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FORM 1 SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

The Goodyear Tire & Rubber Company, incorporated in Ohio, of 1144 East Market Street, Akron, Ohio, 44316-0001, UNITED STATES OF AMERICA, hereby apply for the grant of a standard patent for an invention entitled:

Pneumatic Tire

which is described in the accompanying complete specification.

Details of basic application(s):-

Basic Applic. No:	Country:	Application Date:
169,561	US	17 March 1988

The address for service is:-

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DATED this FIFTEENTH day of MARCH 1989

The Goodyear Tire & Rubber Company

By: M.G. Anderson

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
OUR REF: 81560
S&F CODE: 54815

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 26.10.90

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SPRUSON & FERGUSON

- Australia
- Convention
- Standard
- & Petty Patent
- Declaration
- SFP 4

COMMONWEALTH OF AUSTRALIA
The Patent Act 1952
DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled: PNEUMATIC TIRE

I Carl Henry Krukow

care of THE GOODYEAR TIRE & RUBBER COMPANY, 1144 East Market Street, Akron, Ohio 44316-0001, United States of America

do solemnly and sincerely declare as follows:-

1. I am authorised by

   THE GOODYEAR TIRE & RUBBER COMPANY

   the applicant for the patent to make this declaration on its behalf.

2. The basic application~~(s)~~ as defined by Section 141 of the Act was/~~were~~ made

   in U.S.A.

   on March 17, 1988

   by Rene Louis Bormann and Antonnis Gerardus Maathuis and Jurgen Spielmannand Theo Meijer and Klaus Beer and Thomas Reed Oare,

3. Rene Louis Borman, a citizen of Luxembourg; Antonnis Gerardus Maathuis, a citizen of Netherlands; Jurgen Spielmann, a citizen of Luxembourg;Theo Meijer, a citizen of Netherlands; Klaus Beer, a citizen of the U.S.A.; Thomas Reed Oare, a citizen of the U.S.A. of 2 rue de Pettange, Moesdorf, Luxembourg 7462; 1 rue Tomm, Fouhren, Luxembourg 9454; 22 rue de Cimetiere, Heisdorf, Luxembourg 7313; 22 rue du Travail, Luxembourg, Luxembourg 2625; 1436 Wimbledon Circle, Stow, OH 44224, U.S.A.;1901 Swartz Rd., Suffield, OH 44260, U.S.A. ~~is~~/are the actual inventor(s) of the invention and the facts upon which the applicant~~(s)~~ is/~~are~~ entitled to make the application are as follows:

   The Applicant is the assignee of the invention from the inventor(s).

4. The basic application~~(s)~~ referred to in paragraph 2 of this Declaration was/~~were~~ the first application~~(s)~~ made in a Convention country in respect of the invention~~(s)~~ the subject of the application.

Declared at Akron, Ohio, U.S.A. on November 4, 1988

THE GOODYEAR TIRE & RUBBER COMPANY

By Carl H. Krukow
Administrator, International Section

SFP 4 To: The Commissioner of Patents

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(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 605964

(54) Title
PNEUMATIC TIRE

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(51)[5] B60C 009/20 B60C 009/22

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(56) Prior Art Documents
EP 258822
US 4484965
US 3991803

(57) Claim

1. A pneumatic tire comprising a radial carcass, a tread portion and a belt reinforcing structure comprising steel cords which has a pair of axial edges and is radially interposed between the carcass and the tread portion, a textile reinforced overlay structure being radially interposed between the belt reinforcing structure and the tread portion, the overlay structure comprising a single continuous ribbon helically wound about the belt reinforcing structure and extending between the axial edges of the belt reinforcing structure, said ribbon comprises an elastomeric material reinforced by cords of a heat shrinkable material arranged side by side and extending longitudinally of the ribbon with adjacent turns of the ribbon being in an overlapping relationship, said ribbon and cords being disposed at 0° to 5° with respect to a mid-circumferential plane of the tire, the cords of the overlay structure being oriented in a direction opposite to the direction of the steel cords of radially outermost belt layer of the belt reinforcing structure such that the cords of the overlay structure are in a crossing relationship with the steel cords of the radially outermost

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belt layer of the belt reinforcing structure, and said overlay structure comprising a center portion and a pair of axially outer portions with the width of the overlap of adjacent turns of said ribbon being greater in the axially outer portion than in the center portion.

