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(71) Applicant(s)  
**The Goodyear Tire & Rubber Company**

(72) Inventor(s)  
**WILSON, John David;SCHESSLER, Gregory Alan;SPENCER, Todd James;HUBBELL, David Ray**

(74) Agent / Attorney  
**Spruson & Ferguson, GPO Box 3898, Sydney, NSW, 2001, AU**

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## HEAVY DUTY TYRE AND TREAD

### ABSTRACT

A heavy-duty tyre (10) characterized by a carcass, a tread (12) located radially outward of the carcass, the tread (12) having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges (13, 14), a first row of lugs (30) extending from the tread lateral edge (13) axially inwards toward the centerplane, a second row of lugs (40) extending from the opposite tread lateral edge (14) and axially inwards toward the centerplane and wherein the lugs of the first and second rows (30, 40) are separated by a plurality of shoulder grooves (22, 24), wherein the first row of lugs (30) are aligned with the second row of lugs (14), a center row of lugs (50) located between a first and second offset lug, wherein all of the lugs in each row (30, 40, 50) are aligned circumferentially.

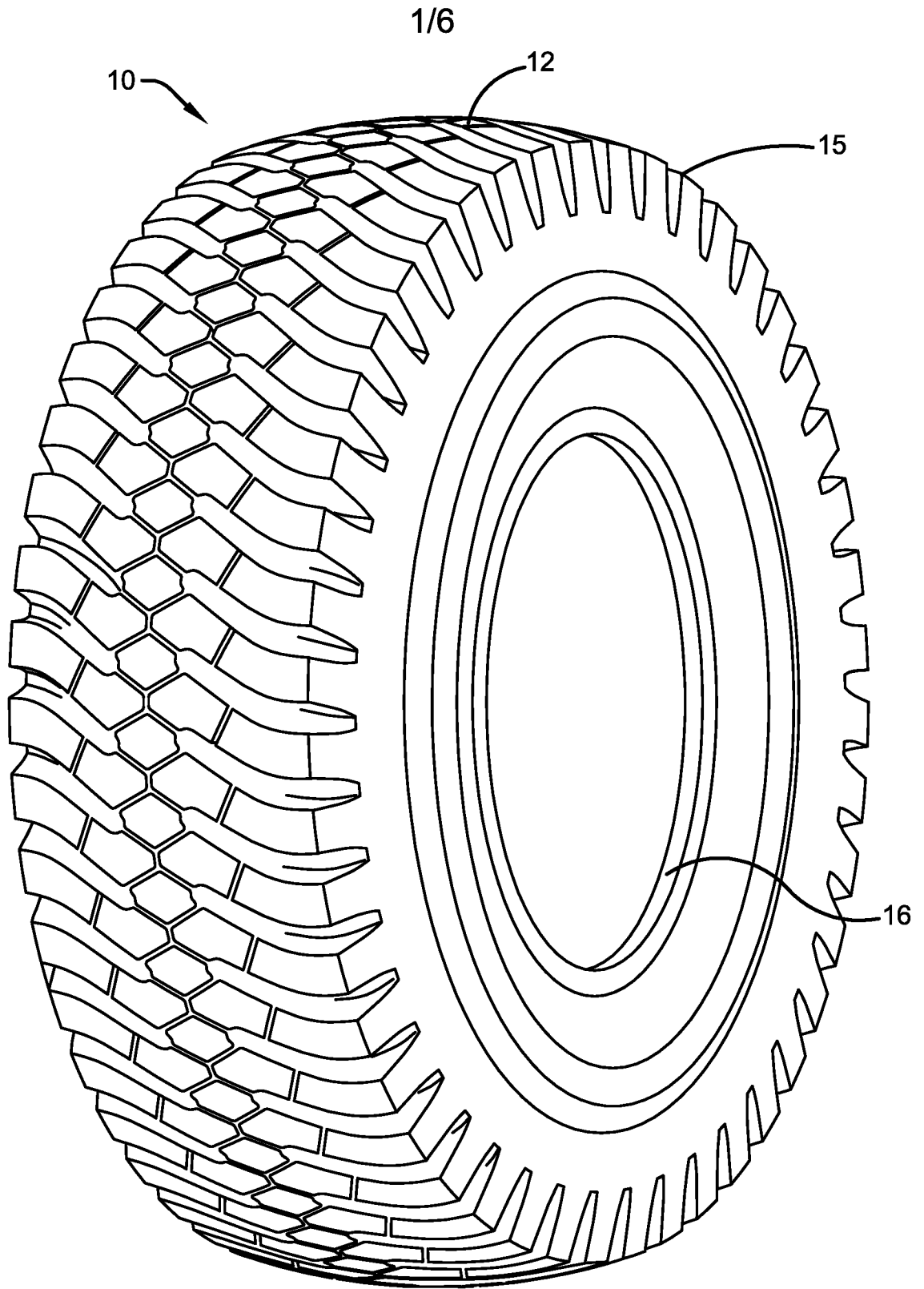


FIG. 1

## **HEAVY DUTY TYRE AND TREAD**

### **FIELD OF THE INVENTION**

[0001] The present invention relates to pneumatic tires, and more particularly to very large, wide base tires for use for example, on construction vehicles such as earth movers, and rigid haul dump trucks.

