijaisen kulman (γ1) toisen poikittaisosan (214) pituussuunnan (D214) kanssa siten, että

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– ensimmäinen toissijainen kulma (γ1) avautuu suuntaan (DO1), joka on vastakkainen pyörimissuuntaan (R) nähden, ja
– ensisijaisen välikuviopalan (240) pituussuunta (D240) muodostaa toisen toissijaisen kulman (γ2) toissijaisen välikuviopalan (250) pituussuunnan (D250) kanssa siten, että
– toinen toissijainen kulma (γ2) avautuu suuntaan (DO2), joka on vastakkainen pyörimissuuntaan (R) nähden, jolloin
– kuviopalajärjestely (200) on tarkoitettu käytettäväksi paineilmarenkaassa (100), jolla on käytön yhteydessä pyörimissuunta (R).

5. Jonkin patenttivaatimuksista 1–4 mukainen kuviopalajärjestely (200), jossa
– ensimmäinen ensisijainen pitkittäinen pääuraosuus (312) jää poikkisuunnassa (ST, AX) ensisijaisen reunakuviopalan (220) ja ensisijaisen välikuviopalan (240) väliin,
– ensimmäinen toissijainen pitkittäinen pääuraosuus (314) jää poikkisuunnassa (ST, AX) toissijaisen reunakuviopalan (230) ja toissijaisen välikuviopalan (250) väliin,
– toinen ensisijainen pitkittäinen pääuraosuus (316) jää poikkisuunnassa (ST, AX) ensisijaisen reunakuviopalan (220) ja ensisijaisen poikittaisosan (212) väliin,
– toinen toissijainen pitkittäinen pääuraosuus (318) jää poikkisuunnassa (ST, AX) toissijaisen reunakuviopalan (250) ja toissijaisen poikittaisosan (214) väliin, ja
– ainakin yhteen seuraavista: ensimmäiseen ensisijaiseen pitkittäiseen pääuraosuuteen (312), ensimmäiseen toissijaiseen pitkittäiseen pääuraosuuteen (314), toiseen ensisijaiseen pitkittäiseen pääuraosuuteen (316) tai toiseen toissijaiseen pitkittäiseen pääuraosuuteen (318) on järjestetty pohjakohouma (313, 315, 317, 319),
edullisesti
– ensimmäiseen ensisijaiseen pitkittäiseen pääuraosuuteen (312), ensimmäiseen toissijaiseen pitkittäiseen pääuraosuuteen (314), toiseen ensisijaiseen pitkittäiseen pääuraosuuteen (316) ja toiseen toissijaiseen pitkittäiseen pääuraosuuteen (318) on järjestetty pohjakohouma (313, 315, 317, 319).

6. Patenttivaatimuksen 5 mukainen kuviopalajärjestely (200), jossa

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– ensimmäinen ensisijainen pitkittäinen pääuraosuus (312) jatkuu ensimmäisen ensisijaisen pitkittäisen pääuraosuuden pituussuunnassa (D312) muodostaen 60–85 asteen kulman (β1) poikkisuuntaan (ST; AX) nähden,
– ensimmäinen toissijainen pitkittäinen pääuraosuus (314) jatkuu ensimmäisen toissijaisen pitkittäisen pääuraosuuden pituussuunnassa (D314) muodostaen 60–85 asteen kulman (β2) poikkisuuntaan (ST; AX) nähden,
– toinen ensisijainen pitkittäinen pääuraosuus (316) jatkuu toisen ensisijaisen pitkittäisen pääuraosuuden pituussuunnassa (D316) muodostaen 60–85 asteen kulman (β3) poikkisuuntaan (ST; AX) nähden, tai
– toinen toissijainen pitkittäinen pääuraosuus (318) jatkuu toisen toissijaisen pitkittäisen pääuraosuuden pituussuunnassa (D318) muodostaen 60–85 asteen kulman (β4) poikkisuuntaan (ST; AX) nähden,
edullisesti
– kaikki kulmat (β1, β2, β3 ja β4) ovat 60–85 astetta.

7. Jonkin patenttivaatimuksista 1–6 mukainen kuviopalajärjestely (200), jossa
[A]
– ensimmäinen ensisijainen reunakuviopala (220a) on järjestetty poikkisuuntaan (ST, AX) nähden kohtisuorassa suunnassa (SC, SL) toisen ensisijaisen reunakuviopalan (220b) ja kolmannen ensisijaisen reunakuviopalan (220c) viereen,
– ainakin puolet ensimmäisestä ensisijaisesta reunakuviopalasta (220a) on järjestetty poikkisuuntaan (ST, AX) nähden kohtisuorassa suunnassa (SC, SL) toisen ensisijaisen reunakuviopalan (220b) ja kolmannen ensisijaisen reunakuviopalan (220c) väliin,
– ensimmäinen ensisijainen reunakuviopala (220a) on järjestetty poikkisuunnassa (ST, AX) keskikuviopalan (210) ensisijaisen poikittaisosan (212) viereen,
– toinen ensisijainen reunakuviopala (220b) on järjestetty poikkisuunnassa (ST, AX) ensisijaisen välikuviopalan (240) viereen, ja
– kolmas ensisijainen reunakuviopala (220c) on järjestetty poikkisuunnassa (ST, AX) erään toisen ensisijaisen välikuviopalan (240) viereen, ja
[B]
– ensimmäinen toissijainen reunakuviopala (230a) on järjestetty poikkisuuntaan (ST, AX) nähden kohtisuorassa suunnassa (SC, SL) toisen toissijaisen reunakuviopalan (230b) ja kolmannen toissijaisen reunakuviopalan (230c) viereen,

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– ainakin puolet ensimmäisestä toissijaisesta reunakuviopalasta (230a) on järjestetty poikkisuuntaan (ST, AX) nähden kohtisuorassa suunnassa (SC, SL) toisen toissijaisen reunakuviopalan (230b) ja kolmannen toissijaisen reunakuviopalan (230c) väliin,
– ensimmäinen toissijainen reunakuviopala (230a) on järjestetty poikkisuunnassa (ST, AX) keskikuviopalan (210) toissijaisen poikittaisosan (214) viereen,
– toinen toissijainen reunakuviopala (230b) on järjestetty poikkisuunnassa (ST, AX) toissijaisen välikuviopalan (250) viereen, ja
– kolmas toissijainen reunakuviopala (230c) on järjestetty poikkisuunnassa (ST, AX) erään toisen toissijaisen välikuviopalan (250) viereen.

8. Jonkin patenttivaatimuksista 1–7 mukainen kuviopalajärjestely (200), jossa
– keskikuviopalan (210) yhtenäinen osa (216) ulottuu suoraan kuviopalajärjestelyn (200) poikki suunnassa, joka on kohtisuora poikkisuuntaan (ST, AX) nähden ja kohtisuora kuviopalajärjestelyn (200) paksuuteen nähden.

9. Jonkin patenttivaatimuksista 1–8 mukainen kuviopalajärjestely (200), joka käsittää
– ensimmäisen lukumäärän (N1) ensisijaisia reunakuviopaloja (220),
– toisen lukumäärän (N2) toissijaisia reunakuviopaloja (230),
– kolmannen lukumäärän (N3) keskikuviopalan (210) ensisijaisia poikittaisosia (212), ja
– neljännen lukumäärän (N4) keskikuviopalan (210) toissijaisia poikittaisosia (214), joka
– neljäs lukumäärä (N4) on sama kuin kolmas lukumäärä (N3), ja/tai
– ensimmäinen lukumäärä (N1) on parillinen ja toinen lukumäärä (N2) on parillinen.