12. A method of manufacturing a radial tire comprising the step of placing a textile reinforced overlay structure around the radial outer periphery of a belt reinforcing structure by helically winding an elastomeric ribbon, which is reinforced by cords of a heat shrinkable material arranged side by side and extending longitudinally of the ribbon, from one axial side to the other axial side of the belt reinforcing structure while applying each spiral convolution of the ribbon in overlapping relationship with its respective adjacent spiral convolutions in such a way that the ribbons and cords are disposed at 0° to 5° with respect to a mid-circumferential plane of the tire and the cords of the overlay structure being oriented in a direction opposite to the direction of the steel cords of a radially outermost belt layer of the belt reinforcing structure such that the cords of the overlay structure are in a crossing relationship with the steel cords of the radially outermost belt layer of the belt reinforcing structure, and the axial width of the overlay between adjacent convolutions of the ribbon is greater in axially outer portions of the overlay structure than in a center portion of the overlay structure.

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S & F Ref: 81560

FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

Name and Address of Applicant: The Goodyear Tire & Rubber Company
1144 East Market Street
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Complete Specification for the invention entitled:

Pneumatic Tire

The following statement is a full description of this invention, including the best method of performing it known to me/us

Abstract of the Disclosure

PNEUMATIC TIRE

A pneumatic tire (1) comprises a radial carcass (2), a tread portion (7) and a belt reinforcing structure (8) extending circumferentially around the carcass (2). Disposed radially outwardly of the belt reinforcing structure (8) is a textile reinforced overlay structure (9) having substantially circumferentially extending cords (10). The overlay structure (9) is composed of a series of helical convolutions of a textile ribbon (11) whereby adjacent helical convolutions of the textile ribbon (11) overlap. There is further disclosed a method of applying multiple layers of a single continuous helically wound textile ribbon (11) in a single continuous operation from one axial side to the other axial side of the belt reinforcing structure 8).

PNEUMATIC TIRE

Description of the Invention

This invention relates generally to pneumatic tires and more specifically to tires having a textile reinforced overlay structure located radially outwardly of a belt reinforcing structure.

Such a tire is for example described in LU-85 964. In this prior art patent helical convolutions of a ribbon are wound axially across the belt reinforcing structure such that the convolutions are in abutting contact with each other. Although in practice tires using this construction have exhibited the benefits claimed in LU 85 964, there are a number of restrictions that the construction of this prior art tire imposes onto the manufacturing methods. There is disclosed herein a tire which can be manufactured more economically and using more flexible building methods. The invention is characterized in that adjacent helical convolutions of the ribbon overlap. Preferably adjacent helical convolutions of the ribbon overlap such that the width of the overlap is greater in the axially outer portions than in the center portion of the overlay structure.

The present invention also relates to a method of manufacturing a radial tire in which a textile reinforced overlay structure is placed around the radially outer periphery of a belt reinforcing structure by helically winding of a continuous ribbon of elastomeric material, reinforced by longitudinally extending cords, from one axial side to the other axial side of the belt reinforcing structure. Such a method is also described in the aforementioned LU-85 964. The

method as described in this prior art reference has the drawback that if it is desired to form an overlay structure with two or more layers of the ribbon, two or more complete helical convolutions have to be applied from one axial side of the reinforcing belt structure to the other axial side. This involves a multiple step operation, which considerably slows down the manufacturing process.

There is provided in accordance with one aspect of the invention a pneumatic tire comprising a radial carcass, a tread portion and a belt reinforcing structure which is radially interposed between the carcass and the tread portion, a textile reinforced overlay structure being located radially outwardly of the belt reinforcing structure, the overlay structure comprising a series of helical convolutions of a ribbon which comprises an elastomeric material reinforced by cords arranged side-by-side and extending longitudinally of the ribbon with adjacent turns of the ribbon being in an overlapping relationship.

There is provided with another aspect of the invention a method of manufacturing a radial tire comprising the step of placing a textile reinforced overlay structure around the radially outer periphery of a belt reinforcing structure by helically winding a textile ribbon from one axial side to the other axial side of the belt reinforcing structure while applying each spiral convolution of the textile ribbon in overlapping relationship with its respective adjacent spiral convolutions.

The invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a cross-sectional view of a pneumatic tire according to this invention;

Figure 2 is a schematic view of the ribbon utilized for the construction of the overlay structure;

Figure 3 is a schematic cross sectional view of the construction of the overlay structure as applied on a belt reinforcing structure of a first embodiment of the invention;

Figure 4 is a schematic cross sectional view of the construction of the overlay structure as applied on a belt reinforcing structure of a second embodiment of the invention;

Figure 5 is a schematic cross sectional view of a construction of the overlay structure as applied on a belt reinforcing structure of a third embodiment of the invention;

Figure 6 is a partially schematic view of a two ply belt reinforcing structure in conjunction with an overlay structure and a tread portion;

Figure 7 is another partially schematic view of a two ply belt reinforcing structure in conjunction with an overlay structure and a tread portion; and

Figure 8 is a schematic view illustrating a method for applying an overlay structure on a belt reinforcing structure which is located on a tire building drum.

The terms "axial" and "axially" as used throughout this specification refer to directions parallel to the axis of rotation of a tire. The terms "radial" and "radially" as used throughout this specification refer to directions perpendicular to the axis of rotation of a tire.

With reference to Figure 1 there is illustrated a cross-sectional view of a pneumatic tire 1 having a radial carcass. A radial carcass ply 2 extends between a pair of annular beads 3,4. A sidewall 5 extends radially outwardly from each bead 3,4 to a crown

region 6 of the tire. The crown region 6 has a ground contacting tread 7 extending circumferentially thereabout. The tire is reinforced in the crown region by an annular belt reinforcing structure 8 disposed radially outwardly of the carcass ply 2. The belt reinforcing structure 8 comprises one or more elastomeric plies 12,13 reinforced by steel cord or an other known suitable material, for example glass fiber, or aromatic polyamide.

Radially outwardly of the belt reinforcing structure 8 there is disposed a textile reinforced overlay structure 9 having an axial width D between its lateral edges 14,15 such that it is at least as wide as the axial width C of the belt reinforcing structure 8 so as to completely cover it.

As can be seen from Figure 1 and Figure 2, the overlay structure 9 comprises a helically wound ribbon 11, of elastomeric material having longitudinally extending cords 10 embedded therein, which extend circumferentially around the tire and substantially parallel with the mid-circumferential plane M-M of the tire, that is, they make an angle of between 0° - 5° with the mid-circumferential plane M-M.

By "mid-circumferential plane" is meant a plane which is perpendicular to the axis of rotation of the tire and which is located midway between the beads 3,4.

Adjacent helical convolutions of the ribbon 11 overlap. The ribbon has a width A, preferably in the range of 10 to 40 mm, and a thickness B, preferably in the range of 0.4 to 1.2 mm. Preferably the cords 10 of the ribbon 11 are made of a heat shrinkable material such as nylon.

In Figure 3 there is schematically illustrated a cross section of an embodiment in which the overlay

structure 9 comprises adjacent overlapping convolutions of the ribbon 11 disposed radially outwardly of the belt structure 8. In the embodiment shown here, and throughout this specification, the belt structure that is illustrated comprises two plies 12,13 with reinforcing cords making opposite angles with the mid-circumferential plane M-M of the tire. It is understood that the present invention is not limited thereto, but equally applies to tires having different belt structures. As can be seen from Figure 3, the adjacent convolutions of the ribbon 11 overlap. The width of the overlap between adjacent turns of the ribbon is indicated by an axial distance O. In the embodiment shown in Figure 3, the ribbon overlap is such that the axial width O of the overlap is uniform across the width of the belt reinforcing structure. The uniform axial width O of the overlap is determined by the following equation:

$$O = W\left(1 - \frac{1}{n}\right)$$

whereby: O = axial width of the overlap between adjacent turns of the ribbon
W = width of the ribbon
n = integer which represents the number of desired layers of the ribbon in the overlay structure.

The number of desired layers of the ribbon 11 determines the axial width of the overlap O between adjacent turns of the ribbon 11.

Figure 4 shows an example of a preferred embodiment in which the overlay structure 9 is divided into a center portion and a pair of axially outer portions.

By center portion of the overlay structure 9 is meant the portion of the overlay structure 9 that extends axially outwardly on either side of the mid-circumferential plane M-M over about 25% of the width of the overlay structure 9, and by axially outer portions are meant the portions on either side of the center portion which extend axially inwardly from the axial edges 14,15 of the overlay structure 9 over about 25% of the width of the overlay structure 9. According to Figure 4, the overlap between adjacent helical convolutions of the ribbon 11 is such that the width O of the overlap is not constant across the width of the overlay structure 9 but is greater in the axially outer portions than in the center portion of the overlay structure 9. In the embodiment shown in Figure 4, the axial width of the overlap O_S between adjacent turns of the ribbon in the axially outer portions of the overlay structure 9 is 0.75 times the width W of the ribbon, while the axial width of the overlap O_C between adjacent turns of the ribbon in the center portion of the overlay structure 9 is 0.5 times the width W of the ribbon.