### **BACKGROUND OF THE INVENTION**

[0002] In very large tires having a diameter of 80 inches or more, tire operating conditions can be severe because of the extreme tire loading and off-road conditions. Furthermore, the speed of the vehicles may be high, which can result in excessive heat build-up in the tire. When a very large off the road tire is used in the oil sands environment, the tires are subjected to extreme dynamic and static loads. During vehicle operation, the tire may bounce through the thick, viscous sand conditions. The tire conditions result in the tire bouncing and deflecting, which can result in the tire failing earlier than its predicted life due to heat, high strain and bead failure. Thus it is desired to have an improved tire which is a cooler running tire.

### **OBJECTS OF THE INVENTION**

[0003] It is an object of the invention to provide a tire which overcomes or at least ameliorates one or more of the deficiencies of the prior art or provides a useful alternative.

### **SUMMARY OF THE INVENTION**

[0004] According to a first aspect of the invention, there is provided a heavy-duty tire comprising a carcass and a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread area and being located between a first and a second lateral tread edge, a first row of circumferentially aligned lugs, the lugs extending from the first tread lateral edge axially inwards toward the center plane, a second row of circumferentially aligned lugs, the lugs extending from the opposite second lateral tread edge and axially inwards toward the center plane, wherein the lugs of the first and the second row are separated by a plurality of shoulder grooves, wherein the lugs of the first row of lugs are axially aligned with the lugs of the second row of lugs, wherein a center row of lugs is located

between a first and second row of center offset lugs, the first row of center offset lugs being offset from the second row of center offset lugs, and wherein all of the lugs in each row are aligned circumferentially, and wherein the center lugs are joined to each other by a center groove, the center groove extending at an angle of 0 degrees with respect to the circumferential direction, and wherein the axially outer ends of the center lugs are defined by grooves which are arranged to form a diamond like shape of the center lugs.

[0005] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially.

[0006] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the center lugs are joined to each other by a center groove.

[0007] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are

separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the center lugs are joined to each other by a center groove, and wherein at least one of the center grooves has a tie bar.

[0008] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, further comprising a carcass, a tread located radially outward of the carcass, the carcass further comprising sidewalls which terminate in bead area, wherein said tire has a molded base width in the range of 44-50 mm.

[0009] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the shoulder drop ranges from 64mm to 120 mm.

[0010] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are

separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the gauge of the shoulder wedge ranges from 70-89 mm, and more preferably in the range of 75-85 mm.

[0011] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the width of the fourth belt ranges from 744 to 780mm, and more preferably 760 to 770 mm.

[0012] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the fourth belt width is 55 to 65% of the tread arc width.

[0013] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the

second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the gauge of the turn up pad is preferably in the range of 35-46 mm, and more preferably in the range of 38-43 mm.

[0014] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the tread has a multi radius tread.

[0015] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the tread has a multi radius tread, wherein R1 may range from 2200-2500 mm, R2 is less than R1, R2 may range from 1600-2100 mm, and R3 may range from 1000-1500mm.

[0016] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the

second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the gauge of the turn up pad is preferably in the range of 35-46 mm.

[0017] One or more embodiments of the present invention provides a heavy-duty tire comprising a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially, wherein the gauge of the turn up pad is in the range of 38-43 mm.

## DEFINITIONS

[0018] “Aspect Ratio” means the ratio of a tire’s section height to its section width.

[0019] “Axial” and “axially” means the lines or directions that are parallel to the axis of rotation of the tire.

[0020] “Bead” or “Bead Core” means generally that part of the tire comprising an annular tensile member, the radially inner beads are associated with holding the tire to the rim being wrapped by ply cords and shaped, with or without other reinforcement elements such as flippers, chippers, apexes or fillers, toe guards and chafers.

[0021] “Belt Structure” or “Reinforcing Belts” means at least two annular layers or plies of parallel cords, woven or unwoven, underlying the tread, unanchored to the bead, and having both left and right cord angles in the range from 7° to 36° with respect to the equatorial plane of the tire.

[0022] “Bias Ply Tire” means that the reinforcing cords in the carcass ply extend diagonally across the tire from bead-to-bead at about 25-65° angle with respect to the equatorial plane of the tire, the ply cords running at opposite angles in alternate layers

[0023] “Breakers” or “Tire Breakers” means the same as belt or belt structure or reinforcement belts.

[0024] “Carcass” means a laminate of tire ply material and other tire components cut to length suitable for splicing, or already spliced, into a cylindrical or toroidal shape. Additional components may be added to the carcass prior to its being vulcanized to create the molded tire.

[0025] “Circumferential” means lines or directions extending along the perimeter of the surface of the annular tread perpendicular to the axial direction; it can also refer to the direction of the sets of adjacent circular curves whose radii define the axial curvature of the tread as viewed in cross section.

