Dec. 24, 1929. E. FETTER 1,740,445

CORD REENFORCED TUBE

Filed March 23, 1928 2 Sheets-Sheet 1

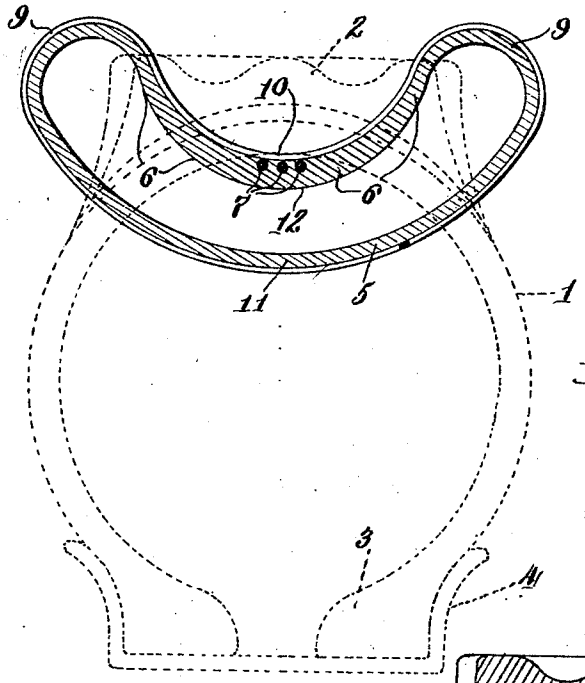


Fig. 2.

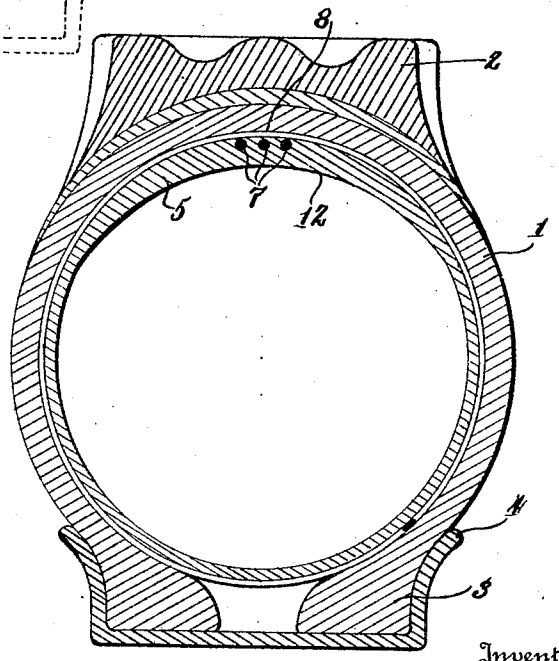


Fig. 1.

WITNESSES

Inventor

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CORD REENFORCED TUBE

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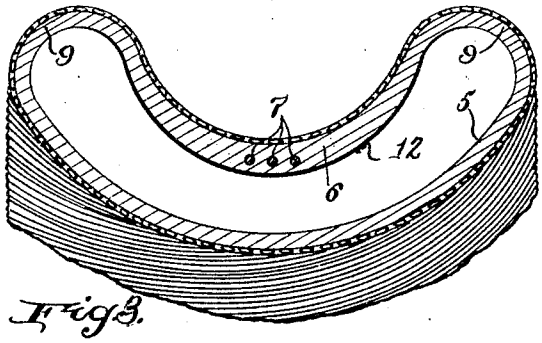


Fig. 3.



Fig. 6.

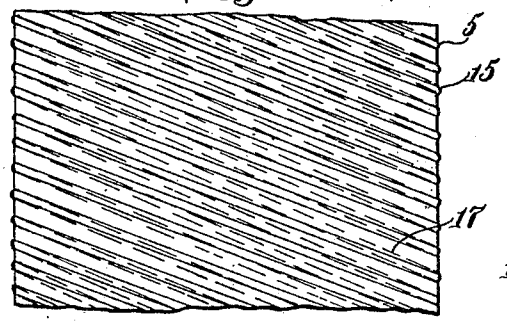


Fig. 5.