The greater axial width of the overlap between adjacent helical convolutions of the ribbon 11 in the axially outer portions of the overlay structure 9 results in a greater density of cords in this area of the tire and hence, confers a greater strength to these areas. This may be desirable for counteracting the stresses which the tire experiences during service and which are most concentrated in its shoulder portions.

In a further preferred embodiment of the invention, illustrated in Figure 5, the adjacent helical convolutions of the ribbon are arranged such that the width O of the overlap decreases continuously from each

axial edge 14,15 of the overlay structure 9 towards the center of the overlay structure 9.

In the embodiment shown in Figure 5, the axial width of the overlap O between adjacent turns of the ribbon decreases gradually from 0.75 times (O_S) the width W of the ribbon in the axially outer portions to 0.5 times (O_C) the width W of the ribbon in the center portion of the overlay structure 9, while there is also shown an intermediate value O_i of the overlap between adjacent turns of the ribbon which are located between the axially outer portions and the center portion of the overlay structure 9, O_i being 0.66 times the width W of the ribbon.

With reference to Figure 6 there is provided a schematic view of a two ply belt reinforcing structure 8 in conjunction with an overlay structure 9 and a tread portion 7. As can be seen from this Figure, the first and the last convolution of the ribbon begin and finish at an axial distance beyond each axial edge 12, 13 of the belt reinforcing structure 8, the axial distance being at least equal to the width of the overlap as measured at the axial edges 12, 13 of the belt reinforcing structure 8. Such an arrangement of the ribbon 11 ensures that the entire belt reinforcing structure 8 is covered by the helically wound convolutions of the ribbon 11. The excess material of the overlay structure 9 beyond the axial edges 12, 13 of the belt reinforcing structure may be trimmed back to the axial edges 12,13 if it is so desired.

Alternatively, as illustrated in Fig. 7, the axially outer edges of the first and the last convolutions of the ribbon 11 can be arranged such that they coincide with the axially outer edges 12,13 of the belt reinforcing structure 8 and that they are

substantially parallel to the mid-circumferential plane of the tire, while the other convolutions of the ribbon 11 are all helically wound. This particular construction has the advantage that the axial width of the overlay structure 9 is identical to the axial width of the belt reinforcing structure 8 and that no trimming of the normally obtained excess material at the axial edges 12,13 of the belt reinforcing structure is required.

As can be seen further from both Figure 6 and Figure 7, the overlay structure 9 is preferably applied such that the cords 10 of the overlay structure 9 are in a crossing relationship with the cords 8" of the radially outermost belt layer 8' of the belt reinforcing structure 8, i.e. are oriented in a direction opposite to the direction of the cords 8" of the radially outermost belt layer 8'. This crossing relationship of the cords helps towards reducing the tendency of the tire steering in a particular direction which tendency is commonly known in the tire art as ply steer.

However, the present invention is not limited to this crossing relationship between the cords 10 of the overlay structure 9 and the cords 8" of the radially outermost belt layer 8', but is equally applicable to an overlay structure 9 where the cords 10 are positioned such that they are in a parallel relationship with the cords 8" of the radially outermost belt layer 8' of the belt reinforcing structure 8.

There are two alternative methods generally used for applying the overlay structure to the belt reinforcing structure. A first method comprises assembling the overlay structure around the belt

reinforcing structure on a separate drum before the total belt assembly is applied on the carcass band, the belt reinforcing structure thus being built on a separate drum. A second method comprises assembling a tire whereby the overlay structure is assembled around the belt reinforcing structure durir the final step of the tire building process, that is after that the belt reinforcing structure has been assembled around a toroidal tire casing.

Figure 8 schematically illustrates the method for assembling a tire according to the present invention that can be used with either of the methods described above. In Figure 8, there is illustrated a drum 16 upon which there is placed a belt reinforcing structure 8. In the case of the second method as explained above, the drum would be replaced by a toroidal tire casing. The overlay structure 9 is placed around the belt reinforcing structure 8 by helically winding a single continuous ribbon 11 of cord reinforced elastomer around the outside of the belt reinforcing structure 8 from one axial edge 12 thereof to the other axial edge 13 thereof. In the embodiments shown, the ribbon 11 is wound in one continuous operation from the left hand axial edge 12 of the belt reinforcing structure 8 to its right hand edge 13, but could alternatively be wound in the other direction. The ribbon 11 is wound such that each helical convolution is in overlapping relationship with its respective adjacent helical convolutions.