10. Jonkin patenttivaatimuksista 1–9 mukainen kuviopalajärjestely (200), jossa
– ensisijaiset reunakuviopalat (220) ja toissijaiset reunakuviopalat (230) on järjestetty siten, että
– kahden vierekkäisen toissijaisen reunakuviopalan (230b, 230a) väliin suunnassa (SL), joka on kohtisuora poikkisuuntaan (ST, AX) nähden ja kohtisuora kuviopalajärjestelyn (200) paksuuteen nähden, voidaan järjestää ensimmäinen kuvitteellinen suora poikkiviiva (500), siten että ensimmäinen

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kuvitteellinen suora poikkiviiva (500) kulkee ensisijaisen reunakuviopalan (220, 220b) läpi, ja/tai

– kahden vierekkäisen ensisijaisen reunakuviopalan (220b, 220a) väliin suunnassa (SL), joka on kohtisuora poikkisuuntaan (ST, AX) nähden ja kohtisuora kuviopalajärjestelyn (200) paksuuteen nähden, voidaan järjestää toinen kuvitteellinen suora poikkiviiva (505), siten että toinen kuvitteellinen suora poikkiviiva (505) kulkee toissijaisen reunakuviopalan (230, 230b) läpi;

edullisesti

– kukin kahden vierekkäisen toissijaisen reunakuviopalan (230) väliin pituussuunnassa tai kehäsuunnassa (SL, SC) järjestetty kuvitteellinen suora poikkiviiva (500) kulkee ensisijaisen reunakuviopalan (220) läpi, ja

– kukin kahden vierekkäisen ensisijaisen reunakuviopalan (220) väliin pituussuunnassa tai kehäsuunnassa (SL) järjestetty kuvitteellinen suora poikkiviiva (505) kulkee toissijaisen reunakuviopalan (230) läpi.

11. Jonkin patenttivaatimuksista 1–10 mukainen kuviopalajärjestely (200), jossa

– ainakin yksi seuraavista:

- keskikuviopalan (210) ensisijainen poikittaisosa (212),
- keskikuviopalan (210) toissijainen poikittaisosa (214),
- ensisijainen välikuviopala (240) ja
- toissijainen välikuviopala (250)

rajoittaa uran (340, 350) päätyseinämää (342, 352), joka

– ura (340, 350) kulkee

- päätyseinämästä (342, 352) uran (340, 350) kääntöpisteeseen (344, 354) ja
- uran (340, 350) kääntöpisteestä (344, 354) pääuraosuuden (348, 358) leikkauspisteeseen (346, 356).

12. Patenttivaatimuksen 11 mukainen kuviopalajärjestely (200), jossa

– leikkauspisteestä (346, 356) lähtee vain seuraavat kolme uraosuutta:

- ura (340, 350),
- pääuraosuuden (348, 358) ensimmäinen puolikas (348a, 358a), joka jatkuu ensimmäiseen suuntaan, ja
- pääuraosuuden (348, 358) toinen puolikas (348b, 358b), joka jatkuu muuhun suuntaan, kuin ensimmäiseen suuntaan, esimerkiksi ensimmäiseen suuntaan nähden vastakkaiseen suuntaan.

13. Jonkin patenttivaatimuksista 1–12 mukainen kuviopalajärjestely (200), jossa on

– ensimmäinen jako (400, 400a, 400a1), joka käsittää kuviopalajärjestelyn (200) kuviopalojen ensimmäisen osuuden, ja

– toinen jako (400, 400a, 400a2), joka käsittää kuviopalajärjestelyn (200) kuviopalojen toisen osuuden, joka

– toinen jako (400, 400a, 400a2) on järjestetty ensimmäiseen jakoon (400, 400a, 400a1) nähden pituussuuntaan (SL, SC), ja

– toisen jaon (400, 400a, 400a2) kuviopalamuodostelma on samanlainen kuin ensimmäisen jaon (400, 400a, 400a1) kuviopalamuodostelma;

edullisesti

– kuviopalajärjestelyssä (200) on lisäksi kolmas jako (400, 400b, 400c), jonka

– kolmannen jaon (400, 400a, 400a2) kuviopalamuodostelma on erilainen kuin ensimmäisen jaon (400, 400a, 400a1) kuviopalamuodostelma;

edullisesti

– ensimmäinen jako, toinen jako ja kolmas jako käsittävät kukin

- vain kaksi ensisijaista reunakuviopalaa (220),
- vain kaksi toissijaista reunakuviopalaa (230),
- keskikuviopalaosan (210), joka keskikuviopalaosa (210) käsittää vain yhden ensisijaisen poikittaisosan (212) ja vain yhden toissijaisen poikittaisosan (214),
- vain yhden ensisijaisen välikuviopalan (240) ja
- vain yhden toissijaisen välikuviopalan (240).

14. Paineilmarengas (100) tai paineilmarenkaan (100) kulutuspintanauha (150), joka paineilmarengas (100) tai kulutuspintanauha (150) käsittää jonkin patenttivaatimuksen 1–13 mukaisen kuviopalajärjestelyn (200), jossa

[A]

– kuviopalajärjestelyn (200) poikkisuunta (ST, AX) on yhdensuuntainen paineilmarenkaan (100) aksiaalisuunnan (AX) kanssa, ja

– kuviopalajärjestelyn (200) paksuus on yhdensuuntainen paineilmarenkaan (100) radiaalisuunnan (SR) kanssa, tai

[B]

– kuviopalajärjestelyn (200) poikkisuunta (ST, AX) on yhdensuuntainen kulutuspintanauhan (150) poikkisuunnan (ST) kanssa, ja

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– kuviopalajärjestelyn (200) paksuus on yhdensuuntainen kulutuspintanauhan (150) paksuuden kanssa.