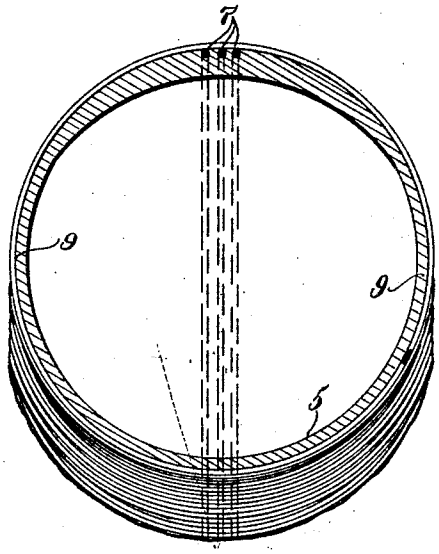


Fig. 4.

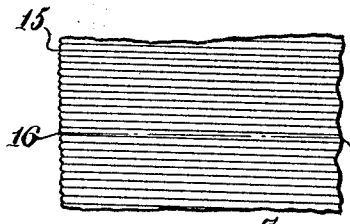


Fig. 8.

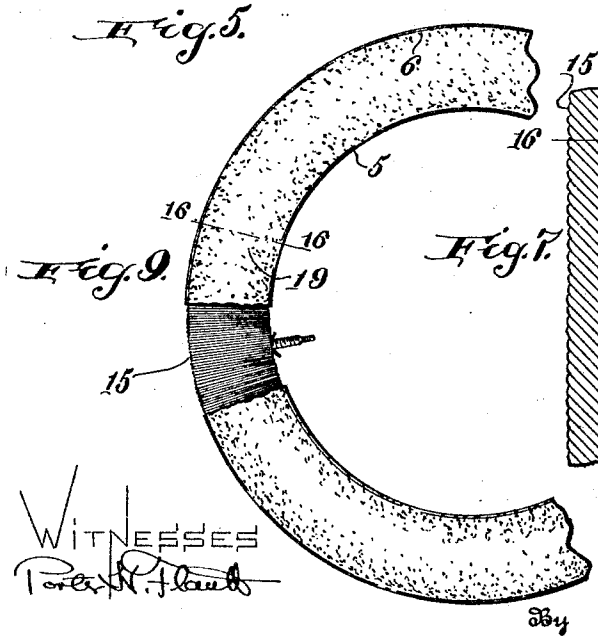


Fig. 9.

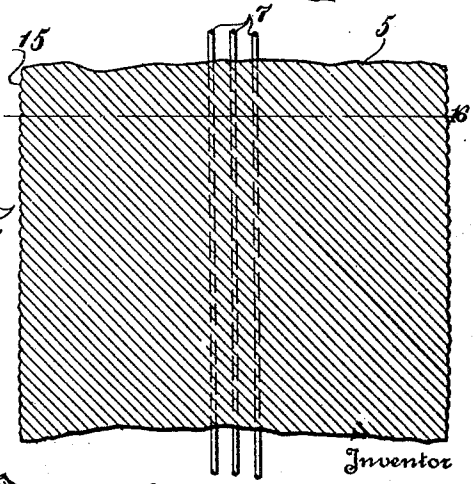


Fig. 7.

Witnesses

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UNITED STATES PATENT OFFICE

EDWARD FETTER, OF BALTIMORE, MARYLAND

CORD-REENFORCED TUBE

Application filed March 23, 1928. Serial No. 264,190.

The invention relates to inner tubes for pneumatic tires, the tube being primarily of the puncture closing type though it includes other features of importance.

The construction of inner tubes having the tread so formed that when the tube is uninflated the tread portion is concave as to its transverse section, the curvature of the concave portion being reversed and the entire tube assuming a circular cross section when it is inflated, resulting in a tendency to compress the portion of the rubber adjacent the inner surface of the tread wall which, in turn, results in a tendency to close any punctures which may be formed in the tread area, is well known.

In the construction of such tubes the circumferential length of the center of the tread has been reduced in order to give the concave cross section just described, so that when the tire is inflated this central portion of the tread is elongated or stretched and the helpful effect of the transverse compression just described is thus largely neutralized. If the desired puncture closing effect is attained at all it is in a minor degree and less effective than is desirable for the purposes in hand.

