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(54) IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF TYRE CARCASSES

(71) We, DUNLOP LIMITED, a British Company of Dunlop House, Ryder Street, St. James's, London S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to the manufacture of tyre carcasses, and in particular to tyre carcasses having a structure which includes a single ply of cord fabric, the cords being orientated at substantially 90° to the mid-circumferential plane of the carcass after manufacture.

In the building of a tyre from cord fabric it is conventional to build up the tyre carcass in a substantially cylindrical configuration from sheets of cord fabric and subsequently to shape up this cylindrical pocket into toroidal form. Clearly, in converting the cylindrical pocket to toroidal form, that portion adjacent the beads of the tyre remains at substantially the same diameter whilst the portion at the mid-circumferential plane is considerably increased in diameter. In the shaping of a carcass having two or more crossed plies of cords this diameter change results in trellising between the cords' plies which changes the bias angle of the cords.

In the case of a carcass composed of a single ply of cord fabric whose cords are orientated at substantially 90° to the mid-circumferential plane, this diameter change has to be accommodated by increasing spacing of the cords within their rubber matrix, and in order to have uniform properties the tyre requires uniform cord spacing at all points around its circumference.

A problem therefore arises in the manufacture of tyres having a single ply carcass of this kind in that the conventional building technique introduces a point of discontinuity, namely the joint where the ends of the ply of cord fabric meet, and here excessive warp spacing can occur in tyre manufacture because of lack of warp anchoring across the joint if the joint is a butt joint. Anchoring of the warp cords by forming a lap joint has proved unacceptable because of non-uniformity of mechanical properties across the joint. Accordingly the invention proposes a warp-anchored butt-joined tyre carcass with minimal non-uniformity.

According to the present invention, a method for the manufacture of a tyre carcass composed of a single ply of cord fabric wherein the cords are orientated at substantially 90° to the mid-circumferential plane of the tyre carcass after manufacture, includes the steps of firstly assembling into a cylinder a ply of rubberised cord fabric including a warp of reinforcing cords and a weft of threads having a low tensile strength and a low elastic modulus relative to the warp cords, the warp cords being aligned substantially parallel to the axis of the cylinder, such that in said cylinder the ends of said ply abut without overlapping, secondly laying over the joint between the ends of said ply a cover strip of a sheet material comprising threads having low tensile strength and low elastic modulus relative to the warp cords and having tensile strength, elasticity, and elongation properties similar to said weft threads and embedded in rubber compound, the strip being arranged such that its threads are orientated substantially at 90° to the ply joint, and thirdly shaping said cylinder into toroidal form.

According also to the present invention there is provided a method of manufacturing a tyre carcass comprising the steps of firstly forming from a material having cords embedded in an uncured rubber, a cylinder having a joint axially along the surface of the cylinder, said cords being aligned to extend substantially axially along the surface of said cylinder, and secondly placing over and along said joint a cover strip formed from material having threads embedded in an uncured rubber, said threads being aligned to extend substantially along the circumference of said cylinder.

The invention further provides a tyre carcass composed of a single ply of reinforcing cord fabric wherein the reinforcing cords are orientated at substantially 90° to the mid-circumferential plane of the tyre carcass after manufacture, said cord fabric being rubberised and including a warp of the reinforcing cords and a weft of threads having a low tensile strength and a low elastic modulus relative to the warp cords, the ply of said fabric being assembled to have the ends of the ply abut