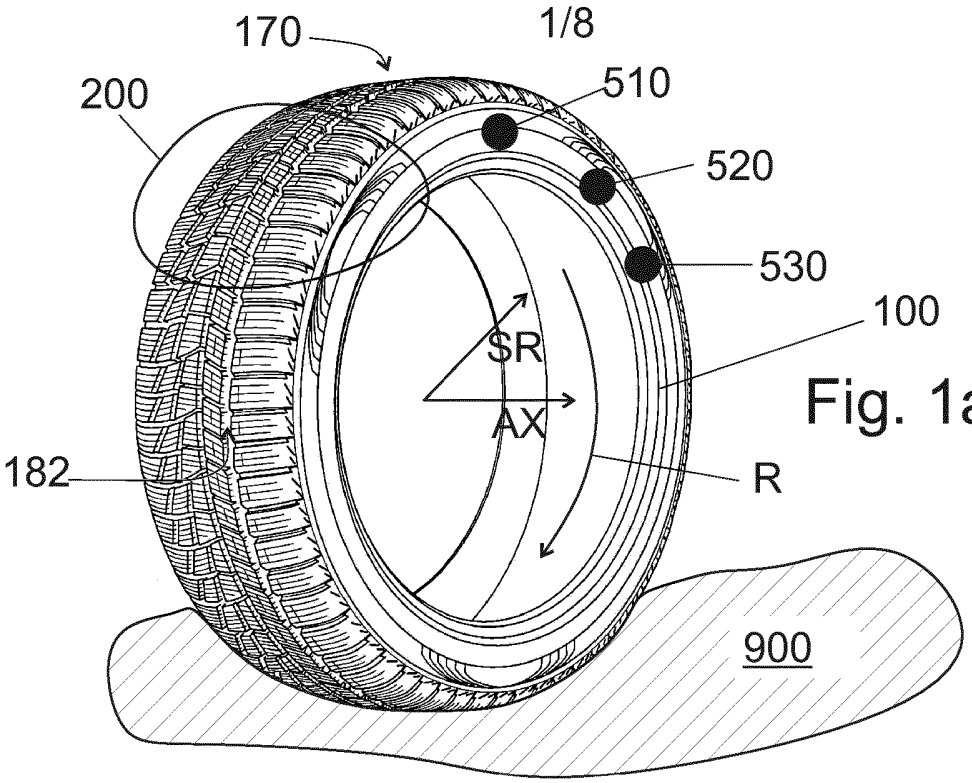

Fig. 1a

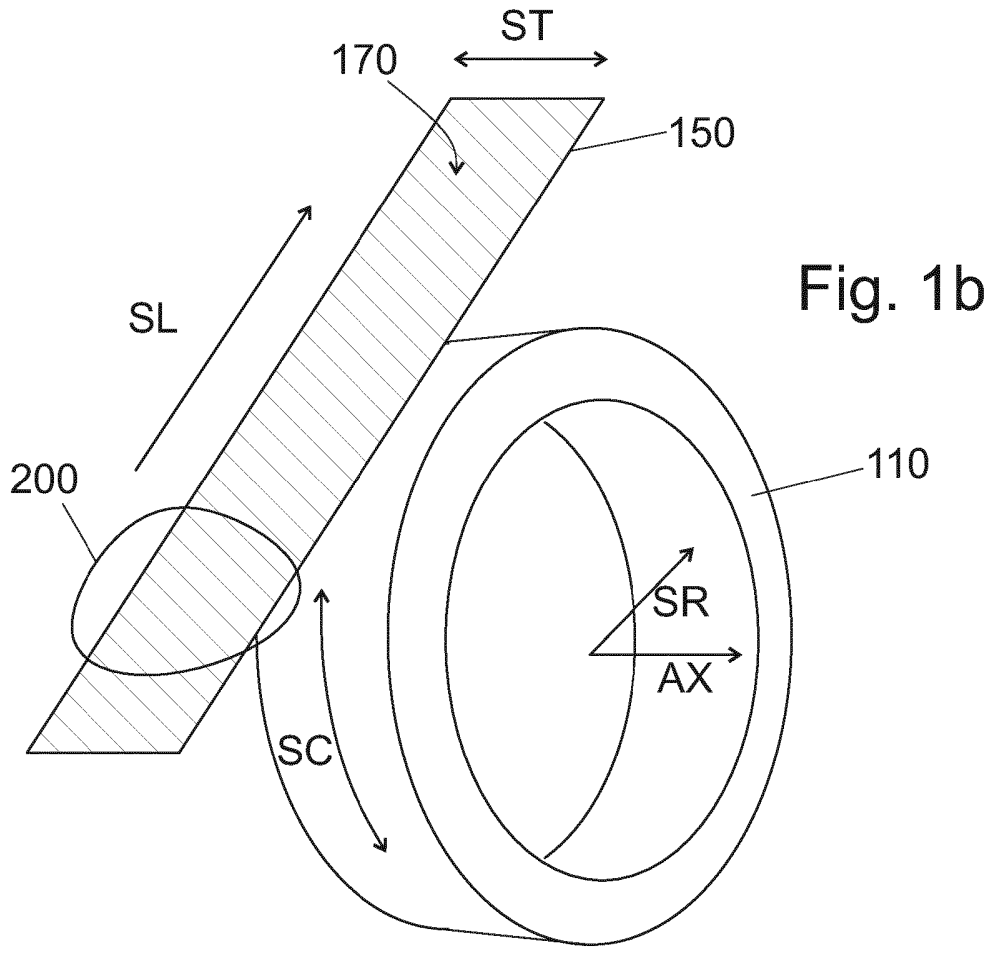

Fig. 1b

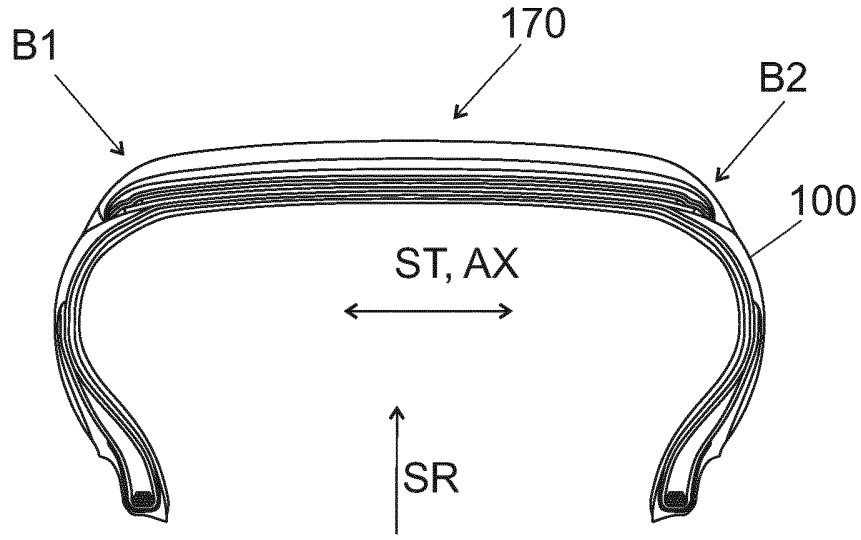

