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(54) Title: TYRE BODY ANCHORING

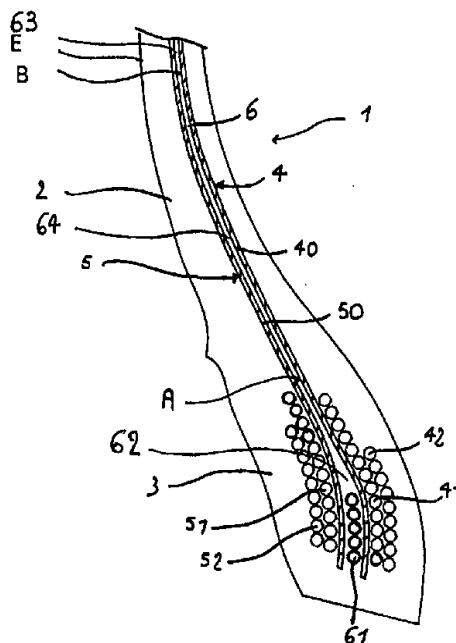
(54) Titre: ANCRAGE DE LA CARCASSE D'UN PNEUMATIQUE

(57) Abstract

The invention concerns a tyre comprising a top, two sidewalls and two beads, a body reinforcement anchored in the two beads including to-and-fro wires adjacently arranged, circumferentially aligned and having, at each bead, loops linking each wire turn, and in each bead, means anchoring said body reinforcement comprising circumferentially oriented wires axially bordering said circumferential alignments of said body reinforcement to-and-fro wires. The invention is characterised in that said body reinforcement consist of wires forming two or three circumferential alignments separated, at least at the beads and sidewalls, by a filler material.

(57) Abrégé

Pneumatique comportant un sommet, deux flancs et deux bourrelets, une armature de carcasse ancrée dans deux bourrelets comprenant des fils formant des allers et retours disposés de façon adjacente, alignés circonférentiellement avec, au niveau de chaque bourrelet, des boucles reliant chaque fois un aller à un retour, et dans chaque bourrelet des moyens d'ancrage de ladite armature de carcasse comprenant des fils orientés circonférentiellement bordant axialement lesdits alignements circonférentiels desdits allers et retours des fils de l'armature de carcasse, caractérisé en ce que ladite armature de carcasse est constituée de fils formant deux ou trois alignements circonférentiels séparés, au moins au niveau des bourrelets et des flancs, par une matière de remplissage.



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TIRE CARCASS ANCHORING

The present invention concerns tires and more particularly the arrangement of the carcass reinforcement wires and the anchoring thereof in the beads.

Patent Applications EP 0,582,196 A1 and EP 0,664,232 A1 have recently proposed a novel type of tire carcass reinforcement and its anchoring in its two beads. A tire, according to said applications, comprises a crown, two sidewalls and two beads, a carcass reinforcement anchored in the two beads comprising wires worked back and forth next to each other aligned circumferentially with, in each bead, back-and-forth connecting loops, and in each bead, means of anchoring the carcass reinforcement comprising piles of wires oriented circumferentially and axially bordering said circumferential rows of the back-and-forth arrangement of the carcass reinforcement wires. For these tires, absorption of the stress developed on the carcass wires upon inflation is solely ensured by lateral adhesion between each wire of the carcass and the piles of circumferential wires bordering them.

Said applications also propose, when the carcass reinforcement needs to be so strong that it is no longer geometrically possible to arrange the wires in the beads in a single circumferential row, that a single circumferential back-and-forth row be conserved in each sidewall and that this row be split into two rows progressively diverging axially from one another from one sidewall towards the base of a bead.



The advantage of this solution is that it maintains a great deal of flexibility in the sidewalls while at the same time enabling the use of a higher density of wires, therefore making it possible to increase the number of carcass wires above which a separate additional carcass is needed due to lack of space in the bead to house all the wires.

Applicant has, however, observed that it is very tricky to produce such a tire with a circumferential row of wires as carcass reinforcement in the crown and in the sidewalls which splits into two at the beads. Actually, industrialization constraints are such that it is difficult to prevent a certain number of the wires from coming into contact with one another, and this can lead to problems of endurance.

The object of the present invention is to overcome this problem.

In the following, the term "wire" is understood to mean both monofilaments and multifilaments, or assemblies such as cords, twisted wires, or even any type of equivalent assemblage irrespective of the material and treatment of said wires, for example, surface treating or coating or a pre-coating to promote adhesion to the rubber.

The term "elastic modulus" for a rubber compound is understood to be a secant extension modulus obtained at a deformation in uni-axial extension of the order of 10% at room temperature.