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- without overlapping, and laid over the joint a cover strip of a sheet material comprising threads having low tensile strength and low elastic modulus relative to the warp cords and
- 5 having tensile strength, elasticity, and elongation properties similar to said weft threads and embedded in rubber compound, the strip being aligned such that its threads are orientated substantially at 90° to the ply joint.
- 10 It has been found that presence of a cover strip of this type permits the cords of the ply adjacent to the joint to increase their spacing during the shaping operation in the same manner as the cords of the remainder of the
- 15 ply, i.e., the threads in the cover strip provide a comparable measure of warp anchoring across the joint as the ply weft remote from the joint.
- The invention is of particular use when the reinforcing cords (warp) of the carcass ply consist of relatively stiff, high elastic modulus
- 20 cords relative to said threads, such as steel cords, glass cords or aromatic polyamide cords.
- Preferably the weft threads in the ply cord fabric and the threads in the cover strip are of
- 25 the same material and have substantially the same cross-sectional dimensions. The physical properties of these threads are preferably in the following ranges:
- | | |
|-----------------------|-------------------------|
| 30 Tensile strength | 9 to 35 grams per tex |
| Modulus of elasticity | 10 to 300 grams per tex |
| Elongation at break | 30 to 250% |
| Linear density | 10 to 50 tex |
- 35 The preferred thread material is a polymeric thermoplastic fibre such as polyamide or polyester.
- It is also preferred that the rubber compound of the cover strip in which the threads
- 40 are embedded, e.g. by calendering, is the same as the topping compound on the cord fabric of the carcass ply.
- Preferably, the cover strip is dimensioned so as not to extend over the full length of the
- 45 joint such as to leave the remote ends of the joint free across the joint, whereby to facilitate the folding of the ply around bead wires in a subsequent stage of tyre manufacture.
- An embodiment of the invention will now
- 50 be particularly described, by way of example only, with reference to the accompanying drawings in which:
- Figure 1 is a perspective view of a partially formed tyre carcass;
- 55 Figure 2 is an enlarged view of the portion of Figure 1 indicated by the arrow II;
- Figure 3 is an enlarged view of the portion of Figure 1 indicated by the arrow III;
- Figure 4 is a side view of a completed but
- 60 uncured tyre carcass.
- Referring now to Figure 1, a tyre carcass 10 is formed from a strip of rubberised material 12. As can best be seen in Figure 2 the material 12 comprises a plurality of equally spaced warp
- 65 cords 14 interwoven with a plurality of equally spaced weft threads 16. The cords 14 and threads 16 are embedded in a layer of uncured rubber 18 by any suitable process, for example calendering.
- The material 12 is formed into a cylinder 70 around a former, which for convenience is not shown, and the ends of the material 12 are butted together to form a joint 20 which is a discontinuity in the cylinder. The warp cords 14 are arranged to extend substantially parallel 75 with the axis of the cylinder.
- A cover strip 22 is formed from a material having threads 24 embedded in a layer of uncured rubber 26 and is placed over the joint 20 such that the threads 24 extend around the circumference of the cylinder. 80
- The threads 24 are similar to and preferably identical to the weft threads 16 and the rubber 26 is similar to the rubber compound 18.
- The cover strip 22 is dimensioned so as to 85 leave the margins of the cylinder free as shown in Figure 1. This enables the bead portions of the tyre to be fitted later in the conventional manner.
- The tyre carcass is shaped to the toroidal 90 form shown in Figure 4 by moving the edges of the cylinder toward one another and forcing the intermediate material axially outward, the warp cords 14 thereby being orientated at substantially 90° to the mid-circumferential plane 95 of the tyre carcass after manufacture. The cover strip 22 reinforces the joint 20 during the shaping operation to anchor the warp cords 14 across the joint 20 similar to the effect of the weft threads 16 remote from the joint 20, so 100 that the spacing of the warp cords 14 is more uniform in the shaped carcass than would be the case if the cover strip 22 were not employed.
- The separation of the warp cords 14 during 105 shaping of the carcass follows the relationship:—
- $$S = \frac{R - R_0}{R_0}$$
- 110 where S is the ratio of final warp spacing to initial warp spacing,
- R₀ is the initial radius of the carcass, and
- R is the radius at any point in the shaped tyre. 115
- By maintaining the cord spacing more uniform around any given circumference of the tyre, a more consistent tyre is produced which obviates common defects such as imbalance. Since the cover strip 22 need only have a 120 minimal thickness there is little effect on the overall tyre thickness in the region of the joint 20, and mechanical properties are substantially uniform around the tyre.
- WHAT WE CLAIM IS:— 125
1. A method for the manufacture of a tyre carcass composed of a single ply of cord fabric wherein the cords are orientated at substantially 90° to the mid-circumferential plane of the tyre carcass after manufacture, including 130