Fig. 1c

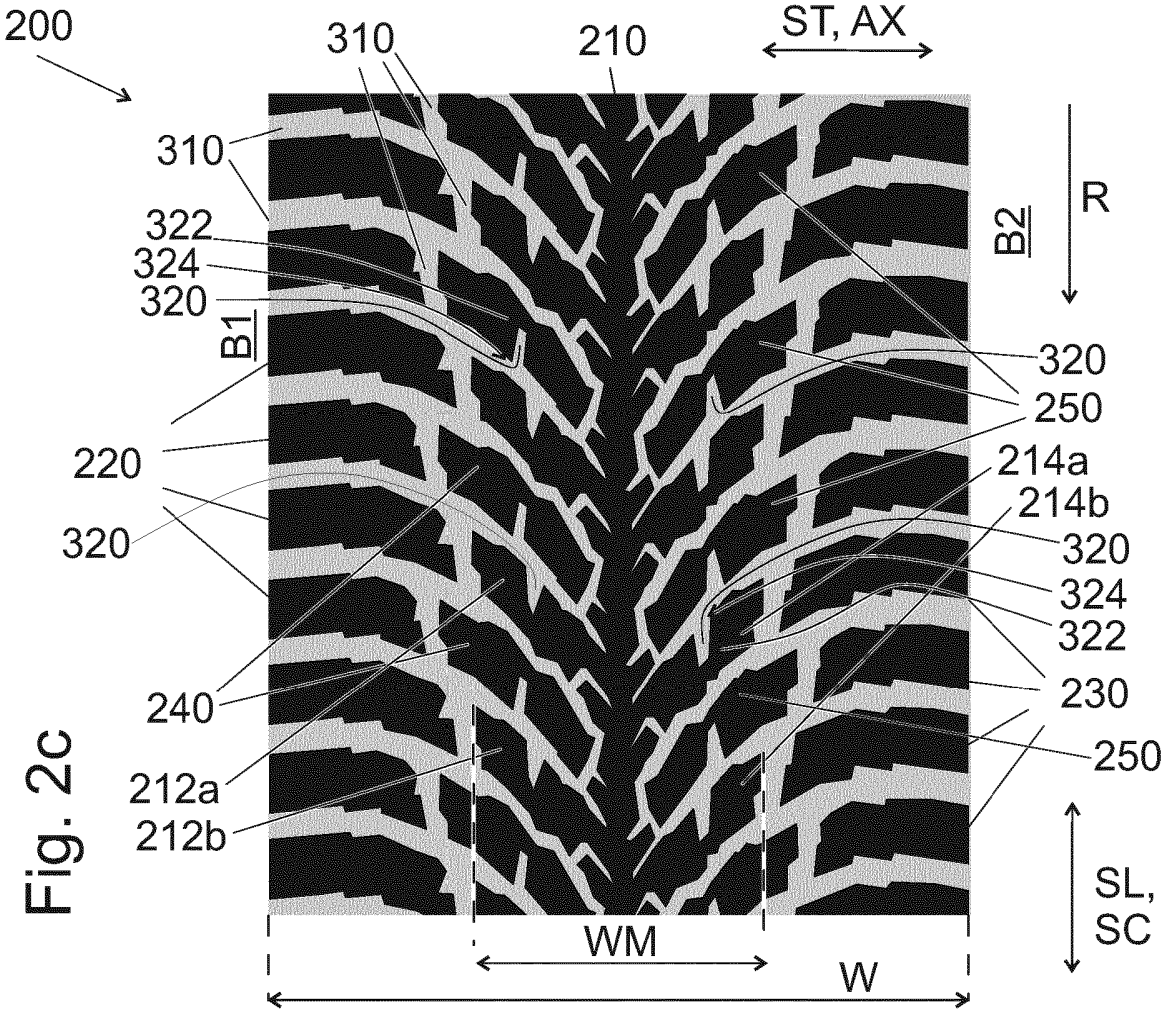

Fig. 2c

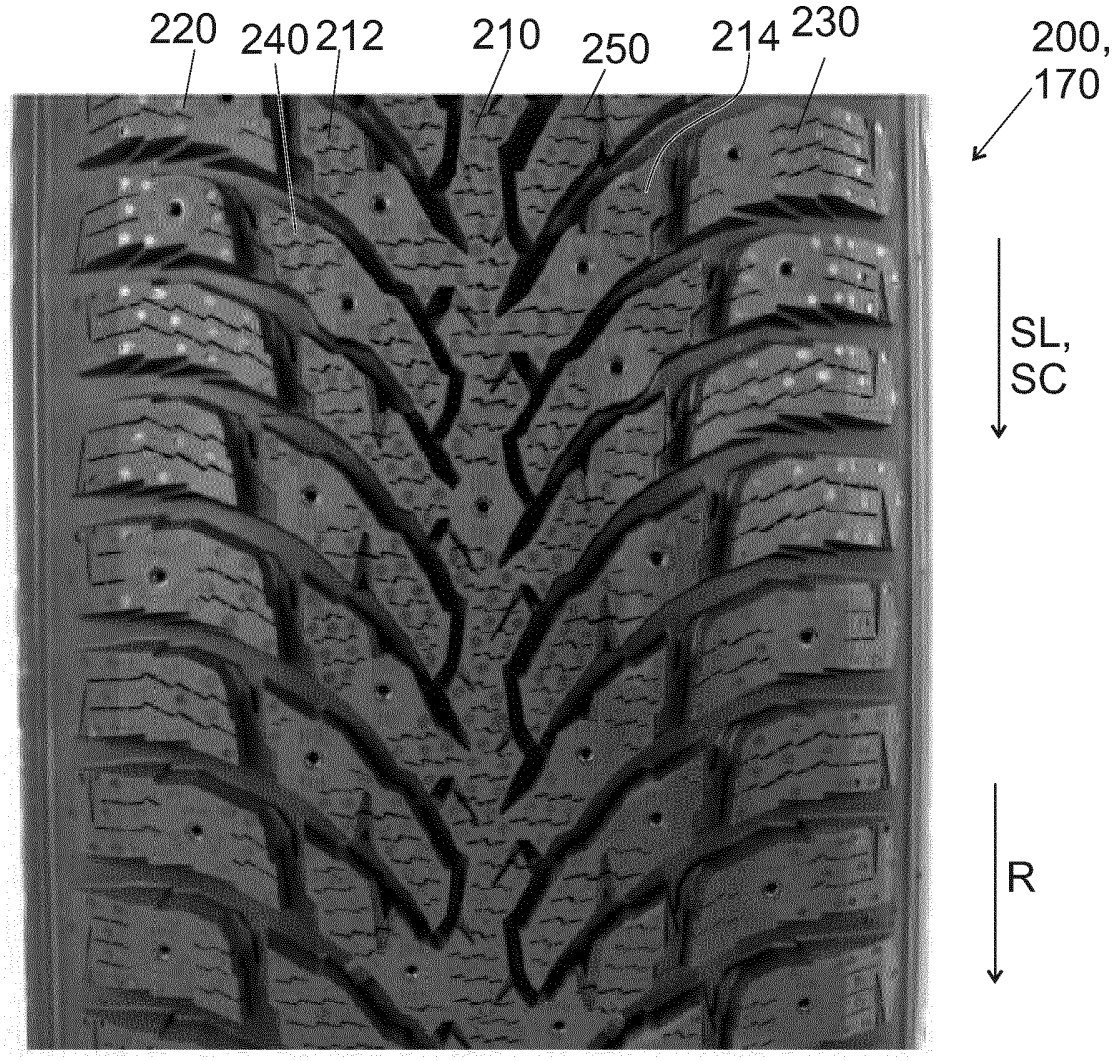

Fig. 2a