In a preferred embodiment of a tire according to the invention, as shown in Figure 3, adjacent convolutions of the ribbon 11 are applied in such a way that the axial width of the overlap between adjacent convolutions is uniform across the width of the belt

reinforcing structure 8. The uniform width of the overlap is determined by the equation described above in conjunction with the pneumatic tire of the present invention.

The method of the present invention equally applies to the manufacture of the other preferred embodiments of the pneumatic tires as described above and illustrated in Figures 4, 5, 6 and 7.

While certain representative details and embodiments have been shown and described for the purpose of illustrating the invention, it will be apparent to those skilled in the tire art that various changes and modifications may be made therein without departing from the spirit or the scope of the invention.

The claims defining the invention are as follows:

1. A pneumatic tire comprising a radial carcass, a tread portion and a belt reinforcing structure comprising steel cords which has a pair of axial edges and is radially interposed between the carcass and the tread portion, a textile reinforced overlay structure being radially interposed between the belt reinforcing structure and the tread portion, the overlay structure comprising a single continuous ribbon helically wound about the belt reinforcing structure and extending between the axial edges of the belt reinforcing structure, said ribbon comprises an elastomeric material reinforced by cords of a heat shrinkable material arranged side by side and extending longitudinally of the ribbon with adjacent turns of the ribbon being in an overlapping relationship, said ribbon and cords being disposed at 0° to 5° with respect to a mid-circumferential plane of the tire, the cords of the overlay structure being oriented in a direction opposite to the direction of the steel cords of radially outermost belt layer of the belt reinforcing structure such that the cords of the overlay structure are in a crossing relationship with the steel cords of the radially outermost belt layer of the belt reinforcing structure, and said overlay structure comprising a center portion and a pair of axially outer portions with the width of the overlap of adjacent turns of said ribbon being greater in the axially outer portion than in the center portion.

2. A pneumatic tire as claimed in claim 1, wherein the overlay structure has a pair of axial edges and the axial width of the overlap decreases gradually from each axial edge of the overlay structure to the center portion of the overlay structure.

3. A pneumatic tire as claimed in either claim 1 or 5 wherein the axial width of the overlay structure is equal to the axial width of the belt reinforcing structure.

4. A pneumatic tire as claimed in either claim 1 or 5 wherein the axial width of the overlay is greater than the axial width of the belt reinforcing structure.

5. A pneumatic tire as claimed in either claim 1 or 5 wherein the width of the ribbon is in the range of 10 to 40 mm.

6. A pneumatic tire as claimed in either claim 1 or 5 wherein the thickness of the ribbon is in the range of 0.4 to 1.2 mm.

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7. A pneumatic tire as claimed in claim 5 wherein the thickness of the ribbon is in the range of 0.4 to 1.2 mm.

8. A pneumatic tire as claimed in either claim 1 or 2 wherein the reinforcing cords of the ribbon comprise a material selected from the group consisting of nylon and polyester.

9. A pneumatic tire as claimed in claim 1 wherein the axial width of the overlap between adjacent turns of the ribbon in the axially outer portions of the overlay structure is about 0.75 times the width of the ribbon while the axial width of the overlap between adjacent turns of the ribbon in the center portion of the overlay structure is about 0.5 times the width of the ribbon.

10. A pneumatic tire as claimed in either claim 1 or 9 wherein the center portion of the overlay structure extends axially outwardly on each side of the mid-circumferential plane of the tire over each 25% of the width of the overlay structure and the axially outer portions extend axially inwardly from the axial edges of the overall structure over about 25% of the width of the overlay structure.

11. A pneumatic tire as claimed in claim 2 wherein the axial width of the overlap between adjacent turns of the ribbon decreases gradually from about 0.75 times the width of the ribbon in the axially outer portions of the overlay structure to about 0.5 times the width of the ribbon in the center portion of the overlay structure.