- the steps of firstly assembling into a cylinder a ply of rubberised cord fabric including a warp of reinforcing cords and a weft of threads having a low tensile strength and a low elastic modulus relative to the warp cords, the warp cords being aligned substantially parallel to the axis of the cylinder, such that in said cylinder the ends of said ply abut without overlapping, secondly laying over the joint between the ends of said ply a cover strip of a sheet material comprising threads having low tensile strength and low elastic modulus relative to the warp cords and having tensile strength, elasticity, and elongation properties similar to said weft threads and embedded in rubber compound, the strip being arranged such that its threads are orientated substantially at 90° to the ply joint, and thirdly shaping said cylinder into toroidal form.
2. A method of manufacturing a tyre carcass comprising the steps of firstly forming from a material having cords embedded in an uncured rubber, a cylinder having a joint forming a discontinuity extending substantially axially along the surface of the cylinder, said cords being aligned to extend substantially axially along the surface of said cylinder, and secondly placing over and along said joint a cover strip formed from material having threads embedded in an uncured rubber, said threads being aligned to extend substantially along the circumference of said cylinder.
3. A tyre carcass composed of a single ply of reinforcing cord fabric wherein the reinforcing cords are orientated at substantially 90° to the mid-circumferential plane of the tyre carcass after manufacture, said cord fabric being rubberised and including a warp of the reinforcing cords and a weft of threads having a low tensile strength and a low elastic modulus relative to the warp cords, the ply of said fabric being assembled to have the ends of the ply abut without overlapping, and laid over the joint a cover strip of a sheet material comprising threads having low tensile strength and low elastic modulus relative to the warp cords and having tensile strength, elasticity, and elongation properties similar to said weft threads and embedded in rubber compound, the strip being aligned such that its threads are orientated substantially at 90° to the ply joint.
4. A method according to claim 1, or a tyre carcass according to claim 3, wherein the warp of reinforcing cords are stiff, high elastic modulus cords relative to said threads and selected from the group of steel cords, glass cords, and aromatic polyamide cords.
5. A method according to claim 1 or 4, or a tyre carcass according to claim 3 or 4, wherein the weft threads in the ply cord fabric and the threads in the cover strip are of the same material and have substantially the same cross-sectional dimensions.
6. A method according to any of claims 1, 4 or 5 or a tyre carcass according to any of claims 3, 4, or 5, wherein the physical properties of said weft threads and of said threads in the cover strip are in the following ranges:—
- | | | |
|-----------------------|-------------------------|----|
| tensile strength | 9 to 35 grams per tex | 70 |
| modulus of elasticity | 10 to 300 grams per tex | |
| elongation at break | 30% to 250% | |
| linear density | 10 to 50 tex. | |
7. A method according to claim 1, or to claims 5 or 6 as dependent on claim 1, or a tyre carcass according to claim 3, or to claims 5 or 6 as dependent on claim 3, wherein the material of the weft threads in the ply cord fabric and the material of the threads in the cover strip is a polymeric thermoplastic fibre.
8. A method or a tyre carcass according to claim 7 wherein said material is a polyamide or a polyester.
9. A method according to any of claims 1 or 2 or 4–8, or a tyre carcass according to any of claims 3–8, wherein the rubber compound of the cover strip is the same as the rubber of the cord fabric of the carcass ply.
10. A method according to any of claims 1 or 2 or 4–9, or a tyre carcass according to any of claims 3–9, wherein the cover strip is dimensioned so as not to extend over the full length of the joint such as to leave the remote ends of the joint free across the joint, whereby to facilitate the folding of the ply round bead wires in a subsequent stage of tyre manufacture.
11. A method of manufacturing a tyre carcass, substantially as hereinbefore described with reference to the accompanying drawings.
12. A tyre carcass substantially as hereinbefore described with reference to the accompanying drawings.
13. A tyre having a carcass, manufactured by the method according to any of claims 1, 2 or 4–11.
14. A tyre manufactured from a tyre carcass according to any of claims 3–10 or 12.

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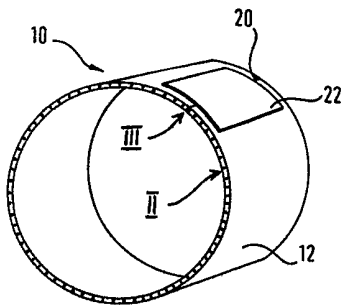


FIG. 1

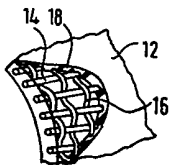


FIG. 2

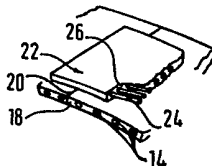


FIG. 3

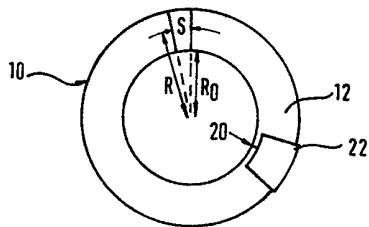


FIG. 4