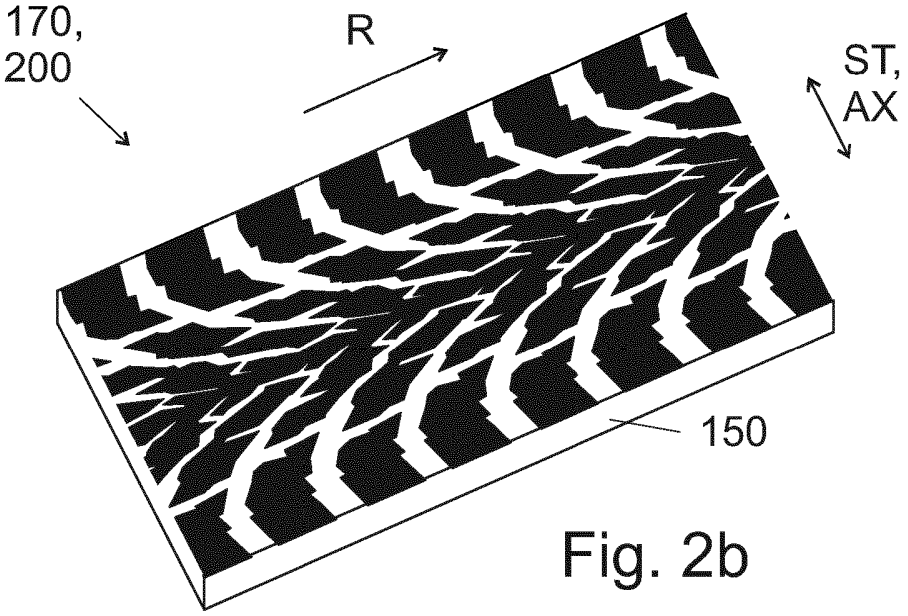

Fig. 2b

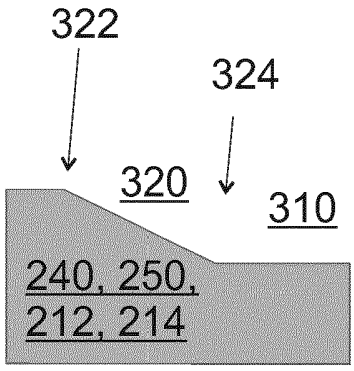

Fig. 2d

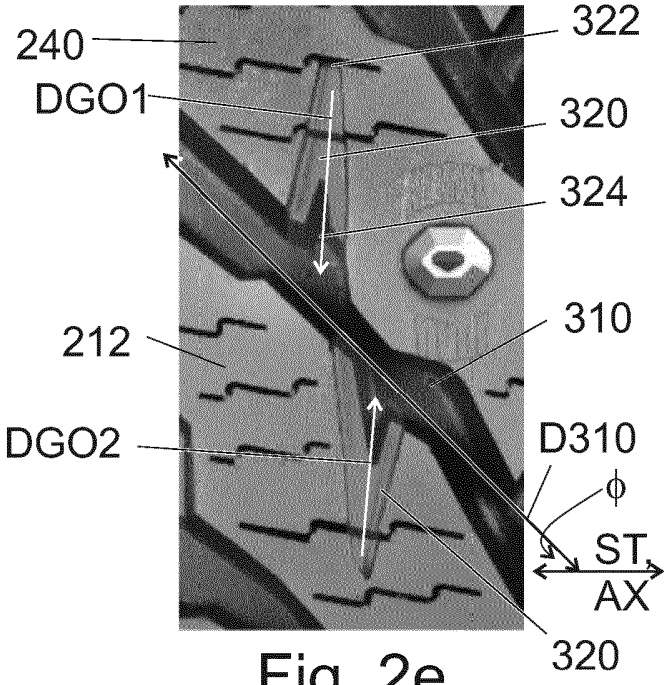

Fig. 2e