12. A method of manufacturing a radial tire comprising the step of placing a textile reinforced overlay structure around the radial outer periphery of a belt reinforcing structure by helically winding an elastomeric ribbon, which is reinforced by cords of a heat shrinkable material arranged side by side and extending longitudinally of the ribbon, from one axial side to the other axial side of the belt reinforcing structure while applying each spiral convolution of the ribbon in overlapping relationship with its respective adjacent spiral convolutions in such a way that the ribbons and cords are disposed at 0° to 5° with respect to a mid-circumferential plane of the tire and the cords of the overlay structure being oriented in a direction opposite to the direction of the steel cords of a radially outermost belt layer of the belt reinforcing structure such that the cords of the overlay structure are in a

crossing relationship with the steel cords of the radially outermost belt layer of the belt reinforcing structure, and the axial width of the overlay between adjacent convolutions of the ribbon is greater in axially outer portions of the overlay structure than in a center portion of the overlay structure.

13. A method as claimed in claim 12 wherein adjacent spiral convolutions of the ribbon are applied in such a way that the axial width of the overlap between adjacent convolutions of the ribbon decreases gradually from each axial edge of the overlay structure to the center portion of the overlay structure.

14. A method as claimed in claim 12 or 13 wherein the first and the last convolutions of the ribbon begin and finish at an axial distance beyond each axial edge of the belt reinforcing structure, the axial distance being at least equal to the width of the overlap, measured at the axial edges of the belt reinforcing structure.

15. A method as claimed in claim 12 or 13 wherein the axially outer edges of or the last convolutions of the ribbon coincide with the axially outer edges of the belt reinforcing structure.

16. A method as claimed in claim 12 or 13 wherein the convolutions of the ribbon are applied such that the first and the last convolution of the ribbon are substantially parallel to the mid-circumferential plane of the tire.

17. A method as claimed in claim 12 or 13 wherein the ribbon has a width in the range of 10 to 40 mm.

18. A method as claimed in claim 12 or 13 wherein the ribbon has a thickness in the range of 0.4 to 1.2 mm.

19. A method as claimed in claim 17 wherein the ribbon has a thickness in the range of 0.4 to 1.2 mm.

DATED this EIGHTEENTH day of OCTOBER 1990
The Goodyear Tire & Rubber Company

Patent Attorneys for the Applicant
SPRUSON & FERGUSON



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Fig. 1.

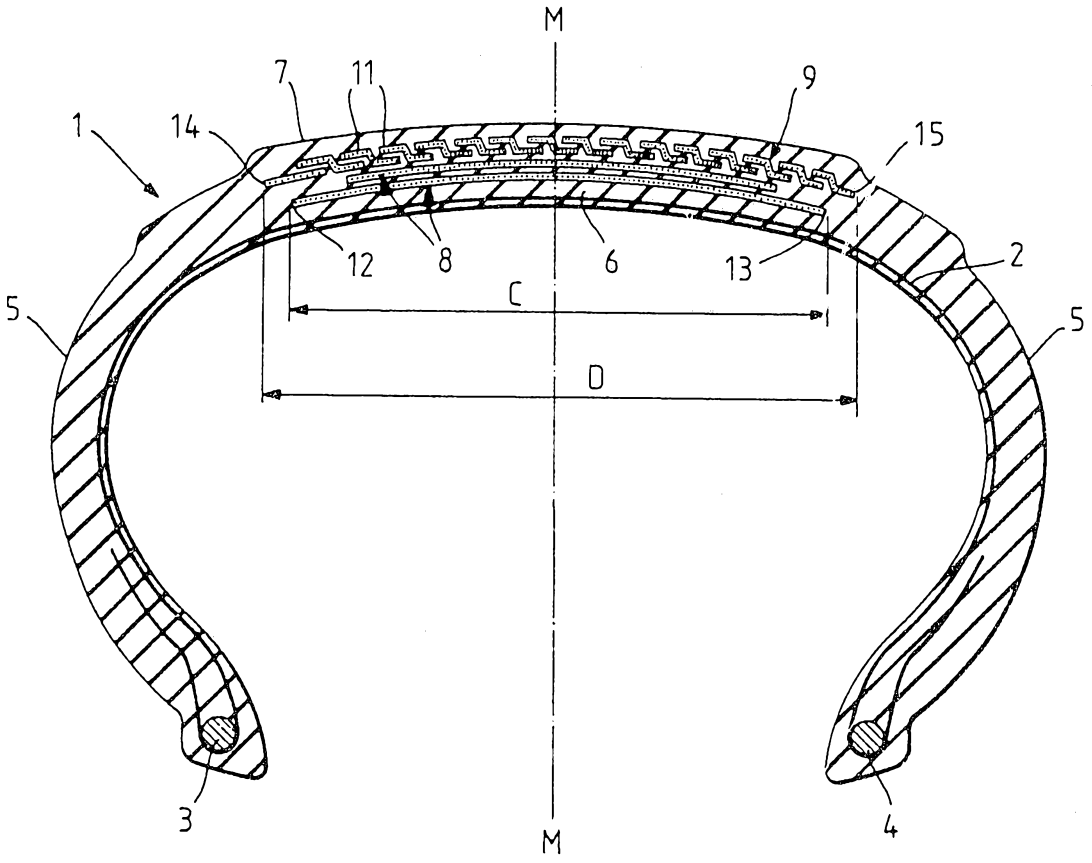
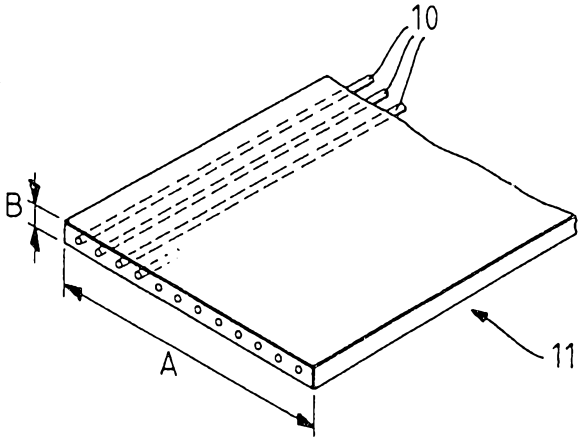