In a first aspect the invention provides a tyre including a crown, two sidewalls and two beads, carcass reinforcing first wires worked back and forth next to each other, circumferentially aligned in at least a row and anchored in the two beads with, in each bead, loops each connecting a back and a forth first wire portion, and, in each bead, means for anchoring the said first wires including second wires oriented circumferentially and axially bordering said circumferential row of the back-and-forth arrangement of the first wires, said anchoring means absorbing the stress developed in the first wires upon inflation of the tyre solely by lateral adhesion between each first wire and said anchoring means, characterized in that at least at the beads and sidewalls, the first wires form two circumferential rows separated by a filler material.



In a second aspect, the invention provides a tyre including a crown, two sidewalls and two beads, carcass reinforcing first wires worked back and forth next to each other, aligned circumferentially in at least a row and anchored in the two beads with, in each bead, loops each connecting a back and a forth first wire 5 portion and, in each bead, means for anchoring the said first wires including second wires oriented circumferentially and axially bordering said circumferential row of the said first wires, said anchoring means absorbing the stress developed in the first wires upon inflation of the tyre solely by lateral adhesion between each first wire and said anchoring means, characterized in that at least at the beads 10 and sidewalls, the first wires form three circumferential rows separated by a filler material.

In accordance with one preferred embodiment, the filler is supplemented, in each bead, by third wires oriented circumferentially.

The carcass reinforcement according to the invention has the advantage of 15 allowing a larger average space between the wires which makes it possible, even if this average space fluctuates, to better ensure that the wires are actually separated by a rubber coating compound or of filler material. Alternatively, thanks to the possibility of using more wires without them touching, for a given carcass reinforcement strength, it is possible to use wires of a smaller cross section than 20 would have been used in the solutions shown previously which leads to this reinforcement being anchored more firmly in the bead, especially upon heavy stresses.

Preferably, the filler material comprises a first rubber compound with a very high elastic modulus arranged in the region where the carcass reinforcement is 25 anchored and a second rubber compound with low elastic modulus arranged in the crown region and in at least part of the sidewalls adjacent to the crown.



The first rubber compound with very high elastic modulus has an elastic modulus greater than 20 MPa and preferably greater than 30 MPa, and the second rubber compound with low elastic modulus has an elastic modulus less than 6 MPa and preferably between 2 and 5 MPa.

We shall now describe the invention with the aid of the following drawings:

- Figure 1 is a radial section essentially showing a sidewall and a bead of a tire according to the invention;
- Figure 2 is a perspective view schematically showing the arrangement of a portion of the reinforcing wires.

Figure 1 is a radial section essentially showing a sidewall 2 and a bead 3 of a tire 1 according to the invention. The carcass reinforcement consists of two circumferential rows 4, 5 of first wires corresponding, in this figure, to the two portions of wires 40 and 50. In the case of the tire according to the invention described herein, the two portions of the wires 40 and 50 are oriented radially in the sidewall 2 and consist of aramid fibers. The portions of first wires 40 and 50 are arranged parallel to each other and separated by a filler material 6. The two circumferential rows 4 and 5 of first wires are anchored in the bead 3 by piles 41, 42, 51, 52 of second circumferential wires arranged axially on either side of the portions of first wires 40 and 50. Preferably, in the region of the bead 3, the filler material 6 is supplemented by at least one pile 61 of third circumferential reinforcing wires. The piles of second and third circumferential reinforcing wires may advantageously be wire windings. The circumferential and radial wires are separated from one another by some rubber compound in order to avoid any direct contact of one wire with another. The lateral adhesion between each portion of wires



40 and 50 and the piles of circumferential wires makes it possible to absorb the stress developed in those portions of wires 40, 50 upon inflation of the tire.

The filler material 6 in the example shown is composed of three rubber compounds of varying rigidity. A first compound 62 is in the region where the carcass reinforcement is anchored between the two circumferential rows of first wires up to the limit A. This first compound has a very high elastic modulus greater than 30 MPa. A second rubber compound 63 is arranged in the crown region and in part of the sidewalls 2 adjacent to the crown, that is, in the shoulder and in all of the part radially above a limit B located roughly at the equator E. The "line" E corresponding to the greatest axial width of the tire is called the "equator." This second compound has a low elastic modulus of the order of 2 to 5 MPa. Finally, a third compound 64 is arranged in an intermediate region between the previous two limits A and B. This third compound has an intermediate elastic modulus of between 6 and 20 MPa.

The presence of the first rubber compound of high elastic modulus in the anchoring region contributes to the good mechanical strength of the bead. Furthermore, the second rubber compound with low rigidity in the crown region and in the portion of the sidewalls adjacent to the crown, above the equator, a region of intense bending, makes it possible for the bending rigidity of the sidewalls not to be increased too markedly on account of the presence of two or three circumferential rows of first wires.

Figure 2 is a perspective view of one of the circumferential rows of first wires, the row 5, in which only the reinforcing wires are depicted. In this figure, the



circumferential row 5 of first wires can be seen which consists of portions of wires 50. At their radially lower ends, the portions of wire 50 form juxtaposed loops 55 located in the bead 3. Said loops 55 are adjacent and do not overlap. Axially on either side of the circumferential row 5 of first wires, just the piles 61 and 51, axially directly adjacent to said row 5, are shown.