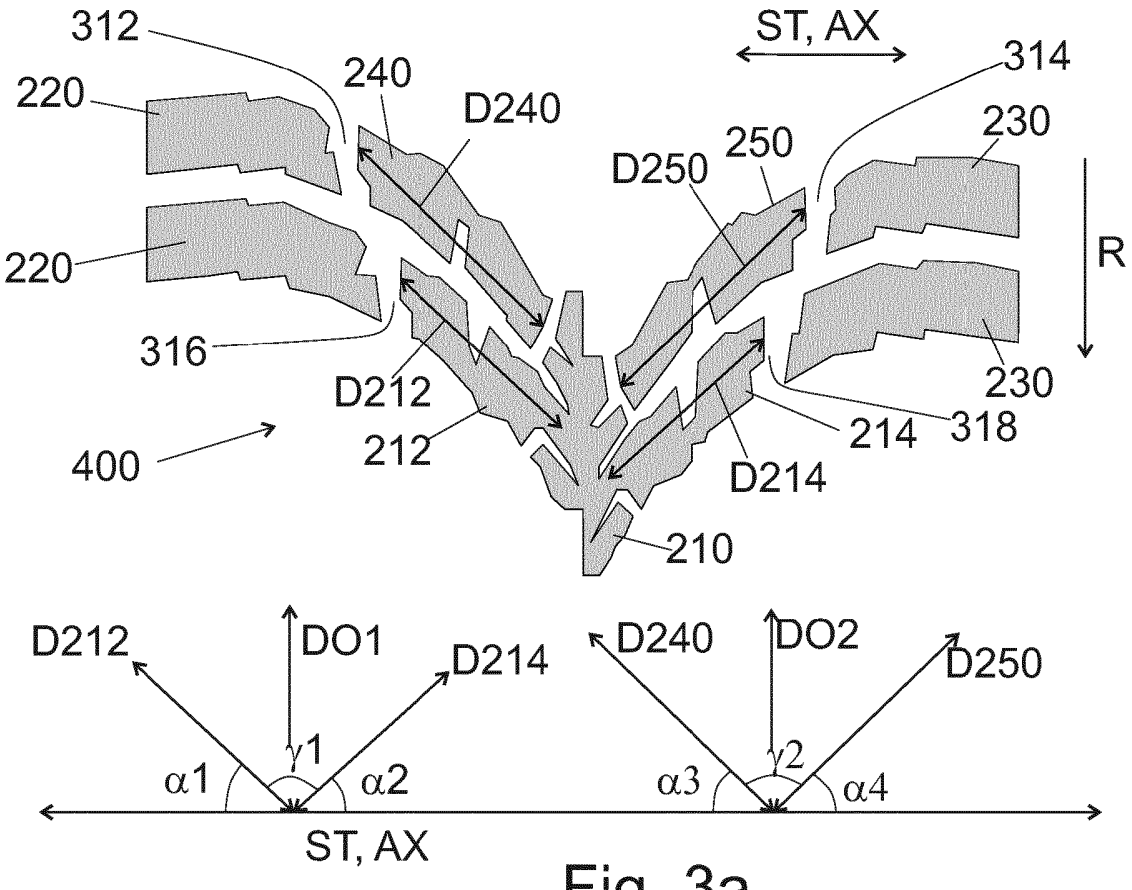

Fig. 3a

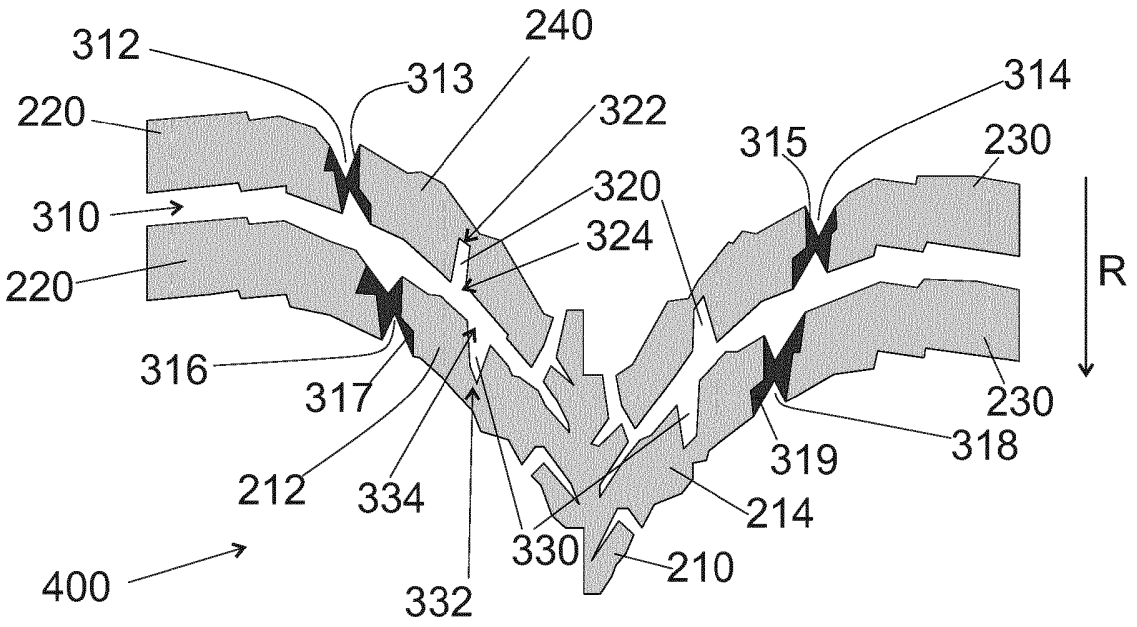

Fig. 3b

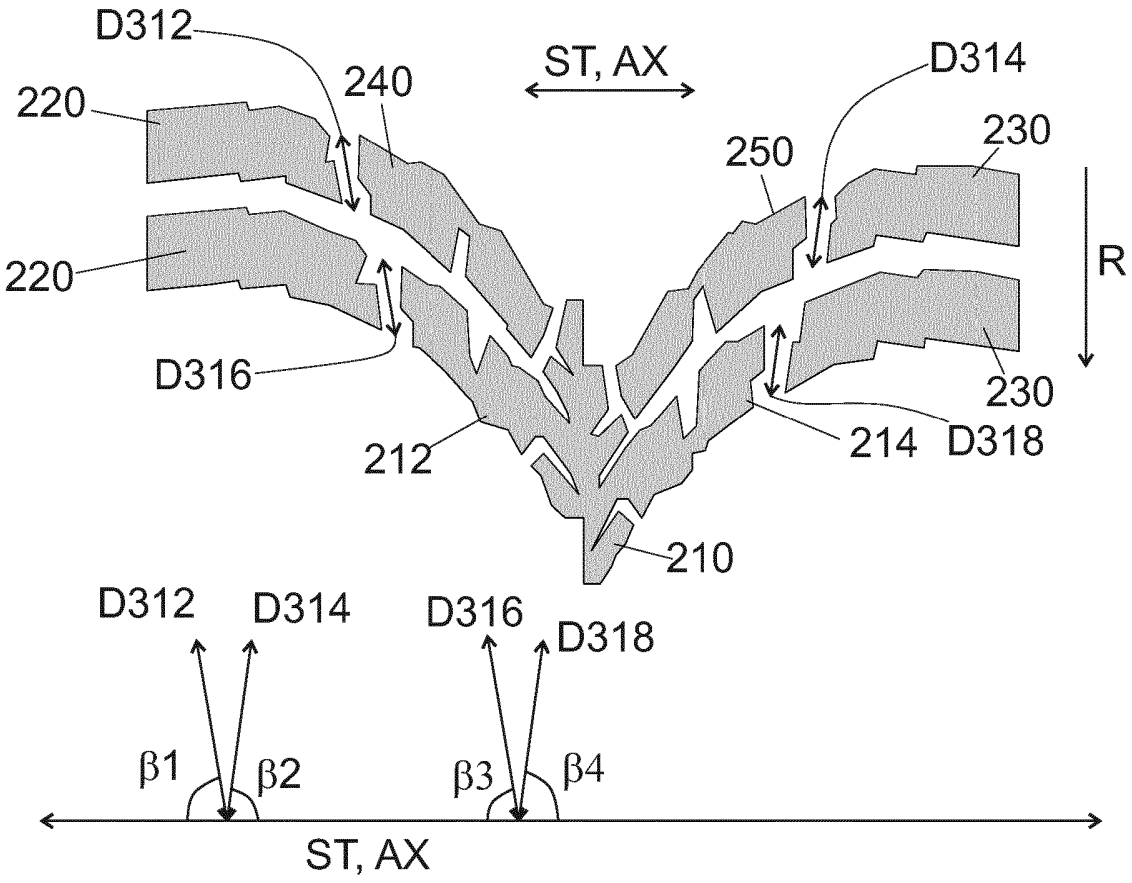

