(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 December 2014 (18.12.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/201368 A4

(51) International Patent Classification:
B60C 7/00 (2006.01)

(21) International Application Number:
PCT/US2014/042327

(22) International Filing Date:
13 June 2014 (13.06.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/835,549 15 June 2013 (15.06.2013) US

(72) Inventor; and
(71) Applicant : **THOMPSON, Ronald** [US/US]; 300 Gilderbrook Road, Greenville, South Carolina 29615 (US).

(74) Agent: **ALCE, Padowithz**; Oliff PLC, 277 S. Washington Street, Suite 500, Alexandria, Virginia 22314 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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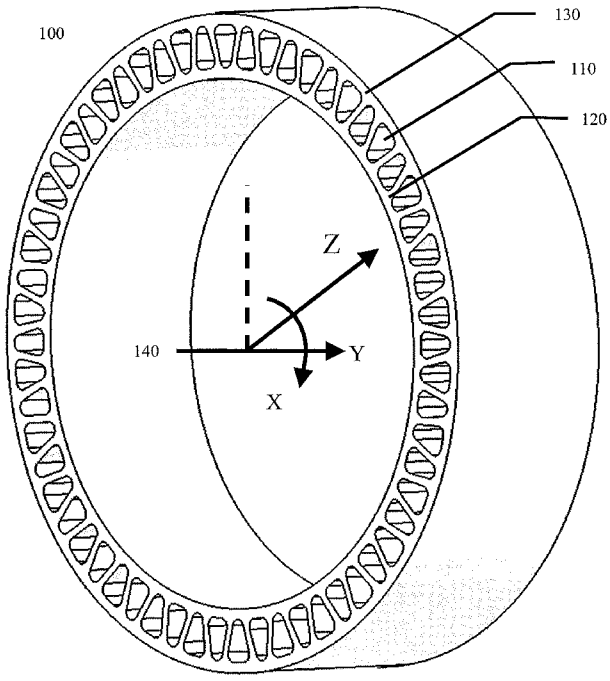
(54) Title: ANNULAR RING AND NON-PNEUMATIC TIRE

Fig. 1



(57) Abstract: The present invention provides an annular beam of monolithic construction of one homogeneous material and a related efficient, low-cost non-pneumatic tire. Specific geometric design, combined with nonlinear elastomer physical properties, enable the suppression of all reinforcing belts, continuous fibers, or other strengthening layers in the annular beam. The annular beam consists of at least two bands that are continuous in the circumferential direction and connected by a web geometry. The non-pneumatic tire consists of the annular beam, a ground contacting portion, a central wheel, and a plurality of web spokes that connect the wheel and beam. When the tire is loaded to a design load against a flat surface over a design contact length, a contact area of essentially uniform pressure is produced, while the load is transmitted from the beam to the hub via tension in the web spokes. The tire can be economically manufactured.

WO 2014/201368 A4

WO 2014/201368 A4

Published:

— *with international search report (Art. 21(3))*

— *with amended claims (Art. 19(1))*

Date of publication of the amended claims: 19 February 2015

AMENDED CLAIMS
received by the International Bureau on 05 January 2015 (05.01.2015)

1. An annular beam of monolithic construction, comprising:

one homogeneous material having a Young's modulus of at least 90 MPa;

at least a first circumferentially continuous band lying on a radially inward extent of a web structure extending axially across the first circumferentially continuous band;

at least a second circumferentially continuous band lying on a radially outward extent of the web structure; and

wherein a ratio of a transverse beam deflection due to shear to a transverse beam deflection due to bending of the annular beam at a center of a design contact length is at least 1.2:1, when an outermost radial extent of the annular beam is loaded against a substantially flat surface over the design contact length.

2. The beam of claim 1, wherein no portion of the web structure is circumferentially continuous.

3. The beam of claim 1, wherein the one homogeneous material has a Young's modulus of at least 160 MPa.

4. The beam of claim 1, wherein the ratio of the transverse beam deflection due to shear to the transverse beam deflection due to bending of the annular beam at the center of the design contact length is at least 3:1, when the outermost radial extent of the annular beam is loaded against the substantially flat surface over the design contact length.

5. The beam of claim 1, wherein the one homogeneous material is an elastomer having a Young's modulus which is at least four times the value of a secant modulus at 100% elongation.

6. A non-pneumatic tire comprising:

an annular beam of monolithic construction, comprising: one homogeneous material having a Young's modulus of at least 90 MPa; at least a first circumferentially continuous band lying on a radially inward extent of a web structure extending axially across the first circumferentially continuous band; at least a second circumferentially continuous band lying on a radially outward extent of the web structure;

and wherein a ratio of a transverse beam deflection due to shear to a transverse beam deflection due to bending of the annular beam at a center of a design contact length is at least 1.2:1, when an outermost radial extent of the annular beam is loaded against a substantially flat surface over the design contact length;

a central hub; and

a plurality of web spokes extending axially across and radially inward from the annular beam, and connecting the annular beam to the central hub, said web spokes transferring a design load from the annular beam to the hub by tensile forces and negligibly by compressive forces.

7. The tire of claim 6, wherein the web structure of the annular beam has no portion which is circumferentially continuous.

8. The tire of claim 6, wherein each web spoke is a thin, sheet-like element following a generally radial path, with a slight curvature in the equatorial plane to facilitate bending when under compression in the radial direction.

9. The tire of claim 6, wherein each web spoke is oriented parallel to the axial direction.

10. The tire of claim 6, wherein the annular beam, the central hub, and the plurality of web spokes are composed of the one homogeneous material.

11. The tire of claim 6, wherein the one homogeneous material of the annular beam has a Young's modulus of at least 160 MPa.

12. The tire of claim 6, wherein the ratio of the transverse beam deflection due to shear to the transverse beam deflection due to bending of the annular beam at the center of the design contact length is at least 3:1, when the outermost radial extent of the annular beam is loaded against the substantially flat surface over the design contact length.

13. The tire of claim 6, wherein the one homogeneous material of the annular beam is an elastomer having a Young's modulus which is at least four times a value of a secant modulus at 100% elongation.

14. The tire of claim 6, further comprising a ground contacting tread portion affixed to an outward radial extent of the annular beam.

15. The tire of claim 14 wherein the ground contacting tread portion extends partially or completely around axial extents of the annular beam.

16. The tire of claim 14, wherein the annular beam, the central hub, the plurality of web spokes, and ground contacting tread portion are composed of the one homogeneous material.

17. A method of manufacturing a non-pneumatic tire, the method comprising:

forming an annular beam of monolithic construction, wherein the annular beam comprises:

an annular beam of monolithic construction, comprising: one homogeneous material having a Young's modulus of at least 90 MPa; at least a first circumferentially continuous band lying on a radially inward extent of a web structure that extends axially across the first circumferentially continuous band; at least a second circumferentially continuous band lying on a radially outward extent of the web structure; and wherein a ratio of a transverse beam deflection due to shear to a transverse beam deflection due to bending of the annular beam at a center of a design contact length is at least 1.2:1, when an outermost radial extent of the annular beam is loaded against a substantially flat surface over the design contact length;

forming a central hub; and

forming a plurality of web spokes extending axially across and radially inward from the annular beam, and connecting the annular beam to the central hub, said web spokes transferring a design load from the annular beam to the hub by tensile forces and negligibly by compressive forces.

18. The method of claim 17, wherein forming the non-pneumatic tire is completed by any one of high-pressure thermoplastic injection, reaction injection, cast molding, and spin-cast molding.

19. The method of claim 17 further including forming a ground contacting tread portion affixed to the outward radial extent of the annular beam.