The present invention relates to a feature of construction whereby this difficulty is overcome and the full benefit of the lateral compression of the inner portion of the tread wall is retained. It further relates to a new manner of constructing and reenforcing an inner tube and to said reenforce and construction.

In the accompanying drawings I have illustrated an inner tube for pneumatic tires embodying the features of my invention in the preferred form.

In the drawings:

Figure 1 is a transverse radial cross section through a casing or shoe containing the tube, which is partially inflated for the purposes of installation in accordance with the practice herein outlined.

Figure 2 is a view showing the uninflated tube in radial transverse cross section and showing in dotted lines a corresponding cross section of a casing and rim, the purpose of the figure being to illustrate the relations of the long diameters of the tread portion of the tube and the corresponding portion of the casing prior to inflation of the tube. The figure is diagrammatic in the sense that the casing and tube never assume the relations illustrated.

Figure 3 is a radial cross section of the tube uninflated, showing in elevation a fragmentary portion of the tube in the rear of the section.

Figure 4 is a view corresponding to Figure 3 showing the tube inflated at a low pressure as compared to running pressures and ready for installation in a casing.

Figure 5 is a fragmentary plan showing a short fragment of the tube including the transverse reenforcing cords, the tube being deflated, or substantially so.

Figure 6 is a fragmentary plan showing the inflated condition of the tube, illustrating the position of the reenforcing cords due to the increased diameter. It will be understood that both Figures 5 and 6 are on a smaller scale than are Figures 3 and 4.

Figure 7 is a fragmentary plan view showing the tube deflated, the reenforcing cords being more closely arranged than in Figures 5 and 6.

Figure 8 is a fragmentary plan showing the position of the cords, Figure 7, when the tube is inflated.

Figure 9 is a side elevation with parts broken away showing the arrangement of the cords when the tube is inflated or partially inflated, the rest of the tube being shown coated with rubber.

Referring to the drawings by numerals, each of which is used to indicate the same or similar parts in the different figures, the illustration includes a casing or shoe 1 having a tread portion 2 and beads 3, the same being seated in a suitable rim 4.

The inner tube 5, the preferred form of which is illustrated, is shown in Figure 1 in cross section partially inflated for convenience in installing in the casing in which it is shown.

A feature of the invention relates to a tube so molded that when deflated, or substantially deflated, the cross section normally assumes the outline illustrated in Figures

2 and 3 in which the tread portion 6 is normally concave as viewed from without. This tread portion is also preferably thickened, as illustrated.

The theory of operation of the concave tread, whereby the rubber lying near the inner surface of the tread wall is compressed, giving a puncture closing tendency when the tube is inflated, has been recited. In the tube previously constructed on this principle, the long circumference of the center of the tread portion is elongated when the tube is inflated, which elongation or stretching partially neutralizes the puncture closing effect of the lateral compression due to reversing the curvature of the normally concave tread.

In accordance with the present invention this difficulty is overcome by making the center of the tread of the circumferential length it will have when inflated.

To avoid elongation of the tread, and for convenience in installing partially inflated, the center of the tread portion may be reenforced by cords 7 extending around the tube in the direction of the long circumference. These are preferably placed near the outer surface of the rubber, though this is not essential.

An important feature of the invention is that the central zone of the tread being, when the tube is deflated, of the circumferential length of the corresponding zone of the inner wall of the casing opposite the center of the tread, as indicated by reference character 8 in Figure 1, the concave effect is produced by making the central zones of the side walls, what may be termed the edges of the tube when it is deflated and flattened, the same being indicated by reference character 9, Figure 2, of greater length in the direction of the long circumference and of greater radius and long diameter than corresponding dimensions of the center of the tread portion at 10, the tire and tube bearing when the tube is uninflated the relation illustrated in Figure 2. Under these circumstances, it being understood that on inflation the tube tends to assume a shape in which the cross section of the tube is circular, when enclosed within the casing, it assumes the shape of the casing.