To clarify the drawing, only the circumferential row 5 of first wires and two piles are depicted, but the circumferential row 4 of first wires has the same arrangement of portions of wires 40.

In the example shown, the two circumferential rows are separated over their entire length by the filler material 6. It is also possible to restrict the splitting of the carcass reinforcement into two or three circumferential rows to just the beads and the sidewalls and to have only one or two rows in the crown of the tire. Actually, in this region, the mechanical stresses to which the carcass reinforcements are subjected are appreciably lower than in the region of the sidewalls.

The tire according to the invention may advantageously be manufactured on a rigid core that dictates the shape of its interior cavity. In the order required by the final architecture, all the constituent parts of the tire are laid over said core, said parts being arranged directly in their final position without undergoing shaping at any time. This manufacture can, notably, use the devices described in patent EP 0,243,851 for placing wires of



the carcass reinforcement and in EP 0,264,600 for placing rubber compounds. The tire can then be molded and vulcanized as explained in US Patent 4,895,692.

The tire according to the invention has two attractive advantages.

First of all, the risk of one wire in the portions of wires 40 and 50 of the circumferential rows 4 and 5 of first wires coming into contact with another is considerably reduced. This in particular makes it possible to slacken the running tolerances for industrial production, which is the yardstick for reliability and lower cost. This also makes the endurance of the tire more reliable.

Moreover, for a given breaking strength of carcass reinforcement, that is, for a given total cross section of portions of first wires 40 and 50, the presence of two circumferential rows 4 and 5 of parallel wires makes it possible, compared with the solution recommended in patent application EP 582,196 where there is only one circumferential row of wires in the crown and the sidewalls which is split into two in the beads, to use a higher number of wires. Consequently, the diameter of the wires used is smaller and the total contact surface between these wires and the adjacent rubber compounds is higher, which has the advantage of improving the mechanical strength of the bead, especially when highly stressed.

Applicant has also observed that the presence in the sidewalls 2 of a carcass reinforcement composed of two or three parallel circumferential rows did not detrimentally increase the flexural rigidity of the sidewalls. This result is especially connected with the presence between the circumferential rows of a rubber compound of low rigidity. In contrast, if the number of rows of wires is increased to more than three, the flexural rigidity could become excessive.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Tyre including a crown, two sidewalls and two beads, carcass reinforcing first wires worked back and forth next to each other, circumferentially aligned in at least a row and anchored in the two beads with, in each bead, loops each connecting a back and a forth first wire portion, and, in each bead, means for anchoring the said first wires including second wires oriented circumferentially and axially bordering said circumferential row of the back-and-forth arrangement of the first wires, said anchoring means absorbing the stress developed in the first wires upon inflation of the tyre solely by lateral adhesion between each first wire and said anchoring means, characterized in that at least at the beads and sidewalls, the first wires form two circumferential rows separated by a filler material.

2. Tyre including a crown, two sidewalls and two beads, carcass reinforcing first wires worked back and forth next to each other, aligned circumferentially in at least a row and anchored in the two beads with, in each bead, loops each connecting a back and a forth first wire portion and, in each bead, means for anchoring the said first wires including second wires oriented circumferentially and axially bordering said circumferential row of the said first wires, said anchoring means absorbing the stress developed in the first wires upon inflation of the tyre solely by lateral adhesion between each first wire and said anchoring means, characterized in that at least at the beads and sidewalls, the first wires form three circumferential rows separated by a filler material.

3. Tyre according to Claim 1 or 2, wherein said filler material is supplemented in each bead by third wires oriented circumferentially.



4. Tyre according to any one of Claims 1 to 3, wherein the filler material includes a first rubber compound of very high elastic modulus arranged in the region of said anchoring means of the first wires and a second rubber compound of low elastic modulus arranged in the crown and in at least part of the sidewalls adjacent to the crown.

5. Tyre according to Claim 4, wherein said first rubber compound of very high elastic modulus has an elastic modulus greater than 20 Mpa and wherein the second rubber compound of low elastic modulus has an elastic modulus below 6 Mpa.

6. Tyre according to Claim 5, wherein said first rubber compound of very high elastic modulus has an elastic modulus greater than 20 Mpa.

7. Tyre according to Claim 4 or 5, wherein said second rubber compound of low elastic modulus has an elastic modulus between 2 and 5 Mpa.

8. Tyre according to any one of Claims 4 to 7, wherein the filler material further includes a third rubber compound of intermediate elastic modulus in part of each sidewall between the region of the anchoring means, where the first rubber compound is arranged, and the part of the sidewall adjacent to the crown where the second rubber compound is arranged.

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