[0026] “Cord” means one of the reinforcement strands, including fibers, which are used to reinforce the plies.

[0027] “Inner Liner” means the layer or layers of elastomer or other material that form the inside surface of a tubeless tire and that contain the inflating fluid within the tire.

[0028] “Inserts” means the reinforcement typically used to reinforce the sidewalls of run flat-type tires; it also refers to the elastomeric insert that underlies the tread.

[0029] “net to gross ratio” means the ratio of the area of the tread in the footprint that contacts the road to the total area of the tread in the footprint.

[0030] “Ply” means a cord-reinforced layer of elastomer-coated, radially deployed or otherwise parallel cords.

[0031] “Radial” and “radially” mean directions radially toward or away from the axis of rotation of the tire.

[0032] “Radial Ply Structure” means the one or more carcass plies or which at least one ply has reinforcing cords oriented at an angle of between  $65^\circ$  and  $90^\circ$  with respect to the equatorial plane of the tire.

[0033] “Radial Ply Tire” means a belted or circumferentially-restricted pneumatic tire in which the ply cords which extend from bead to bead are laid at cord angles between 65° and 90° with respect to the equatorial plane of the tire.

[0034] “Sidewall” means a portion of a tire between the tread and the bead.

[0035] “Laminate structure” means an unvulcanized structure made of one or more layers of tire or elastomer components such as the innerliner, sidewalls, and optional ply layer.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0036] The invention will be described by way of example and with reference to the accompanying drawings in which:

[0037] FIG. 1 is a perspective view of a tire of the present invention;

[0038] FIG. 2A is a front view of the tread of a control tire and FIG. 2B is a front view of the tread of a tire of the present invention;

[0039] FIG. 3 is a close-up front view of the tire tread of the present invention;

[0040] FIG. 4 is a close-up side view of the tire of the present invention;

[0041] FIG. 5 is a schematic of a tire molded profile of the present invention as compared to a control tire.

[0042] FIG. 6 illustrates the footprint of a control tire and the footprint of a tire of the present invention.

### **DETAILED DESCRIPTION OF THE INVENTION**

[0043] Figure 1 illustrates a first embodiment of a tire 10 of the present invention. The tire may have a nominal rim diameter of 35 inches or more. The tire may have a nominal rim diameter of 35 inches or more. The tire 10 has an outer ground engaging tread portion 12 which has axially outer lateral edges 13, 14. Sidewalls 15 extend radially inward from the tread lateral edges 13,14 and terminate in a pair of bead regions 16 having an annular bead core (not shown). The tire 10

is further provided with a carcass which has a reinforcing ply structure (not shown) which extends from bead region to bead region. The tire may further include breakers and other tire components known to those skilled in the art.

[0044] The tire tread 12 preferably has a non-directional tread pattern. The tire tread 12 comprises two rows of shoulder grooves 22,24 wherein each row of shoulder grooves extend from a respective lateral tread edge 13,14 towards the centerplane of the tread. The shoulder grooves 22,24 do not cross the centerline of the tread and are angled at an angle  $\theta_1, \theta_2$ . The shoulder grooves in the first row 22 each have a first axially inner end 22a which are aligned with an axially inner end 24a of a shoulder groove 24, so that if groove 22 extended across the entire lateral width of the tire, it would substantially overlap with the opposite groove 24. The shoulder grooves in the first row 22 are similarly shaped as the shoulder grooves in the second row, and have an angular orientation that is rotated about 180 degrees out of phase from the other row. The shoulder grooves are deep, and have a depth of 70-100% of the non-skid tread depth, or NSK, and more preferably 90-100% of the NSK. The shoulder grooves 22,24 are angled at an angle  $\theta_1, \theta_2$  in the range of about 20-65 degrees, more preferably in the range of about 30 to 55 degrees, and more preferably 30-45 degrees. The high angled grooves provide forward and lateral traction. The width of the shoulder grooves are about 25-40% of the tread width W, and more preferably 30-38% of the tread width W.

[0045] The tread is further divided into four rows of lugs. A first row of lugs is comprised of circumferentially aligned lugs 30 which extend from the lateral tread edge 13 to a cross groove 35. Each lug in row 30 is further bounded by two shoulder grooves 22, and have the same angular orientation as the shoulder grooves 22. Each lug has a width of about 2/3 the width of the shoulder grooves 22. The tread has cross grooves 35 which are circumferentially aligned and extend in a circumferential direction completely across the lugs 30 joining the shoulder grooves 22. The cross grooves 35 is a deep groove whose depth varies from about 90% to about 100% NSK, more preferably about 95% NSK. The cross groove 35 has a width of about 10% to about 20% of the width of the shoulder grooves 22. The cross grooves 35 form a small angle of about 10-15 degrees with the circumferential direction.

