

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
15 March 2007 (15.03.2007)

PCT

(10) International Publication Number
WO 2007/030286 A1

(51) International Patent Classification:

B60C 17/00 (2006.01) **B60C 15/00** (2006.01)
B60C 9/00 (2006.01)

(21) International Application Number:

PCT/US2006/031783

(22) International Filing Date: 15 August 2006 (15.08.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

11/217,167 1 September 2005 (01.09.2005) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

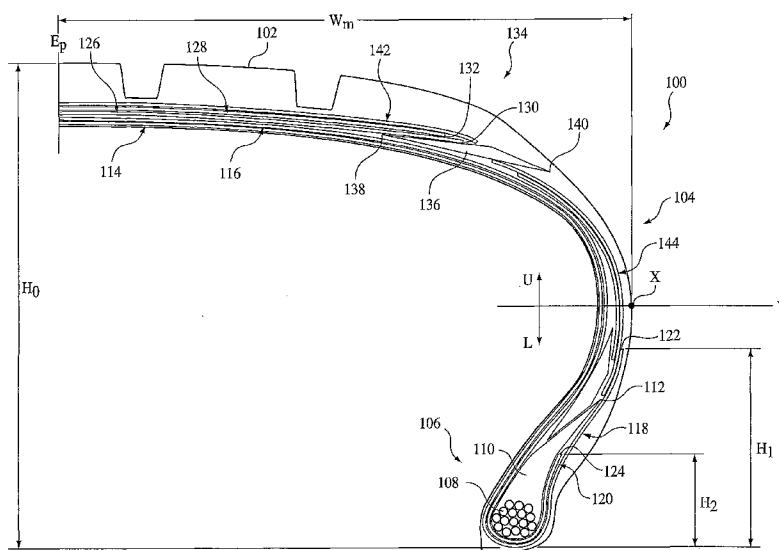
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: TIRE HAVING A SIDEWALL REINFORCEMENT



(57) Abstract: A tire (100), which has a maximum section width (Wm), an upper section (U) above the maximum section width (Wm), and a lower section (L) below the maximum section width (Wm), (100) includes a circumferential tread (102), a pair of sidewalls (104), and a pair of bead portions (106). The tire (100) further includes at least one carcass ply (114, 116) extending circumferentially about the tire (100) from one bead portion (106) to the other and first and second reinforcement plies (202, 204) extending circumferentially about the tire (100). The first and second reinforcement plies (202, 204) are provided between the at least one carcass ply (114, 116) and at least one of the sidewalls (104) of the tire (100). The first and second reinforcement plies (202, 204) include lower ends (208, 212) that terminate in the lower section (L) of the tire (100) and upper ends (206, 210) that terminate in the upper section (U) of the tire (100).

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TIRE HAVING A SIDEWALL REINFORCEMENT

FIELD OF THE INVENTION

[0001] The present application relates to tires and, more particularly, to a tire with a sidewall reinforcement to improve sidewall performance of the tire.

BACKGROUND

[0002] In an inflated and loaded condition, a radial tire is subject to bending moments at the sidewall areas at the center of the tire footprint. The strains and stresses created by the moments are directly related to the sidewall performance of the tire.

[0003] Previous research and studies have demonstrated that the maximum sidewall surface strain occurs in the least stiff area of the sidewall of a tire. Because of cord compression created during the loading of the tire, the combined cord tension in the upper sidewall area is reduced and that area is most vulnerable to sidewall bending. Therefore, the maximum sidewall surface strain is located in the upper sidewall area.

SUMMARY

[0004] A tire, which has a maximum section width, an upper section above the maximum section width, and a lower section below the maximum section width, includes a circumferential tread, a pair of sidewalls, and a pair of bead portions, each having a bead core and a bead filler. The tire further includes at least one carcass ply extending circumferentially about the tire from one bead portion to the other and first and second reinforcement plies extending circumferentially about the tire. The first and second reinforcement plies are provided between the at least one carcass ply and at least one of the sidewalls of the tire. The first and second reinforcement plies include lower ends that terminate in the lower section of the tire and upper ends that terminate in the upper section of the tire.

BRIEF DESCRIPTION OF DRAWINGS

[0005] The accompanying drawings, together with the detailed description provided below, describe exemplary embodiments of the claimed invention. In the drawings and description that

follow, like elements are identified with the same reference numerals. The drawings are not to scale and the proportion of certain elements may be exaggerated for the purpose of illustration.

[0006] **Figure 1** is a cross-sectional view of one embodiment of half of a tire **100**.

[0007] **Figure 2** is an enlarged perspective view of a portion of the tire **100** of **Figure 1**.

[0008] **Figure 3** is a perspective view of one embodiment of a portion of a dual reinforcement layer provided in the tire **100** of **Figure 1**.

[0009] **Figure 4** is a sidewall surface strain plot comparing a P255/45R18 tire with and without a sidewall dual layer reinforcement.

DETAILED DESCRIPTION

[0010] The following includes definitions of selected terms employed herein. The definitions include various examples and/or forms of components that fall within the scope of a term and that may be used for implementation. The examples are not intended to be limiting. Both singular and plural forms of terms may be within the definitions.

[0011] “Axial” or “axially” refer to a direction that is parallel to the axis of rotation of a tire.

[0012] “Circumferential” and “circumferentially” refer to lines or directions extending along the perimeter of the surface of the tread parallel to the equatorial plane perpendicular to the axial direction of the tire.