Fig. 2.



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Fig. 3.

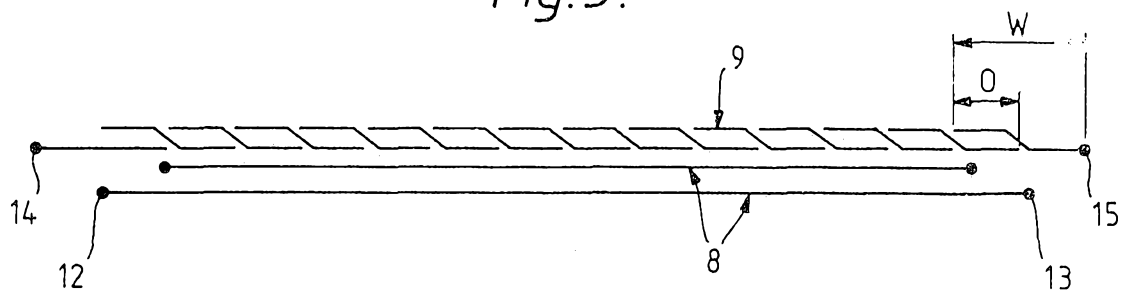


Fig. 4.

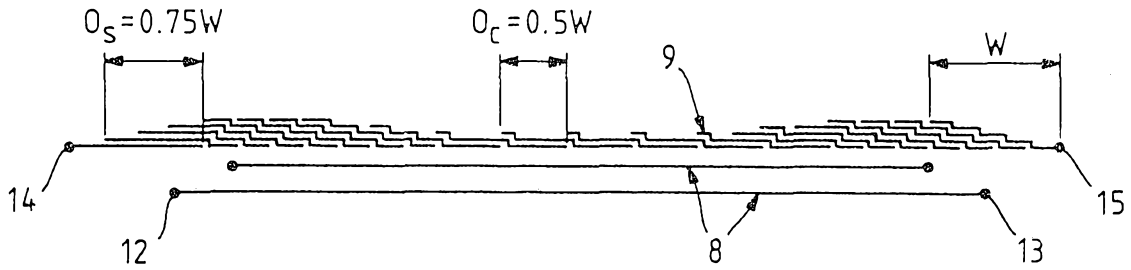


Fig. 5.

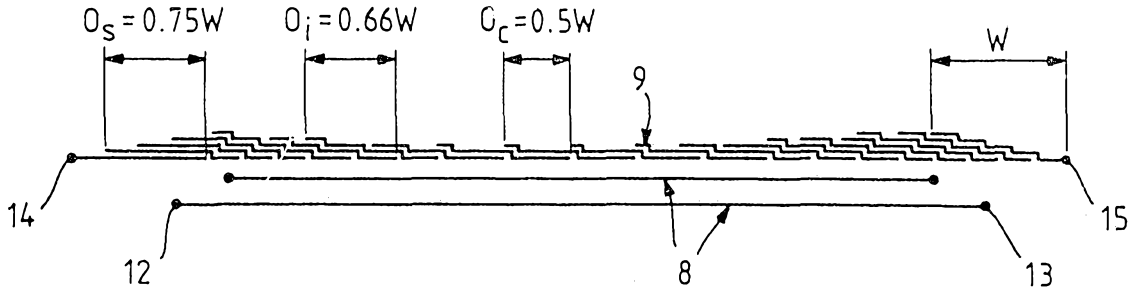


Fig. 6.