[0046] The tread further comprises a second circumferentially aligned row of lugs 40. The second row is comprised of lugs 40 which extend from the opposite lateral tread edge 14 and axially inward to a second row of cross grooves 45. Each lug 40 is further bounded by two

shoulder grooves 24, and have the same angular orientation as the shoulder grooves. Each lug has a width of about  $\frac{2}{3}$  the width of the shoulder grooves 24. The cross grooves 45 are circumferentially aligned and extends in a circumferential direction completely across the lug 40 joining the adjacent shoulder grooves 24. The cross groove 45 depth varies from about 90% to about 100% NSK, more preferably about 90% NSK. The second groove has a width of about 10% to about 20% of the width of the shoulder grooves.

[0047] The tread further comprises a third circumferentially spaced row of center lugs 50. The center lugs 50 may or may not be the same size. The axially outer ends of lugs are defined by grooves 52, 54,56,58 which are arranged to form a diamond like shape of lug 50. A circumferential groove 61 joins each center lug 50. Grooves 52,54,56,58 are deep grooves, and preferably have a depth of 70-100% NSK. The circumferential groove 61 may further comprise tie bars 62 to help stiffen the center tread region. The tie bars have a height about 50% of the NSK. Each circumferential groove 61 is preferably oriented on the centerline of the tread.

[0048] The tire tread further comprises center offset lugs 60 and 70. Center offset lug 60 is located between shoulder lug 30 and center lug 50. Offset lug 70 is located adjacent center offset lug 60, and is separated from lug 60 by center circumferential groove 61. Offset lug 70 is located between shoulder lug 40 and center lug 50. Center circumferential grooves 61 are shallow, and have a depth of 10-20% NSK.

[0049] The overall net to gross ratio of the tire ranges from about 60 to about 80, more preferably about 65 to 75, and most preferably in the range of about 68 to 72.

[0050] As shown in Figure 5, the tire 10 of the present invention has a wider molded base width, so that the bead areas 20 are spaced farther apart as compared to a control tire. Preferably, the molded base width is in the range of 40 to 50 inches, more preferably in the range of 44-49 inches. The reduction of molded base width results in a reduced section width. Preferably, the molded base width is wider than the rim width. The reduced molded base width results in a more stable tire, and reduced section width that has lower rolling resistance. The reduced molded base width also results in a crown of the tire that has increased load bearing resulting in a more rounded footprint, as shown in Figure 6.

[0051] As shown in Figure 6 and in Figure 2b, the shoulder drop has been increased as compared to the control tire, which is shown in Figure 2a. Preferably, the shoulder drop D ranges

from 64mm to 120 mm, and more preferably in the range of 85-115, and more preferably 93-97. As shown in Figure 2b as compared to the control tire in Figure 2a, the tread profile has more rounded edges. As shown in figure 5, the tread has a multi radius tread, R1 in the center, R3 at the shoulder, and R2 therebetween. In this example, R1 is 2325 mm, R2 is 1800 mm, and R3 is 1400 mm. R1 may range from 2200-2500 mm, R2 is less than R1, R2 may range from 1600-2100 mm, and R3 may range from 1000-1500 mm.

[0052] The tread and carcass design has an improved overall performance resulting in an improved footprint and improved distribution of the heat load.

[0053] Variations in the present invention are possible in light of the description of it provided herein. While certain representative embodiments and details have been shown for the purpose of illustrating the subject invention, it will be apparent to those skilled in this art that various changes and modifications can be made therein without departing from the scope of the subject invention. It is, therefore, to be understood that changes can be made in the particular embodiments described which will be within the full intended scope of the invention as defined by the following appended claims.

[0054] The following clauses describe some variations of the present invention in connection with the foregoing detailed description.

[0055] Clause 1: A heavy-duty tire characterized by a carcass, a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread and being located between first and second lateral tread edges, a first row of lugs extending from the tread lateral edge axially inwards toward the centerplane, a second row of lugs extending from the opposite tread lateral edge and axially inwards toward the centerplane and wherein the lugs of the first and second rows are separated by a plurality of shoulder grooves, wherein the first row of lugs are aligned with the second row of lugs, a center row of lugs located between a first and second offset lug, wherein all of the lugs in each row are aligned circumferentially.

[0056] Clause 2: The heavy-duty tire of clause 1 characterized in that the center lugs are joined to each other by a center groove.

[0057] Clause 3: The heavy-duty tire of clause 2 characterized in that at least one of the center grooves has a tie bar.

[0058] Clause 4: The heavy-duty tire of clause 1 characterized by further comprising a carcass, a tread located radially outward of the carcass, the carcass further comprising sidewalls which terminate in bead area, wherein said tire has a molded base width in the range of 44-50 mm.

[0059] Clause 5: The heavy-duty tire of clause 1 characterized in that the shoulder drop ranges from 64mm to 120 mm.

[0060] Clause 6: The heavy-duty tire of clause 1 characterized in that the gauge of the shoulder wedge ranges from 70-89 mm, and more preferably in the range of 75-85 mm.

[0061] Clause 7: The heavy-duty tire of clause 1 characterized in that the width of the fourth belt ranges from 744 to 780mm, and more preferably 760 to 770 mm.