[0013] “Equatorial plane” refers to the plane that is perpendicular to the tire’s axis of rotation and passes through the center of the tire’s tread.

[0014] “Groove” refers to an elongated void area in the tread of the tire that extends circumferentially in a straight, curved or zig-zag manner.

[0015] “Lateral” or “laterally” refer to a direction along the tread of the tire going from one sidewall of the tire to the other sidewall.

[0016] “Radial” or “radially” refer to a direction perpendicular to the axis of rotation of the tire.

[0017] “Sidewall” refers to that portion of the tire between the tread and the bead.

[0018] “Tread” refers to that portion of the tire that comes into contact with the road under normal load.

[0019] Directions are also stated in this application with reference to the axis of rotation of the tire. The terms “upward” and “upwardly” refer to a general direction towards the tread of the tire, whereas “downward” and “downwardly” refer to the general direction towards the axis of rotation of the tire. Thus, when relative directional terms such as “upper” and “lower” are used in connection with an element, the “upper” element is spaced closer to the tread than the “lower” element. Additionally, when relative directional terms such as “above” or “below” are used in connection with an element, an element that is “above” another element is closer to the tread than the other element. The terms “inward” and “inwardly” refer to a general direction towards the equatorial plane of the tire, whereas “outward” and “outwardly” refer to a general direction away from the equatorial plane of the tire and towards the sidewall of the tire. Thus, when relative directional terms such as “inner” and “outer” are used in connection with an element, the “inner” element is spaced closer to the equatorial plane of the tire than the “outer” element.

[0020] Illustrated in **Figure 1** is a cross-sectional view of half of one embodiment of a tire **100**. Although only half of the tire **100** is depicted in the drawings, it will be appreciated that the other half of the tire **100** is a substantial mirror image of the half depicted. The tire **100** has an equatorial plane E_p and a maximum section width W_m measured from the equatorial plane E_p to the outer most point of the tire **100** (i.e., point **X**). The tire **100** can be divided into two sections – an upper section **U** and a lower section **L**. Separating the upper section **U** from the lower section **L** is a hypothetical line **Y** drawn through point **X** that is substantially parallel to the axis of rotation of the tire **100**. The upper section **U** is the portion of the tire **100** that is disposed above the maximum section width W_m of the tire **100** (represented by line **Y**), while the lower section **L** is disposed below the maximum section width W_m of the tire **100** (represented by line **Y**).

[0021] With continued reference to **Figure 1**, the tire **100** includes a tread **102** provided in the upper section **U** of the tire **100**, a sidewall **104** provided in both the upper and lower sections **U**, **L** of the tire **100**, and a bead portion **106** provided in the lower section **L** of the tire **100**. The bead portion **106** includes a bead core **108** and a bead filler **110** having an upper end **112**.

[0022] The tire 100 includes first and second carcass plies 114, 116 that extend circumferentially about the tire 100 from one bead portion (e.g., bead portion 106) to the other bead portion (not shown). The first and second carcass plies 114, 116 are wound outwardly about the bead core 108 and extend upwardly towards the tread 102 to form first and second turn-up portions 118, 120, respectively. Each turn-up portion 118, 120 terminates at a turn-up end 122, 124, respectively. Although the tire 100 illustrated in **Figure 1** includes two carcass plies, the tire 100 can include a single carcass ply or more than two carcass plies in alternative embodiments (not shown).

[0023] With continued reference to the embodiment illustrated in **Figure 1**, the first turn-up portion 118 of the first carcass ply 114 has a height H_1 measured radially from the turn-up end 122 to the base of the bead core 108, while the second turn-up portion 120 of the second carcass ply 116 has a height H_2 measured radially from the turn-up end 124 to the base of the bead core 108. In this embodiment, H_1 is greater than H_2 as shown in **Figure 1**. In other embodiments (not shown), H_1 may be equal to or less than H_2 . Preferably, the height H_1 of the first turn-up portion 118 is between about 30% and about 70% of the section height H_0 (which is measured from the outer tread surface at the equatorial plane E_p to the base of the bead core 108), while the height H_2 of the second turn-up portion is between about 16 mm and about 25 mm.

[0024] In one embodiment, the first and second carcass plies 114, 116 include parallel-aligned cords that are radially disposed. In other words, the parallel-aligned cords are oriented substantially perpendicular to the equatorial plane E_p of the tire 100. In alternative embodiments, one or more of the carcass plies can include parallel-aligned cords that are biased with respect to the equatorial plane E_p of the tire 100. In all cases, the cords can be constructed of, for example, nylon or polyester.

[0025] With continued reference to **Figure 1**, the tire 100 further includes first and second belts 126, 128 that extend circumferentially about the tire 100. The first and second belts 126, 128 are provided between the tread 102 and the first and second carcass plies 114, 116 as shown in **Figure 1**. The first and second belts 126, 128 terminate at edges 130, 132, respectively, at a location near a shoulder region 134 of the tire 100. Although the tire 100 illustrated in **Figure 1** features two belts, the tire 100 can include a single belt or more than two belts in alternative embodiments (not shown).

[0026] In one embodiment, the first and second belts **126, 128** include parallel-aligned cords or wires that are radially disposed. In alternative embodiments, one or more of the belts can include parallel-aligned cords or wires that are biased with respect to the equatorial plane E_p of the tire **100**. In all cases, the cords or wires can be constructed of, for example, steel or other steel alloys.