Fig. 3c

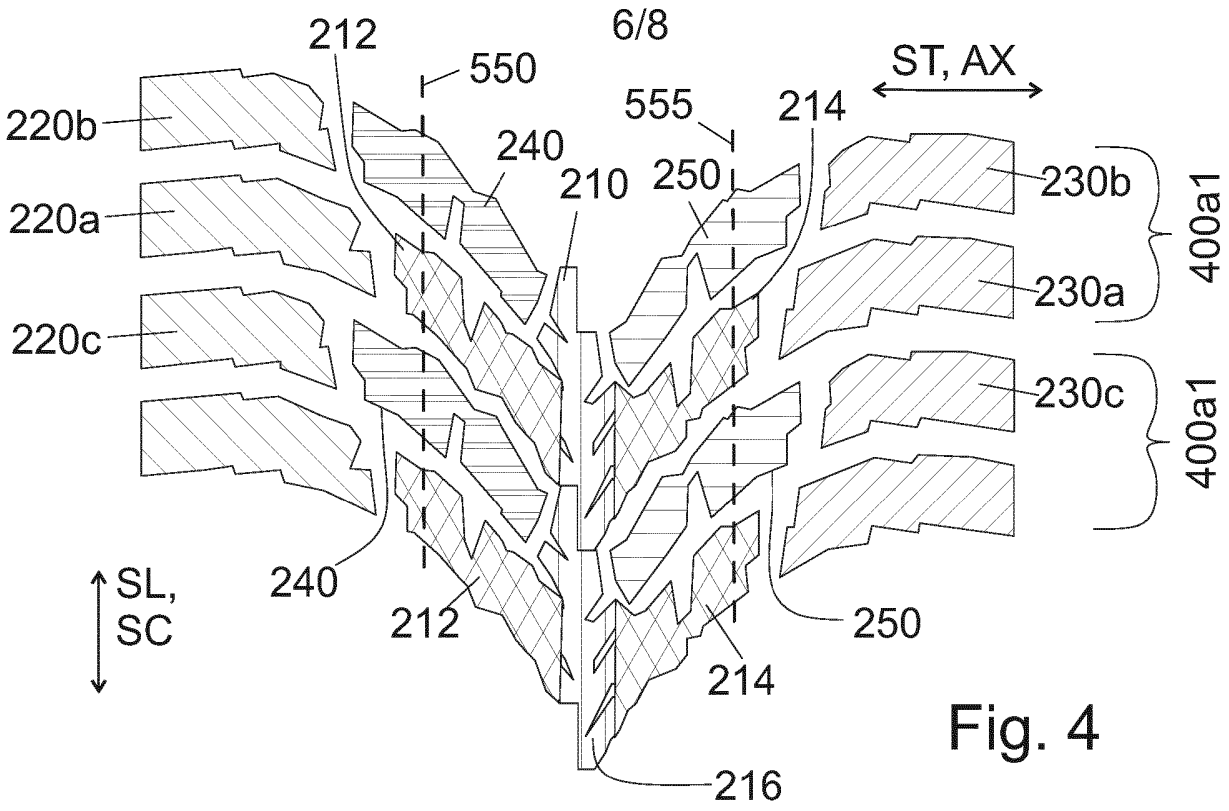

Fig. 4

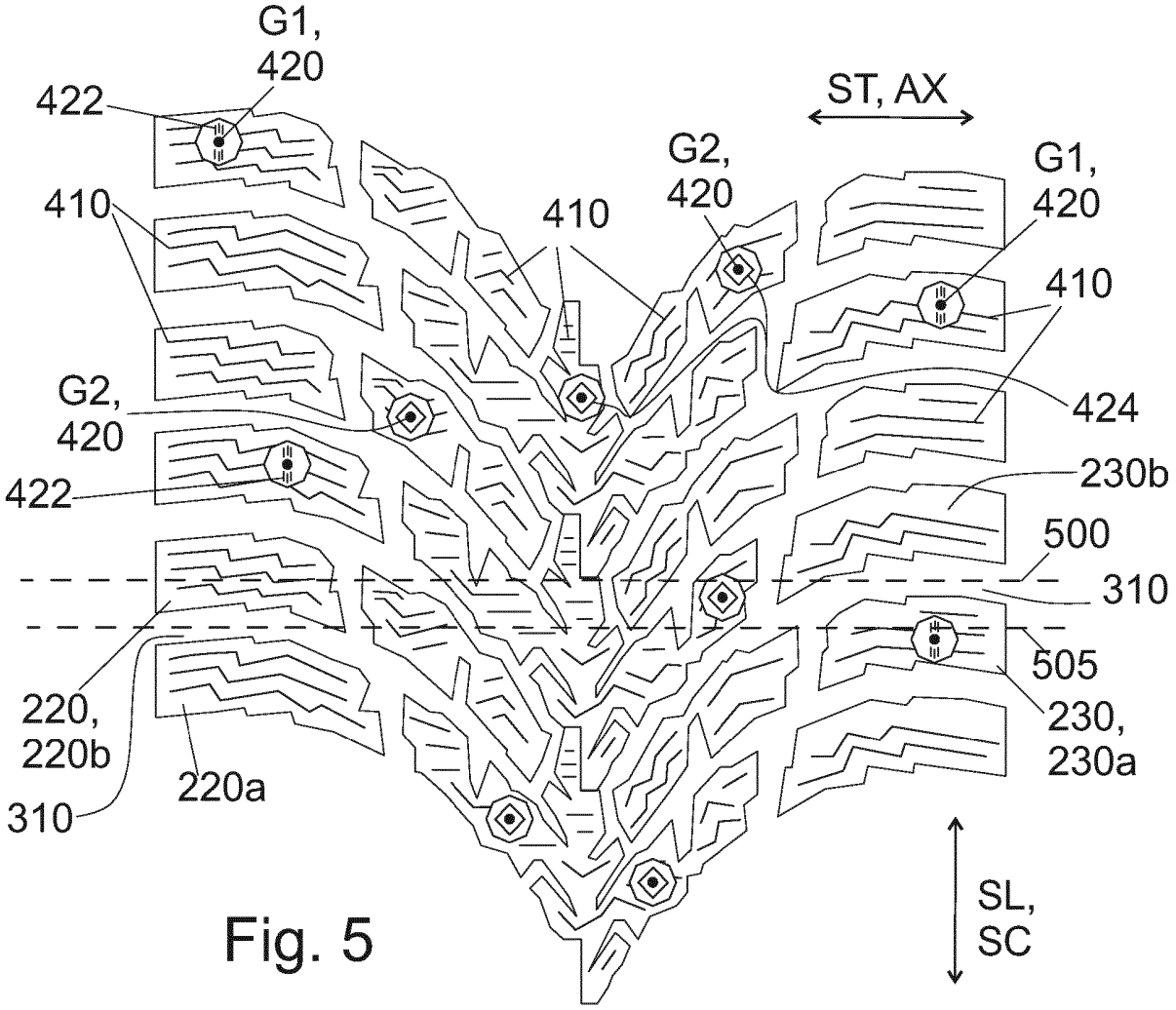

Fig. 5