[0062] Clause 8: The heavy-duty tire of clause 1 characterized in that the fourth belt width is 55 to 65% of the tread arc width.

[0063] Clause 9: The heavy-duty tire of clause 1 characterized in that the gauge of the turn up pad is preferably in the range of 35-46 mm, and more preferably in the range of 38-43 mm.

[0064] Clause 10: The heavy-duty tire of clause 1 characterized in that the tread has a multi radius tread.

[0065] Clause 11: The heavy-duty tire of clause 1 characterized in that the tread has a multi radius tread, wherein R1 may range from 2200-2500 mm, R2 is less than R1, R2 may range from 1600-2100 mm, and R3 may range from 1000-1500mm.

[0066] Clause 12: The heavy-duty tire of clause 1 characterized in that the gauge of the turn up pad is preferably in the range of 35-46 mm.

[0067] Clause 13: The heavy-duty tire of clause 1 characterized in that the gauge of the turn up pad is in the range of 38 -43 mm.

[0068] The term "comprising" (and its grammatical variations) as used herein is used in the inclusive sense of "including" or "having" and not in the exclusive sense of "consisting only of".

**CLAIMS**

1. A heavy-duty tire comprising a carcass and a tread located radially outward of the carcass, the tread having a plurality of lugs, the lugs extending radially outward from an inner tread area and being located between a first and a second lateral tread edge, a first row of circumferentially aligned lugs, the lugs extending from the first tread lateral edge axially inwards toward the center plane, a second row of circumferentially aligned lugs, the lugs extending from the opposite second lateral tread edge and axially inwards toward the center plane, wherein the lugs of the first and the second row are separated by a plurality of shoulder grooves, wherein the lugs of the first row of lugs are axially aligned with the lugs of the second row of lugs, wherein a center row of lugs is located between a first and a second row of center offset lugs, the first row of center offset lugs being offset from the second row of center offset lugs, and wherein all of the lugs in each row are aligned circumferentially, and wherein the center lugs are joined to each other by a center groove, the center groove extending at an angle of 0 degrees with respect to the circumferential direction, and wherein the axially outer ends of the center lugs are defined by grooves which are arranged to form a diamond like shape of the center lugs.
2. The heavy-duty tire of claim 1 wherein at least one of the center grooves has a tie bar.
3. The heavy-duty tire according to any one of the previous claims wherein the tire has a shoulder drop in a range of from 64 mm to 120 mm.
4. The heavy-duty tire according to any one of the previous claims wherein the tire has a shoulder drop in a range of from 80 mm to 100 mm.
5. The heavy-duty tire according to any one of the previous claims wherein the tire has a shoulder drop in a range of around 90 mm.
6. The heavy-duty tire according to any one of the previous claims wherein the tire comprises four belts and wherein the width of the fourth belt ranges from 744 mm to 780 mm, or
7. The heavy-duty tire according to any one of the previous claims wherein the tire comprises four belts and wherein the width of the fourth belt ranges from 760 mm to 770 mm.

8. The heavy-duty tire according to any one of the previous claims 1 to 5 wherein the tire comprises four belts and wherein the width of the fourth belt is in a range of from 55% to 65% of the tread arc width.
9. The heavy-duty tire of claim 8 wherein the tread arc width is in a range of from 1200 mm to 1340 mm
10. The heavy-duty tire of claim 8 wherein the tread arc width is in a range of from 1250 mm to 1290 mm.
11. The heavy-duty tire of claim 8 wherein the tread arc width is around 1270 mm.
12. The heavy-duty tire according to any one of the previous claims wherein the tread is a multi radius tread having at least three different radii, wherein a first radius (R1) ranges from 2200 to 2500 mm.
13. The heavy-duty tire according to claim 12 wherein a second radius (R2) is less than the first radius (R1).
14. The heavy-duty tire according to claim 12 wherein the second radius (R2) is in a range of from 1600 to 2100 mm.
15. The heavy-duty tire according to any one of claims 12 to 14 wherein a third radius (R3) is in a range of from 1000 to 1500 mm.

**The Goodyear Tire & Rubber Company**  
**Patent Attorneys for the Applicant/Nominated Person**  
**SPRUSON & FERGUSON**