[0027] With continued reference to **Figure 1**, the tire **100** also includes a belt edge insert **136** provided in the shoulder region **134** of the tire **100** between the edges **130, 132** of the first and second belts **126, 128**, respectively, and the first and second carcass plies **114, 116**. The belt edge insert **136** has an inner end **138** and an outer end **140**. The belt edge insert **136** is configured to protect the carcass plies **114, 116** from the edges of the belts **126, 128**. The belt edge insert **136** is constructed of extruded rubber, but may be constructed of another elastomeric material. Although shown in the **Figure 1** embodiment, the belt edge insert **136** is optional and may be omitted in alternative embodiments (not shown).

[0028] The tire **100** further includes a tread cap **142** provided between the tread **102** and the first and second belts **126, 128**. The tread cap **142** can be used to assist in holding the components of the tire together (e.g., the belts, plies, and tread). The tread cap **142** can include, for example, one or more polyester or nylon fabric plies. Although shown in the **Figure 1** embodiment, the tread cap **142** is optional and may be omitted in alternative embodiments (not shown).

[0029] As shown in **Figure 1**, the tire **100** also includes a dual layer reinforcement **144** provided between the first and second carcass plies **114, 116** and the sidewall **104** (or portion thereof) of the tire **100**. Although the tire **100** features a dual layer reinforcement **144**, the reinforcement can include one layer or three or more layers in alternative embodiments (not shown).

[0030] Illustrated in **Figure 2** is an enlarged perspective view of a portion of the tire **100** of **Figure 1** depicting the positioning of the dual layer reinforcement **144** in the tire **100** in greater detail. The dual layer reinforcement **144** includes first and second reinforcement plies **202, 204** that extend circumferentially about the tire **100**. The first and second reinforcement plies **202, 204** are provided between the first and second carcass plies **114, 116** and the sidewall **104** of the tire **100**. The first reinforcement ply (or inner reinforcement ply) **202** has an upper end **206** and a

lower end **208**, while the second reinforcement ply (or outer reinforcement ply) **204** has an upper end **210** and a lower end **212**.

[0031] As shown in the embodiment illustrated in **Figure 2**, the lower end **212** of the second reinforcement ply **204** extends beyond the lower end **208** of the first reinforcement ply **202**. More specifically, the lower end **212** of the second reinforcement ply **204** extends downwardly beyond the lower end **208** of the first reinforcement ply **202** a radial distance B_1 between about 3 mm and about 6 mm. Similarly, the upper end **210** of the second reinforcement ply **204** extends beyond the upper end **206** of the first reinforcement ply **202**. More specifically, the upper end **210** of the second reinforcement ply **204** extends inwardly beyond the upper end **206** of the first reinforcement ply **202** an axial distance B_2 between about 3 mm and about 6 mm. In alternative embodiments (not shown), the upper and/or lower ends **210**, **212** of the second reinforcement ply **204** may not extend beyond the upper and/or lower ends **206**, **208** of the first reinforcement ply **202**, respectively.

[0032] With continued reference to **Figure 2**, the tire **100** also includes a bead filler insert **214** having an upper end **216** and a lower end **218**. The bead filler insert **214** is positioned above the bead filler **112** and between the reinforcement plies **202**, **204** and the carcass plies **114**, **116**. The bead filler insert **214** is configured to serve as a cushion between the reinforcement plies **202**, **214** and the carcass plies **114**, **116**. The bead filler insert **214** is constructed of rubber, but may be constructed of another elastomeric material. Although the bead filler insert **214** is illustrated as a separate component, it can be an extension of the bead filler **112**.

[0033] The upper ends **206**, **210** of the first and second reinforcement plies **202**, **204** terminate in the upper section **U** of the tire **100**. More specifically, the upper ends **206**, **210** of the first and second reinforcement plies **202**, **204** terminate in the shoulder region **134** of the tire **100**. As shown in **Figure 2**, the upper ends **206**, **210** of the first and second reinforcement plies **202**, **204** extend beyond the outer end **140** of the belt edge insert **136**. In other words, the belt edge insert **136** overlaps the first and second reinforcement plies **202**, **204**. Preferably, the outer end **140** of the belt edge insert **136** extends beyond the second reinforcement ply **204** by an axial distance A_1 between about 6 mm and about 12 mm. Similarly, the outer end **140** of the belt edge insert **136** extends beyond the first reinforcement ply **202** by an axial distance A_2 between about 3 mm and about 6 mm.

[0034] The lower ends 208, 212 of the first and second reinforcement plies 202, 204 terminate in the lower section L of the tire 100. More specifically, the lower ends 208, 212 of the first and second reinforcement plies 202, 204 may extend below the upper end 216 of the bead filler insert 214. In other words, the bead filler insert 214 may overlap the first and second reinforcement plies 202, 204. Preferably, the lower end 212 of the second reinforcement ply 204 extends below the upper end 216 of the bead filler insert 214 a radial distance R_2 between about 10 mm and about 15 mm. Similarly, the lower end 208 of the first reinforcement ply 202 extends below the upper end 216 of the bead filler insert 214 a radial distance R_1 between about 4 mm and about 6 mm.