If the tube were inflated within the casing, the casing itself would tend to prevent the center of the tread from becoming elongated, but when the tube is partially inflated outside the casing, see Figures 4 and 9, as is desirable in assembling the tire, the cords 7 prevent elongation of the tread to any material extent, under which circumstances the remaining portions of the tube, i. e., the side walls 9 and the inner wall 11 move inwardly in the direction of the radii of the wheel until the tube assumes substantially the cross sectional shape illustrated in Figures 1 and 4, in which condition its greatest long circumference is that of the center of the tread which is equal to the circumference of the corresponding portion of the inside of the casing.

Prior to installing the tube in the casing it is partially inflated. This is done in the present regular practice to prevent pinching and in connection with the device of the invention it assists in the operation by reducing the outside long circumference of the tube to the corresponding dimension of the casing and it further causes the cross section of the tube to conform to the cross section of the casing. More particularly, the long circumference of the center of the tread is preferably fixed and rendered inextensible by the presence of the circumferential reenforcing cords 7, which are of a length conforming to the corresponding dimension of the casing.

This preliminary inflation which causes the tube to assume a circular cross section, which is the tendency of all flexible bodies when inflated, serves to draw the edges or side walls 9 inwardly from the position in which they are shown in Figure 2 to that in which they are shown in Figures 4 and 1. This tube is thus made to conform in shape and dimension to the inside of the casing.

This operation illustrates an important function of the invention, i. e., the reversal of the curvature of the thread shown in its normal uninflated position in Figures 2 and 3 to the inflated position or semi-inflated position shown in Figures 1 and 4 whereby the portion of the tread wall adjacent the inner surface 12 is compressed, establishing a puncture closing tendency which is maintained so long as the tube is inflated.

The previous practice, according to which the concavity of the tread which we have described, was effected by reducing the long diameter at the center of the tread below the corresponding long diameter of the casing instead of as in the present instance, maintaining it equal to the long diameter of the casing and increasing the long diameter of the side walls 9, 9, is regarded as defective in that the inflation of the tube within the casing causing it to conform to the inside of the casing resulted in the elongation or stretching of the tread in the direction of its length, which partly neutralized the lateral compression and hence the puncture closing tendency.

In accordance with the present practice, this elongation of the tread when the tube is inflated inside the casing is eliminated and the full effect of the lateral compression is retained.

The tube, as illustrated, and in the preferred form, is thickened as to the tread area 6 and further reenforced by means of transverse cords 15, see Figure 8. These cords,

considering any point in the length of the tube, are laid at an angle to a transverse or radial plane intersecting the tube at that point at right angles to the long diameter, as indicated by the line 16, 16, in Figure 7 and which is also a radial plane, see Figure 7. The angularity of the reenforcing cords provides for the lateral expansion of the tube, the tendency being for the cords to approach the radial plane 16 as the tube is expanded by inflation or otherwise. Fragments of inflated tube are shown in Figures 6 and 8, in which figures the cord or cords 15 are shown as nearly parallel to a radial plane.

While they may be otherwise applied, in accordance with the preferred form of the invention, the cords are continuous or substantially continuous for a considerable length and the entire tube may be wrapped with a single cord. To this end one or more cords may be wound about the tube while it is on the mandril and prior to vulcanization, when it will be understood the rubber composition is sticky or tacky, holding the cord or cords in the position in which they are laid.

To produce this effect the cords are not laid in a helix, as they could not be so laid with the successive turns close together and provide for lateral expansion. In accordance with the present invention the cord or cords 15, it being perfectly feasible to wind a single cord about the entire length of the tube for this purpose, are laid about the tube, the respective turns or loops of the cord being substantially parallel to each other. For this purpose the angle chosen may be thirty degrees or thereabouts, as shown in Figure 5, or forty-five degrees, as shown in Figure 7.

The respective loops of the reenforcing cord are substantially parallel to the intersection with the tube of a plane of the radius at the point under consideration, which plane is located at the predetermined angle, as described, with the circumference of the tube, but slightly deflected therefrom, the deflection being too minute for illustration. This deflection provides that the winding may be continuous for any desired number of turns, or for the entire tube.

In the illustration, Figures 7 and 8, no attempt is made to show the windings or cords on the opposite side of the tube from the observer. In Figures 5 and 6, however, the windings are spaced a little further apart than they would ordinarily be in practice and the return or back windings 17 are illustrated in dotted lines.