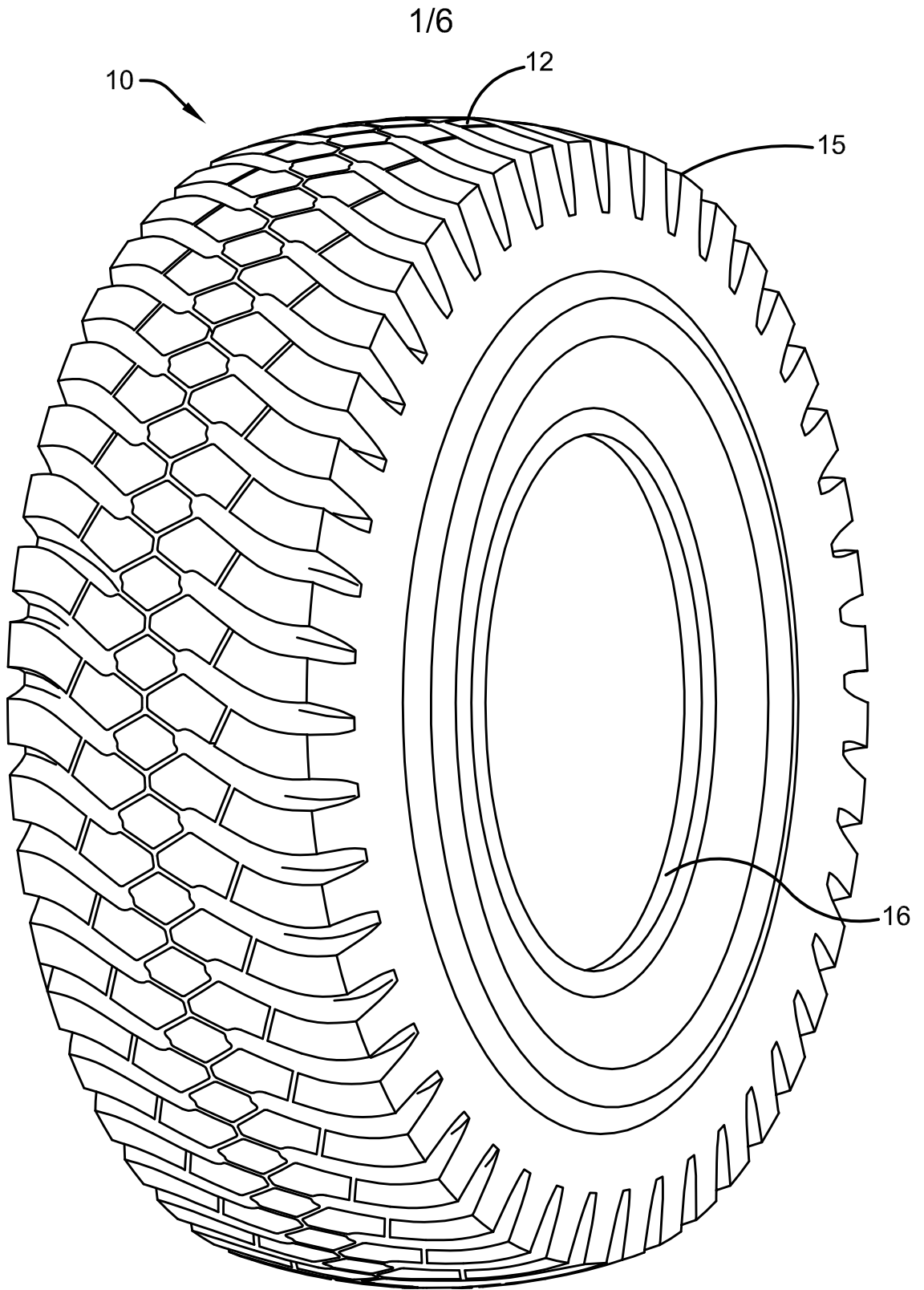


FIG. 1



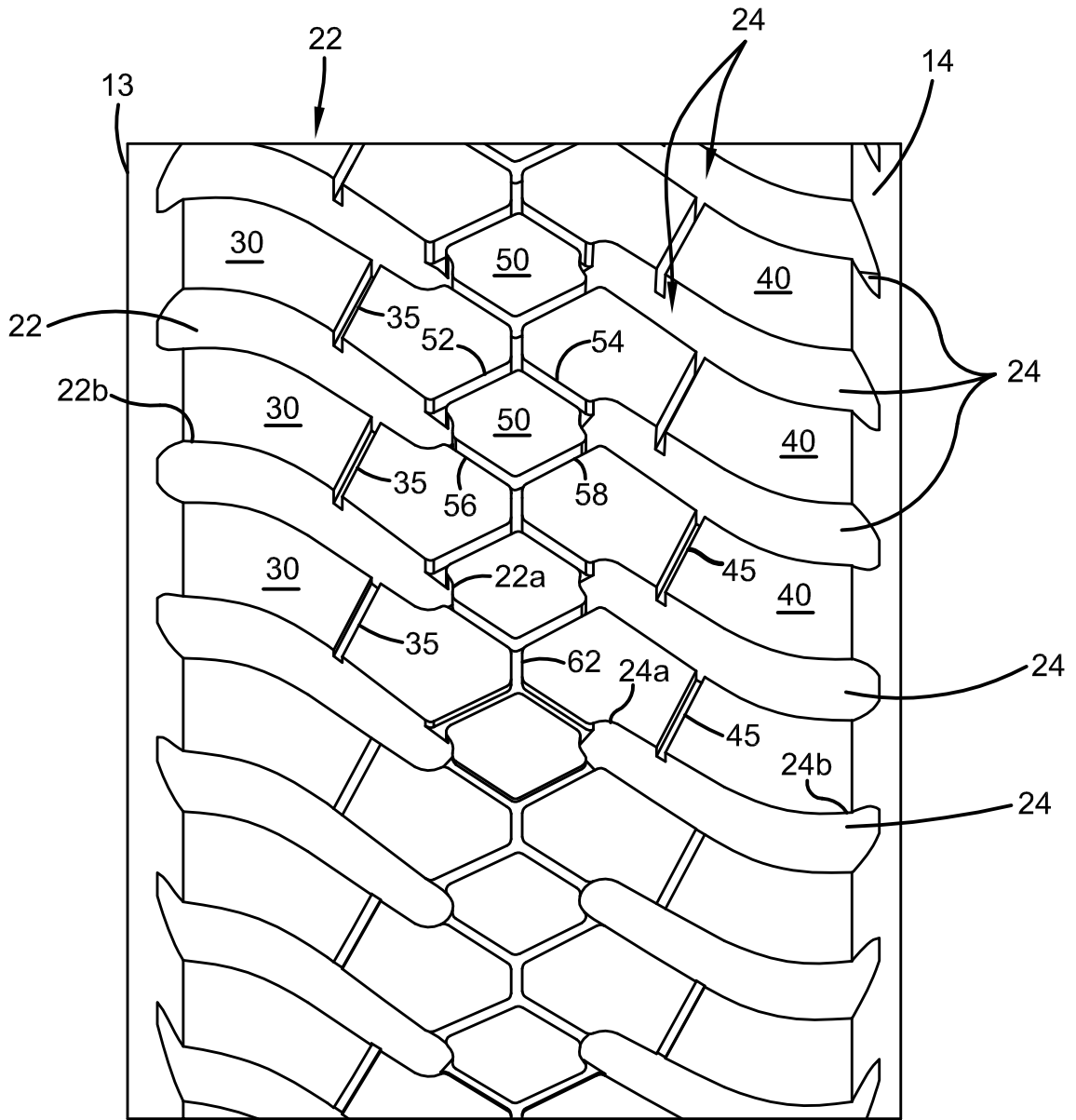


FIG. 3