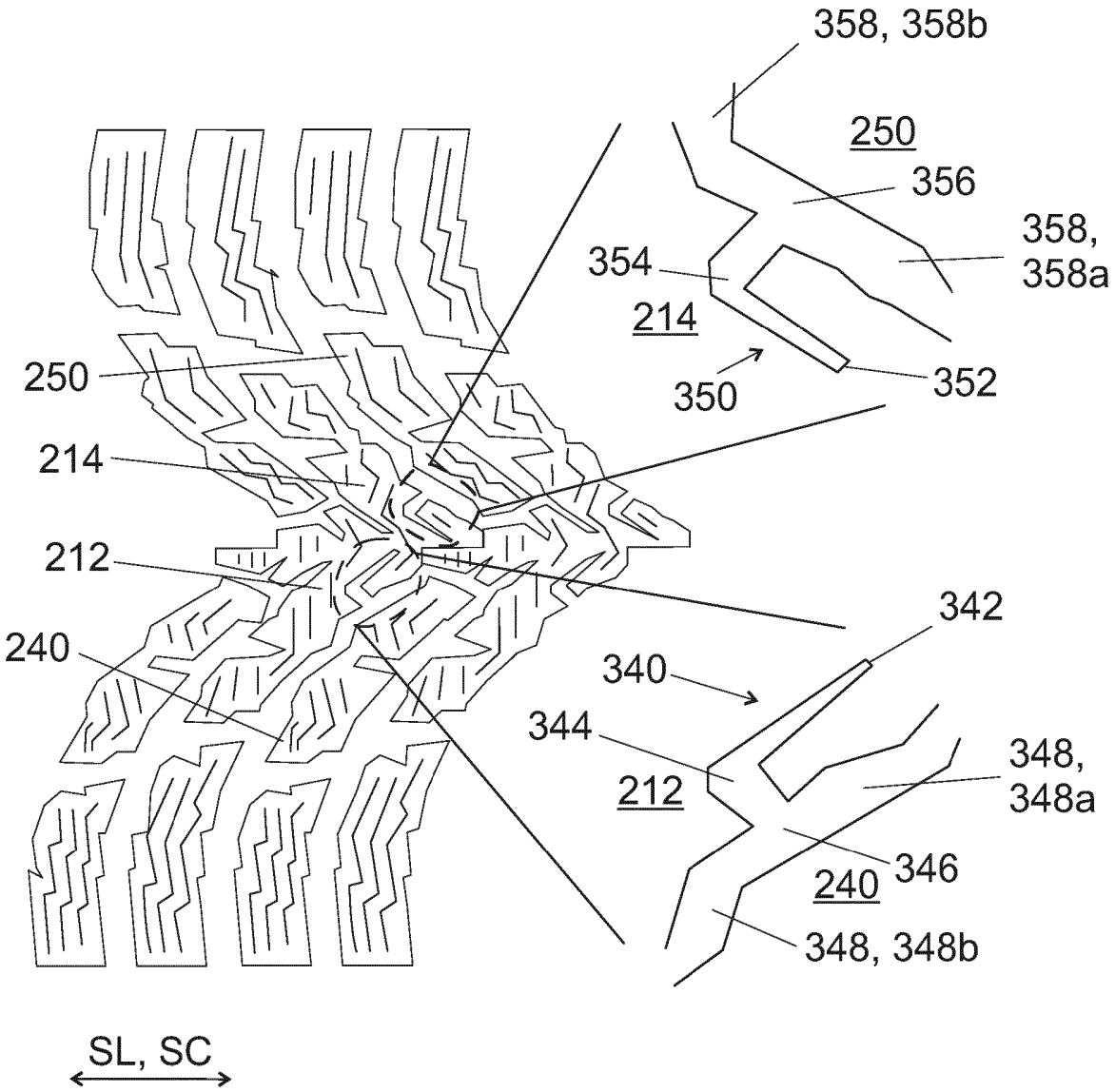

Fig. 6

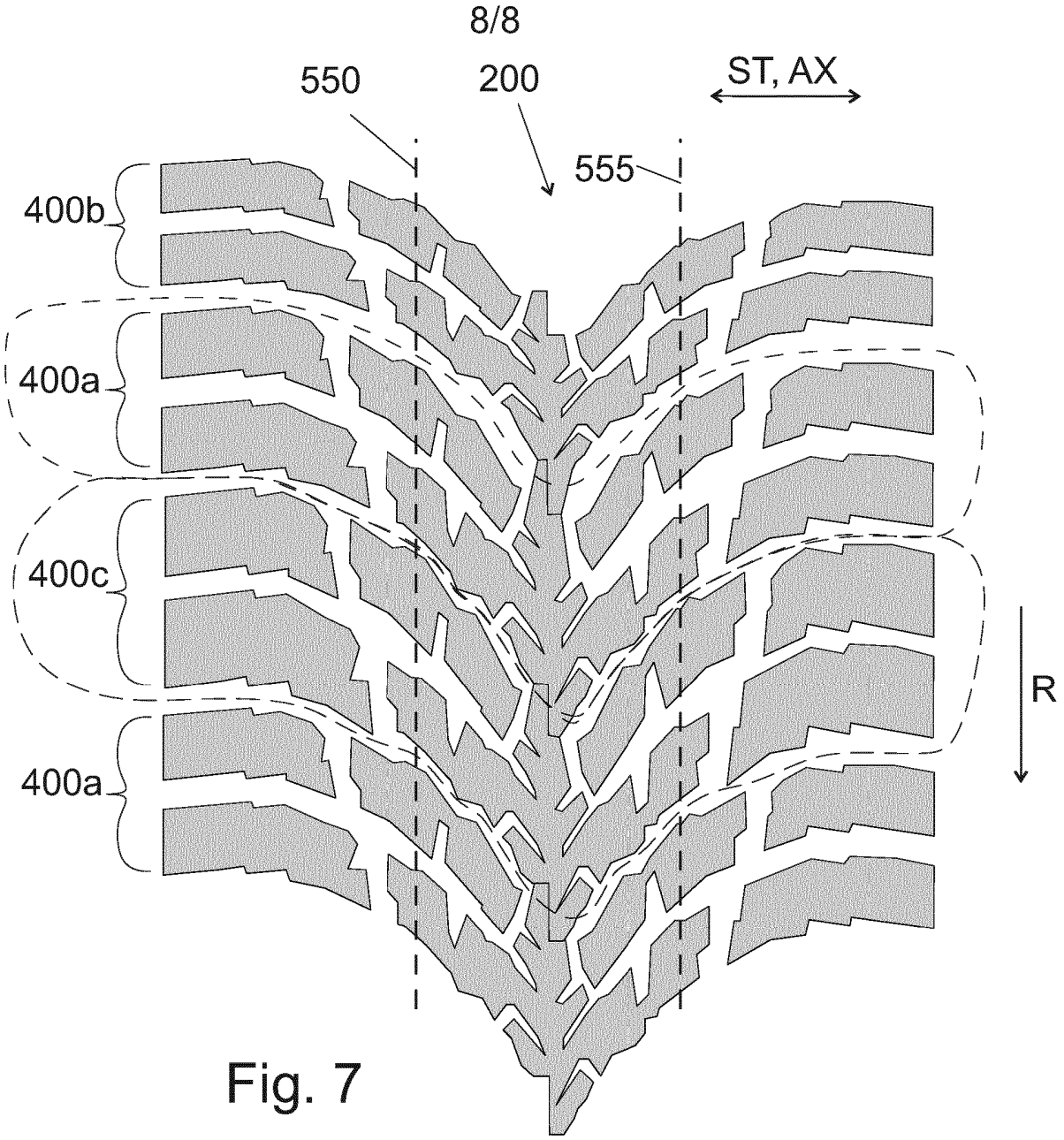

Fig. 7

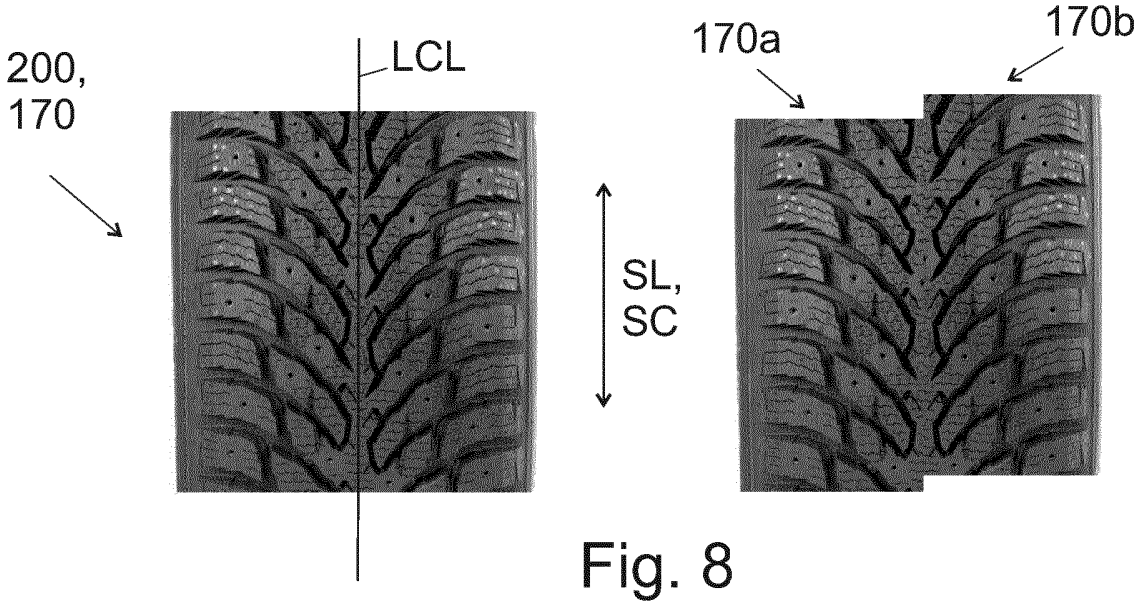

Fig. 8