[0035] The termination of the lower ends 208, 212 of the first and second reinforcement plies can also be discussed in relation to the turn-up end 124 of the first carcass ply 114. For example, the lower ends 208, 212 of the first and second reinforcement plies 202, 204 extend downwardly below the turn-up end 124 of the first carcass ply 114. In other words, the first turn-up portion 118 of the first carcass ply 114 overlaps the first and second reinforcement plies 202, 204. Preferably, the lower end 212 of the second reinforcement ply 204 extends below the turn-up end 124 of the first carcass ply 114 a radial distance R_3 (which is approximately the same distance as R_2 as shown in Figure 2) between about 10 mm and about 15 mm. Similarly, the lower end 208 of the first reinforcement ply 202 extends below the turn-up end 124 of the first carcass ply 114 a radial distance R_4 (which is approximately the same distance as R_1 as shown in Figure 2) between about 4 mm and about 6 mm.

[0036] Illustrated in Figure 3 is a perspective view of a portion of one embodiment of the dual layer reinforcement 144, which includes first and second reinforcement plies 202, 204. The first reinforcement ply 202 includes a first set of parallel-aligned cords 302 encapsulated in rubber or another elastomeric material. Similarly, the second reinforcement ply 204 includes a second set of parallel-aligned cords 304 encapsulated in rubber or another elastomeric material.

[0037] As shown in Figure 3, the dual layer reinforcement 144 is illustrated as an integral component having a first layer (i.e., first reinforcement ply 202) and a second layer (i.e., second reinforcement ply 204). In this case, the dual layer reinforcement 144 can be installed as a single component during the green tire assembly process. In an alternative embodiment (not shown); the first and second reinforcement plies 202, 204 can be discrete layers that are installed

separately during the green tire assembly process, yet cooperate with each to form the dual layer reinforcement **144** at the conclusion of the tire manufacturing process.

[0038] With reference to **Figure 3**, the first and second set of parallel-aligned cords **302**, **304** are oriented at an angle α with respect to circumferential direction **C** of the tire **100**. Preferably, the first and second sets of parallel-aligned cords **302**, **304** are oriented at an angle α between about 45° and 85° with respect to the circumferential direction **C** of the tire **100** and are transversely oriented with respect to each other. In alternative embodiments (not shown), the angular orientation of one or both sets of parallel-aligned cords **302**, **304** can be less than 45° with respect to the circumferential direction **C** of the tire **100** depending on the design. In addition, one or both sets of parallel-aligned cords **302**, **304** can be radially or circumferentially disposed. Furthermore, the parallel-aligned cords **302**, **304** need not be oriented transverse to each other.

[0039] The first reinforcement ply **202** preferably has a thickness T_1 between about 0.6 mm and about 1.2 mm and the second reinforcement ply **204** preferably has a thickness T_2 between about 0.6 mm and about 1.2 mm. Most preferably, the first reinforcement ply **202** has a thickness of about 1.0 mm and the second reinforcement ply **204** has a thickness of about 1.0 mm. Hence, the preferred total thickness T_3 of the dual layer reinforcement is about 2.0 mm.

[0040] In one embodiment, the first and second sets of parallel-aligned cords **302**, **304** are constructed of nylon. In alternative embodiments, one or both sets of parallel-aligned cords **302**, **304** may be constructed of polyester.

[0041] By providing the dual layer reinforcement in one or both sidewalls of a tire, sidewall performance of the tire is improved. For example, when the tire deflects, the dual layer reinforcement is shifted outward towards the sidewall of the tire, thereby increasing the stiffness of the sidewall of the tire. As stiffness of the sidewall of the tire increases, surface strain in the sidewall of the tire decreases. Reduction of surface strain at the sidewall of the tire can lead to a reduction of surface cracks at the sidewall of the tire, a reduction of deflection of the sidewall, and/or an improvement in vehicle handling.

[0042] Although **Figures 1** and **2** illustrate only half of a cross-section of the tire **100**, a second dual layer reinforcement, similar to the one described above and illustrated in **Figure 3**,

can be provided in the other sidewall (not shown) of the tire **100**. In this case, upper ends of the second dual layer reinforcement can terminate in the upper section **U** of the tire **100** and lower ends of the second dual layer reinforcement can terminate in the lower section **L** of the tire **100** as described in more detail above.

[0043] The following example demonstrates the potential effects of providing the dual layer reinforcement in both sidewalls of a tire and should not be construed as limiting the scope or spirit of the present application.

Example 1

[0044] A P255/45R/18 tire, having a maximum allowable inflation of 35 psi and maximum load capacity of 1709 lb (hereinafter referred to as the “Control Tire”), was inflated to 19 psi (its minimum allowable inflation) and mounted on a fixture. A computer system was used to simulate the Control Tire to obtain dimensional data of the Control Tire in its unloaded state.

[0045] A maximum load of 1709 psi was then applied to the Control Tire causing it to deflect. The computer system then obtained dimensional data of the Control Tire in its loaded state. The dimensional data of the Control Tire in its unloaded state was then compared to the dimensional data of the Control Tire in its loaded state to determine actual strain values along various points on the sidewall of the Control Tire.

[0046] This dimensional data was also used to create a computer simulated model of the Control Tire. Modifications could be made to the computer simulated model of the Control Tire to create virtual tires. From these virtual tires, surface strain values along any point on the sidewall of a tire could be predicted. In this case, the computer simulated model of the Control Tire was modified to create a virtual tire that included a dual layer reinforcement (nylon cords; 45° equal, but opposite bias) similar to the dual layer reinforcement described above and shown in **Figure 3** provided in each sidewall (hereinafter be referred to as the “Reinforced Tire”).