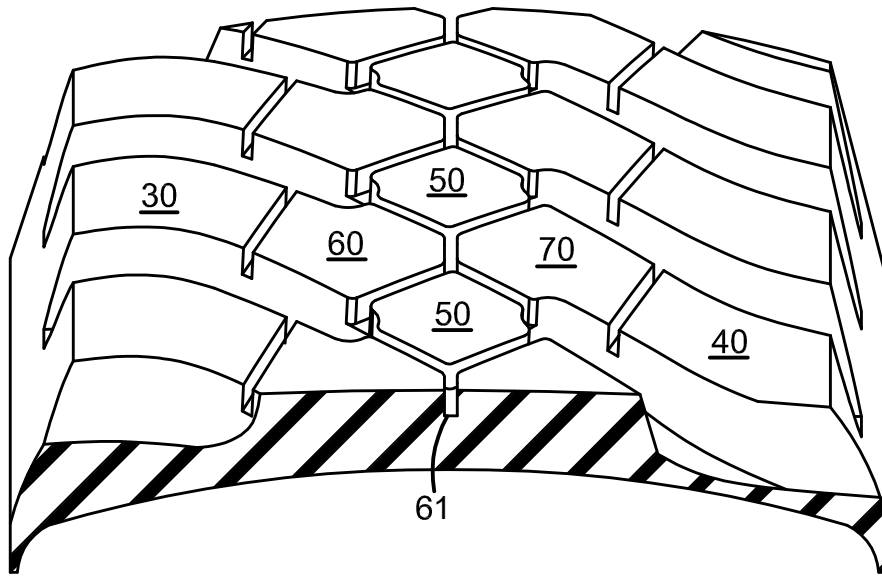


FIG. 4

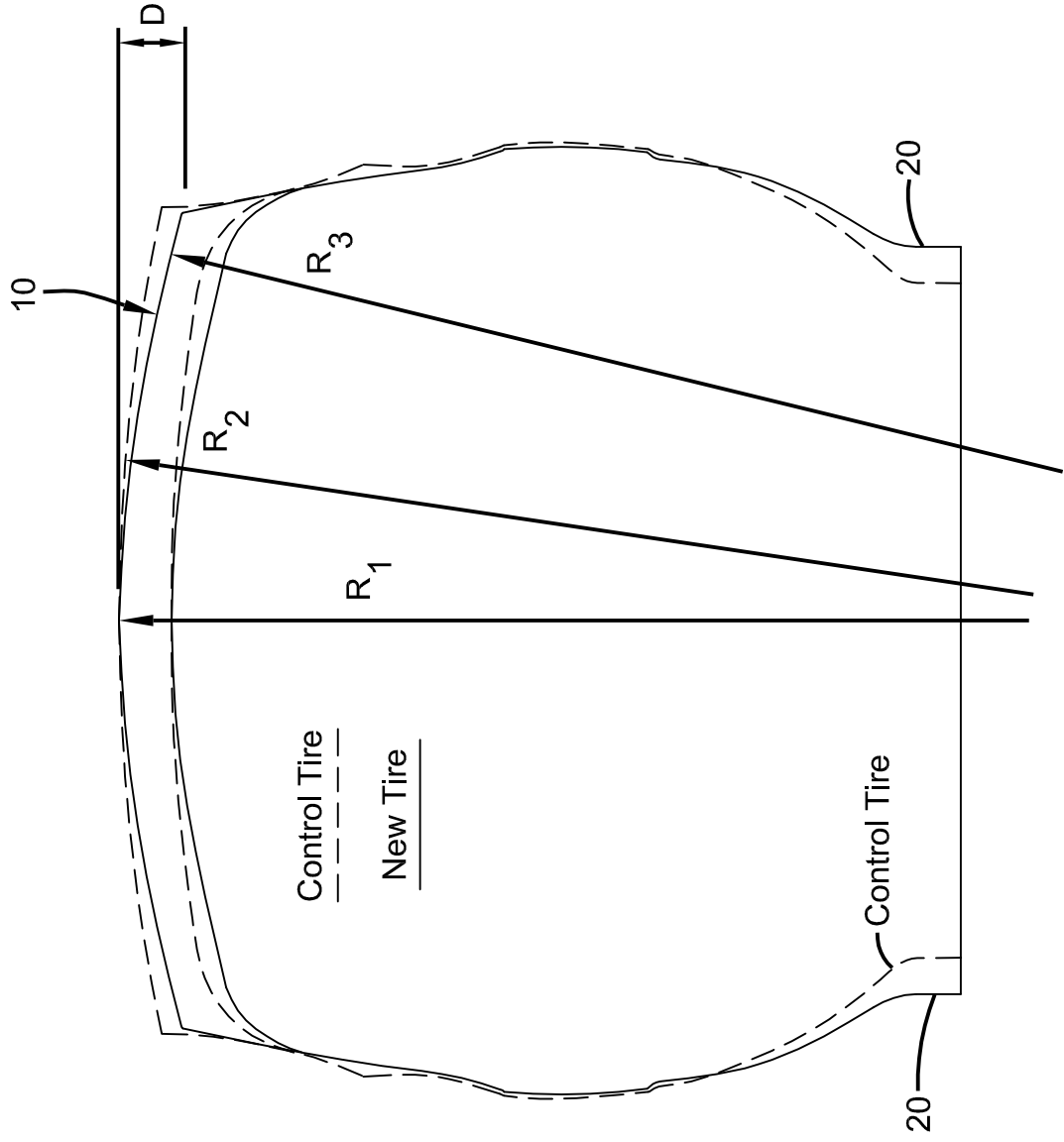


FIG. 5