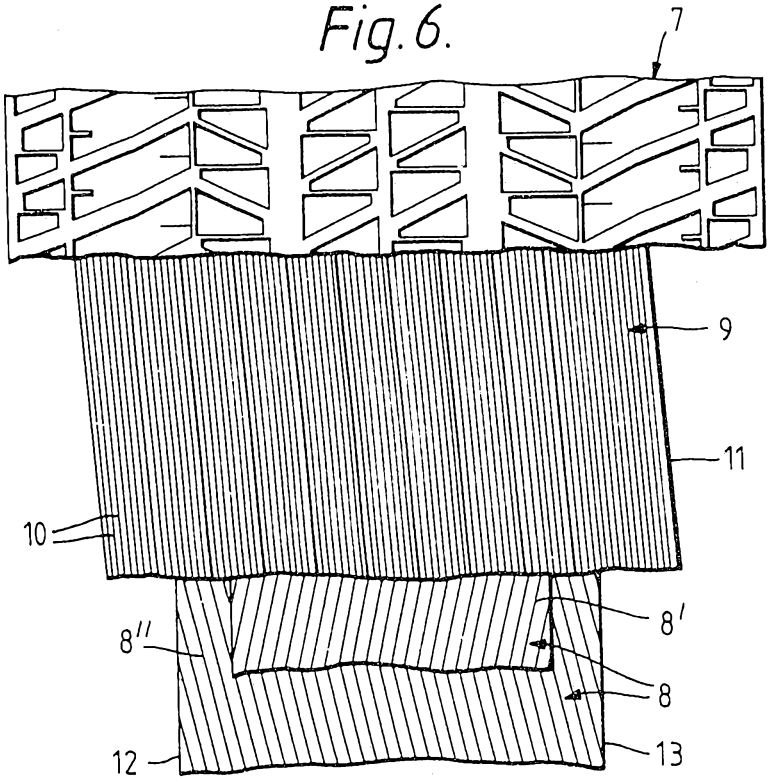


Fig. 7.

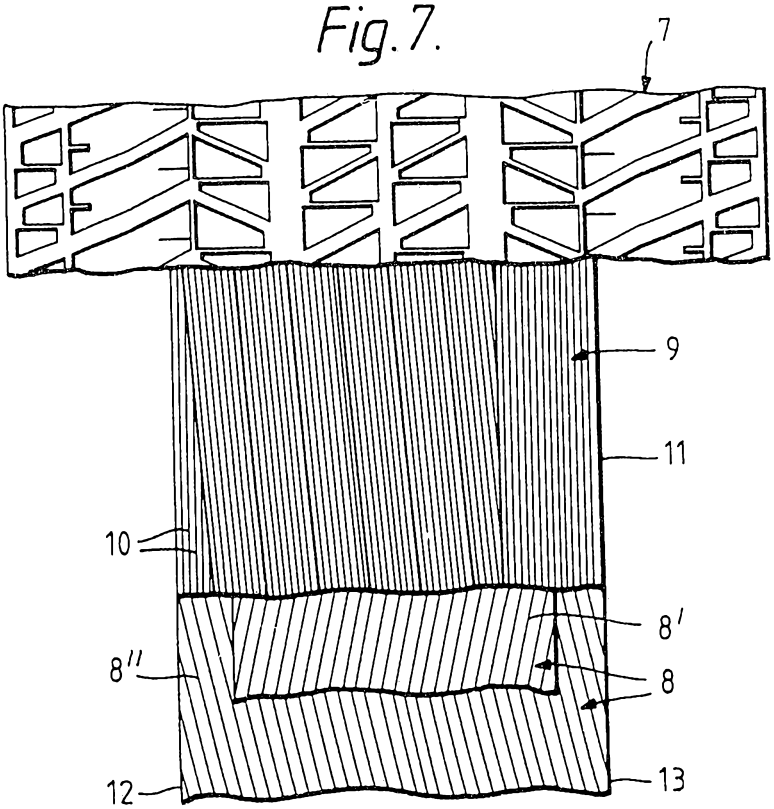


Fig.8.