[0047] **Figure 4** illustrates the sidewall surface strain graph comparing the predicted surface strain values of the Control Tire with the predicted surface strain values of the Reinforced Tire. The x-axis represents the radial distance in inches from the axis of rotation of the tires, while the y-axis represents the surface strain at the center of the footprint of the tires. In this case, since

both tires have a diameter of 18 inches, surface strain measurements were taken at a radial distance beginning at 9 inches and ending at about 13.5 inches (which is the end of the sidewall of the tires). As shown in the graph in **Figure 4**, the predicted maximum sidewall surface strain of the Control Tire was 21.8%, while the predicted maximum sidewall surface strain of the Reinforced Tire was 12%. This represents a reduction in sidewall surface strain of about 9.8%.

[0048] To the extent that the term “includes” or “including” is used in the specification or the claims, it is intended to be inclusive in a manner similar to the term “comprising” as that term is interpreted when employed as a transitional word in a claim. Furthermore, to the extent that the term “or” is employed (e.g., A or B) it is intended to mean “A or B or both.” When the applicants intend to indicate “only A or B but not both” then the term “only A or B but not both” will be employed. Thus, use of the term “or” herein is the inclusive, and not the exclusive use. See, Bryan A. Garner, *A Dictionary of Modern Legal Usage* 624 (2d. Ed. 1995). Also, to the extent that the terms “in” or “into” are used in the specification or the claims, it is intended to additionally mean “on” or “onto.” Furthermore, to the extent the term “connect” is used in the specification or claims, it is intended to mean not only “directly connected to,” but also “indirectly connected to” such as connected through another component or multiple components.

[0049] While the present application illustrates various embodiments, and while these embodiments have been described in some detail, it is not the intention of the applicant to restrict or in any way limit the scope of the claimed invention to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention, in its broader aspects, is not limited to the specific details, the representative apparatus, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's claimed invention.

CLAIMS

1. A tire (100) having a section height (H_o), a maximum section width (W_m), an upper section (U) above the maximum section width (W_m), and a lower section (L) below the maximum section width (W_m), the tire (100) comprising:
 - a circumferential tread (102);
 - a pair of sidewalls (104);
 - a pair of bead portions (106);
 - at least one carcass ply (114) extending circumferentially about the tire (100) from one bead portion to the other; and
 - at least two reinforcement plies, the at least two reinforcement plies including first and second reinforcement plies (202, 204) extending circumferentially about the tire (100), the first and second reinforcement plies (202, 204) provided between the at least one carcass ply (114) and at least one of the sidewalls (104) of the tire (100), wherein lower ends (208, 212) of the first and second reinforcement plies (202, 204) terminate in the lower section (L) of the tire (100) and upper ends (206, 210) of the first and second reinforcement plies (202, 204) terminate in the upper section (U) of the tire (100).
2. The tire of claim 1, wherein the first reinforcement ply (202) includes a first set of parallel-aligned cords (302) and the second reinforcement ply (204) includes a second set of parallel-aligned cords (304).
3. The tire of claim 2, wherein the angular orientation of the first and second sets of parallel-aligned cords (302, 304) are between about 45 degrees and 85 degrees with respect to a circumferential direction (C) of the tire (100).
4. The tire of claim 3, wherein the first and second sets of parallel-aligned cords (302, 304) are transversely oriented with respect to each other.
5. The tire of claim 1, wherein each bead portion (106) includes a bead core (108) and a bead filler (110).

6. The tire of claim 5, wherein the at least one carcass ply (114) is wound outwardly about one of the bead cores (108) and extends toward the tread (102) to form a turn-up portion (120) that terminates at a turn-up end (124), wherein the lower ends (208, 212) of the first and second reinforcement plies (202, 204) extend below the turn-up end (124) of the at least one carcass ply (114).
7. The tire of claim 6, wherein the turn-up portion (120) has a height (H_1) that is between about 30% and about 70% of the section height (H_0) of the tire (100).
8. The tire of claim 6, wherein at least one of the lower ends (208, 212) of the first and second reinforcement plies (202, 204) extends below the turn-up end (124) of the at least one carcass ply (114) a radial distance between about 4 mm and about 15 mm.
9. The tire of claim 6, wherein the lower ends (208, 212) of the first and second reinforcement plies (202, 204) are provided between the at least one carcass ply (114) and the turn-up portion (120) of the at least one carcass ply (114).
10. The tire of claim 5, further comprising a bead filler insert (214) provided above the bead filler (110) and between the first and second reinforcement plies (202, 204) and the at least one carcass ply (114).
11. The tire of claim 10, wherein the lower ends (208, 212) of the first and second reinforcement plies (202, 204) extend below an upper end (216) of the bead filler insert (214).
12. The tire of claim 1, further comprising at least one belt (126) extending circumferentially about the tire (100), the at least one belt (126) provided between the tread (102) and the at least one carcass ply (114).
13. The tire of claim 12, further comprising a belt edge insert (136) provided between an edge (130) of the at least one belt (126) and the at least one carcass ply (114).

14. The tire of claim 13, wherein the upper ends (206, 210) of the first and second reinforcement plies (202, 204) extend inwardly beyond an outer end (140) of the belt edge insert (136).
15. The tire of claim 1, wherein at least one of the upper ends (206, 210) of the first and second reinforcement plies (202, 204) terminates in a shoulder region (134) of the tire (100).