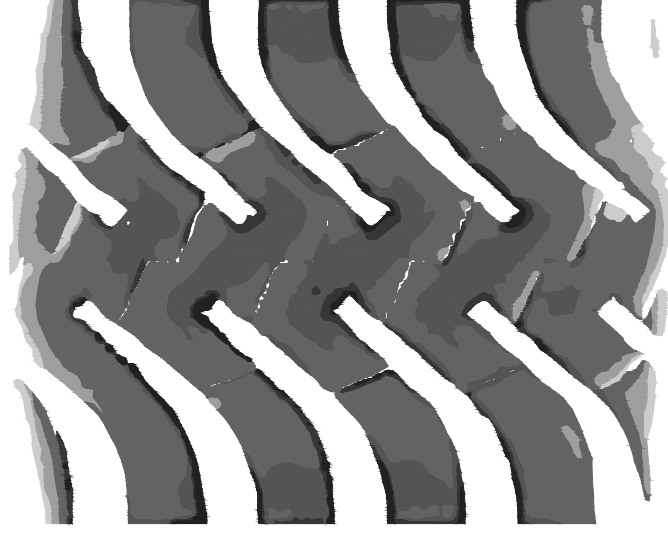


FIG. 6B

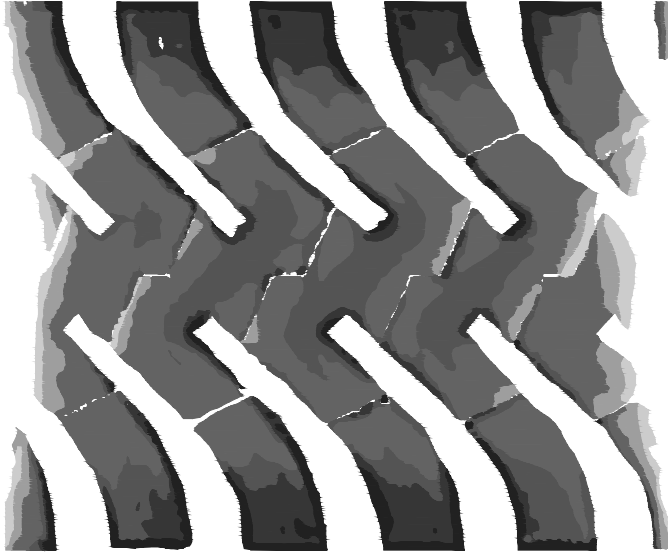


FIG. 6A