As already pointed out the placing of the reenforce is preferably effected by laying the cord on the surface of the unvulcanized rubber when it is tacky or sticky, and this can be most easily accomplished when the tube is on the mandril. When the tube is cured the cords are permanently held, the tackiness being eliminated.

Figure 9 shows on a reduced scale an inner tube on which the reenforcing cords 15 are covered with an outside layer of rubber 19. This is regarded as desirable if not necessary in all instances to prevent undue friction between the tube and casing. In the other figures it has been omitted, the main object being to illustrate the manner of laying the cords. A portion of the layer of rubber 19 is broken away to show the cords 15.

The tube is inflated to the maximum so that the cords lie at right angles to the long circumference and parallel to radial plane 16. In this position the tube is distended beyond the preferred service inflation.

The behavior of the cords during the expansion of the tube will be understood from Figure 9 and Figures 5, 6, 7 and 8 of the drawings. All of these views except Figure 9 are assumed to be taken in the direction of the radii of the tube or wheel, i. e., the observer is looking at the tube either from the wheel center or from the outside in the direction of the radius. When the tube is deflated the transverse reenforcing cord or cords 15 take the position shown in Figures 5 and 7. As the cord is inelastic and does not elongate when the tube is inflated, the angularity of the cords is necessary to provide for expansion.

In thus expanding the two sides of the tube, as it is seen in plan in Figures 5 and 7, actually move in opposite directions as the tube is inflated so that in the inflated condition the direction of the winding has approached, or has possibly assumed the position of the corresponding transverse plane 16, 16, at right angles to the long circumference of the tube. This gives a cross section which is increased in proportion to the change of angularity of the winding.

I have thus described specifically and in detail a single embodiment of my invention in order that the nature and operation of the same may be clearly understood, however, the specific terms herein are used descriptively rather than in a limiting sense, the scope of the invention being defined in the claims.

What I claim as new and desire to secure by Letters Patent is:

1. An inner tube for pneumatic tires the tube being of elastic material and having a tread portion which is concave outwardly as to its lateral cross section, the circumferential length of the central zone of the tread of the tube being constant the central zone of the tread of the tube having a reinforce of inelastic material extending in the direction of the long circumference and for substantially the entire length of the same.

2. The combination with a pneumatic tire of an outer shoe or casing and an inner tube therefor, the inner tube being in its unin-

flated condition of a circumferential length greater than the length of the casing, the tube being of elastic material and having an outwardly concave tread portion, the central zone of which is less elastic in the direction of its length than the remainder of the tread and of a length not exceeding the corresponding dimension of the casing, whereby the greater external length or circumference of the tube is reduced by inflation causing it to fit inside the casing.

3. An inner tube for pneumatic tires in which when uninflated the sides of the tread are of greater circumferential length than is the center of the tread which is less freely extensible than the remainder of the tube, the circumferential length of the sides of the tread being reduced by inflation so that it is less than that at the center of the tread.

4. The combination is a pneumatic tire of a casing and a tube having a nonextensible portion and a freely extensible portion, the freely extensible portion being when noninflated of greater length than the nonextensible portion and of greater outside circumference than the inside of the casing, and on inflation is reduced as to its outside circumference so that it fits inside the casing.

5. The combination with a tire casing of an inner tube of elastic material to fit the casing, the tube comprising a tread portion, the central zone of which is of a fixed circumferential length, to fit the corresponding dimension of the inside of the casing, said dimension not being subject to elongation within the casing, and the tread portion of the tube being concave laterally as considered from the outside when the tube is uninflated, the portions of the tube at each side of the said central zone being, when the tube is uninflated, of a greater long circumference or length than the said central zone whereby on inflation of the tube, the tendency of the tube to assume a circular cross section forces the edge portions inwardly to conform to the walls of the casing, reducing the length or long diameter of the side portions.

6. An inner tube for pneumatic tires having a tread portion which is concave outwardly as to its lateral cross section when the tube is deflated and relaxed, the circumferential length of the central zone of the tread being constant and the tread having means therein in the central zone of the tread to prevent elongation from the noninflated to the inflated condition of the tube, the sides of the tube being of greater circumferential length than said central zone.

Signed by me at Baltimore, Maryland, this 21st day of March, 1928.

EDWARD FETTER.