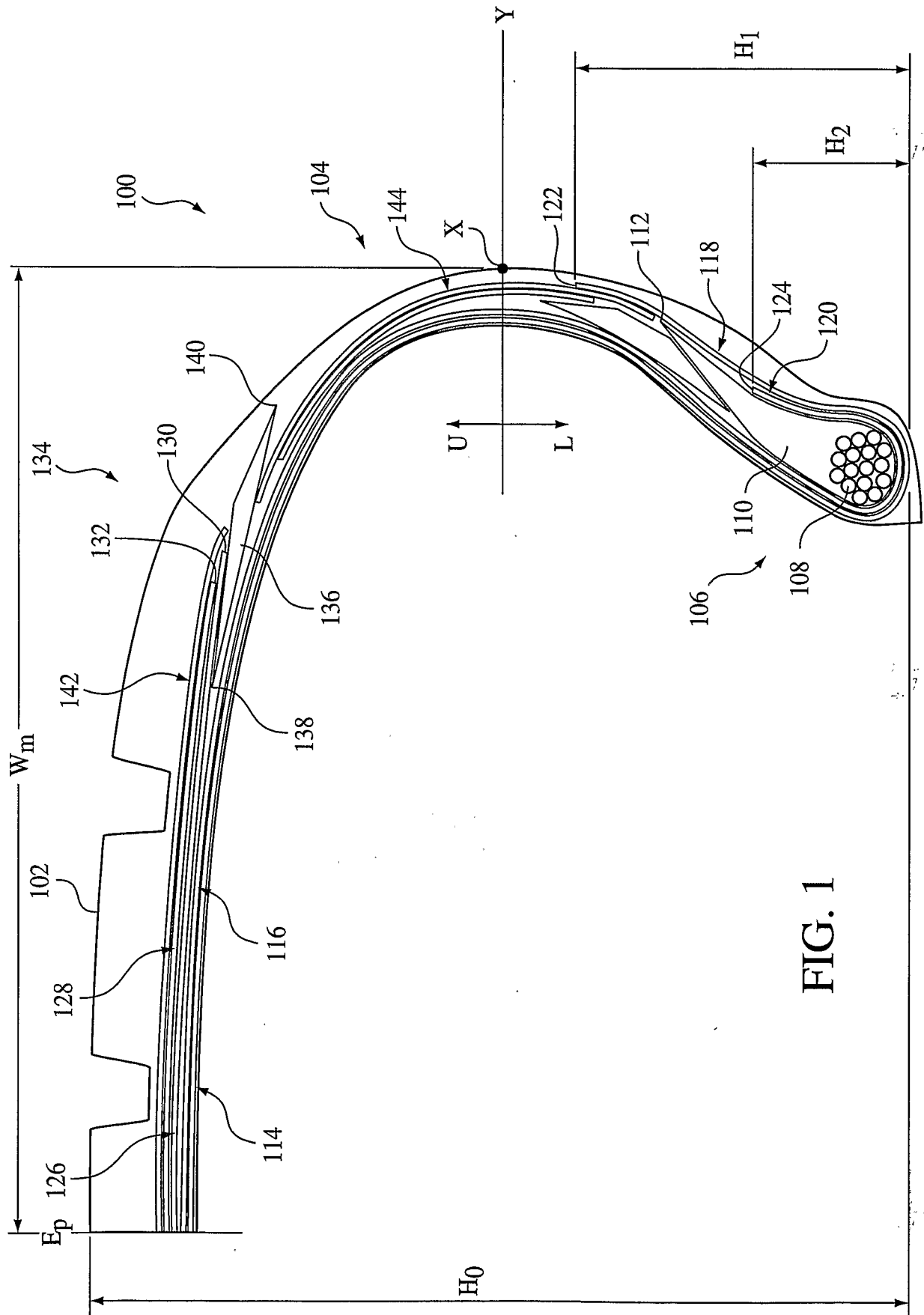


FIG. 1

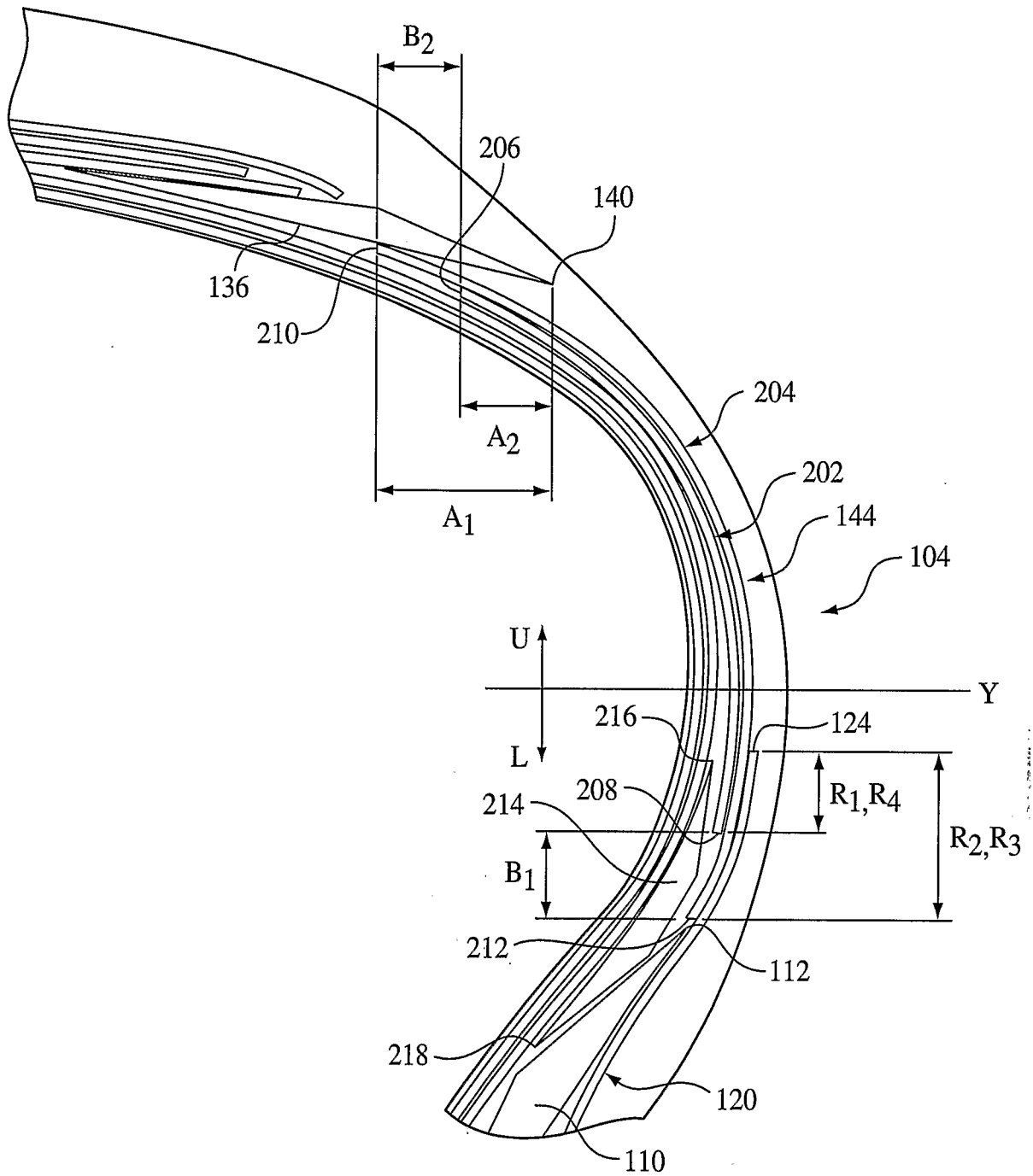


FIG. 2

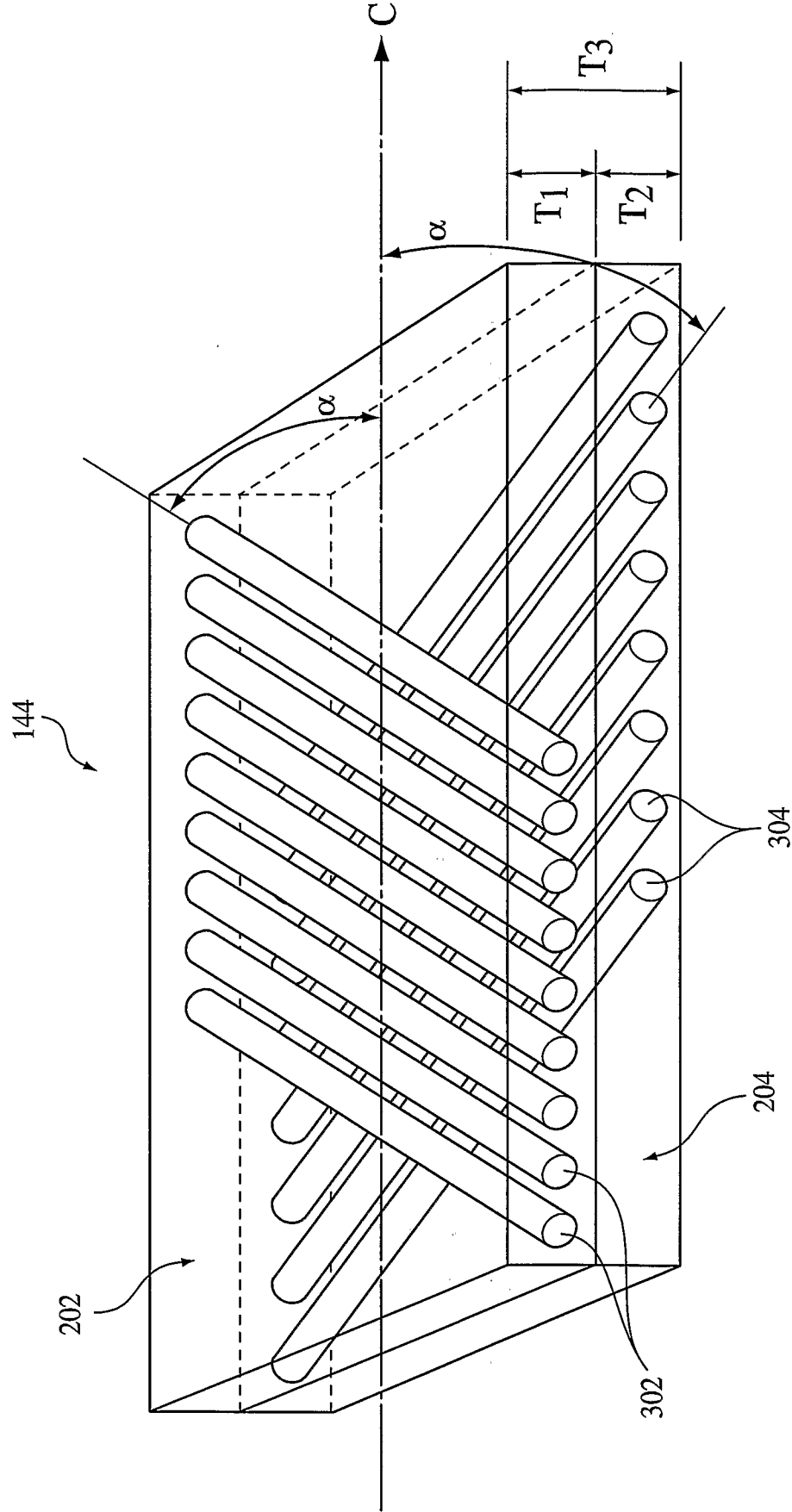


FIG. 3

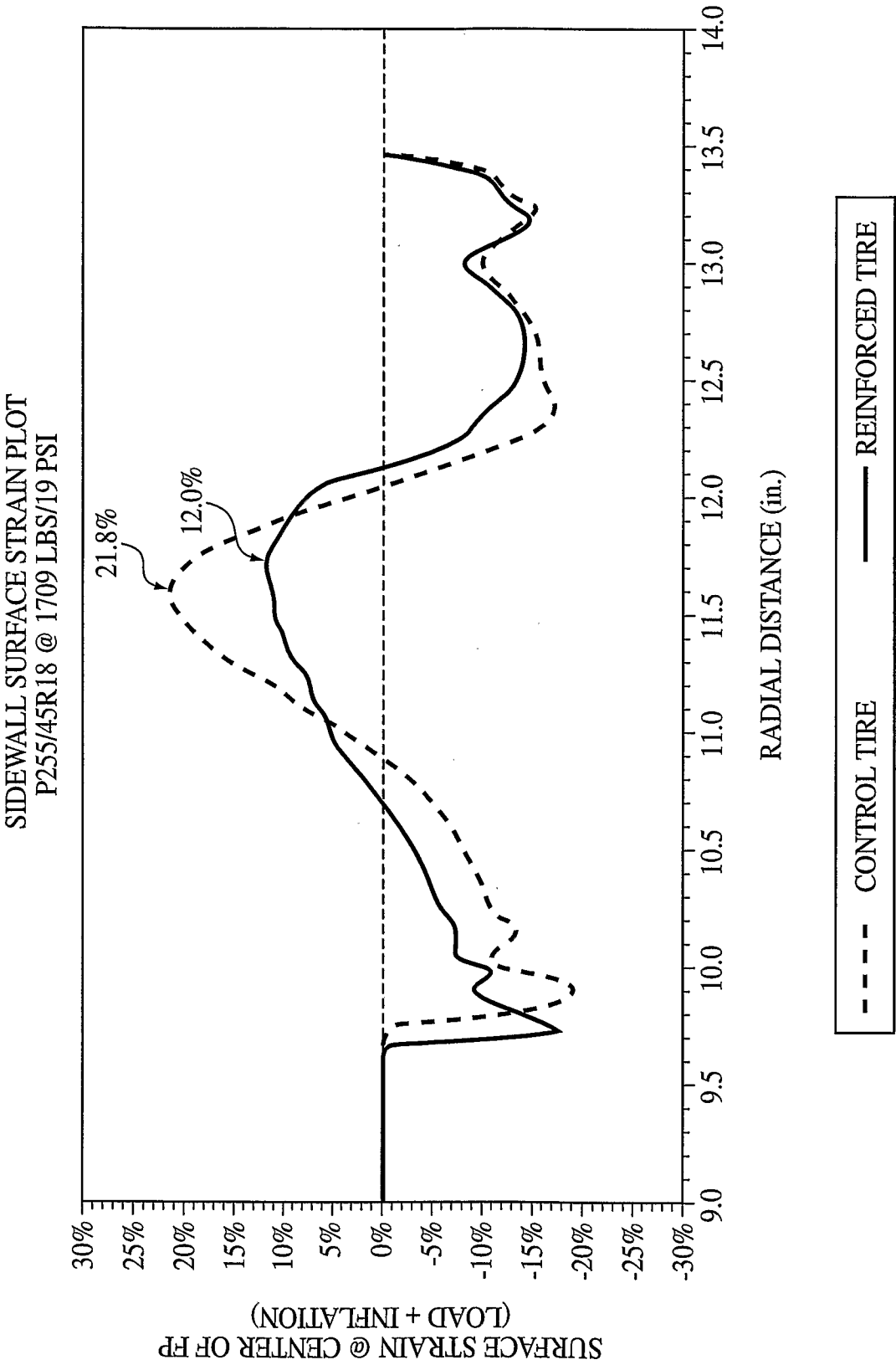


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2006/031783

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60C17/00 B60C9/09 B60C15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 231 409 A (MEZZANOTTE MARIO) 4 November 1980 (1980-11-04) column 4, line 31 - column 5, line 12; figures	1-6,8, 12,14,15
X	JP 59 145607 A (SUMITOMO RUBBER IND) 21 August 1984 (1984-08-21) the whole document	1-5,12, 13,15
E	EP 1 700 718 A (SUMITOMO RUBBER IND [JP]) 13 September 2006 (2006-09-13) paragraphs [0013], [0015], [0041] - [0044]; figures 4,5	1-7, 12-15
P,X	WO 2005/113260 A (GOODYEAR TIRE & RUBBER [US]; MARKOFF MICHAEL SPIRO [US]; POLING DAVID) 1 December 2005 (2005-12-01) paragraphs [0033], [0034]; figures 4A,4B	1,2,4,5, 12,15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

21 December 2006

Date of mailing of the international search report

04/01/2007

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/031783

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